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Mahshitah Abdul Manan
University of Wollongong, mam572@uowmail.edu.au

Peter Hyland
University of Wollongong, phyland@uowmail.edu.au

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Mahshitah Abdul Manan
Peter Hyland
School of Information Systems and Technology
University of Wollongong, Australia
Email: mam572@uowmail.edu.au
Email: phyland@uowmail.edu.au

Abstract

Many vendors have acclaimed Service Oriented Architecture (SOA) as a better way to design and build enterprise-wide software. While these claims may be true in the private sector, there is scant evidence in the literature for the same success in the public sector. The adoption of SOA as the dominant development paradigm within an organisation often requires significant organisational changes, which are difficult to achieve in the public sector, with its strict hierarchies and departmental independence. Indeed, many government departments are not ready to adopt this new paradigm. However, the literature does not provide a suitable SOA readiness framework for use in the public sector. This research proposes such a SOA readiness framework, based on Critical Success Factors associated with the three phases of a process model. The framework was tested in two case studies in the Malaysian government, and initial results validate the usefulness of the framework

Keywords

Critical Success Factor; CSF; Service Oriented Architecture; Enterprise SOA Implementation; Public Sector

INTRODUCTION

Service Oriented Architecture (SOA) is a development paradigm which reduces a system's functionality into a set of interoperable *services* that can be re-used in multiple, separate systems across an organisation. Instances of SOA in the literature are described as e-services, Web services, service engineering and service science (Callaway et al. 2010; Chesbrough 2006; Sheehan 2006). The potential benefits of SOA have received much attention from academics and IT practitioners alike (Feuerlicht et al. 2009; Janiesch et al. 2009; Schepers et al. 2008). One of the main benefits of SOA is the ability to maximise reuse of existing services, thus reducing both costs and development time, and so increasing business agility. There is much debate in the literature on whether SOA should be adopted *bottom-up* starting with one or two systems and expanding from there, or *top-down* from a SOA governance perspective, with SOA becoming the dominant paradigm across the whole enterprise (Hau et al. 2008; Marks 2008; Rosen et al. 2008). However, to achieve the benefits associated with service reuse, an organisation must adopt SOA across the whole enterprise i.e. Enterprise-wide adoption of SOA (Marks 2008).

However, Enterprise SOA adoption is still at the early stage in many organisations and not well understood (Geric and Vrcek 2009; Lee et al. 2010; Luthria and Rabhi 2008). Moreover, Enterprise SOA is difficult to achieve because it assumes a willingness by units within the enterprise to share with other units those services that were developed for their own needs. In addition, the enterprise needs expertise to design solutions using a service approach and to integrate service-based systems with existing traditional or legacy systems (Arsanjani et al. 2007). A study by Gartner suggest that less than 25% of enterprises have the technical and organisational skills to deliver Enterprise SOA, and the lack of adequate SOA governance is partly blamed for many SOA project failures (Feuerlicht et al. 2009).

To use SOA effectively, an organisation needs to identify and select appropriate services for sharing or reuse. Orchestration of multiple services to support business processes often requires collaboration and integration of cross-boundary platforms and multiple stakeholders (Brown and Carpenter 2004). Thus, Enterprise SOA requires tight coupling of strategy, people and technology to deliver services across the enterprise. Some researchers recommend changing organisational structure in order to leverage the service concept. For example, Bieberstein (2005) argue for a flexible and agile organisational structure based on core, team-based services to improve collaboration across business units. However, it is unlikely that this is plausible in the public sector where the organisational structure is usually static, with many reporting layers and rigid stakeholder control. Moreover, policy or decision making in the public sector often changes in an abrupt manner, due to changes in the policies of the government, which affects business process management (McAdam and Donaghy 1997).

