

# A CONCEPTUAL INTEGRATIVE MODEL OF KANSEI ENGINEERING, KANO AND TRIZ TOWARDS SUSTAINABILITY IN SERVICES

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**Abstract---** Kansei Engineering (KE) has shown its superiority in modeling customer emotional needs (Kansei in Japanese) into service performance. By incorporating Kano model and TRIZ, this integrative KE model is able to reveal what service attributes are sensitive and critical to customer emotions, and how to satisfy them with very less contradiction of proposed improvements. Moreover, sustainability aspect is embedded as a way to finalize the proposed solutions to be more feasible and relevant to today's challenges. As an illustrative example, healthcare service-based experience is presented. It shows that Kansei-based service experience is quite related to the sustainability thinking.

**Keywords---** Kansei Engineering, Kano, TRIZ, sustainability

## I. INTRODUCTION

Sustainability is of high interest both in the fields of industry and research, nowadays. Not only for production process, but also for service industries, where materials, products, people, information and finance take place. Sustainability doesn't mean to achieve high profit for business orientation only; it may deal with customer satisfaction, social and environmentally friendliness [1].

By incorporating customer's needs and wants, especially, affect and emotions, sustainability may have close relationship with. According to Rasamoelina et al. [1], customer and user's environmental awareness is closely related to emotional satisfaction (or Kansei in Japanese). In other words, by producing new environmentally responsible products or services that are more appealing to the customers will lead to customer emotions. It is clearly noted that when customer satisfy and perceive a certain service or product as eco-based attribute, it will evoke emotional bond.

Study on user emotions has been of interest since 1970s. It has been applied extensively to product designs [2], extended into services with quality tools [3; 4]. It is a powerful product and service development method to translate user and customer's feelings and images into design elements. In facts, people choose and buy products not only based on functional or usable attributes, rather something which perform appeal and emotional preference[6].

The most recent research on Kansei Engineering is about how to integrate Kansei with Kano model and TRIZ (i.e., the Theory of Inventive Problem Solving), addressed by Hartono [4]. The most significant finding was to generate service designs for improvement with the lowest contradiction between the proposed service design solutions, focusing on emotional satisfaction. It has the potential in delivering innovative solutions for service designs in related to customer affect [4]. However, it lacks concern on sustainability. In other words, there is no such structured methodology to include sustainability aspects in Kansei-based integrated model.

Study on human factors is surely related to human capabilities and limitations, and has been extensively applied into product and service system. Related to socio- technical system, human is the core element. Nowadays, due to rapid changing environment system, the studies on sustainability play important concern. To achieve more effective design of appealing product (Kansei-based product), the design for sustainability will be of benefit [6]. This also applies to services, indeed. In addressing current issue on sustainability and close the research gap, this study is conducted to complete the previous model of Kansei Engineering, Kano and TRIZ [4], by taking into account sustainability concern, applied into services. Surely, starting from the identification of emotional-based voice of customer, to how to fill the gap, and propose sustainability-based solutions is addressed. In providing state of the art of this study, the summary of Kansei-based research in services in the last 5 years, is presented in Table I below.

**TABLE I. SUMMARY OF KANSEI-BASED RESEARCH IN SERVICES**

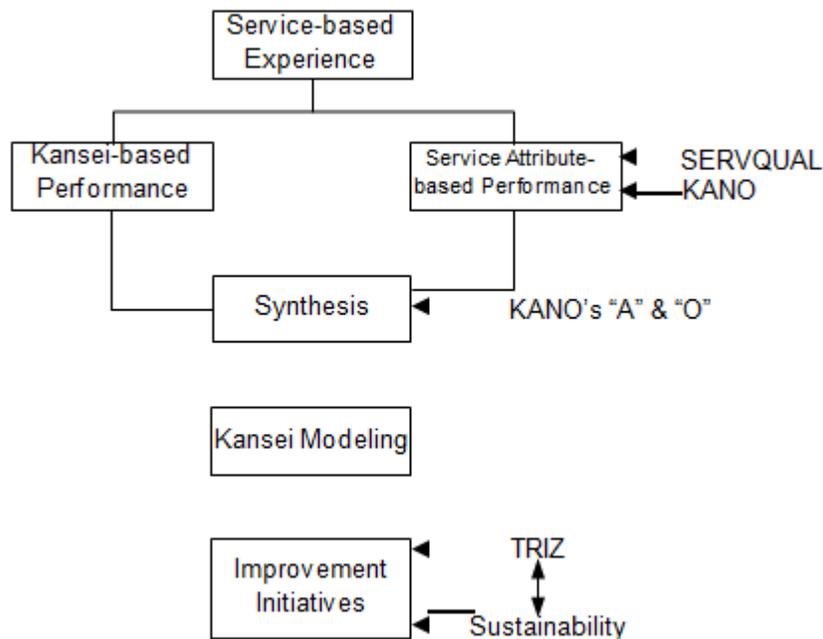
Author(s)	Kansei Eng.	SERVQUAL	Aspects			
			Kano	TRIZ	Cultures	Sustainability
Llinares & Page, 2011 [13]	✓		✓			
Hartono & Tan, 2011 [3]	✓		✓			
Hartono, 2012 [14]	✓		✓			
Rasamoelina et al., 2013 [11]	✓					✓
Hartono et al., 2013 [15]	✓	✓	✓		✓	
Hartono, 2014 [10]	✓	✓	✓			
Hartono & Raharjo, 2015 [7]	✓	✓	✓		✓	
Hartono, 2016 [4]	✓			✓	✓	
This current study	✓	✓	✓	✓		✓

This article is structured as follows. Following this section, model development and methodology is provided. It, then, continues with discussion and conclusion. The last section will discuss further research recommendation.

**II. MODEL DEVELOPMENT AND METHODOLOGY**

By referring to Hartono [4], this current study proposes a conceptual integrative framework of Kansei Engineering, Kano model and TRIZ incorporating sustainability. It complements the previous model {see Hartono [4]} by incorporating sustainability concerns.

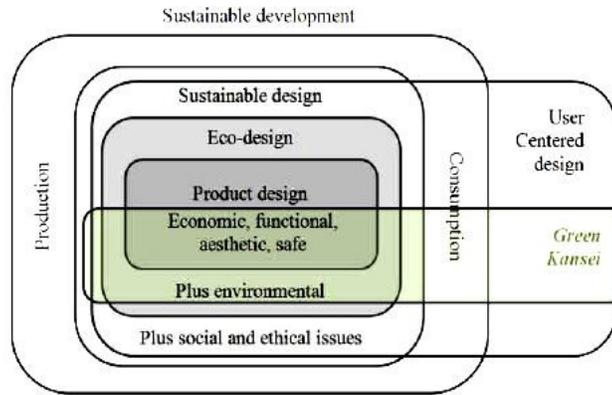
It starts with the selection of service-based services. Services consist of both cognition and emotional satisfactions [7]. It then deploys into two phases, i.e., (i) Kansei-based performance. It shows how to formulize and refine the affective needs of particular customers due to stimuli; (ii) Service attribute-based performance. This step will assess the performance of service attributes with regard to SERVQUAL [8] and Kano model [9]. According to Hartono [4], the Kano model is to categorize service attribute performance into the main three types, namely, attractive [A], one-dimensional [O], and must-be [M]. Afterwards, it moves to the synthesis phase, which is to screen out the service attributes taking priority on [A] or [O] Kano categories, and to model build up Kansei model. Kansei is deemed to be the function of service experience response.



**Fig. 1. A conceptual integrative model of Kansei Engineering, Kano and TRIZ towards sustainability**

At the subsequent phase, it's how to finalize the proposed Kansei model with improvement initiatives. The most critical service attributes taking from significant Kansei model will be weighted by Kansei score, service performance gap, and Kano level. Then, TRIZ methodology takes place by providing contradiction analysis and elimination and generating ideal solution, taking into account sustainability concerns.

More specifically, this study will promote what and how Kansei contributes to sustainable design, in the sense that how Kansei-based design is positioned in the entire sustainable design and development process. According to Rasamoelina et al. [1], it starts with sustainable development that covers sustainable design, eco-design and product design. Incorporating user centered design, product design which is positioned in the core process, is proposed to include economic, functional, aesthetic, safe and environmental concerns. This is where Kansei engaged with sustainable design, known as Green Kansei. More details, it is shown in Fig. 2.



**Fig. 2. Green Kansei and sustainability, adopted from Rasamoelina et al. [1]**

In short, to begin and end with customer point of view, this proposed integrative framework highlights a belief that user's environmental awareness is closely correlated with the emotions, represented by Kansei [1].

### III. TESTING THE CONCEPTUAL MODEL: AN ILLUSTRATIVE CASE STUDY

This study provides an empirical case on healthcare services, located in Surabaya, Indonesia. Research on healthcare services is of high interest since it is a multidisciplinary field which contains social factors, health technology, quality and cost of healthcare, and most importantly, it deals with humans.

