Service-Oriented Enterprise Architecture (SoEA) Adoption and Maturity Measurement Model: A Systematic Literature Review

Nur Azaliah Abu Bakar, Harihodin Selamat, Mohd Nazri Kama

Abstract—This article provides a systematic review of existing research related to the Service-oriented Enterprise Architecture (SoEA) adoption and maturity measurement model. The review's main goals are to support research; to facilitate other researchers' search for relevant studies; and to propose areas for future studies within this area. In addition, this article provides useful information on SoEA adoption issues and its related maturity model, based on research-based knowledge. The review results suggest that motives, critical success factors (CSFs), implementation status, and benefits are the most frequently studied areas, and that each of these areas would benefit from further exposure.

Keywords—Systematic Literature Review, Service-oriented Architecture, Adoption, Maturity Model.

I. INTRODUCTION

THIS article reviews existing research on the Service-oriented Enterprise Architecture (SoEA) adoption and maturity measurement model. The focus is on the identifying the factors influencing the SoEA adoption and maturity models used to measure its level in an organisation. Since the concept of SoEA is still new, the term SOA is still relevant to be the context of this study and will be used interchangeably.

The objectives of this paper are:
1. To summarize the existing works on SOA/SoEA adoption in the organization.
2. To identify the critical success factors (CSFs) on SOA/SoEA adoption in the organization.
3. To identify the maturity models used in measuring the SOA/SoEA adoption in the organization.

In line with these objectives, the researcher shall provide an updated overview of SOA/SoEA that captures the research activities in these rapidly evolving areas. The focus is restricted to manuscripts that explicitly incorporate adoption and maturity levels considerations. Adoption is understood in this context as the process of adapting and implementing SOA/SoEA principles and introducing the best practice recommendations prescribed by SOA/SoEA research community. Whereas maturity level in this context can be viewed as a set of structured levels that describe how well the behaviors, practices and processes of an organization can

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reliably and sustainably produce required outcomes.

Service Oriented Architecture (SOA) is an approach focused on software development to build loosely-coupled distributed applications using a collection of services [1]. In an SOA, resources are made available to other participants in the network as independent services that are accessed in a standardized way. According to Erl et al. [2], Service-oriented architecture is a technology architectural model for service-oriented solutions with distinct characteristics in support of realizing service-orientation and the strategic goals associated with service-oriented computing.

Meanwhile, Enterprise Architecture (EA) is a term used for facilitating the integration of strategy, business, information systems and technology towards a common goal and mastering organizational complexity through the development and usage of architectural descriptions [3]. Enterprise Architecture (EA) has developed to bring the information system design and business requirements together. EA analyses an organization all the way from its generic strategic components to its detailed IT infrastructure. Hence, EA is more than architecture because it encompasses governance as well as a roadmap for aligning IT investments with business needs.

The concept of SOA has induced EA methodological changes. The combination of SOA and EA introducing the notion of Service-oriented Enterprise Architecture (SOEA) which has highlights their synergic relationship. This new approach allows EA and SOA to complete each other for better support of agile business needs [4]. However, SoEA adoption is still at the early stage in many organizations and not well understood [5], [6]. Moreover, SoEA might be 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 [7].

There are several reasons why SOA always gain the research interest. SOA has been widely promoted by analysts and IT vendors as the architecture capable of addressing the business needs of modern organizations in a cost-effective and timely manner. Perceived SOA benefits include improved flexibility and alignment between business processes and the supporting enterprise applications, lower integrations costs (in particular for legacy applications), and numerous other advantages [8]. It is clear that SOA is having a substantial impact on the way in which software systems are developed. According to a Gartner Group report, 50 per cent of new mission-critical operational applications and business

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processes were designed in 2007 around SOA, and that number will be more than 80 per cent by 2010 [9]. Despite recent news that SOA adoption rates are falling and that "SOA is dead," Forrester Group recently reported that SOA adoption is increasing across all of its vertical-industry groups [10]. The reality is that SOA is currently the best option available for systems integration and leverage of legacy systems [11].

The purpose of this study is to identify the factors influencing the SoEA adoption and maturity models used to measure its level in an organization. The contextual limitation is set to research that focus on the SOA/SoEA adoption, including antecedents and consequences as well as the maturity model used to gauge the level of SOA/SoEA. The temporal limitation for this review is from January 2005 until end of August 2013. The researcher utilizes research of verified quality, which means that only articles in peer-review journals and from reputable conferences shall be addressed. The remaining four sections are as follows. Section II explains the review method applied in this study and Section III reports the findings. In Section IV research results is analyzed and discussed in order to identify knowledge gaps. Finally, Section V concludes and outlines some possible future works.

II. REVIEW METHOD

The review processes follow the SLR guidelines for software engineering by Kitchenham & Charters and Okoli & Schabram [12], [13]. According to Kitchenham & Charters, the guidelines have three main phases (see Fig. 1): planning the review, conducting the review and reporting the review phase. The review planning phase consists of 3 mandatory stages; 1) identification of the need for a review, 2) specifying the research question(s) and 3) developing a review protocol. The second phase is conducting the review with 5 stages associated with it. This phase consists of 1) identification of research; 2) selection of primary studies; 3) study quality assessment; 4) data extraction & monitoring and 5) data synthesis. Lastly, the final phase is reporting the review with 2 mandatory stages; 1) specifying dissemination mechanisms and 2) formatting the main report.
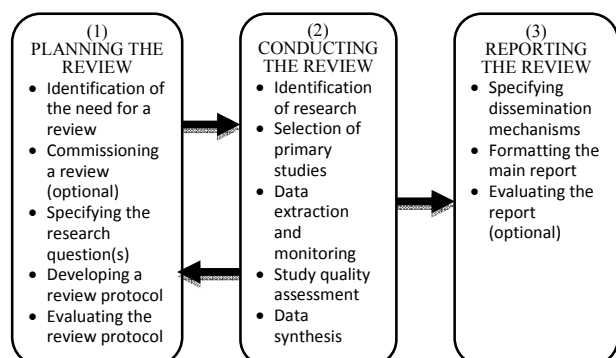

Fig. 1 Systematic review phases and stages

A. Research Questions

To come out with the research questions, the researcher follow the criteria by Petticrew and Roberts [14]. Table I shows the criteria and scope of research question structure.

TABLE I
STRUCTURE OF RESEARCH QUESTIONS

Criteria	Scope
Population	Public sector organisations and industry
Intervention	Maturity measurement models to assess SOA/SoEA adoption level and factors
Comparison	Public sector organisations and industry
Outcomes	A set of SOA/SoEA adoption factors, issues and maturity models used in the organisations
Context	Reviewed of any studies of the SOA/SoEA adoption factors, issues and maturity models

Based on the research question structure as shown in Table I, the research questions are:

1. Research Question 1 (RQ1)

What research has been conducted on SOA/SoEA adoption factors and related maturity models in public sector organisation and industry? Who has published, when, and where (journal, conference)? The researcher intends to seek out and catalogue the research that has been conducted for the benefit of current and potential researchers in this area.

2. Research Question 2 (RQ2)

What research objectives in the scope of SOA adoption have been addressed? The researcher wants to know which subjects the existing research has covered, and record the key objectives underlying in these studies.

3. Research Question 3 (RQ3)

What theoretical frameworks and reference theories have been applied to study the topic? The researcher wants to know which theories and models have been used in existing research.

4. Research Question 4 (RQ4)

What research methods have been used? As a guide to future studies, we attempt to identify the approaches that have been adopted. Based on Creswell [15] research categories, conceptual research refers to studies that formulate emerging concepts, models and frameworks, while empirical research refers to surveys, interviews, case studies, multi-method research, and experiments.

5. Research Question 5 (RQ5)

What are the critical factors for the successful adoption of SOA in the organization can be identified in the existing studies?

6. Research Question 6 (RQ6)

What is the maturity models used to measure the level of SOA adoption in the organization identified in the existing studies?

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7. Research Question 7 (RQ7)

What conclusions can be drawn from existing research? The researcher intends to summarize and analyze findings from existing research in order to draw conclusions on central issues.

B. Data Sources

The research involved 7 online databases as data sources which are ACM Digital Library, IEEEXplore Digital Library, ProQuest, ScienceDirect, SpringerLink, Taylor & Francis and Google Scholar. The selection of online databases was based on own knowledge of databases that indexed "Service-oriented Architecture" or "Service-oriented Enterprise Architecture" studies and the list of available online databases subscribed by the University Teknologi Malaysia's library under the "Computer Science" subject category.

C. Search Strategy

The initial search string is service-oriented architecture, service-oriented enterprise architecture, government, public sector organization, organization, and SOA maturity models. The search string is then constructed using Boolean "and" and Boolean "or" to allow synonyms and word class variants of each keyword. The resulting search string are (service-oriented architecture or service-oriented enterprise architecture) AND (government or public sector organization or organizations) and (adoption or implementation or maturity models). The search string was executed in the digital libraries/indexing services to titles, abstracts and metadata, assuming that these provide a concise summary of the work.

D. Study Selection

This step ranks the source of papers from highest to lowest priority: journals, conferences or proceedings, technical reports, thesis reports, books and magazine articles.

E. Inclusion and Exclusion Criteria

This review targeted peer reviewed articles on SOA/SoEA adoption and maturity measurement models studies published between January 1, 2005 and August 31, 2013. Only articles in English were included. The search included articles on the following subtopics:
- Motives, goals and reasons to adopt and preconditions for adoption.
- Strategies and methodologies for adoption.
- Status or level of adoption.
- Maturity model used to measure level of adoption.
- Consequences of adoption including outputs and benefits.
Articles on the following topics were excluded:
- Non-research articles that was purely descriptive.
- Articles that only described tools.
- Articles that is not written in English.
- Articles that did not match the inclusion criteria.

F. Data Collection

The data extracted from each study were as follows:
- The source (journal or conference) and full reference

- The authors, their institutions, and the countries where they were situated.
- Classification of the research methods
- Theoretical frameworks and reference theories used
- Research questions or research objectives
- Research settings
- SOA/SoEA adoption factors, motives, CSFs, challenge, strategy and impacts
- SOA/SoEA Maturity Models

III. Findings

Fig. 2 shows results of the search procedure. The initial phase of the search process identified 1,785 studies using the search term defined. Of these, only 96 were potentially relevant based on the screening of titles and abstracts. Each of these studies was filtered according to the inclusion and exclusion criteria before being accepted for the synthesis of evidence. If titles and abstracts were not sufficient to identify the relevance of a paper, full articles were used. Finally, 45 studies (46 percent of 96 studies) were accepted for the synthesis of evidence after a detailed assessment of abstracts and full text and exclusion of duplicates.
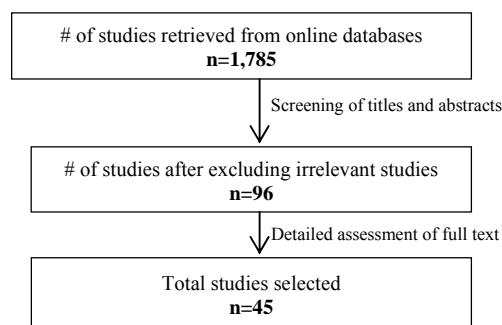

Fig. 2 Literature selection process

A. What Research Has Been Conducted on SOA/SoEA Adoption Factors and Related Maturity Models in Public Sector Organization and Industry?

Overall 45 relevant studies were identified from 7 journal articles, 23 conference articles, 6 working reports, 3 theses, 2 book chapters and 4 magazine articles. Fig. 3 shows that the numbers of conference articles are consistently published between 2009 until 2012. Tables II and III provide an overview of the journals and conference proceedings. A complete list of the articles is given in Appendix (Table X).The earliest study identified by this review was 2 working reports by CDBI published in 2005. Meanwhile, the first journal article was published in 2009. Most European researchers (23 articles spread among 11 countries) dominate the studies. Researchers at the Technische Universität Darmstadt, Germany and University of St. Gallen, Switzerland are the main contributors, with three articles of each university. North American is represented by 10 articles. Seven studies from Asia (India, Korea, Malaysia, Iran and Morocco). The Pacific is represented with three studies (Australia) and Africa is represented with

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two studies, both from South Africa. Table XI in Appendix section provides an overview of author affiliation details.

TABLE II
RELATED RESEARCH PUBLISHED IN JOURNALS

Journals	Article ID	Year
Business & Information Systems Engineering (BISE)	J1, J2, J7	2011
Information Systems and e-Business Management	J6	2013
Information Systems Management	J4	2009
Journal of Information Technology Management	J3	2009
Journal of Theoretical and Applied Electronic Commerce Research (JTAER)	J5	2009

TABLE III
RELATED RESEARCH PUBLISHED IN CONFERENCE PROCEEDINGS

| Conference	Article ID	Year
Americas Conference on Information Systems (AMCIS)	C20	2008
Annual ACM Symposium on Applied Computing (SAC)	C22	2008
Australasian Conference on Information Systems (ACIS)	C12	2011
Distributed Applications and Interoperable Systems, 8th IFIP WG 6.1 International Conference (DAIS)	C21	2008
European Conference on Information Management (ECIME)	C13	2012
European Conference on Information Systems (ECIS)	C10	2007
European Conference on Software Maintenance and Reengineering (CSMR)	C7	2009
Hawaii International Conference on System Sciences (HICSS)	C8,C5, C4	2007,2008,2009
IEEE International Conference on Digital Ecosystems and Technologies(DEST)	C16	2010
IEEE International Conference on Services Computing (SCC)	C23	2011
International Conference on Information Management (ICIME)	C9	2012
International Conference on Information Technology Interfaces (ITI)	C15, C17	2010, 2009
International Conference on Multimedia Computing and Systems (ICMCS)	C19	2012
International Conference on Software Engineering (ICSE)	C11	2012
International Conference on Theory and Practice of Electronic Governance (ICEGOV)	C2	2009
International Joint Conference on Computer Science and Software Engineering (JCSSE)	C3	2012
International Symposium on Information Technology (ITSIM)	C1	2010
International Symposium on Telecommunications (IST)	C18	2010
Proceedings of the Special Interest Group on Services (SIG SVC)	C6	2010
Twente Student Conference on IT (TSCIT)	C14	2009
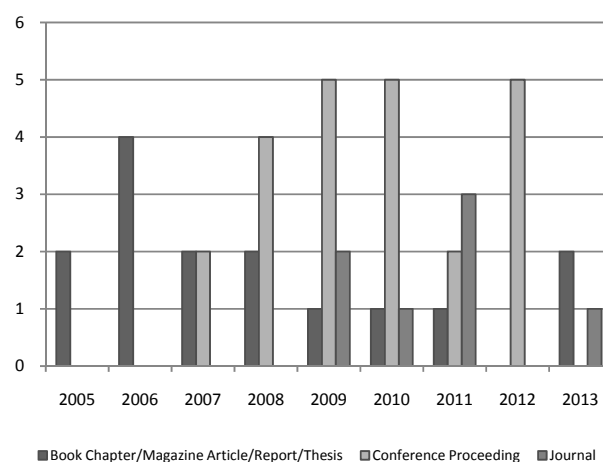
Fig. 3 Number of studies per year

TABLE IV
RESEARCH OBJECTIVES ADDRESSED IN THE SELECTED STUDIES

Stages/Research Objectives	Number	Article ID
Prerequisite of SOA Adoption		
to identify the CSFs for SOA adoption/implementation	10	C12,C13,C14,C3, J1,J4,J5,J6,J7,T1
to identify the drivers/motives of SOA adoption/implementation	3	B2,C6, T1
In process of SOA Adoption		
to identify the challenges in SOA adoption/implementation	8	B1,C2,C7,J2,J3,J7,M1,R3
to understand the SOA adoption/implementation strategy	5	C16, C5, C7, J2, R1
to propose SOA adoption/implementation best practices	5	B1, C10, C4, J4, M1
to identify the role of SOA governance in SOA adoption/implementation	3	C18, C22, C7
Post Assessment of SOA Adoption		
to identify the SOA adoption/implementation impact	8	C11,C16,C6,C8,C9,J2,J5,T2
to identify benefits of SOA adoption/implementation	4	C15,C2,C7,R3
to identify SOA adoption/implementation level	1	C11
Model Development of SOA		
to propose SOA maturity model	8	C17,C21,C23,M2,M3,M4,R6,T3
to develop a model for SOA adoption/implementation	3	C1,J3,R2
to propose SOA governance model	1	C20
to propose SOA security maturity model	1	C19

B. What Research Objectives Have Been Addressed?

From the studies, the research objectives are grouped in four main categories. These categories are arranged accordingly to the stages of SOA adoption and also SOA maturity model development phase. In prerequisite of SOA adoption stage, there are 12 articles related to it, followed by 16 articles in process stage and 12 articles in post assessment stage. Within the model category, 13 articles discussed about

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it. Most of the research objectives are in process stage, which discuss on the challenges, implementation strategy, role of SOA governance and SOA best practices. The details are shown in Table IV.

C. What Theoretical Frameworks and Reference Theories Have Been Applied to Study the Topic?

This review has identified 13 theoretical frameworks and reference theories in the selected articles. The most widely used reference theory is the maturity models (15 articles) followed by CSFs with 10 articles. Three articles referred to Technology-Organization-Environment (TOE) framework and two articles with Return on Investment Theory. Meanwhile, for the rest of the theories are only referred by one article. There are articles that referred to more than one theory such as article M2, M3, J1 and J6 whereas 20 articles did not mention of using any established theory at all. The details are shown in Table V.

TABLE V
THEORETICAL FRAMEWORKS AND REFERENCE THEORIES APPLIED IN SELECTED STUDIES

Theoretical frameworks and reference theories	Number	Article ID
Maturity Models	15	R2, T3, C20, C21, C18, C19, C17, R4, R5, R6, C16, M4,C23,M2,M3
Critical Success Factors (CSFs)	10	B1,C12,C13,C14,C3,C6,J1,J4,J6,R3
Technology-Organization-Environment (TOE) Framework	3	J3, C6, J6
Return on Investment Theory	2	M2, M3
Diffusion of Innovations Theory	1	J6
Grounded Theory method	1	C7
Organizational culture theory	1	T1
Punctuated-Equilibrium-Theory	1	J1
Resource Based View Theory	1	C1
Scott Morton's Framework	1	C9
Technological Innovation Theory	1	C4
Technology Adoption and Diffusion Theory	1	J5
Upper Echelons Theory	1	T1

D. What Research Methods Have Been Used?

The research approach used is classified according to suggestion by Wohlin et al. [16] and Creswell [15]. The research approaches were grouped into two broad categories, conceptual and empirical. The conceptual research approach refers to studies that formulate concepts, models, and frameworks, including literature reviews (also known as secondary sources). Empirical research includes research with some form of empirical data collection and analysis. The

empirical contributions were further categorized into three sub-categories, surveys, case studies, and mixed-method. Findings reveals that the methods applied are quite balance between conceptual (secondary sources), survey (quantitative) and case study (qualitative). Fig. 4 and Table VI show the results of the categorization.
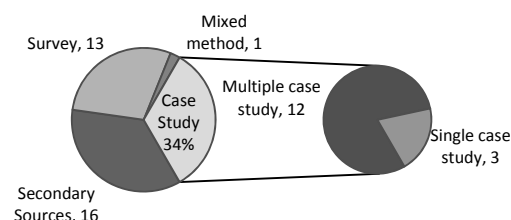

Fig. 4 Research methods applied

TABLE VI
RESEARCH METHODS APPLIED

Research Design	Number	Article ID
Conceptual	16	C20, B1, C17, C19, C21, C23, J5, M2, M3, M4, R2, R3, R4, R5, R6, T3
Empirical		
Surveys	13	C1, C11, C13, C15, C18, C22, C6, C8, J1, J2, J6, R1, T1
Mixed method	1	C14
Multiple case study	12	B2, C10, C12, C16, C2, C3, C4, C5, C7, J3, J4, M1
Single case study	3	C9, J7, T2

E. What Are the CSFs for the Adoption of SOA in the Organization Can Be Identified in the Existing Studies?

Table VII shows the analysis of CSFs for the SOA adoption in the organization. Most cited CSF in the articles is technology, followed by governance and organization itself. Other factors that have been highlighted are categorized as human resources, architecture, strategy, financial resources and product.

TABLE VII
SOA ADOPTION CSFs IDENTIFIED FROM THE STUDIES

CSFs Category	Number	Article ID
Technology	10	B1,C12,C13,C14,C3,C6,J1,J4,J6,R3
Governance	8	B1,C12,C13,C14,C3,J4,J6,R3
Organization	7	B1,C12,C13,C6,J4,J6,R3
Human Resources	4	C6,J1,J4,R3
Architecture	3	C3, J1, J6
Strategy	3	C12,C13,J4
Financial Resources	2	C3, J4
Product	2	C3, J6
Communication	1	J1

F. What is the Maturity Models Used to Measure the Level of SOA Adoption in the Organization Identified in the Existing Studies?

In analysis, 13 SOA maturity models are identified. This is including the existing SOA maturity model that is being

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applied in the studies and the new SOA maturity model proposed in the studies itself. The details of the SOA maturity models are represented in Table VIII.

TABLE VIII
SOA MATURITY MODEL IDENTIFIED FROM THE STUDIES

SOA Maturity Model	Article ID
CBDI Maturity Levels and Roadmap Phases	R2
CSOAMM (Combination of SOAMM and SIMM)	T3
Generalized SOA Governance model	C20
iSOAMM: an independent SOA maturity model	C21
SOA evaluation framework	C18
SOA Security Maturity Model	C19
New SOAMM	C17
SOA Maturity Model	R4,R5
SOA Capability Maturity Model	R6
SOA Maturity Model (Johannsen and Goeken)	C16
SOA Maturity Cube	M4
SOAMMI – SOA Maturity Framework Integration	C23
Wipro SOAM	M2,M3

G. What Conclusions Have Been Made from Existing Research?

In this section the findings from current research are analyzed and the conclusions are derived. Basically SOA adoption analysis can be grouped to 3 different stages with one independent stage known as model development stage. The stages are, Prerequisite of SOA Adoption, In process of SOA Adoption, Post Assessment of SOA Adoption and Model Development of SOA. Table XII in Appendix shows the complete list of the studies, tabulated according to the stages. The conclusions are made as follows.

1. Prerequisite of SOA Adoption

From the studies, 10 articles mentioned on CSFs and 15 articles stated the motives of SOA Adoption. Research finds that adoption is motivated by a variety of reasons which can be categorized as per Table IX. The most frequent motive highlighted is flexibility, which covers business, services, user, application and infrastructure flexibility. Other motives that mentioned is the need of speed, process optimization, reducing cost, ease of use, ability to reuse, fulfill customer satisfaction, increase revenue and also organization support.

2. In Process of SOA Adoption

In the related studies, seven articles mention on the strategy to adopt the SOA concept. The related articles are C1, C2, M1, C8, T2, C14 and C16. Anyway none of them stated the detail strategy plan that should be applied in the SOA execution. Meanwhile nine articles discussed on the SOA challenges. The articles are J2, J3, C2, M1, C7, J6, R2, J7 and C15. The most mention challenge is on the technology aspect and the complexity of the SOA adoption. Other issues that are raised such as difficult to manage service metadata, difficult to identify the best services among many and determining the service provider, problem in control and ownership of shared

services, obstacles to process re-engineering, lack of testing tools and also lack of SOA professionals that can work on this approach.

TABLE IX
SOA MOTIVES IDENTIFIED FROM THE STUDIES

SOA Motives	Number	Article ID
Flexibility	6	B1,B2,C10,C15,J2,R1
Speed	5	B1,C10,C2,J2,R1
Process Optimization	4	B2,C7,J6,R2
Reduce Costs	4	B1,C4,J2,T2
Ease	3	C16, J2, R1
Reuse	2	C2,R1
Customer Satisfaction	1	B1
Increase Revenue	1	J2
Organization Support	1	C6

3. Post Assessment of SOA Adoption

Ten articles discussed on the adoption status of SOA, meanwhile seven articles highlighted on the impact. Some articles highlight both of these factors, for example article C16 and R2. Overall, all studies reported that the awareness of SOA is high, but still the adoption status is at infancy level. This study also reveals that organizational strategy, organizational culture and structure, management processes and technology are the SOA impact to the recent adoption process.

IV. DISCUSSION

In this section, the findings is analyzed and discussed in order to identify knowledge gaps and opportunities for future research.

A. Issues in SOA Adoption

The most research issues highlighted in this scope is to identify the CSFs for SOA adoption, followed by identifying the challenges in SOA adoption and SOA adoption impact. From the synthesis it is suggested that the success of SOA adoption is determined by a vigorous effort from the beginning of the SOA initiative and it should be continuously maintained. SOA adoption strategy document should be prepared with flexibility so that it will be able to evolve with nature, and change as it moves through the integration and adoption. The SOA strategy should clearly define the expected results of the project with different matrices to crosscheck whether the results are met. The most important thing is SOA strategy should reflect the plan and design for change [C2].

Some challenges that are highlighted are on the security issues, incomplete or immature standards or solution of SOA, inability to integrate legacy applications and quality of service (QoS) issues. Limited developer support and lack of skills or expertise in this area also become the main concern. With the beliefs that SOA shall provide a viable business models make it more difficult to identify the best services among many SOA service provider. Organization also has difficulty determining where and how to start the SOA initiatives [J2], [C2], [C15]. Other pertinent challenge is SOA governance. The concerns

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are on shared business services, integration with Business Process Modeling (BPM) or other vendors, organizational IT architecture and policy and lack of concise mapping of processes to organizational units in different organizations. All these complex governance issues impede the SOA approach in the organization.

In any organization, every initiative should provide a significant value. Same issue happened to SOA. Most organizations still have problem on SOA budget justification and return on investment (ROI) [C7], [J3]. Even with top management support, unclear allocation of the investments and operation expense between the involved departments hinder the SOA planned activities [J2].

With all the issues stated, organization has to work in an incremental manner to ensure successful SOA adoption. This involves a major cultural change in the organization, so one should never think of SOA without thinking on the business value of the organization. All decision on SOA initiatives, regardless it is just on technology or IT infrastructure it should always reflects on the business of the organization itself.

B. SOA Adoption CSFs

Critical success factors within the context of this research can be defined as the key areas where "things must go right" in order for the adoption project to achieve a high level of success. This review finds that researchers have extensively discussed the factors that are important for successful SOA adoption. Overall, two approaches have been used to answer this research question. Case studies have mainly asked what the most important factors are for success when adopting SOA, and surveys have presented the respondents with predefined alternatives and asked them to rank the relevance of each alternative. The findings from these questions are stated in Table VII. Table VII presents an a priori model for SOA adoption success factors based on this review. It has categorized to nine candidate success factors: (1) technology; (2) governance; (3) organization; (4) human resources; (5) architecture; (6) strategy; (7) financial resources; (8) product; and (9) communication. Although existing research has successfully identified the CSFs, there is little empirical evidence on how to conduct an adoption project successfully. The set of success factors has not yet been tested and validated. This should be addressed by future research.

C. SOA Maturity Model

This review reveals there are 13 maturity models used in the selected articles (see Table VIII). Some are well known model such as SOA Maturity Model by Oracle and The Open Group, while there are also self-developed maturity model which are tailored to the specific used of the study itself.

Based on the comparison of all selected maturity models, their maturity levels, characteristics and how are they defined, it can be concluded that there are some overlapping and joint characteristics. Basically the levels and criteria defined are very similar especially on the lower maturity, medium maturity and higher maturity. Under lower maturity which also can be defined as the early phases of SOA adoption are characterized by initial learning and initial project phase of SOA adoption. At this level projects are typically done to meet a specific need to implement functionality while trying out specific technologies and an approach to SOA. This maturity level normally includes R&D activities testing the SOA technologies in a controlled environment. The initial introduction of SOA is driven as part of an application integration project.

After the organization establishes necessary prerequisites from lower maturity area, the next step is called medium maturity. At this level that standards normally set as to the technical governance of SOA adoption, typically under leadership of the architecture organization. The key business benefit of this level is development and deployment cost reductions through the use of SOA standard infrastructure and components as compared to using older technologies. This level also checked on costs accumulated from SOA projects and also focuses on creating strong interconnections between technologies and business processes. So that, it will enables fast and seamless changes in business processes, ease integration of business processes between different business units and provide ICT support to entire system.

The third level is higher maturity level. Organizations that achieved the highest maturity levels are characterized with SOA information system that has become the "enterprise nervous system" (ENS) (as defined by Gartner) and takes action according to events occurring at the business level according to rules optimizing business goals. The emerging ENS is based on the traditional enterprise network, but it is an evolution of that network, providing value-added functions that elevate the role of the network well beyond that of plain communication. At this level, organizations can truly explore the value of SOA.

Based on the review, conclusion can be made that is possible to define a basic set of criteria, which comprises of a set of prerequisites that an organization has to fulfill if it wants to establish successful SOA adoption. Which criteria should be used and the additional prerequisites are depends on their specific domains for example public administration, manufacturing, retail, financial institutions and others.

D. Future Works

As part of researcher future work, the study shall focus on verifying the identified CSFs in this review. This shall be done through case study and survey with the relevant respondent. Based on the review, the research is mostly on the private sector, which comprises of company (18 articles), financial industry (4) and service industry (2). As for the public sector, there are only six studies, which are on government and municipal (5) and 1 on university setting. Based on this fact, the researcher decided to conduct the research in the context of public sector organization in order to gain more insights on the organization perception and acceptance of SOA initiatives. Once the proposed CSFs is verified, the next step is to develop the SOA adoption guideline and maturity model assessment specific for public sector organization. It is hope that public sector able to leverage on these tools to boost up their quality and quantity of services that they shall provide to the citizen.

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E. Threats to the Validity of the Results

Several factors need to be taken into account when generalizing the results of this review. During the process of identifying the relevant literature, researcher only considered as primary sources articles published electronically, thus neglecting studies that might have appeared in conference proceedings or journals that were not published online. This was particularly applicable to material published before 1987. However, since the scope of this review is focus from articles published from 2005 until 2013, this issue is not a main concern. Furthermore, an extensive list of search databases is used and included in the searching process. Another threat is on the issue of handling the review. In order to ensure the review is done in high quality, the review process strictly followed the guideline by Kitchenham & Charters; Okoli & Schabram [12], [13]. Thus, this would provide a valid review of the scope defined in the study.

V. CONCLUSION

In this study, the researcher systematically reviewed research articles on the SOA adoption. The analysis was done with respect to specific research questions. This article contributes to research in several ways. First, it provides a systematic overview of existing research in this area. 45 articles are identified and provide significant contributions: 7 journal articles, 23 conference articles, 6 working reports, 3 theses, 2 book chapters and 4 magazine articles. The contributions have been systematically categorized, which provides the current status of this emergent research field and will ease researchers' search for relevant studies. Second, through a thorough analysis, the potential areas and approaches is suggested for future studies. The review concludes that the motives, goals, CSFs, implementation status, and the impact are well covered in current research. The review shows that

there is only limited research on adoption strategies and methods which suggests the need for future research on these issues. Nevertheless, all mention factors are not discussed in depth, as most of the papers only highlight the topic and simple explanation related to it. Therefore researchers are encouraged to explore more on that research area.

This study also contributes to practice, and IT managers would gain benefit from this review. The summaries of the various issues may serve as guidelines for IT managers who are planning to adopt or already are adopting SOA in their organization. The catalogue of CSFs and the proposed a priori model may be especially significant to be the reference as well. The review and the search process are based on methodological recommendations prescribed in the literature [12], [13] thus, the quality of this review is at high level. However, the selection of key words, sources, inclusion and exclusion criteria, and time frame is based on researcher own judgment, and the choice has limitations. Other than that concern, researcher is fairly confident that the review has been able to identify the relevant contributions.

APPENDIX

TABLE X
ARTICLES REVIEWED IN THIS RESEARCH

Article ID	Article Details
	BOOK
B1	L. Bastida, A. Berreteaga, and I. Cañadas, "Adopting service oriented architectures made simple," in in *Enterprise Interoperability III*, Springer, 2008, pp. 221–232.
B2	H. Luthria and F. A. Rabhi, "Building the business case for SOA: A study of the business drivers for technology infrastructure supporting financial service institutions," in *Enterprise Applications and Services in the Finance Industry*, 2009, pp. 94–107.
	CONFERENCE PROCEEDINGS
C1	M. Abdi and P. D. D. Dominic, "Strategic IT alignment with business strategy: Service oriented architecture approach," *2010 International Symposium on Information Technology*, pp. 1473–1478, Jun. 2010.
C2	R. K. Das and M. R. Patra, "SOA for e-Governance in India: Potentials and Pitfalls," in *3rd international conference on Theory and practice of electronic governance*, 2009, pp. 36–42.
C3	M. Galinium and N. Shahbaz, "Success factors model: Case studies in the migration of legacy systems to Service Oriented Architecture," *2012 Ninth International Conference on Computer Science and Software Engineering (JCSSE)*, pp. 236–241, May 2012.
C4	M. N. Haines and W. D. Haseman, "Service-oriented architecture adoption patterns," in *42nd Hawaii International Conference on System Sciences (HICSS'09)*, 2009, pp. 1–9.
C5	T. Hau, N. Ebert, A. Hochstein, and W. Brenner, "Where to Start with SOA: Criteria for Selecting SOA Projects," in *41st Annual Hawaii International Conference on System Sciences (HICSS 2008)*, 2008, pp. 314–314.
C6	N. Joachim, D. Beimborn, and T. Weitzel, "Investigating Adoption Determinants of Service-Oriented Architectures (SOA)," in *Proceedings of the Special Interest Group on Services (SIG SVC) (Pre-ICIS Workshop)*, 2010, vol. 10, no. 2010, pp. 10–13.
C7	T. Kokko, J. Antikainen, and T. Systä, "Adopting SOA-Experiences from Nine Finnish Organizations," in *13th European Conference on Software Maintenance and Reengineering*, 2009, pp. 129–138.
C8	S. Kumar, V. Dakshinamoorthy, and M. S. Krishnan, "Does SOA Improve the Supply Chain ? An Empirical Analysis of the Impact of SOA Adoption on Electronic Supply Chain Performance," in *40th Annual Hawaii International Conference on System Sciences (HICSS'07)*, 2007, pp. 1–10.

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C9   S. Lavin and L. Seymour, "Towards an Understanding of Enterprise-Level SOA Adoption : A South African Case Study," in *3rd International Conference on Information Management (ICIME 2012)*, 2012, p.174.

C10   C. Legner and R. Heutschi, "SOA Adoption in Practice - Findings from Early SOA Implementations," in *European Conference on Information Systems (ECIS 2007)*, 2007, no. February, pp. 1643–1654.

C11   M. Leotta, F. Ricca, M. Ribaudo, G. Reggio, E. Astesiano, T. Vernazza, and S. Dibris, "SOA adoption in the Italian industry," *34th International Conference on Software Engineering (ICSE)*, pp. 1441–1442, Jun. 2012.

C12   M. A. Manan and P. Hyland, "Enterprise SOA Implementation Readiness: A Case Study in Malaysia," in *22nd Australasian Conference on Information Systems*, 2011.

C13   I. Owens and J. Cunningham, "The Identification of Service Oriented Architecture-Specific Critical Success Factors," in *6th European Conference on Information Management and Evaluation*, 2012, p. 267.

C14   W. Vegter, "Critical success factors for a SOA implementation A case study in the financial sector," in *11thTwente Student Conference on IT, Enschede*, 2009.

C15   S. Geriü, "The Potential of Service-Oriented Architectures," in *32nd International Conference on Information Technology Interfaces (ITI 2010)*, 2010, pp. 471–476.

C16   J. Eckert, M. Bachhuber, A. A. Miede, A. Papageorgiou, and R. Steinmetz, "Readiness and maturity of service-oriented architectures in the German banking industry," in *4th IEEE International Conference on Digital Ecosystems and Technologies*, 2010, pp. 270–274.

C17   S. Geric and N. Vrcek, "Prerequisites for successful implementation of Service-Oriented Architecture," in *ITI 2009 31st Int. Conf. on Information Technology Interfaces*, 2009, pp. 175–180.

C18   A. Hassanzadeh and L. Namdarian, "Developing a framework for service oriented architecture governance maturity (SOAGM)," in *2010 5th International Symposium on Telecommunications (IST'2010)*, 2010, pp. 513–520.

C19   M. Kassou, L. Kjiri, and U. M. V Souissi, "SOASMM: A novel service oriented architecture Security Maturity Model," in *2012 International Conference on Multimedia Computing and Systems (ICMCS)*, 2012, pp. 912–918.

C20   M. Niemann, J. Eckert, N. Repp, and R. