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A CONCEPTUAL MODEL FOR SERVICE-ORIENTED ARCHITECTURE ADOPTION MATURITY MODEL

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ABSTRACT. Service-oriented architecture (SOA) maturity model is a model that can be used to guide the SOA adoption. There are several SOA maturity models that have been constructed by the previous researchers. However, most of the existing models are focused on what to evaluate rather than how to perform the evaluation. Therefore, the aim of this study is to propose a conceptual model for SOA adoption maturity evaluation. This study reviewed and investigated the existing models in order to identify the issues and current implementation of the SOA maturity model. The findings implied that there is a lack of SOA maturity models that evaluated on the SOA adoption and focused specifically on both IT and business benefits. Furthermore, the existing models also do not provide any details on how to evaluate the maturity of SOA adoption. As a result, this study proposed a conceptual model for SOA adoption maturity evaluation that also consist of a tool to assess the maturity of SOA adoption.

Keywords: SOA adoption, SOA maturity model, maturity level, evaluation dimension, evaluation technique

INTRODUCTION

SOA is a paradigm that can be used to integrate distributed services via a communication protocol in order to perform business processes. SOA has become a trend where it has been applied in several different domains such as robotic, healthcare and e-governance portal. The promised benefits that SOA provided such as flexible reconfiguration and reducing the development cost have attracted many organizations to adopt SOA (Annamalai & Ramani, 2015). Still, there have been an organizations who are unwilling to adopt SOA because of several issues such as lack of best practices for SOA adoption (Basias et al., 2015) and there has been a confusion on how to adopt SOA successfully (Joukhadar & Rabhi, 2015). Thus, in order to solve this problem, previous industry and academia have introduced SOA maturity models which can be used to provide a roadmap for successful SOA adoption (Ameller et al., 2015).

SOA maturity model is a model for clarifying and providing a common definition of SOA inside an organization (Meier, 2006). However, prior models constructed their maturity level based on Capability Maturity Model Integration (CMMI). The maturity level that are based on CMMI are not appropriate to be used because CMMI is commonly used for evaluating the generic software processes; whereas SOA maturity model should evaluate the maturity of SOA adoption in the organization. Furthermore, the existing SOA maturity models also constructed their evaluation dimension focused mainly on the management aspect (e.g. architec-

ture, governance, information, infrastructure and engineering method). The previous model that lack on assessing the underlying IT perspective of SOA in supporting the business processes can cause the organization failed to achieve the goals and benefits of SOA adoption (Basias et al., 2015). Additionally, there is also a lack of systematic evaluation method provided in the previous model where the assessor need to depend on their own subjective assessments for quantitative evaluation in order to use the previous SOA maturity models (Hwang & Yeom, 2006). Therefore, this study proposed a conceptual model for SOA adoption maturity evaluation that highlight the maturity level, evaluation dimension and evaluation technique. The following section is going to first highlight the "adoption" term in order to shed some light for evaluating the SOA adoption.

SOA ADOPTION

According to Joachim et al. (2009), the term "adoption" refer to the decision to make full use of an innovation. Previously, Finch (1992) conducted an empirical research and presented the Adoption of Innovation concept as the process of "adopting an innovation" over a period of time. It appear that, majority of previous literatures on the 'Adoption of Innovation' discussed on the levels of the adoption processes (Abdul Manan, 2013). Previous researchers also have stated that there were three main levels in the "adoption of innovation" which are initiation, adoption and implementation (Zaltman, Duncan, & Holbek, 1973). The 'initiation' is about recognizing the innovation which then lead to the decision of 'adopting' the innovation (Rogers, 1995). The 'implementation' is concern with the activities such as using, modifying and continuing to use it until it becomes a routine feature of the organization (Duncan, 1976). Therefore, this study choose to adapt the Adoption of Innovation in order to construct the maturity levels for the proposed conceptual model. The reason behind this idea is because the Adoption of Innovation can provide a proper levels that the adopter must passes through in order to adopt the SOA. Thus, it can provide a strong underlying framework that is appropriate in order to construct the maturity level for evaluating the adoption of SOA.