Taking a case study on healthcare has been conducted [10], this study extends the scope of framework model incorporating TRIZ and sustainability concerns. It is especially on how provide more comprehensive improvement designs and initiatives.

Face-to-face questionnaire was chosen as the main data gathering method for this research. It has been deemed to be the most powerful research method in the exploration phase and theory building, testing, and extension [11][16].

There were 102 respondents involved with the age range of 21 – 40 years old. Mostly they were professionals. Through convenience sampling method, they were screened out; those who have been hospitalized in medium-large healthcare centres with a minimum of 2 days experience chosen. All variables in the survey (i.e., SERVQUAL, Kansei and Kano) were deemed valid and reliable after passing through validity and reliability tests using confirmatory factor analysis (CFA). The results of synthesis, Kansei modeling and proposed improvement are provided in Table II and III.

**TABLE II. SYNTHESIS AND KANSEI MODELING**

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No	Kansei word	p-value	R <sup>2</sup>	Linear model	Significant service attribute(s)
1	Happiness	0.000	0.189	Happiness = 1.528 - 0.300 RL5 - 0.309 E2 - 0.275 TH1 - 0.252 TH3	Variative and fresh food menu (RL5) Nurse, doctor and staff always give special attention and greeting to patients (E2) Ease of communication among patient, nurse, doctor and staff (TH1) Complain and suggestion are promptly handled (TH3)
2	Friendliness				N/A
3	Comfort				N/A
4	Satisfaction	0.007	0.070	Satisfaction = 2.367 - 0.346 T5	Facilities at healthcare are complete, comfortable and clean (T5)
5	Belief				N/A
6	Endurance	0.022	0.052	Endurance = 4.735 - 0.290 RL5	Variative and fresh food menu (RL5)
7	Quietness	0.007	0.094	Quietness = 0.772 - 0.416 RL6 -0.271 TH3	Procedures of service and payment are easy and simple (RL6) Complain and suggestion are promptly handled (TH3)
8	Spaciousness	0.021	0.052	Spaciousness = 2.329 - 0.334 L1	You will recommend this healthcare to your relatives or colleagues (L1)
9	Arrangement				N/A
10	Boredom				N/A

Based on the Table II above, there were 5 dominant Kansei experienced by the customers. These were, namely, happiness, satisfaction, endurance, quietness and spaciousness. Among these Kansei, happiness was the most dominant one. It was due to quality of services given by the healthcare center, covering all service attributes, which brought impacts physically (tangible aspects) and mentally (intangible aspects and interaction-based activities). Happiness was related to various and fresh food menu, friendliness and ease communication of doctors, nurses and staffs, and the prompt complaint handling. It also implied that, nowadays, healthcare is proposed to be a second home for patients, which may result significant happiness to everyone who experiences any service given by healthcare/hospital.

According to findings of synthesis and Kansei modeling as shown in Table II above, there were 5 Kansei insignificant to the any service attributes experience, i.e., friendliness, comfort, belief, arrangement and boredom. Compared to the significant Kansei (i.e., happiness, satisfaction, endurance, quietness and spaciousness), the insignificant ones seemed to be the second layer of Kansei. Patients were needed to be fast treated, and thus, they showed their first layer impressions/Kansei. The insignificant Kansei might be due to relatively limited number of respondents, and also unidentified service attributes.

TABLE III. IMPROVEMENT INITIATIVES WITH SCORE OF IMPORTANCE

No	Service attributes	[Satisfaction score]	Kano weight	Kansei word & its mean	Importance of what(*)
1	Facilities at healthcare are complete, comfortable and clean (T5)	1.41	A	Satisfied 3.87	21.87
2	Nurse, doctor and staff always give special attention and greeting to patients (E2)	1.65	A	Happy 3.79	25.05
3	The skill of nurse, doctor and staff to serve you (RL2)	2.11	A	-	8.44
4	Variative and fresh food menu (RL5)	2.64	A	Happy 3.79 Endure 3.6	78.1
5	Procedures of service and payment are easy and simple (RL6)	2.19	O	Quiet 3.53	15.47
6	Nurse, doctor and staff are always in time of need (RP2)	2.52	O	-	5.04

\*Importance of what = |Satisfaction score| x Kano weight x sum of Kansei means

Using reverse significant model, there were 6 summarized important service attributes (see Table III).

According to the weighting process {see Hartono [4]}, there were 3 most dominant service attributes, i.e., various and fresh food menu (1<sup>st</sup> priority); nurse, doctor and staff always give special attention and greeting to patients (2<sup>nd</sup> priority) and facilities at healthcare are complete, comfortable and clean (3<sup>rd</sup> priority).

#### IV. ANALYSIS AND DISCUSSION

Kansei is challenged to be an entity which bridges the service attributes and improvement initiatives. More specifically, this study will focus on non-contradictive and eco-sustainable solutions.

As it is based on SERVQUAL dimensions, both concrete and abstract Kansei factors may be taken into account. Those are believed to have relations with environmental awareness. For instance, green color building as a tangible stuff will bring Kansei comfortable; whereas, prompt response given by nurses, doctors and staffs will bring Kansei satisfaction.

Kansei happiness was then found to be the most significant Kansei, according to the modeling process. It shows that patients were mostly happy when visiting and staying in the healthcare centers, due to various and fresh food menu, friendliness and ease communication of doctors, nurses and staffs, and the prompt complaint handling (as it was discussed previously in the Table I). Afterwards, it was found that various and fresh food menu is the most important service attribute for healthcare. It was a surprising finding. Perhaps, nowadays patients have assumed that hospitals have sufficient quality for doctors, staffs and nurses. Though, it was marked as an “A” [attractive Kano quality]. It can be understood that the good

quality of doctors, staffs, and nurses may become an “O” or even “M” Kano category soon.

Thus, various and fresh food menu is a point of difference. Surely, it was rated as “A” Kano quality. It was confirmed that various and fresh food menu is critical to customers/patients, according to the interview result. Patients were relatively bored when they stayed more than 2 days, they had no choice, then. No choice in terms of what food menu will be provided, with a very limited ingredients, constrained by the severity of disease and general patient conditions. However, this is critical. They need more variation and differentiation of meals. They are all human beings.

Back to the principle of Ergonomics/Human Factors Engineering, humans need to be more humanized. They are constrained by physical and mental capabilities and limitations. However, they are wanting something to adjust and adapt more. It is a challenge for all engineers and designers. More often, it brings significant impact to Kansei. Why is this very important issue? According to Hartono and Raharjo [7], a very clear and final stage of judgment made by customers is significantly influenced by emotions, rather than cognition. Again, emotions deal with Kansei.

Referring to the 1<sup>st</sup> priority of service attribute, i.e., various and fresh food menu; an improvement initiative may refer to TRIZ for services [12; 4]. TRIZ will overcome the limitations of the idea generation process, with very less contradiction among alternatives of solution. Usually, service designers will rely on past solutions when asked to generate ideas for improvement, known as cognitive inertia. Based on the 40 TRIZ principles and the TRIZ contradiction matrix (see <http://www.triz40.com>), this improvement idea refers to the improved feature 38, i.e., extend of automation, which is contradictory to feature 26, i.e., quantity of substance. Thus, there are two principles proposed to solve this contradiction, i.e., (i) parameter changes, and (ii) the other way around.

The parameter changes and the other way around relate to several alternatives, such as, (i) change the degree of flexibility, e.g., hospital may offer a daily simplified food menu professionally, as it is available in a restaurant. The patient may custom it, within a boundary of health and hygiene specified by the doctor or staff; (ii) change the temperature, e.g., hospital may wrap the cooked food in aluminium foil packaging. This is to maintain the freshness of food once it is served to the patient; (iii) provide a patient with a self-order system for meal, rather than provide a package of meal to patient without any confirmation.

Those all mentioned above alternatives of improvement will be appropriate and sufficient for fulfilling the 1<sup>st</sup> prioritized service attribute, which is how to provide various and fresh food menu. However, we need to screen out which one is the most effective and efficient, according to sustainability criteria (i.e., economy, society, and environment aspects). It is assumed that economy, society, and environment aspect have the equal weight and there is no sub-items for each aspect in assessing which alternative to select. Due to cost efficiency/effectiveness, social impact, and eco-friendly design, then, change the degree of flexibility is selected. The healthcare may apply an offer a daily simplified food menu professionally, as it is in a restaurant. Patient will experience flexibility, in terms of various and fresh meals. An order can be made a day in advance. Surely, all offers may satisfy the prohibited meals and ingredients as prescribed by the doctors.

Once the 1<sup>st</sup> priority for service attribute improvement has been done, it continues to the 2<sup>nd</sup> and 3<sup>rd</sup> prioritized service attributes. It then follows the same TRIZ methodology process as it is of that the 1<sup>st</sup> priority. The formulized result of TRIZ principles to solve any contradiction might be different. However, what has been formulized at the 1<sup>st</sup> priority should be set as the core component of improvement strategy.