To succeed in Enterprise SOA, an organisation must adopt the best practices of SOA governance or achieve SOA maturity. However, most SOA governance frameworks are abstract, which makes it difficult for an enterprise to adopt all the best practices. In addition, too much emphasis on SOA governance may create more bureaucracy in the organisation (Schepers et al. 2008). On the other hand, a SOA maturity approach emphasises incremental SOA implementation until an organisation is mature enough to embark on Enterprise SOA. For example, the enterprise has to begin from the bottom-up with initial attempts to build basic SOA solutions and gradually progresses to service messaging, such as Enterprise Service Bus, as the enterprise integration solution. Although this approach may sound pragmatic, it is often characterised by technological hype driven by SOA IT vendors who promote their own SOA solution (Arsanjani et al. 2007).

Some researchers recommend the use of Critical Success Factors (CSFs) for successful migration to Enterprise SOA but this implementation methodology is also based on incremental implementation and Service Maturity (Lee et al. 2010). Ericson and Sau (2008) also identified a list of CSFs for SOA implementation but are yet to report the results of their study. In addition, many researchers address SOA-based CSFs in a fragmented way, focusing, for example, only on reusability of services, reducing SOA complexity or some specific aspects of SOA governance (Vegter 2009) and ignoring other aspects of SOA implementation. It appears that research has yet to apply CSFs to the implementation of Enterprise SOA in a top-down, systematic manner. This paper addresses this shortcoming by proposing and validating an Enterprise SOA readiness framework based on CSFs.

The following section reviews the literature on SOA readiness, governance, CSFs and a process model. This is followed by the research methodology for the development of a SOA readiness framework and the evaluation of that framework in two public sector organisations in Malaysia. Lastly, there is a set of conclusions and description of the next phases of this research.

BACKGROUND

Service Oriented Architecture is a way of developing information systems for a business or enterprise (Rosen et al. 2008). Although SOA offers many potential benefits, organisations usually encounter many challenges in the process of adopting SOA (Hojaji and Shirazi 2010; Rosen et al. 2008; Vegter 2009). For example, Luthria and Rabhi (2008) examined organisational constraints and challenges for Enterprise SOA adoption across fifteen firms. Some of the challenges noted in their studies are: difficulty in justifying a business case for SOA adoption; lack of availability of funding for long-term SOA adoption; lack of industry support and mature tools; lack of business understanding of SOA; problems with service ownership; and lack of skills and training. In a study of the challenges in SOA adoption in two European Banks, Baskerville et al. (2005) found that the SOA concept is difficult to define and practice because of the range of technical terminology associated with SOA, poor alignment of business benefits with SOA, a lack of understanding of the SOA concept among IT developers, and slow SOA learning curves. Legner and Heutschi (2007) identified in their study three major activities which are important for successful SOA adoption: introduction of organisational roles and governance processes; creation of architectural guidelines; and use of SOA for infrastructure projects.

The literature on SOA readiness focuses either on SOA maturity, governance issues or CSFs. However, the literature lacks a clear definition of what constitutes SOA readiness and empirical research on SOA readiness is also lacking (Hojaji and Shirazi 2010). Conway (2009) defined SOA readiness as being when an organisation understands what SOA is, and recognizes the problems, costs, benefits and limitations associated with a SOA approach. Reynolds (2009) from Oracle describes multifaceted aspects of Enterprise SOA readiness including business and strategy, architecture, infrastructure and information capability, project portfolio, post operation, organisation and governance. Although, these approaches cover both high-level and operational-level SOA, they are used as an initial online assessment tool to gauge the level of SOA maturity in an organisation rather than as roadmap for actual SOA implementation. Brahmandam (2008) from Priceton Blue measures SOA goals from the perspectives of both the business unit and IT unit, organisational and IT barriers to SOA adoption, and other key problems associated with SOA readiness. BEA (2006) provides best practices to implement and manage the service lifecycle including SOA initiation, SOA roadmap (which touches on the need for an Enterprise Architecture), and SOA execution roadmap. However, these approaches are generic and do not provide a detailed or systematic process to implement Enterprise SOA as an integrated framework in an enterprise environment such as in public sector organisation.

