A Service-Oriented Architecture Adoption Maturity Matrix using Kano Model: Cross Evaluation between IT and Business Benefits

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Abstract **- The many promised benefits of SOA adoption have attracted numerous organizations to adopt SOA. These SOA adoption benefits have been identified by the previous researchers and can be distinguished into IT and business benefits. However, this study found that there is a lack of work that provide a method on how to construct the matrix for evaluating the SOA adoption focuses on both IT and business benefits. Therefore, this study aims to provide a method that can be used to construct a cross evaluation matrix focuses on SOA adoption IT and business benefits. This study first determines the IT and business benefits characteristics and sub-characteristics in order to provide the evaluation criteria for evaluating the SOA adoption. Then this study adapted Kano Model in order to construct the cross evaluation matrix between IT and business benefits. The findings implies that Kano Model is appropriate to be used as the underlying structure to construct the cross evaluation matrix in this study. Kano Model provides the approach on how to plot, organize and better represent the evaluation dimension for evaluating the SOA adoption.**

Index Terms **- Cross Evaluation Matrix; Kano Model; Service-Oriented Architecture and SOA Benefits.**

I. INTRODUCTION

Service-Oriented Architecture (SOA) is a concept or a paradigm that follows service-orientation principles in order to integrate distributed services across network. SOA also has been successfully adopted in several different domains such as e-government portal, health-based application, supply chain management and many more [1], [2]. Majority of the organizations adopted SOA because of the many promised benefits that SOA provided and these benefits can be distinguished between IT benefits and business benefits [3]. Furthermore, previous industry and academia also have constructed several SOA maturity models in order to guide the SOA adoption [4]. However, this study found that the existing models are still lacking on the method that can be used to construct the matrix for evaluating the SOA adoption. Therefore, this study is going to adapt Kano Model in order to construct the matrix that focused on evaluating both SOA IT and business benefits. This study found that Kano Model is a model that can provide an appropriate method to plot, organize and better represent the matrix for evaluating the SOA adoption [5]. The structure of this study is organize as follow: section II and III provide the information on the related works and literature review. Section IV covers the research method where this section discusses on the determining the SOA benefits and constructing the cross evaluation matrix using Kano Model. Section V is concern with the discussion of this study and section VI conclude the study with a brief summary.

II. RELATED WORKS

Review from literatures shows that Kano Model has been widely used in several different domains such as evaluating web services, lean production tools, e-library and express services [5]–[7]. Prior studies have adopted Kano Model because it is a great way to determine what makes a quality and well receive service for a dynamic user requirements and economic environment [8]. Kano Model also can be used as a highly useful tool for prioritization, discovering user issues and weighting the potential service value [6]. Furthermore, past researchers also have applied Kano Model in constructing a matrix to better represent the relationship between user need fulfillment and perceived user satisfaction [5]. Table 1 summarizes the Kano Model usage in prioritizing the user requirements that need to be fulfill.

Referring to Table 1, Kano Model has been successfully used to classify and prioritizing the user requirements and needs in several different domains. Kano Model has been used to plot the matrix and determined the type of requirements that need to be fulfill [9]. However, there is a lack of work that applied Kano Model in the SOA maturity model domain. Therefore, this study found that it is appropriate to adapt Kano Model in order to construct the matrix for cross evaluation between IT and business benefits. Kano Model is required in this study in order to determine and verify the importance of SOA benefits best practices and classify the SOA IT benefits sub-characteristics into three types of needs which are basic needs, expected needs and excitement needs [6]. This study also used Kano Model in order to better represent and organize the matrix for cross evaluation dimension between IT and business benefits [5]