## V. CONCLUSION

In general, nowadays, people make judgment on products and services based on emotions rather than cognition. Thus, emotions (or Kansei in Japanese) is more dominant today. Research on Kansei becomes critical and important, especially when it deals tight competition in the market and also sustainability concerns.

In addressing the issues of market competition and eco-sustainable design, a study on services taking into account Kansei, Kano and TRIZ has been conducted. Previous approach has been done, but it has several niches to fill in. Through this study, a comprehensive approach with more formal methodology has been addressed. It is hoped that a model with concerns on emotions (Kansei) and less contradictory solutions applied, with sustainability concern as the final control. Practically, it may be useful as a guide for service managers or practitioners in evaluating which service attributes need to improve and modify, surely, with a focus on sustainable business and environment.

## VI. FURTHER RESEARCH RECOMMENDATION

Due to a very limited service domain and number of sample size, this study is of quite limited. The proposed integrative model need to be tested by taking more level of services with more complex and comprehensive problems.

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## REFERENCES

- [1] F. Rasamoelina, C. Bouchard, and A. Aoussat, "Towards a Kansei-based user modeling methodology for eco-design," *International Journal of Affective Engineering*, Vol. 12, No. 2, pp. 337-348,2013.
- [2] M. Nagamachi, "Kansei Engineering: A New Ergonomic Consumer-oriented Technology for Product Development," *International Journal of Industrial Ergonomics*, Vol. 15, No. 1, pp. 3–11,1995.
- [3] M. Hartono and K.C. Tan, "How the Kano Model Contributes to Kansei Engineering in Services," *Ergonomics*, Vol. 54, No. 11, pp. 987–1004,2011.
- [4] M. Hartono, "The extended integrated model of Kansei Engineering, Kano, and TRIZ incorporating cultural differences into services," *International Journal of Technology*, Vol. 7, No. 1, pp. 97–104,2016.
- [5] P. W. Jordan, *Designing Pleasurable Products*. London: Taylor & Francis,2000.
- [6] T. Childs, V. Agouridas, C. Barnes, and B. Henson, "Controlled Appeal Product Design: a Life Cycle Role for Affective (Kansei) Engineering," in *Proceedings of International Conference on Life Cycle Engineering LCE 2006*, pp.537-542.
- [7] M. Hartono and H. Raharjo, "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. 971-985,2015.
- [8] Hanan, S.N. The inhibitory efficiency of flavonoid extract of black mustard seeds (*Brassica nigra*) and cold aqueous extract of *euphorbia prostrata* L. on growth of *staphylococcus aureus* invitro and invivo (2019) *International Journal of Pharmaceutical Research*, 11 (1), pp. 395-405..
- [9] N. Kano, N. Seraku, F. Takahashi, and S. Tsuji, "Attractive quality and must-be quality," *The Journal of the Japanese Society for Quality Control*, Vol. 14, No. 2, pp. 39–48, 1984.
- [10] M. Hartono, "Incorporating customer emotional needs using Kansei Engineering and Kano model to support Customer Relationship Management: A case study in healthcare services," in *Proceedings of Joint Asia Pacific Computer and Human Interaction and Ergofuture International Conference, October 22-25, 2014*, Bali, Indonesia.
- [11] C. Voss, N. Tsikriktsis and M. Frohlich, "Case study research in operations management," *International Journal of Operations and Product Management*, Vol. 22, No. 2, pp. 195–219,2002.
- [12] K. H. Chai, Z. Jun, and K. C. Tan, "A TRIZ-based Method for New Service Design," *Journal of Service Research*, Vol. 8, No. 1, pp. 48–66,2005.
- [13] C. Llinares, and A. F. Page, "Kano's model in Kansei Engineering to evaluate subjective real estate consumer Preferences," *International Journal of Industrial Ergonomics*, Vol. 41, pp. 233–246,2011.
- [14] M. Hartono, "Incorporating service quality tools into Kansei Engineering in services: A case study of Indonesian tourists," *Procedia Economics and Finance*, Vol. 4, pp. 201–212,2012.
- [15] M. Hartono, K. C. Tan, and J. B. Peacock, "Applying Kansei Engineering, the Kano model and QFD to services," *International Journal of Services, Economics and Management*, Vol. 5, No. 3, pp. 256–274,2013.
- [16] Paulina, O. A., & Hammed, A. K. (2018). Comparative Evaluation of the Nutritional, Physical and Sensory Properties of Beef, Chicken and Soy Burgers. *Agriculture and Food Sciences Research*, 5(2), 57-63.