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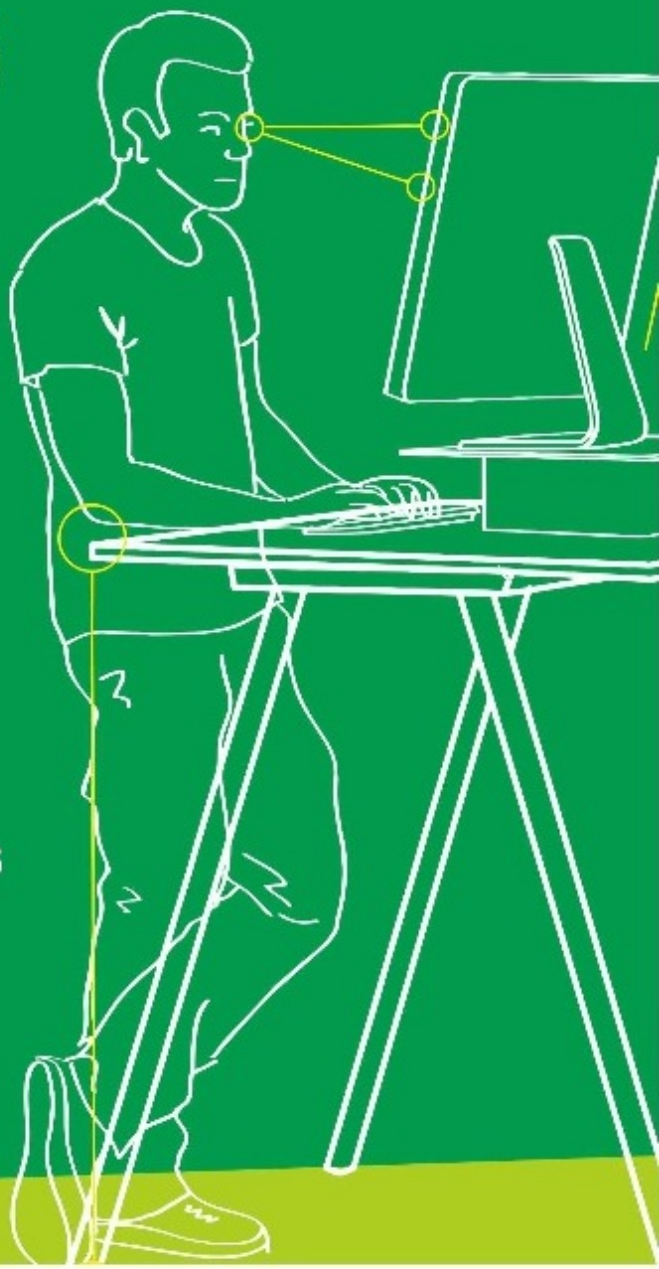
SEANES SOUTHEAST ASIAN NETWORK OF ERGONOMICS SOCIETIES

PROCEEDING

SEANES 2016

THE 4TH SEANES INTERNATIONAL CONFERENCE ON HUMAN FACTORS AND ERGONOMICS IN SOUTH-EAST ASIA

29 November - 1 December 2016
Bandung - Indonesia



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PERHIMPUNAN ERGONOMI INDONESIA

in collaboration with

INSTITUT TEKNOLOGI BANDUNG 1920

UNIVERSITAS KATOLIK PARAHYANGAN

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Green Ergonomics – Sustainability, Productivity, and Well-being

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Preface

Southeast Asian Network of Ergonomics Societies (SEANES) is a regional ergonomics society in Southeast Asia, founded by local ergonomics societies of few countries in the region. SEANES holds a biennial conference since 2010, which provides a forum for scientists, academics, and professionals from around the world, especially in the Southeast Asian region.

In 2016, **4th SEANES International Conference on Human Factors and Ergonomics in South-East Asia** will focus on **"Green Ergonomics: Sustainability, Productivity, and Well-being"**. Within this theme, SEANES 2016 Conference supports and expands the application of human factors and ergonomics with regards to recent local and global needs. This international conference aims to enhance the awareness of the importance of Human Factors Engineering (HFE) in various human activities and application domains, including product design, learning, communication, healthcare, transportation, defense and security.

Hosted by Indonesian Ergonomics Society (Perhimpunan Ergonomi Indonesia/PEI), in collaboration with Institut Teknologi Bandung (ITB) and Universitas Katolik Parahyangan (UNPAR), the committees publish this proceeding as publication of communities' participations on research papers.