SOA MATURITY MODEL

SOA maturity is one of the most pressing challenges of SOA adoption issues in SOA lifecycle (MacLennan & Belle, 2014). Therefore, this study compared and discussed on several of the most referred SOA maturity models such as SOAMM (Sonic Software et al., 2005), SIMM (Kreger et al., 2009), Veger's Model (Veger, 2008), iSOAMM (Rathfelder & Groenda, 2008) and Welke's Model (Welke, Hirschheim, & Schwarz, 2011). Table 1 below compared the existing SOA maturity models based on their maturity levels, evaluation dimensions and evaluation method. The reason of choosing these comparison criteria's is because SOA maturity model should exhibit the maturity level, evaluation dimension and evaluation method (Pulparambil & Baghdadi, 2015; Rathfelder & Groenda, 2008).

Table 1. Comparisons of Existing SOA Maturity Models.

	SOAMM	SIMM	Veger Model	iSOAMM	Welke Model
Maturity Level	1. Initial Service 2. Architected Service 3. Business Service 4. Measured Business Service 5. Optimized Business Service	1. Silo 2. Integrated 3. Componentized 4. Simple Service 5. Composite Service 6. Virtualized Service 7. Dynamic Reconfigurable Service	1. Siloed 2. Experimental 3. Applied 4. Integrated 5. Institutionalized 6. Networked	1. Trial SOA 2. Integrative SOA 3. Administered SOA 4. Cooperative SOA 5. On demand SOA	1. Initial 2. Managed 3. Defined 4. Quantitatively managed 5. Optimized

Evaluation Dimension	• Prime business benefits • Scope • Critical technology success factors • Critical people & organization success factors • Selected relevant standard	• Business view • Governance & organization • Method • Application • Architecture • Information • Infrastructure & management	• Strategy & Governance • Organizational Change • Business Architecture • Information Model • Application Architecture • Operational Infrastructure	• Service architecture • Infrastructure • Enterprise structure • Service development • Governance	• SOA View • Benefits and metrics • Business involvement • Methodology • Service Sourcing • Governance
Method	Questionnaires	Questionnaires	Questionnaires	Not Defined	Not Defined

Based on Table 1 above, most of the maturity levels are based on CMMI and it is not appropriate to used CMMI level to measure the SOA adoption because CMMI is usually used for evaluating a generic software processes (Abdul Manan, 2013; Veger, 2008). Veger's Model was the only model that constructed their maturity level based on the Adoption of Innovation concept but they does not precisely specified and used the level identified in the Adoption of Innovation concept. Furthermore, the existing models also constructed their evaluation dimension focused on the management aspect of SOA adoption such as scope, information, infrastructure, method, governance and many more. There are lack of models that focused on the IT and business benefits where this issue can lead to the difficulties of achieving the promise benefits of SOA adoption (Baghdadi, 2014; Joachim, 2011). In addition, there also have been a lack of a systematic evaluation technique provided by the previous works on how to come out with a structured approach in order to produce the metrics for evaluating the SOA adoption. Therefore, the need to improve the SOA maturity model focused on the maturity level, evaluation dimension and evaluation technique are significantly required. The following section is going to discuss on the proposed SOA adoption maturity evaluation.

CONCEPTUAL MODEL FOR SOA ADOPTION MATURITY EVALUATION

Figure 1 illustrates the proposed conceptual model for SOA adoption maturity evaluation in this study. Based on Figure 1, there are three main components which are maturity level, evaluation dimension and evaluation technique. Details description for each component are described below.

Maturity Level	**IT Benefits**					**Business Benefits**
Optimized						Business Optimization
Routinized						Business Quality
Implemented						IT/Business Alignment
Adopted						Cost Reduction
Initial						New Functionality

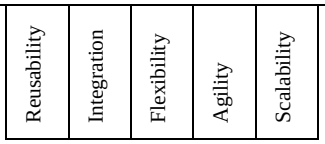

Figure 1. Conceptual Model for SOA Adoption Maturity Evaluation

MATURITY LEVEL

This study found that it is appropriate to adapt the "adoption of innovation" levels in constructing the maturity level. As illustrated in Figure 1, the proposed model consist of five maturity levels which are Initial, Adopted, Implemented, Routinized and Optimized. Table 2 below discussed on the proposed maturity level.

Table 2. Proposed Maturity Level (Adapted from Adoption of Innovation Theory)

Maturity Level	Descriptions
Level 1 (Initial)	This level indicated that organization becomes aware and familiar to the existence of SOA. The organization evaluate whether SOA will improve the existing process or operation.
Level 2 (Adopted)	This level specified that organization has choose to adopt SOA standard based on the evaluation made in the initial level.
Level 3 (Implemented)	In this level, the organization has implemented SOA in their system and align the IT and business resources.
Level 4 (Routinized)	This level indicated that SOA has been widely integrated into work processes and has become a reliable paradigm that also provide the Quality of Service in order to satisfy the adopter need.
Level 5 (Optimized)	This level indicated that SOA has not only become an integral part of a business processes but has gone beyond being used as an individual technology.

EVALUATION DIMENSION

The evaluation dimension in the proposed model are focused on cross evaluation dimension between IT and business benefits. The cross evaluation is important in order to reflect the definition of SOA, where SOA should be viewed and treated equally from both IT and business perspective (Baghdadi, 2014; Joachim, 2011). The failure to apropriately measured the IT and business benefits can lead to the failure of being successfull toward supporting the business goal in SOA adoption (Aldris et al., 2013). There are various SOA IT benefits and business benefits proposed by the previous researchers and based on the previous literatures, this study proposed a set of a generic IT and business benefits characteristics. The characteristics proposed for IT benefits in this study are Reusability, Integration, Flexibility, Agility and Scalability whereas the business benefits will consist of Functionality, Cost Reduction, IT/business Alignment, Business Quality and Business Optimization. Details descriptions for IT and business benefits are shown in Table 3 and Table 4 below.

Table 3. SOA IT Benefits

Characteristics	Definitions
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.
Integration	The ability of a system to integrate different services, components or business process.
Flexibility	The ability to adapt to changing business and stakeholder requirements more efficiently, easily and rapidly
Agility	The ability of a system to adapt proactively to unexpected and unpredicted changes.
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.

Table 4. SOA Business Benefits

Characteristics	Definitions
New Functionality	The ability to provide the business functionality required while also learning how to develop and deploy a basic SOA application.
Cost Reduction	The ability to reduce development cost of SOA such as time.
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.
Business Quality	The ability to provide quality of service in SOA system.
Business Optimization	The ability to be able to spread business processes out from the organization.

EVALUATION TECHNIQUE

This study propose to adapt the Goal Question Metric (GQM) approach because it can provides a systematic approach to formalize the goals of a project and to refine them into a measurement plan. GQM also is a hierarchical structured approach, where the hierarchy of specific characteristics and sub-characteristics helps the understanding of problem and simplify the problem by providing a better focus (Ishizaka & Labib, 2011). There are three components in GQM which are Goals, Questions and Metrics (Basili & Cladiera, 1994). The goal component would be the characteristics of the SOA adoption that this study will evaluate such as reusability, integration, agility, flexibility and scalability. These characteristics will be refined into several questions or sub-characteristics in order for goals to be measurable. Each of the question or sub-characteristic are then refined into metrics which consist of qualitative evaluation. This study also is going to extend the metric component by providing a scale for each metric based on the NPLF rating scale that adapted from ISO/IEC 15504. The score for each metric then can be calculated and based on the percentage from the calculation, each factor will be assessed based on the NPLF rating scale, where N = not achieved (0 – 15%), P = partially achieved (>15- 50%), L = largely achieved (> 50 -85%) and F = fully achieved (> 85- 100%) which demonstrate the fulfillment of the SOA process factors. The data obtained from applying these metrics will be formulated as a feedback report to the organization to facilitate them in assessing their maturity level for SOA adoption. The SOA adoption maturity is achieved and can proceed to the next level if the score for maturity is F = fully achieved (> 85- 100%).

CONCLUSION

This study has successfully proposed a conceptual model for SOA adoption maturity evaluation that focused on the issues identified in this study where the first issue is regarding the maturity level constructed in the existing SOA maturity models. This study found that in the Adoption of Innovation concept, there exist several levels that the adopter must passes through in order to fully adopt an innovation such as SOA. Thus, this study found that it is appropriate to construct the maturity level by adapting the level identified in the Adoption of Innovation concept. The second issue is related to the SOA definition and dimension where SOA should be viewed and treated from both IT and business perspectives. The cross evaluation dimension proposed in this study is to ensure that the benefits of adopting SOA can be achieved while it also reflect the definition of SOA. The third issue of this study is on the evaluation technique where previous models do not provided a systematic evaluation method to evaluate the SOA adoption maturity. Therefore, the goal oriented-approach should be integrated into the SOA adoption maturity model through the GQM method in order to provide a systematic evaluation method for evaluating the SOA adoption maturity.

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