Table 1
The existing studies on Kano Model

Descriptions	Advantages	Resources
This study develop a decision making model for the selection and evaluation of lean production tools. The purpose of this study is to implement the lean technique in a product assembly environment by combing the Kano model with Quality Function Deployment.	The Kano Model has been used to support the decision makers in dealing with multi-criteria problems in a manufacturing environment.	[6]
This study aims to measure the efficiency and the effectiveness of a website in order to achieve the objective of guiding the users to their preferred requirement by implementing the Kano Model in a form of a web metric.	Kano Model can be used to support an ever changing consumer requirement and economic environment.	[8]
This study applied and integrated the Kano Model in order to represent the relationship between customer needs and satisfaction. The outcome of this study shows that Kano Model can be used to allocate the product development resources.	Kano's model can provide a better representation of the relationship between customer need fulfillment and perceived customer satisfaction.	[5]
This study explores the problems of service quality classification from the perspective of express service quality by using the analytical Kano model. Kano model was used to classify the service quality elements objectively, and to calculate priority index based on the result of classification.	Kano Model provide customers with better service as well as a greatest degree service productivity enhancement.	[9]
The study applied the Kano model with the strategic experiential module (SEM) in order to determine the innovative service attributes of the e-book service model.	Kano Model can be used to shorten the rift between early and late adopters, thereby providing real benefits to product development and marketing strategy.	[7]

III. Literature Review

A. SOA Adoption

SOA adoption is a complex process that involves a migration process from a legacy system which can disturbs the social and technological structure of organizations [10]. The organization resources (e.g. employee, technology, workflow and etc.) will be affected and a proper organizational redesign (e.g. individual and culture) is needed in order to adopt SOA successfully. This migration process encompasses the introduction of new technologies, concepts and principles of software development, IT management and IT architecture [12]. Thus, the adoption of SOA is not an easy process where it require some big changes and well-defined planning in order to migrate towards SOA.

Previously, SOA have been successfully adopted in several different domains. Health care is one of the domains that applied SOA in their system architecture [1], [13]. The work by Ganapathy [14] on the geriatric health care proposed the SOA framework in order to provide health care services for older people. The framework has the capabilities of interoperable services, lower operational cost, low response time, higher throughput and memory space reduction. The SOA framework in this healthcare system also was able to improve the decision-making process and generate a timely alerts efficiently. Besides that, Sedek and Omar [2] adopted SOA into their proposed one-stop e-government portal as SOA adoption provides interoperable capabilities, which can be used to integrate different government agency portals into the one-stop e-government portal. Their work has provided effective and efficient services among the target users. This one-stop e-government portal allows easy access to different government agencies anytime anywhere. Moreover, the SOA also has been adopted in the supply-chain management where Cheng et al. [15] applied the SOA in the integration of the supply-chain services from different stakeholders who provide products, services, and information's. Their proposed work has successfully provided customize and economical tool for integrating different supply chain associate with comprehensive computing powers. Thus, the succession of adopting SOA in variety of domains proves that SOA provides a reliable architecture which can be used to integrate different services, legacy systems and applications.

B. SOA Benefits

There have been numerous SOA benefits identified in the past literatures. The perceived benefits of SOA have promoted SOA as an architecture that capable of addressing the business needs of modern organizations in a cost-effective and timely manner [16]. Luthria and Rabhi further mentioned that based on their finding, SOA has been widely adopted because there are many benefits provided by SOA and these benefits also can appear in a form of business strategy and infrastructure [17]. There also has been an increasing interest in academia to investigate the approaches for migrating legacy systems to SOA because of the benefits that SOA provided [18]. The possible list of SOA benefits also can be easily extended [10] and these possible benefits should be categorized and specified into two major benefits which are the IT and business benefits [8, 9]. The identification of the IT benefits allows the application to be easily coupled, adapted and combined in order to cope with changing environment [21]; whereas the identification of the business benefits can be used to examine the organizational performance impacts of SOA [22]. Table 2 and 3 shows the proposed IT and business benefits characteristics.

Table 2
SOA Adoption IT Benefits

Characteristics	Description	Resources
Reusability	The degree to which the service can be used in more than one business process or service application, without having much overhead to discover, configure, and invoke it.	[23]
Integration	The ability of a system to integrate different services, components or business process.	[24]
Flexibility	The ability to adapt to changing business and stakeholder requirements more efficiently, easily and rapidly	[25]
Agility	The ability of a system to adapt proactively to unexpected and unpredicted changes.	[26]
Scalability	The ability of SOA to function well (without degradation of other quality attributes) when the system is changed in size or in volume in order to meet users' needs.	[27]

Table 3
SOA Adoption Business Benefits

Characteristics	Description	Resources
New Functionality	The ability to provide the business functionality required while also learning how to develop and deploy a basic SOA application.	[28]
Cost Reduction	The ability to reduce development cost of SOA such as time.	[22]
IT/Business Alignment	The ability in which the Information Technology (IT) is a dynamic state where a business organization is able to use IT effectively in order to achieve business objectives.	[29]
Business Quality	The ability to provide quality of service in SOA system.	[29]
Business Optimization	The ability to be able to spread business processes out from the organization.	[28]

C. Kano Model

The Kano Model was proposed by Doctor Noriaki Kano in 1980s and many researchers have applied it extensively in order to classify the feature or function into one of three categories (Attractive, Must-be and One-dimensional). Furthermore, Kano Model can be used to investigate any requirements in greater detail in order to understand which of the requirements need to be included in the final services [30]. Thus, this study found that Kano Model can be used to provide an effective approach to construct and better represent matrix for cross evaluation between IT and business benefits by prioritizing the identified SOA IT and business benefits into the potential list that the product or service should try to satisfy.

Kano Model categorized the requirements or quality services into three types of needs (basic need, expected need and excitement need) and displayed it in a two-dimensional graph as shown in Figure 1. The horizontal axis shows the functionality of the service and the vertical axis indicate the satisfaction towards that service. The point where the horizontal and vertical axis meet is where the satisfaction and dissatisfaction are even. The lowest and the highest point of the vertical axis indicates the dissatisfaction and satisfaction of user. The left side of the horizontal axis shows that the service do not provide any quality requirement and the right side of the horizontal axis shows that the expected quality requirements is fully provided.

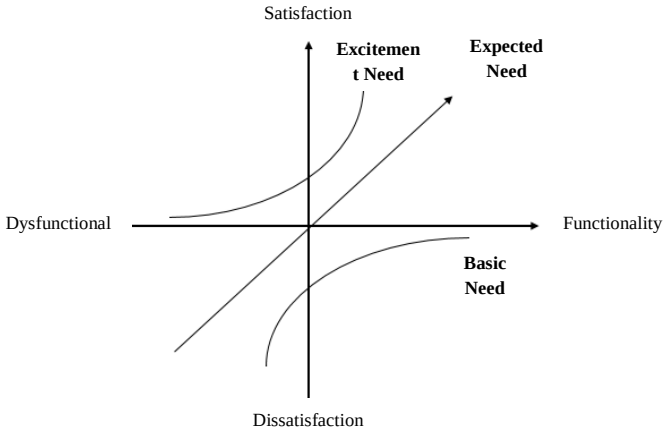

Figure 1: Kano Model

Based on Figure 1, there are three types of needs in Kano Model:

- Basic needs (Must-be): This need is essential and it does not increase the user satisfaction. However if it is not provided the user is not going to use the application.
- Expected needs (One-dimensional): The fulfilment of this need is going to increase user satisfaction and if the expected need is not provided, the user is not going to use the application.
- Excitement needs (Attractive): The fulfillment of this need is going to increase user satisfaction but it does not affect the user dissatisfaction if it is not provided.

IV. METHODOLOGY

This study aims to construct a cross evaluation dimension between IT and business benefits. The construction of this cross evaluation dimension is to reflect the definition of SOA and to achieve the promise benefits of SOA adoption. There are two major phases in this study which are i) the identification of the IT and business benefits characteristics and sub-characteristics and ii) construct the IT benefits sub-characteristics using Kano Model. Figure 2 shows the flow of this study. The IT and business benefits characteristics and sub-characteristics were identified based on the prior literature. The cross evaluation matrix will be constructed based on Kano Model.

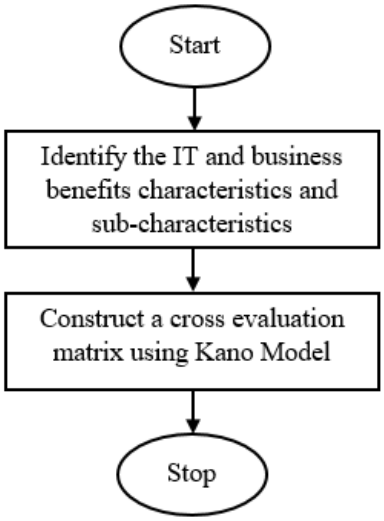

Figure 2: Flow of the Study

There have been numbers of potential benefits of SOA identified in the literatures. Based on the previous literatures, this study has identified that these potential benefits can be categorized into IT benefits and business benefits. The proposed characteristics and sub-characteristics for IT and business benefits will be discussed in the following section.

A. IT Benefits Characteristics and Sub-characteristics

Based on the findings from the literature, this study proposed the following IT benefits characteristics and sub-characteristics such as shown in Table 4.

Table 4
IT Benefits Characteristics and Sub-characteristics

	Sub-characteristics	Descriptions	Resources
Reusability	Publicity	The degree to which the service should be publically available for use.	[31]
	Discoverability	The degree of the service to be easily, accurately, and suitably found.	[23]
	Commonality	The degree to which the service are commonly used to consumers in a domain.	[23]
	Standard Conformance	The degree to which a service conforms to the widely accepted industry standards such as OASIS WS-standards, etc.	[23]
	Comprehensibility	The degree to which the functionality, interface, and constraints are in a highly understandable form.	[32]
	Understandability	The degree to which the service description should be in a highly understandable form.	[32]
	Composability	The degree of a service that is typically composed with other services and/or integrated into the target application.	[33]
	Portability	The ability which service can be adapted in many different environments.	[32]
	Adaptability	The capability of the service to be well-adapted to different service consumers.	[23]
Integration	Modularity	The extent to which a service provides independent functionality without relying on other service.	[23]
	Availability	The proportion of time a system or component is operational and accessible when required for use.	[33]
	Enterprise Service Bus	A bus-like architecture that implement a communication system between mutually interacting software applications in a service-oriented architecture (SOA).	[34], [35]
	Automation	The ability to provide automatic semantic integration of services.	[36]
Flexibility	Interoperability	The ability of a collection of communicating entities to share specific information and operate on it according to an agreed-upon operational semantics.	[37]
	Changeability	The ability to change service interfaces, service bindings and inter-service relationships.	[37]
	Reliability	The ability of a system to keep operating over time without failure.	[33]
Agility	Modifiability	The ability to make changes to a system quickly and cost-effectively.	[26]
	Evolvability	The ability for a service model and the definition of the services interfaces that can evolve over time.	[26][38]
Scalability	Migration	The ability to migrate services from one node to another.	[39]
	Replication	The ability to replicate the services to another server/machine.	[40]

B. Business Benefits Characteristics and Sub-characteristics

The proposed business benefits characteristics and sub-characteristics are presented in the following Table 5.

Table 5
Business Benefits Characteristics and Sub-characteristics

	Sub-characteristics	Descriptions	Resources
Functionality	Functionality	The capability to construct a new functionality in SOA.	[28]
Cost Reduction	Time	The capability to reduce the development time by shortening time to market for new application	[22]
	Cost	The capability to reduce the budget for application development cost.	[22]
IT/Business	Orchestration	The capability to manage different services and the dependencies between them such that we promote the	[29]

		principles of loose coupling.	
	Resources Alignment	The capability to align the resources effectively.	[41]
Business Quality	QoS Assurance	The degree to which Service Level Agreement (SLA) can be enforce.	[29]
	Security	The degree to ensure that the security objectives (confidentiality, integrity and availability) of the organization are met	[27]
Business Optimization	Networked	To degree to which SOA can also be institutionalized for long-term and short-term business collaborations and can be used outside the organization.	[42]
	Automation	The capability to react and response automatically to the business change.	[28]

C. Matrix Construction using Kano Model

This study proposes to construct the SOA adoption maturity model by aligning the maturity level horizontally with the business benefits because the goal for each maturity level is going to achieve the business goal. The IT benefits are cross evaluate vertically in order to evaluate each of the SOA characteristics (e.g. loosely coupled, reusable, composable and etc.) through all the maturity level. Figure 3 illustrates the matrix for cross evaluation between IT and business benefits.

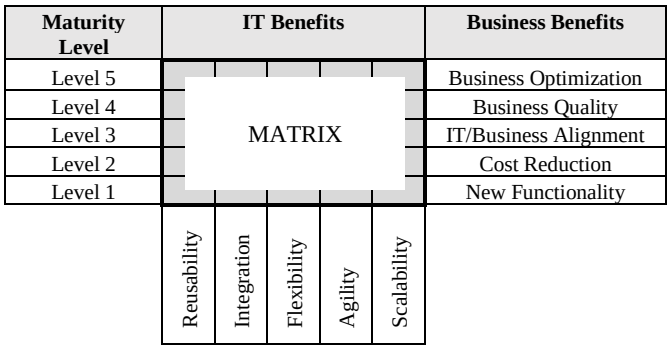

Figure 3: Cross Evaluation Matrix between IT and Business Benefits

The SOA IT and business benefits characteristics shown in Figure 3 are immeasurable and these characteristics consist of several sub-characteristics that can be measured. The business benefits sub-characteristics can be directly measured because these benefits were organized in horizontal ways; whereas the IT benefits need a specific method to organize and determine which sub-characteristics should be measured in which maturity level. Thus this study adapts Kano Model to organize and better represent the IT sub-characteristics shown in Figure 3.

Based on Kano Model, in order to classify the level of needs for IT benefits sub-characteristics. The first step in Kano Model is to construct a questionnaire based on Kano Method. There are two parts (functional and dysfunctional) that should be included for each question such as presented in Table 6.

Table 6
Example of Kano Questions

Type of Questions	Questions	Answers
Functional form of the question	If the service can be easily and correctly found, how do you feel?	1. I like it. 2. It expect it. 3. I am neutral. 4. I can tolerate it. 5. I dislike it.
Dysfunctional form of the question	If the service cannot be easily and correctly found, how do you feel?	1. I like it. 2. It expect it. 3. I am neutral. 4. I can tolerate it. 5. I dislike it.

The identified SOA IT benefits sub-characteristics will be classified into several needs (Basic need, Expected Need, Excitement need and etc.) by using Kano Model. The examples of the Kano Questionnaire have been shown in Table 6 and the answer from the questionnaire will be mapped with the Kano Evaluation Table presented in Table 7. The answer can be mapped into one of six categories such as:

A = Excitement Need
M = Basic Need
O = Expected Need
I = Indifferent
R = Reversal
Q = Questionable

Table 7
Kano Evaluation Table

Requirements		Dysfunctional				
		1.Like	2.Must be	3.Neutral	4.Live with	5.Dislike
Functional	1.Like	Q	A	A	A	O
	2.Must be	R	I	I	I	M
	3.Neutral	R	I	I	I	M
	4.Live with	R	I	I	I	M
	5.Dislike	R	R	R	R	Q

Following the Table 6, if the respondent answer the functional question as "1. Like" and dysfunctional question as "5. Dislike", based on Table 3.2 above, the answer can be classify as One-dimensional (O). Furthermore, once all of the Kano Questionnaires have been collected, we can tabulate the answers by tallying it in the appropriate place in the row for that IT sub-characteristics on a Kano questionnaire tabulation form (Table 8).

Table 8
Tabulation of Responses for each IT Sub-characteristics

IT Sub-characteristics	A	M	O	R	Q	I	Total	Type
1.	1	2	**8**				11	O
2.	2	**7**	1			1	11	M
3.	**7**	1	2			1	11	A

Based on Table 8, we can reduce the data into two numbers which is a positive number that is the relative value of meeting the best practices, and a negative numbers that is the relative cost of not meeting the best practices. These new data can be labelled as "Better" and "Worse". In order to calculate the Better and Worse value, we can used the following equation.

$$Better = \frac{A+O}{A+O+M+I} \qquad Worse = -1 \times \frac{O+M}{A+O+M+I} \qquad (1)$$

The example where Better and Worse have been calculated for the best practices is presented in Table 9.