Foreword from Conference Chair

It is with great pleasure we welcome you to the 4th SEANES International Conference on Human Factors and Ergonomics in South-East Asia (SEANES) 2016. Southeast Asian Network of Ergonomics Societies (SEANES) is a regional ergonomics society in Southeast Asia, founded by local ergonomics societies of few countries in the region. SEANES holds a biennial conference since 2010, which provides a forum for scientists, academics, and professionals in the field of ergonomics from around the world, especially in the Southeast Asian region.

This year SEANES 2016 Conference is organized for the fourth time and is hosted for the first time by Perhimpunan Ergonomi Indonesia (Indonesian Ergonomics Society) in collaboration with Industrial Engineering Department of Parahyangan Catholic University (UNPAR) and Industrial Engineering Department of Institut Teknologi Bandung (ITB). The conference is endorsed by International Ergonomics Association (IEA).

The theme "Green Ergonomics: Sustainability, Productivity, and Well-being" was chosen to reflect our passion to gather and engage ergonomists from academia and industries to exchange state-of-the-art knowledge and share their latest experience relevant to the application of human factors and ergonomics with regards to recent local and global needs. This international conference aims to enhance the awareness of the importance of Human Factors Engineering (HFE) in various human activities and application domains, including product design, learning, communication, healthcare, transportation, defense and security.

SEANES 2016 aims to engage academics and professionals in a number of interactive activities, i.e. keynote sessions, parallel paper presentation sessions, workshops, industry sessions, and also a welcome reception and a conference dinner. We have received the works of about 312 contributors from Indonesia, Malaysia, Singapore, Philippines, Thailand, India, Japan, China, Taiwan, Germany, Estonia, and Mexico through their submissions. Out of 102 research papers submitted, we selected 77 papers through a rigorous review process done by a board of international reviewers. These papers features a number of great and insightful articles related to several topics in the field of human factors and ergonomics.

Organizing the 4th SEANES Conference for the first time in Indonesia has been a great challenge. We knew that this conference would be impossible without the help from many people. We extend our gratitude to our strong and dedicated organizing committee, scientific committee, SEANES steering committee, international board of reviewers, keynote and workshop speakers, and also our generous sponsors.

Last but not least, we do hope that you enjoy the conference and your stay in Bandung. We also wish our international participants a memorable experience during your stay in Indonesia.

Johanna Renny Octavia Hariandja and Manik Mahachandra
(Conference Chairs)
On behalf of SEANES 2016 Organizing Committee

Foreword from President of PEI & SEANES

Selamat Datang di Bandung,

On behalf of the Southeast Asian Network of Ergonomics Societies (SEANES), we are very grateful for your participating in SEANES 2016. SEANES is a network of the International Ergonomics Association (IEA), and its societies are also IEA federated members, including Indonesian Ergonomics Society (PEI), Human Factors and Ergonomics Society of Malaysia (HFEM), Human Factors and Ergonomics Society of Philippines (HFESP), Human Factors and Ergonomics Society of Singapore (HFESS), and Ergonomics Society of Thailand (EST).

SEANES 2016 provides a great opportunity for sharing of ideas, research experiences and best practices in different areas of Human Factors & Ergonomics among academia, practitioners, and other stakeholders. Let's think of any possibility for collaborations in the future.

Among SEANES countries, we are heading similar challenges in improving our working conditions and promoting safety and health. Our stakeholders are looking forward to hearing our ergonomics success stories, practical ergonomics guidelines, simple ergonomics tool-kit, ergonomics approach adjusted to local conditions, more example of "ergonomics=economics", and etc. We are fortunate to have a draft of SEANES Ergonomics Checkpoints discussed in SEANES 2016. I believe that more programs can be initiated by SEANES such as ASEAN ergonomics month, training and certification, and etc. I believe that better collaborations can be established soon among individuals and societies.

This SEANES 2016 event is hosted and organized by Indonesian Ergonomics Society (Perhimpunan Ergonomi Indonesia/PEI), in cooperation with Institut Teknologi Bandung (ITB) and Universitas Katolik Parahyangan (UNPAR). Hence, I thank all the committee members for their hard work.

Finally, we hope you enjoy this SEANES 2016 event, fruitful workshop and successful conference, and also the most pleasurable stay in Bandung.

Thank you.
Sincerely,

Yassierli, Ph.D

President of Indonesian Ergonomics Society (PEI)
President of Southeast Asian Network of Ergonomics Society (SEANES)

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THE APPLIED MODEL OF KANSEI ENGINEERING, SERVQUAL, KANO, AND TRIZ CONSIDERING ERGO-SUSTAINABILITY: A CASE STUDY ON INTERNATIONAL AIRPORT SERVICES

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ABSTRACT

With respect to Ergonomics sustainability (Ergo-sustainability) concerns, this study focuses on how to model customer emotional needs (known as Kansei) with service-based performance and experience, taking into account the Kano model and TRIZ (Theory of Inventive Problem Solving) to filter and refine the improvement concepts effectively, efficiently, and without contradiction. This model has been applied into an international airport services. By involving 100 subjects, it was found out that mostly passengers experienced the Kansei 'Happy', and perceived the service attribute 'The availability of security in the airport lounge and lobby' as the most critical one, subjected to Kano attractive [A] category, importance and satisfaction score. By incorporating TRIZ and Ergo-sustainability concept, providing a porous security system and video-based metal detection security checking procedure in the airport lounge and lobby were deemed of critical. This finding will bring benefits to airport authority, even for any service designers with less experience dependency.

*Keywords***:** Kansei Engineering; TRIZ; Ergo-sustainability; airport services.

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1. INTRODUCTION

Ergonomics must address global quality of life, and conserve the local content (Dekker, 2013). It's today's challenge. Sustainability in ergonomics or human factors engineering tends to be more complex due to its debatable essence of sustainability and how the sustainable ergonomics leads to whom it may belong. It is addressed that sustainability may be good for one side, but it may cause negative impacts for others. In short, contradictory results may occur. Thus, balanced impact of sustainability in human factors field is of challenge.

Sustainability in ergonomics is still of great issue. Since it deals with human, then the objective is how to satisfy and fulfill all human needs and requirements, while still maintaining the conservation of environmental, social and economic aspects. Manuaba (2007) addressed a holistic and comprehensive approach in applying ergonomics for systems or product designs. While using technology, a designer should assess comprehensively considering 6 criteria as a must, namely, technically, economically, ergonomically and socio-culturally sound, saves energy and preserves environment. Apart from physical ergonomics, system and product designs should not overlook the emotional ergonomics. It is indeed related to sustainability issues as well. According to Rasamoelina et al. (2013), affect and emotional satisfaction may be related to customer environmental awareness. It can be extended to say that the more environment-based awareness products or services may lead to more emotional satisfaction. In Japanese, emotional satisfaction is known as Kansei.

By considering the debates of to whom ergonomics sustainability contribute and the comprehensive relationship of ergonomics to sustainability issues, this study is proposed. By extending the study by Hartono (2016), this current study will engage the integrative model of Kansei Engineering and Kano with TRIZ incorporating ergonomics sustainability attributes (known as Ergo-sustainability). Kansei Engineering and Kano will take focus on how to capture customer emotional needs (as it is more dominant than cognitive aspect in any business or product experience) and translate them into service attributes, while TRIZ will resolve the possible contradictions that may occur among any stakeholders. It is hoped to fill the research gap.

This study took a case study on international airport services, as it is one of very complex services, involving many parties, such as passenger, employee, supporting staffs, and many third parties. Due to significant economic growth in Indonesia, the needs for customer satisfaction and comfort become competitive values, while the requirement for maintaining the environment, social and economic aspects is of demanded. Hence, this research was conducted to test the applicability of the proposed model, and find out what critical service attribute(s) and also what ways to resolve the contradiction between improvement strategies in the airport services.

2. BRIEF LITERATURE REVIEW

2.1. Kansei Engineering

Kansei is about emotions, something beyond usability and functionality. Not only product experiences and interactions, the utility of emotional needs and feelings have brought great impact on service design and development (see Hartono & Tan, 2011 ; Hartono et al., 2013 ; Hartono, 2016). Firstly, Kansei Engineering as a powerful methodology taking into account customer emotions has been introduced by Mitsuo Nagamachi (see Nagamachi, 1995) and successfully applied in many products such as Mazda Miata, stereo set, kitchen set, shampo and many more. The challenge of application of Kansei Engineering on services, which is apart from physical products, has been answered (see Hartono & Tan, 2011), and continuously conducted. Basically, this method has superiority in capturing what emotions needed and experienced by users, and translated into physical product/service attributes. In addition, it has a flexibility and compatibility to engage with quality tools. Surely, quality is quite related to Kansei Engineering, as an ergonomics-based product/service development technology (Nagamachi & Lokman, 2011).

2.2. SERVQUAL and Kano Model

SERVQUAL model by Parasuraman et al. (1988) is used as the main dimension and attribute that can be functioned as stimulus to the Kansei. What perceived by the customer, described in 5 dimensions of SERVQUAL (namely, Tangible, Empathy, Responsiveness, Reliability and Assurance) will serve as independent variables to certain Kansei. Kano model (Kano et al., 1984), is used to categorize what performance has been shown by either physical product or service. There are 3 main Kano's categories, namely, (i) basic/must-be. It is something taken for granted, the disfunctionality of this attribute will incur dissatisfaction, while its functionality will create something it's supposed to be. The more effort on this attribute will create insignificant satisfaction level ; (ii) one-dimensional. It is of linear relationship between product/service performance and satisfaction. The higher the effort to perform, the higher the satisfaction level is ; (iii) attractive/delighter. According to Yang (2011) and Hartono & Tan (2011), it is something related to customer emotional satisfaction (Kansei). Something unexpected by customer, however, if it is offered then it will create something beyond satisfaction.

2.3. TRIZ

Service designers may potentially lack of ideas in generating new and fresh, yet innovative proposed improvement concepts. They are bounded to the previous experiences, or the limitation of service design tools. Thus, TRIZ (teoriya resheniya izobretatelskikh zadach, known as TIPS – Theory of Inventive Problem Solving), as the theory of the resolution of invention-related tasks, is proposed to overcome those limitations. According to Altshuller (1997), TRIZ is positioned to be a powerful tool which is full of universal principles of invention, that can be used as the basis for creative innovation.

Basically, the superiority of TRIZ methodology is that to resolve the potential contradictions occurred due to two conflicting requirements to the same element in a system (Chai et al., 2005). These potential contradictions must be identified and resolved. Thus, what will be proposed as improvement strategies can be deemed as a good compromise among any controllable and uncontrollable factors surrounding the identified problems.

There are 40 inventive principles, 39 features of contradiction matrix, the four separation principles, the algorithm of inventive problem solving (ARIZ), and 76 standard solutions as the common tools for TRIZ (Altshuller, 1997). A study by Hartono (2016) has used TRIZ 40 inventive principles and 39 features of contradiction matrix integrated with Kansei Engineering and Kano model, for solving problems on restaurant services.

2.4. Proposed Ergo-Sustainability

Why both sustainability and ergonomics is important? Both sustainability and ergonomics have field incision which emphasize to deal with sociotechnical problem. Ergonomics encompass Human Factor frequently used to optimize the role of human in system covering environmental, social, economic and cultural elements as well. Meanwhile, sustainability may deal with people, planet and profit. According to Slaper & Hall (2011), people, planet and profit, known as triple bottom line, may consist of social equity, economic and environmental factors. Thus, there will be potensial issues to combine two aforementioned diciplines theoritically which is not only used to design optimum system, but also to design suitable system for either worker or user of system itself. Proposed as Ergo-sustainability, it deals with sustainability concerns by incorporating ergonomics tools and concepts. Regarding triple bottom line concept, it should be applied for stakeholders point of view. It talks about anyone who is influenced, either directly or indirectly by the actions of the company or firm. The impacts should be balanced and mutually beneficial.

In this study, by referring to ergonomics point of view, sustainability is closely related firstly on social dimension. It starts and ends with users/humans. Referring to Berry et al. (2008), this study proposes Ergo-sustainable improvement strategies for airport services that may include social-based dimension attributes such as public awareness and education, stakeholder relationships, employee-well being, and passenger-well being.

3. RESEARCH METHODOLOGY, APPLIED MODEL, AND CASE STUDY

3.1. Research Methodology

The chosen service domain was the airport services in Surabaya. For those who were experiencing the international airport services in the last 6 months (in a period of May to October 2015) have been chosen as targeted respondents. They were, at least, experienced once in that airport for either domestic or international flight during that period. This study used convenience sampling, followed by face-to-face questionnaire in interviewing about 100 subjects. It took around 20 minutes maximum to complete the survey. If any refused to do the survey, then the interview has been cancelled. This research has focused only on domestic tourists (Indonesians) ; thus, a culture difference was negleted.

3.2. Applied Integrative Model

The utilized applied integrative model of Kansei Engineering, SERVQUAL, Kano and TRIZ in services has been fulfilled, especially in restaurant services (see Hartono, 2016). Its contribution to theory and practice has been discussed as well. However, this current study complements the previous model by incorporating Ergo-sustainability as a new approach taking into account human sides sustainability applied in services. For now, this model has been tested in airport services. Air transport, nowadays, has become very prominent issue

for any business support. It is not only for material/goods movement, but also, more importantly for people movement. The speedy delivery time, no delay, sufficient number of air carriers are some of important issues ; more specifically, customers now also look for convenience, friendliness of staff, cleanliness, and place to relax while they are waiting for flight. Thus, the challenge is now becoming more and more complex. Physically and emotionally, the expected service performance must be met and satisfied.

According to Hartono & Tan (2011) and Hartono (2016), subsequently, there will be two concurent activities need to perform. They are Kansei-based performance (i.e., the identification, collection and measurement of Kansei performance), and service attribute-based performance (i.e., the identification, collection and measurement of service attribute performance with Kano-categorization process). Afterwards, it is followed by synthesis. It is a process to screen out the relevant service attributes by using criteria of Kano's A (Attractive) and O (One-Dimensional) category, and negative service gap score (i.e., it is a score to explain the discrepancy between expectation and perception, in which perception is below the expectation). More specifically, it shows that what attributes have significant value to customer satisfaction will be proceeded. Next, it will be a modeling, to bridge the selected Kansei and service attributes. It is hoped to filter what service attributes bring significant impact on Kansei, then to continue formulizing improvement innitiatives considering TRIZ-based Ergo-sustainability approach. The TRIZ-based Ergo-sustainability is a significant contribution, as compared to the previous progressive studies. It is about how to confirm the proposed solutions with regard to Ergonomics-concern while maintaining free-contradiction alternatives. Hence, the expected solutions are contradiction-free. More details of applied model, can be seen in Figure 1.

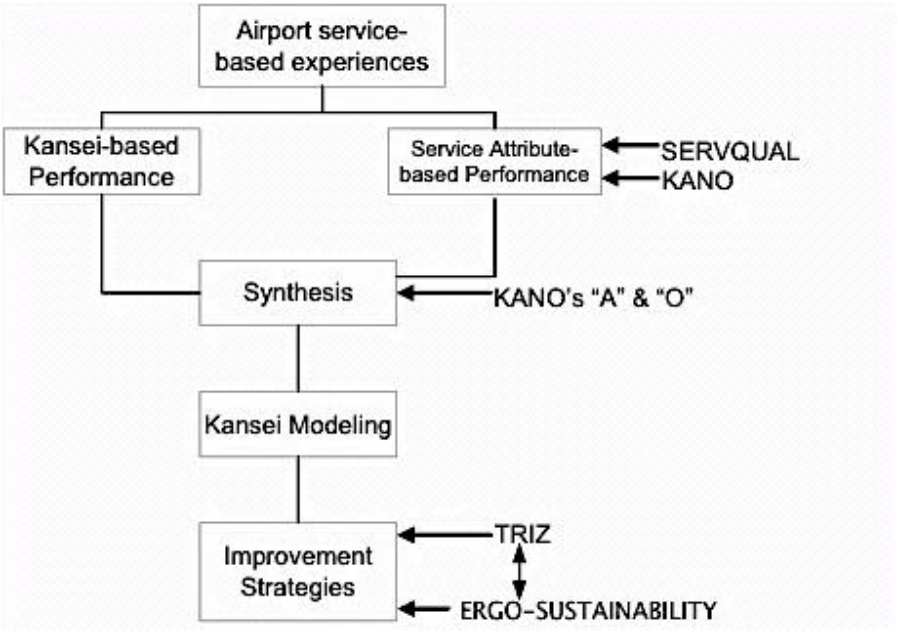

Figure 1 Applied Model of Kansei Engineering, Kano & TRIZ for airport service-based experience (modified from Hartono, 2016b)

4. CASE STUDY ON AIRPORT SERVICES

According to the field survey through face-to-face questionnaires, there were eight Kansei words formulized and finalized, i.e., happy, friendly, satisfied, clean, trusted, delighted, nice, and modern. Those were deemed to be the representative feelings when respondents are enjoying and experiencing the airport services. Likert-based five-scale was used to rate the importance, perception, and expectation of each of service attributes, and also the perception of each of Kansei. Similar to the previous studies (see Hartono & Tan, 2011 ; Hartono et al., 2013 ; Hartono & Raharjo, 2015 ; Hartono, 2016), affective needs (known as Kansei or emotional needs) have been found to be more dominant than usability and cognitive needs. Hence, by engaging and fulfilling what emotions the passengers expect and perceive, will bring competitive advantages to the airport authority, and loyalty to the customers as well.

Next, it was to identify and categorize relevant airport service attributes using Kano model (both A or O category), as the sources of customer emotional impressions (Kansei). In addition, the satisfaction score was provided. For details, the categorization of Kano followed by the results of satisfaction score is provided in Table 1 as follows.

Table 1 Service attributes with negative satisfaction score and Kano's A & O

No	Service Atributes	Satisfaction Score*	Kano Category
1	The accuracy of delay notification (AL_9)	-6.197	A
2	The accuracy of delivered last call (AL_{10})	-5.560	A
3	The clarity of information given by officers (AL_{12})	-5.445	O
4	The cleanliness of toilet (AL_5)	-5.388	A
5	The ease of information obtained (AL_{11})	-5.248	A
6	The availability of security in the airport lounge and lobby (AL_{19})	-5.049	A
7	The secured parking lot (AL_{18})	-4.927	A
8	The hygienic airport (AL_2)	-4.840	A

**Satisfaction Score = {Perception – Expection} x Importance Level*

Afterwards, those selected service attributes have been linked to all the chosen Kansei words. It is to identify which Kansei is the most important due to its connection to service attribute performance. The more Kansei impacted, the more sensitive and important it is (Hartono & Tan, 2011). Using multiple linear regression technique, the significant linear Kansei model is summarized in Table 2.

Table 2 Significant linear Kansei model

No	Kansei	R^2	Significant model **
1	Happy [K_1]	0.122	$K_1 = 2{,}952 + 0{,}341\ AL_{19}$
2	Friendly [K_2]		N/A
3	Satisfied [K_3]	0.067	$K_3 = 3{,}164 + 0.212\ AL_9$
4	Clean [K_4]	0.063	$K_4 = 3{,}230 + 0{,}229\ AL_9$
5	Trusted [K_5]	0.094	$K_5 = 2{,}583 + 0{,}323\ AL_{19}$
6	Delighted [K_6]	0.106	$K_6 = 1{,}996 + 0{,}412\ AL_{19}$
7	Nice [K_7]	0.082	$K_7 = 2{,}383 + 0{,}352\ AL_{19}$
8	Modern [K_8]	0.066	$K_8 = 2{,}914 + 0{,}264\ AL_{19}$

***Significant with α <= 5%*

In order to find out which airport service attribute(s) is/are the most critical one to adjust its priority for improvement, the importance weight was completed. It included the absolute satisfaction score, Kano weight (see Pawitra & Tan, 2001), and the total mean score of Kansei. The higher the importance weight, the more important the service attribute is. See Table 3 for the details of weight calculation process.

Table 3 The importance weight of significant service attribute

Attribute	|Satifaction Score|	Kano Weight		Kansei Word		Importance Weight***
		Category	Score	Perception Mean Score	Kansei Impacted	
AL_{19}	5.049	A	4	3.81 3.67 3.33 3.53	Happy Trusted Delighted Nice	366.56***
AL_9	6.197	A	4	3.81 3.81 3.94	Modern Satisfied Clean	192.09
AL_{10}	5.560	A	4	-	-	22.24
AL_{12}	5.445	O	2	-	-	10.88
AL_5	5.388	A	4	-	-	21.55
AL_{11}	5.248	A	4	-	-	20.99
AL_{18}	4.927	A	4	-	-	19.71
AL_2	4.840	A	4	-	-	19.36

****the important weight = |satisfaction score| x Kano score x Kansei percepition score; ****the most critical airport service attribute*

Based on the result of Table 3 above, it is discovered that Kansei Engineering has significant influence to determine the impotance weights. Obviously, those values will affect to the selection of service attributes to be improved. It implies that company or firm does not need to improve all of the service attributes having negative Satisfaction Score. However, company or firm simply select some key service attributes establishing the expected cutomer emotional. In addition, it is expected to give both satisfaction and efficiency while conducting improvement.

5. DISCUSSION

5.1. Kansei words as the representative of emotional needs

Regarding which Kansei words as the representatives of customer emotional need, airport services of this study served 8 final Kansei. They were happy, friendly, satisfied, clean, trusted, delighted, nice, and modern. All Kanseis were firstly interviewed, involving passengers who have visited an airport for at least once in the last 6 months. For instance, a passenger once said *'I like a modern taste of airport architecture, with a lot of high-tech facilities'*. It means that he expects a modern ambience. Among these significant Kanseis, the 'happy' seemed to be very common and popular impression expected by visitors. It is quite normal, since the feeling 'happy' speaks something general, either we are going to go vacation or business trip. Airport services should have supported all purposes when people take flight. It is talking the way they are served, starting from check-in process, 'delay' management system, security checking, restaurant and souvenir shops, toilet, friendliness of

staff and many things. Thus, 'happy' is a must. Referring to all significant Kanseis, there were two cluster of impression gathered, i.e., physical surrounding Kansei (i.e., modern, nice, clean) and interaction Kansei (i.e., happy, friendly, satisfied, trusted, and delighted). The former talks about how Kansei generated by the impression due to physical facilities (servicescapes), such as the lobby, check-in counter, lightings, restaurant and et cetera. The latter is related to the impact due to interaction-based process and performance, for instance, the performance of front-desk staff, check-in process staff, security staff, etc.

Among 20 airport service attributes, based on the response of targeted subjects/passengers, there were 8 attributes which brought significant emotional appeals. These attributes were of Attractive [A] or One-Dimensional [O] Kano performance. These Kano's performances will make critical contribution to Kansei (see Hartono & Tan, 2011). Among them, the most critical one was that 'the accuracy of delay notification'. It shows that its negative satisfaction score is the highest ; it means that the subjects perceived the performance far below their expectation. Since it was of [A] Kano category, thus it was very critical. Once the resources are limited, we need to put high concern on this attribute (Yang, 2011). Actually, if we look at practical point of view, 'the accuracy of delay notification' seems to be a competitive advantage, due to very thigh competition, nowadays. We need to find something innovative and different, to standout in the global competition. Passengers need certainty, whether they will fly or not, more specifically, if it is delayed, how long they need to wait. Thus, an update notification of delay is a very critical point. Perhaps, since it is an [A] category, a continuous update of 'delay' through email or sms (short message service) can be a great deal or offer to be distinctive.

Based on the proposed significant linear model, it was found that it seems Kansei 'happy' became the most critical, influenced by the performance of 'the availability of security in the airport lounge and lobby'. It was clear enough that the most prevalent factor in influencing the happiness was security both in lounge and lobby. Again, people put trust while they are flying, covering all facilities given by the airport services, especially the safety/security issues. In other words, no worries is a must, as well.

With regard to limited resources and sustainability concern, it was then analyzed which service attribute was the most critical one. It may result the first priority of service attribute to improve. By incorporating the Kano weight, absolute satisfaction score and the sum of Kansei perception mean score, 'the availability of security in the airport lounge and lobby' has been ranked to be the 1st prioritized service attribute for improvement. In addition, this attribute had significant relationship with Kansei 'happy', 'trusted', 'delighted', 'nice', and 'modern'.

5.2. Ergo-sustainability and TRIZ as the way to focus on human

Referring to Table 3, the most prioritized service attribute 'the availability of security in the airport lounge and lobby' was then resolved by incorporating TRIZ 40 principles (Chai et al., 2005) and 39 features of contradiction matrix (Shih et al., 2013). It was formulized that the improving feature was 'object-affected harmful factors', and the worsening feature were

'power' and 'speed'. They were deemed to be contradictive. They were needed to be resolved.

Apart from TRIZ analysis, the proposed solutions and improvements must deal with sustainability issues, especially Ergonomics-sustainability (here, it is called Ergo-sustainability). By implementing ergo-sustainability, idea generation using TRIZ principles is expected to be more specific and powerful because ergo-sustainability, marrying Sustainable Development and Ergonomics-Human Factor, can solve two problems. According to Brown & Legg (2012), first problem solved is it brings a rich set of knowledge and methodology to help bridge the lack of connection between intention and deeds in tripple bottom lines aspect, and second problem solved is it applies certain human values, such as taking moral approach, to system design. According to the Airport Sustainability Practices (Berry et al., 2008), there are 3 dimensions deployed into several attributes, as shown in Table 4.

Table 4 Sustainability dimensions in airport services

Environmental	**Social***	**Economic**
Water quality	*Public awareness and education*	Local hiring
Climate change	*Stakeholder relationships*	Local purchasing
Air quality	*Employee practices and procedures*	Contribution to community
Land use	*Sustainable transportation*	Quantifying sustainability
Biodiversity	*Alleviating road congestion*	Contribution to research and development
Materials	*Accessibility*	Incentives for sustainable behavior
Waste	*Local identity culture and heritage*	
Noise and aesthetics	*Indoor environmental quality*	
Energy	*Employee well-being*	
Green buildings	*Passenger well-being*	

**related to Ergo-sustainability*

This study proposed Ergo-sustainability concerns that related to social dimension since it deals with humans, which consists of public awareness and education, stakeholder relationships, employee practices and procedures, sustainable transportation, alleviating road congestion, accessibility, local identity culture and heritage, indoor environmental quality, employee well-being, and passenger well-being. It is clear enough that both employee-passenger and public will be of priority.

With respect to the integration between TRIZ and Ergo-sustainability, in terms of the contradiction between 'object-affected harmful factor' and 'power ', they are four principles to resolve the contradiction (Chai et al., 2005), namely (i) periodic action, (ii) 'blessing in disguise'/convert harm into benefit, (iii) porous materials, and (iv) taking out/extraction. While, in order to resolve the contradiction between 'object-affected harmful factor' and 'speed', they are four principles as well, i.e., (i) skipping/rushing through, (ii) 'blessing in disguise'/convert harm into benefit, (iii) parameter changes/transformation of properties, and (iv) mechanics substitution/replacement of

mechanical systems. It is summarized some possible solutions with regard to TRIZ principles and Ergo-sustainability aspects, as follows :

Table 5 TRIZ and Ergo-sustainability based alternative solutions

Object-affected harmful factor vs power	Object-affected harmful factor vs speed
Airport authority provides more security-awareness related announcements during peak hours and season. *This is to support a principle of 'instead of continuous action, use periodic or pulsating action'and suits to ergo-sustainability: Public awareness and education ; Stakeholder relationships*	***Airport authority provides a big video display in front of security check counter, showing how to pass through the metal detector, and the list of dangerous/risky/unpermitted/forbidden items. It is to make the security check more efficiently and effectively.** *This is to support a principle of 'conduct a process, or certain stages (e.g., destructible, harmful, or hazardous operations) at high speed' and suits to ergo-sustainability: Public awareness and education ; Employee practices and procedures; Alleviating road congestion.*
Regular or sudden safety audit in the airport lobby and lounge. *This is to support a principle of 'use harmful factors (particularly, harmful effects of the environment or surroundings) to achieve a positive effect' and suits to ergo-sustainability: Employee practices and procedures*	Regular or sudden safety audit in the airport lobby and lounge. *This is to support a principle of 'use harmful factors (particularly, harmful effects of the environment or surroundings) to achieve a positive effect' and suits to ergo-sustainability: Employee practices and procedures*
***Airport authority provides a porous security in the lounge to check all passengers before entering.** *This is to support a principle of 'make an object or system porous or add porous elements' and suits to ergo-sustainability: Public awareness and education ; Stakeholder relationships; Employee practices and procedures*	Airport authority provides simplified security check (perhaps in the group security check). *This is to support a principle of 'change the degree of flexibility' and suits to ergo-sustainability: Public awareness and education ; Stakeholder relationships.*
To setup e-security system to declare what items carried during the flight, allowing the airport authority to note the details of all passenger belongings. *This is to support a principle of 'separate an interfering part or property from an object or system, or single out the only necessary part (or property) of an object or system' and suits to ergo-sustainability: Public awareness and education ; Stakeholder relationships; Employee practices and procedures; Accessibility*	Airport authority provides security check system using camera-based face and voice recognition. *This is to support a principle of 'replace a mechanical means with a sensory (optical, acoustic, taste, or smell) means' and suits to ergo-sustainability: Public awareness and education ; Stakeholder relationships; Employee practices and procedures; Indoor environmental quality*

**relevant and possible executed proposed solutions*

Based on the evaluation process, subjected to cost efficiency, innovate ideas, possibility of implementation, and maximum benefits to public-employee-passenger well being, the ideal proposed solutions will be : (i) Airport authority provides a porous security in the lounge to check all passengers before entering, and (ii) Airport authority provides a big video display in front of security check counter, showing how to pass through the metal detector, and the list of dangerous/risky/unpermitted/forbidden items. It is to make the security check more efficiently and effectively.

6. THEORETICAL CONTRIBUTION AND MANAGERIAL IMPLICATION

Theoretically, this study provides a grounded model of the integration of Kansei Engineering, TRIZ and Kano model, taking into account Ergonomics-sustainability concerns. Thus, it highlights how emotional needs of customer due to service encounters has been modelled, and fulfilled while maintaining the sustainable Ergonomics aspect for any proposed solutions. A case study on airport services has confirmed the validity and reliability of the proposed model.

Practically, this study on the integrated applied model of Kansei Engineering, Kano and TRIZ with regard to Ergo-sustainability has been applied into international airport services. What have been carried out may provide a practical guideline for airport service manager to continously find out service improvement strategies, yet innovative ones, subjected to limited resources and Ergo-sustainability concerns. According to Chai et al. (2005), this research is simple yet powerful, since it can be done by less experienced providers. The proposed improvement strategies are hoped to be free from contradiction, and less experienced-based knowledge dependency.

7. CONCLUSION AND FURTHER RESEARCH

For further study, reflecting to what has been achieved from this current study, it is suggested to involve the airport authority to execute and implement the proposed improvement strategies. Since airport services are of complex system, the involvement of foreign respondents can be considered. More sample size is encouraged, prior to the more valid and reliable data and proposed model.

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