Mahadevan et al (2009), on the other hand, propose a 3-level SOA maturity model with process and governance activities to achieve each level: Level 1 - achieving stability; Level 2 - achieving flexibility and Level 3 - SOA for sense and respond. Unfortunately, their model has not been empirically validated. Arsanjani and Holley (2005) from IBM, also propose a SOA maturity model which also recommends the incremental adoption of SOA through four maturity levels: Level 1 - implementing basic Web services; Level 2 - SOA integration; Level 3 - Enterprise-Wide SOA adoption; and Level 4 - on-demand business transformation. However, the model is based

on the vendor perspective and this incremental development may take too long term for an organisation to achieve Enterprise-Wide SOA transformation.

Other researchers focus on governance as the critical issue for Enterprise SOA adoption. Most SOA governance frameworks are extensions of IT governance frameworks, which define governance structures, governance processes and behaviour mechanisms, which are themselves still immature concepts in the literature (Lee and Lee 2009). For example, Bowen et al. (2007) studied the impact of high-level IT Governance mechanisms such as IT governance structures, processes and outcome metrics on IS project outcomes. They found that effective IT project performance outcomes are associated with a shared understanding of business and IT, active involvement of an IT steering committees, a balance of business and IT representatives in IT decision-making, and comprehensive, well-communicated and documented IT strategies and policies. Haes (2007)found that a governance structure is easy and practical to implement in the organisation, compared to governance processes and governance behavioural mechanisms.

However, in the SOA domain, some researchers argue that SOA requires more than high-level IT governance and decision-making to govern the complete SOA lifecycle. For example, Marks (2008) argues that IT governance decision-making frameworks should also include enforceable policies on service lifecycle processes in SOA projects. His model, which is based on an enterprise approach for SOA governance, consists of many activities or abstract layers, which include the need for SOA governance strategy and goals, SOA principles and policies, governance processes, governance roles and responsibilities, governance behaviour and reinforcement model, governance enabling technology and implementation, funding and budgeting models and reasons for governance. Unfortunately, no detail on SOA implementation is provided. Niemann et al. (2008) provide a conceptual model of SOA governance with four phases: planning, design, realization and operation. Hojaji and Shirazi (2010) also propose a conceptual governance framework, an extension of the COBIT IT governance framework that caters for other activities of governance such as SOA governance structure, service portfolio management, service lifecycle management, governance performance assessment, governance lifecycle management and monitoring and evaluation processes, SOA maturity, SOA roadmap and best practices. Although they claimed that their framework is integrated with other governance frameworks, their framework is also conceptual and does not provide a detailed account on SOA implementation. Another SOA governance method links the execution of SOA governance and SOA maturity levels. For example, Schepers et al. (2008) proposed a lifecycle approach for SOA governance which begins with the creation of SOA strategy, alignment of the organisation with SOA strategy, manage service portfolio, control service lifecycle, enforce policies and manage service levels. However, the execution of SOA governance is based on a maturity level including: Level 1 - pioneer; Level 2 - department; Level 3 - enterprise and Level 4 - network. The OpenGroup (2009) introduces a generic SOA Governance Reference Model that begins with SOA governance principles, SOA governing process, governed SOA process with checkpoints for compliance, SOA process artefacts, SOA governance roles and responsibilities and SOA governance technology. Some researchers also propose a governance solution but from a technical perspective with the design of SOA tools to govern Enterprise SOA (Janiesch et al. 2009) or technical tools to be used in SOA management (Feuerlicht et al. 2009). Another SOA adoption and framework has been proposed specifically for Federal agencies in the US from three perspectives: Service-Oriented Enterprise to govern and manage services, Service-Oriented Architecture as an Enterprise Architecture and Service-Oriented Infrastructure (CIOCouncil 2008). However, the practicality of this framework is not reported.

Thus, we can see that every framework addresses different aspects of governance. Some frameworks which take an enterprise approach are too abstract or have too many activities while others combine governance with a maturity model and take an incremental approach instead. Some frameworks claim that they can be customised but do not explain how that customisation can be done to suit the enterprise environment. Since the scope of SOA governance is broad too much emphasis on governance can add more bureaucracy to the existing enterprise. It is also worth noting that there is little research in the academic literature because SOA implementation methodologies are still immature or conceptual in nature.

Although SOA governance and SOA maturity propose a long-term view for the deployment of Enterprise SOA, other researchers recommend CSFs to achieve quick wins in SOA implementation. CSFs are defined as a small set of goals or prerequisites if addressed appropriately will significantly improve the chances of project success (Pinto and Rouhiainen 2001). CSFs can guide practitioners on where they should focus attention and resources when implementing enterprise projects (Shanks et al. 2000). In the past, CSFs are also used to measure an organisational readiness in Enterprise System implementation (Razmi et al. 2009). Moreover, the concepts of CSFs and process models have been extensively used by researchers to address factors which are critical in ERP implementation (Razmi et al. 2009; Somers and Nelson 2004). Although CSFs are widely used in ERP implementation projects, they can also be used to determine other large-scale IT projects success (Ericson and Siau 2008). In addition, process models have also been applied in many ERP implementations especially in

enterprise transformation projects to determine at which stage or phase losses in projects may occur (Koh et al. 1999).

Different process models have different numbers of stages and in the processes carried out in those stages. For example, Markus and Tanis (1999) suggest a 4-stage model: 1 - project chartering; 2 - project configuration & rollout; 3 - shakedown, and 4 - onward and upward. Somers and Nelson (2004) divide the process model into 6 stages: 1- initiation; 2 - adoption; 3 - adaptation; 4 - acceptance; 5 - routinisation and 6 - infusion. Al-Mashari et al. (2003) provide a taxonomy of CSFs for ERP implementation, in 5 phases: 1 - setting-up; 2- implementation; 3- evaluation; 4 - ERP success and 5 - ERP benefits. In this research we adopt a process model based on 3-stage model namely: 1-pre-implementation; 2- implementation, and 3 - post-implementation (Razmi et al. 2009).

In the SOA research domain, Vegter (2009) focused on reusability of services, reducing complexity of SOA and some activities of SOA Governance as the main CSFs in a SOA project. Lawler et al (2009) also identified the CSFs that contribute to effective planning and effective management of SOA from technical, procedural and business perspectives; they found that business factors are the most important in managing SOA strategy. Lee et al. (2010) used both SOA maturity and CSFs in a study of SOA implementation in Korean companies: Their CSFs included awareness factors, SOA strategy, organisational management, technology infrastructure, project management, governance and technology infrastructure.

From the above discussion on CSFs, it appears that CSFs can be used to determine success in SOA implementation. However, it is worth noting that most studies only include a list of factors without providing a detailed account of how to implement Enterprise SOA. Moreover, there is still insufficient empirical research that addresses CSFs in the enterprise SOA environment.

RESEARCH METHODOLOGY

The aim of this research is to develop and validate an Enterprise SOA readiness framework suitable for public sector organisations. The methodology used in this study was as follows:

1) The critical factors were identified from Enterprise SOA literature, and CSFs of IT Governance are particularly from the works of Haes (2007) and Bowen et al. (2007). The identified CSFs were then grouped into factors and sub-factors, which are shown, along with the studies from which they were derived, in Table 1.

2) An initial instrument was developed to measure Enterprise SOA readiness. The instrument used a 5-point Likert scale (from "strongly disagree" to "strongly agree") to measure the respondents' perceptions of the importance of each CSF for Enterprise SOA. In addition, the instrument asked respondents to indicate which of the 3 phases of the process model each CSF belonged to. In addition, respondents could indicate that a CSF belonged to "No particular phase" or "All phases equally.

3) The framework was validated in two case studies of service-based projects being conducted by 2 Malaysian government agencies. The chosen respondents were from two different; the first group comprised five people from the "expert group" or public sector ICT consultancy teams in one public sector agency while the second comprised seven senior IT practitioners who are project leaders and have hands-on experience implementing an Enterprise SOA project in another public sector agency. The framework developed in steps 1 and 2, covers Enterprise SOA readiness or service enablers from both the strategic and tactical level, so the two groups fit this study because the expert group has vast experience at the strategic level, dealing with enterprise system project failures in many public organisations, while the IT practitioners each have over five years experience on an Enterprise SOA project. Both the agencies used in this study make significant use of assistance from vendors. However, vendors were intentionally excluded from this initial study for two reasons: 1- because vendors might not assess the framework objectively as it may not align well with their company's proprietary methodology or proprietary SOA products and 2- to comply with the Malaysian government procurement policy and methodology which states that proposed IT/SOA solutions should not directly refer to specific product characteristics or features of vendor products.

4) Although the instrument developed in steps 1 and 2 could be used as a survey, it was decided that because of the high rank of the respondents, it would be used as the basis for a structured interview. Each of the respondents were asked to complete the Likert scale questions but were also invited to comment on their reasons for making the choices they did. In addition, they were also asked to give opinion on other factors which are important for Enterprise SOA implementation. The respondents were asked "how critical is this factor?" and "in which phase of the project lifecycle would that CSF be deemed important?". The responses to the Likert scales were analysed at this stage using simple descriptive statistics (e.g. frequency and mean) and the interview data were recorded and informally analysed to look for patterns.

Table1. Factors and sub-factors which are critical in Enterprise SOA implementation

Main Factors	Sub-factors	Study
SOA awareness	Awareness of SOA concept, IT awareness of expected service benefits, Top management awareness of impact of service benefits on business	(Baskerville et al. 2005; Lee et al. 2010; Luthria and Rabhi 2008)
SOA strategy	Strategy align with business strategy, Strategy link with business value, Clear SOA project roadmap, Shared strategy between IT and business users.	(Bowen et al. 2007; CIOCouncil 2008; Luthria and Rabhi 2008; Marks 2008)
Governance (IT Governance)	Governance structure, Roles, responsibilities and behavioural practice, IT project structure with subject matter expert, Shared knowledge between business & IT	(Bowen et al. 2007; CIOCouncil 2008; Haes 2007; Marks 2008)
SOA Governance Process	Enterprise Architecture, Business Reengineering and Standardization Performance Metrics, Documented IT/SOA strategy, Service Portfolio, Policy on service life cycle, Policy on service reuse repository	(BEA 2006; CIOCouncil 2008; Haes 2007; Hojaji and Shirazi 2010; Lee et al. 2010; Marks 2008; OpenGroup 2009)
SOA Infrastructure & technology	Service repository, Standard tools or technology.	(BEA 2006; CIOCouncil 2008; Luthria and Rabhi 2008)
SOA competency	Vendor and IT skills, Training; Evaluation on SOA success outcomes, Expected Service benefits	(Al-Mashari et al. 2003; Lee et al. 2010; Luthria and Rabhi 2008; Mahadevan et al. 2009)

RESULTS

Table 2 shows: i) the average rating of importance of each CSF, by the expert group and by the IT practitioners, and ii) the frequencies with which respondents indicated that a CSF was important in a particular phase. The rest of this section discusses each of the main factors, supported by comments made by respondents.

SOA Awareness

Both groups of respondents strongly agreed that an awareness of the service concept or architecture is critical. One respondent said *"without understanding [the] SOA concept, the project might derail from its original target"* while another commented that the *"SOA concept needs to be defined clearly; SOA [has] different meanings to different people. Failure to define SOA clearly, the organisation might not be able to get the right service benefits"*. Similarly, both groups agreed that the IT unit needs to understand the expected service benefits as possible motivational factors. However, there were slight differences between the groups on the third CSF, as the majority of the expert group felt that it is critical for top management to be aware of how SOA/service might impact their businesses. *"IT needs to brief top management on the service benefits for their support"*. Conversely, as one IT practitioner put it, *"SOA is a technical matter; it is difficult to convince top management as[a] layman to understand how service can impact their businesses"*. The practitioners felt this less strongly.

IT/SOA strategy

Both groups reported that having an IT or SOA strategy is critical. As one respondent from the expert group said, *"IT/SOA strategy that aligns with the organisational strategy is also a critical factor in this framework. IT strategy is a must in every organisation in order to measure the organisational effectiveness in service delivery via star ratings. Without the strategy, the organisation's star ratings may [be] affected"*. In addition, all the respondents agreed that *"the strategy [also needs] to link or support business value. It is also critical to have strategy that provides [a]clear SOA or service roadmap that describes project vision, target services to drive SOA long term strategy"*. The majority of respondents agreed that it is critical to communicate and share the strategy with business users. However, there was some concern about whether SOA strategy should be derived

from IT strategy. The majority of respondents from the expert group perceived that IT strategy should tackle high-level strategy while SOA strategy should specifically address conceptual and tactical service implementation within the IT strategy.

Table 2: Average of respondents ratings for each CSF by group

SOA readiness factor	Ratings (/5)		Stage where CSF applies
	EG	ITG	
Factor 1: SOA Awareness			
Understanding of SOA concept and architecture	5.0	5.0	**Pre (12)**
IT Understanding of SOA expected benefits as project outcomes	5.0	5.0	Pre (12), Imp (3), Post (3)
Top management awareness on impact of SOA/service on business	5.0	4.9	Pre (12), Imp (5); Post (5)
Factor 2: SOA strategy			
Strategy align with organisational strategy	5.0	5.0	Pre (12), Imp (5), Post (5)
Strategy link with business value	5.0	5.0	Pre (12), Imp (5), Post (5)
Strategy that provides clear SOA/service/project roadmap	5.0	5.0	Pre (12), Imp (4), Post (4)
Share Strategy with business users	5.0	5.0	Pre (12), Imp (4), Post (4)
Factor 3: Governance (high-level IT Governance)			
Formal governance structure	5.0	5.0	Pre (12), Imp (7), Post (7)
Governance active support through IT steering committee	5.0	5.0	Pre (12), Imp (7), Post (7)
Governance provides clear project goal settings	5.0	5.0	Pre (12), Imp (7), Post (7)
Governance defined roles and responsibilities	5.0	5.0	Pre (12), Imp (7), Post (7)
Governance active in decision making or resolving SOA issues	5.0	5.0	Pre (12), Imp (7), Post (7)
Governance support on central funding	5.0	5.0	Pre (12), Imp (7), Post (6)
Governance creates collaboration between business and IT	5.0	5.0	Pre (12), Imp (7), Post (6)
Existence of expert group to set SOA policy or direction	5.0	5.0	Pre(12), Imp (7), Post (6)
IT project committee with subject matter expert	5.0	5.0	Pre (12), Imp (7), Post (6)
IT project committee that share knowledge between business & IT	5.0	5.0	Pre (12), Imp (7), Post (6)
Factor 4: SOA Governance Process			
Performance Metrics to measure SOA project Outcomes	4.7	5.0	Pre (9), Imp (9), Post (7)
Documented strategy	5.0	5.0	Pre (12), Imp (7), Post (6)
Enterprise Architecture	5.0	5.0	Pre (12)
Business reengineering study and standardization	5.0	5.0	Pre (12)
Policy on Service Portfolio Management	5.0	5.0	Pre (12), Imp (1)
Policy on service ownership	4.8	5.0	Pre (10), Imp (9), Post (6)
Policy on service reuse	4.9	5.0	Pre (10), Imp (8), Post (6)
Policy to manage service lifecycle	5.0	5.0	Pre (8), Imp (9), Post (5)
Factor 5: SOA Infrastructure and technology			
Support tools (e.g. service repository) to publish/manage services	4.7	5.0	Pre (5), Imp (12), Post (6)
Having the right infrastructure or technology	5.0	5.0	Pre (9), Imp (7), Post (5)
Standard or Mature technology	5.0	5.0	Pre (12), Imp (6), Post (5)
Factor 6: SOA Competency			
SOA training	5.0	5.0	Pre (12), Imp (7), Post (6)
Vendor Competency	5.0	5.0	Pre (12), Imp (7), Post (7)
IT competency	5.0	5.0	Pre (12), Imp (6), Post (6)
Evaluation on SOA success	5.0	5.0	Post (12)

Evaluation on service expected outcomes	5.0	5.0	Post (12)

LEGEND EG: Expert Group; ITG: IT Group; Pre: Pre-implementation; Imp: Implementation; Post: Post implementation

Governance (IT Governance)

The majority of respondents strongly agreed that having a formal governance structure that provides clear project goal settings and clearly defined roles and responsibilities of the member in the committee, is critical. One respondent said "*Since Enterprise SOA require[s] [a] huge budget to start with, central governance structure is important to address and approve issues concerning budget*". Another respondent said "*Governance should be in place to channel and escalate project issues*". Another respondent said, "*Governance through active steering committee support to resolve project issues is important… [the] IT [unit]should ensure that governance play their active role to drive the project and appoint the right subject matter experts sitting as members in the committee*". The respondents also agreed that governance is critical as a channel to promote good working relationships between the IT unit and business users. Although the governance structure addresses high-level decision making, the majority of respondents strongly agreed that it is critical to have an IT project committee with the right subject matter expert (at the project level) to inform the IT unit about their business unit.

SOA Governance Process

 The majority of respondents strongly agreed on the need for an Enterprise Architecture as a blueprint for SOA implementation. Other sub-factors such as service portfolio management, and a business requirement study and standardization are also strongly agreed as critical for SOA implementation. However, several respondents from the expert group felt that factors such as performance metrics, a policy on service ownership, and a policy on service reuse are only important rather than critical. For example, one respondent said, "*Project timelines [are]sufficient to keep track [of] project status. You do not need to complicate the project by introducing yet another performance metric at the project level to keep track [of] project deliverables*". However, another respondent from the expert group also felt that, "*if service reuse is part of the enterprise policy, [the] enterprise needs to measure service reuse as project deliverables*".

Despite the majority of the respondents strongly agreeing on the need for a policy on service ownership, three of the respondents felt that it was only important rather than critical. Several respondents argued that service ownership is not critical in government agencies because the IT unit, as the service provider has control over the enterprise project source-code. One respondent felt that a policy on service ownership is only important when services need to be shared with external organisations. Some respondents felt that a policy on service reuse is important but not critical, depending on project requirements or SOA maturity in their specific organisation.

SOA technology

The majority of respondents strongly agreed that having the right infrastructure or technology with stable and mature development tools is critical. However, a minority of respondents felt that having tools, such as service repository, is not as critical as other factors that might affect the project implementation because the need for a service repository depends on the SOA maturity of the organisation. One respondent felt that a service repository is critical to manage services when the project involves collaboration with external organisations.

SOA competency

The average ratings for each of the sub-factors (vendor competency, IT competency, SOA training, evaluation of project success, and expected benefits as project deliverables) clearly show that the majority of respondents rated the sub-factors as critical. However, in their verbal responses, most respondents made it clear that vendor competency is the most critical factor in SOA implementation readiness in an outsourced, project environment.

Appropriateness of the process model

In addition to rating the CSFs respondents were also asked whether the CSFs were more appropriate in one or another of the process model stages. The following summarises their responses.

(i) Overall, most of the CSFs were felt to be relevant during the pre-implementation stage of a project, particularly the three sub-factors: Awareness of the SOA concept, Enterprise Architecture and Business Reengineering (BPR) Study and standardization. Several respondents commented that "*It is critical to understand [the] SOA concept before we embark on SOA project deployment; to get the right service benefits (outcomes); to gain common understanding of the concept*. It was also noted that the most important CSF is that an organisation has an Enterprise Architecture before deploying SOA. Several respondents said "*EA is important as a blueprint to address silos application; for developers to see cross-application; to put everything [the whole business function] into perspective [business, application, information and technology] before implementation. Without the [EA] blueprint, IT can only make assumptions with trial and error*". Several respondents also raised

the need to complete high-level scanning of BPR before embarking on a SOA project. As one respondent put it, "*BPR [will] enable IT to see common services that can be reused, [and] ease project implementation*". The majority of the expert group made comments that resonated with the following: "*if most of the major activities [e.g. EA, BPR, governance support] are addressed earlier or [are] ready before [the] project begins, there would be less issue to tackle during the implementation stage*" Other important sub-factors such as getting the right vendor with SOA competency, and having mature technology or tools are also critical during pre-implementation. One of the expert group commented "*IT should spell-out clearly the requirement for SOA technology in the contract*".

(ii) Several CSFs appear intertwined with other phases of the project, for example, SOA strategy, IT governance, SOA governance processes, SOA infrastructure and technology, and SOA competency. These factors are expected as several IT practitioners commented "[*The] SOA strategy when implemented should be consistent throughout the project with the deliverables.*" "[The] strategy also needs to be shared throughout the project [in order] to maintain consistency during planning and implementation". Other sub-factors of SOA governance processes are also relevant in all project phases. However, the majority of respondents agreed that a service repository is only important when the project is already stable and during post- implementation.

(iii) It is also noted that the evaluation process to measure project success or expected service benefits is only relevant in post-implementation. In addition, although the majority of the respondents from IT group felt that service performance measurement is relevant throughout the project cycle, one respondent from the expert group felt that service performance measurement is only important during post-implementation.

(iv) Finally, there were differences in opinion between the expert group and IT practitioners about which CSF is relevant in which phase of the project. The majority of the expert group perceived that most of the CSFs are relevant <u>before</u> the project implementation while the majority of IT practitioners perceived most of the CSFs to be relevant throughout the project.

DISCUSSION AND FUTURE RESEARCH

Overall, this research has found that the proposed CSFs derived from the literature were all regarded as critical, for a government agency moving towards Enterprise SOA. Several factors, as shown in Table 2, were considered important rather than critical by minority of the respondents. Nevertheless, there is sufficient evidence both from the Likert scales and from respondents' comments to adopt these "important" factors in subsequent research.

The results above confirm a number of points of view found in the literature. Firstly, the results confirm that SOA awareness is critical for an agency and its top management to understand the impacts that using services may have on business. For example, understanding the general concept of SOA, and the benefits, constrains and challenges associated with SOA is critical before an agency is ready to undertake Enterprise SOA (Conway 2009). Moreover, the perception that the SOA concept is complex (due to various terminologies used in practice) may negatively affect SOA adoption (Baskerville et al. 2005; Luthria and Rabhi 2008) or the migration to a service-oriented culture (Fricko 2006). Thus, it is imperative for the IT unit to help the agency to understand and embrace the SOA concept, and also to brief top management on service benefits that might impact business efficiency. This may help in garnering top management support.

Secondly, although it is widely accepted that an IT or SOA strategy must be aligned with the overall organisational strategy, it was unclear in the literature whether a SOA strategy is an IT strategy (Luthria 2009) or as an extension of IT strategy that addresses the SOA business model within a SOA governance framework (Marks 2008). This study found that a SOA strategy is perceived as a technical document which should address tactical strategy while the scope of an IT strategy should address business benefits or the high-level business strategy of the agency.

Thirdly, the study also found that the establishment of high-level governance including governance structure, governance process or mechanism to steer the project and the behaviour of project members at the level of SOA project governance is critical. In addition, contrary to the literature, where service measurement is critical, several respondents from the expert group perceived that having SOA governance process such as performance metrics to measure common services as part of the project outcomes is not really critical. Indeed, they felt it should be avoided in order to minimize complexity of the Enterprise SOA project.

Lastly, although a policy on service ownership is important (Luthria 2009; Marks 2008; OpenGroup 2009) this study found that several respondents felt that service ownership to address common services is not as critical in the enterprise environment when IT has control over enterprise project source-code. Some respondents also felt that a policy on service reuse is only important when services need to be shared with external organisation, which is contrary to the literature (Janssen 2008).

Now that the list of CSFs has been validated by experts and practitioners, it will be used in the second phase of this research. This will involve using the CSFs to carry out a SOA readiness evaluation of the two Malaysian government agencies used in the first phase. Structured interviews and observation will be used to produce a SOA readiness scorecard for each of the agencies. In the final phase of this research, the scorecard will be presented to staff and senior managers of both agencies, who will be asked to comment on the accuracy of the evaluation. If the respondents in this phase confirm that the scorecard is a good representation of the agencies SOA readiness, then the SOA readiness framework will have been validated in practice.

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