Table 9
The Examples of Better and Worse Calculation

IT Sub-characteristics	A	M	O	I	Better	Worse
1.	1	2	**8**		0.81	-0.91
2.	2	**7**	1		0.3	-0.8
3.	**7**	1	2	1	0.82	-0.27

Based on Table 9, the positive Better numbers indicates that on average, user satisfaction can be increased by providing these (Excitement Need and Expected Need) elements. The negative Worse numbers indicates that user satisfaction will be decreased if these (Expected Need and Basic Need) elements are not included. Furthermore, pair of Better and Worse points for each best practices can be plotted on a two-dimensional graph as show in Figure 3. The minus sign in front of worse value has been ignored in this graph for purposes of clarity.

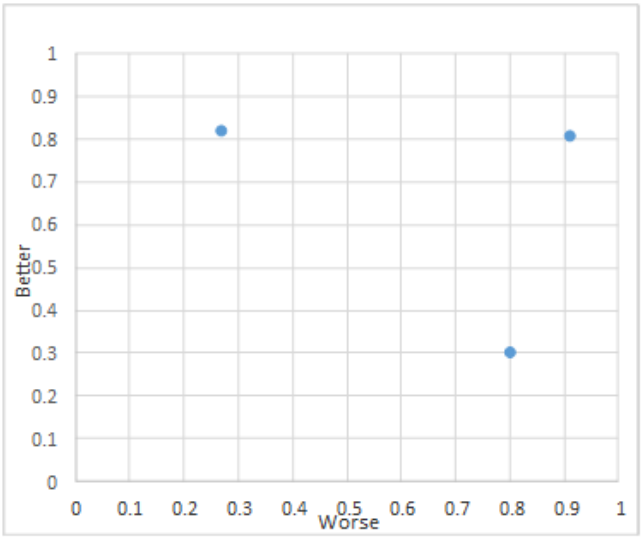

Figure 3: Example of Two-dimensional Representation of Kano Quality Classification

Based on Kano Model, this study found that the IT benefits sub-characteristics can be plotted in two-dimensional graph in order to construct a matrix representation of the proposed SOA IT benefits. The outcome from Kano Questionnaires was use in order to organize and better represent the mapping of IT benefits onto business benefits.

The plotting result of IT benefits sub-characteristics in Figure 3 was used to determine the position of IT sub-characteristics in the matrix refinement. Figure 4 divide the Kano Quality classification representation into five maturity level.

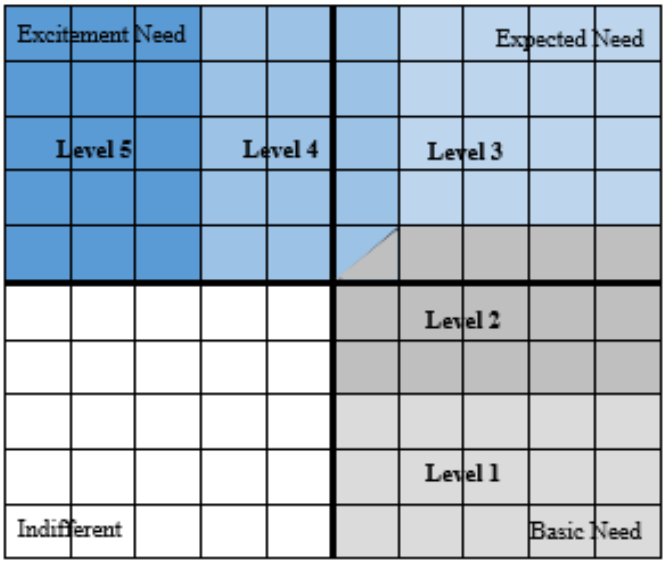

Figure 4: The division of Kano Diagram into Maturity Level

There are five area in Figure 4 in order to categorize IT benefits sub-characteristics into five maturity level. The plotting result of IT sub-characteristics was used to determine the position of IT sub-characteristics in the matrix refinement shown in Figure 5.

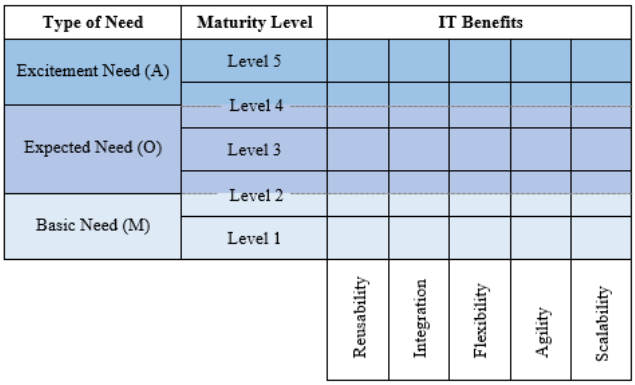

Figure 5: Matrix Refinement of IT Benefits Sub-characteristics

Based on Figure 5, the 'Basic Need' covers the maturity Level 1 and Level 2. The basic need specifies that the IT sub-characteristics are compulsory for SOA adoption. It means that these basic IT sub-characteristics will not increase the satisfaction of the organization if it being fulfilled but will lead to dissatisfaction if it not being provided. Furthermore, the 'Expected Need' covers the maturity Level 2, Level 3 and Level 4. The 'Expected Need' indicates that once the IT sub-characteristics is fulfill, it will lead to more satisfaction. The IT sub-characteristics that being fulfilled is proportional to the satisfaction. Lastly, the 'Attractive Need' shows that the IT sub-characteristics that are provided is a surplus feature where these IT sub-characteristics will increase the satisfaction and even if the IT sub-characteristics are not being provided it will not lead to dissatisfaction.

V. DISCUSSION

This study proposed to evaluate the SOA adoption focus on both IT and business benefits. The reason is to align the maturity model with the SOA definition where in order to successfully adopt SOA, the adopter must viewed and treated SOA from both IT and business perspective. Furthermore, the SOA benefits also should be categorized into these two benefits. Thus in order to achieve this aim, this study has identified the IT and business benefits characteristics. Yet, these characteristics were immeasurable and this study found that these characteristics were consist of several other sub-characteristics and it can be achievable by fulfilling's the SOA best practices.

This study align the business benefits horizontally with the maturity level as the each level will achieve the business goal. However the problem arise on how to cross evaluate vertically the IT benefits. This study choose to evaluate the IT benefits vertically is because for each maturity level, this study intend to assess the SOA characteristics such as loosely coupled, reusable and composable throughout the whole maturity levels. Thus, this study found that Kano Model can be used as it provide the appropriate method to plot and better represent the user requirements.

VI. CONCLUSION

This study has identified that the organization chose to adopt SOA because of the many promised benefits that it provided such as reusability, integration, cost reduction and flexible reconfiguration. These benefits also can be easily extended and based on the literatures, this study found that it can be distinguished into two types of SOA benefits which are IT benefits and business benefits. Based on these two major SOA benefits, this study proposed to construct a SOA adoption maturity matrix that focused on both IT and business benefits. This study first identified the SOA benefits characteristics and sub-characteristics for both IT and business benefits. Then, this study aligned the maturity level horizontally with the business benefits in order to measure the business performance and to achieve the business goals. The IT benefits are cross evaluate vertically in order to measure the SOA characteristics for every maturity level. Each of these IT and business benefits are consist of other sub-characteristics in order to measure the IT and business benefits. Furthermore, this study adapts Kano Model in order to overcome and provide the method for plotting and organizing the cross evaluation of IT benefits sub-characteristics. The finding implies that Kano Model can provide an appropriate method that can be used to construct a cross evaluation matrix for SOA adoption maturity model.

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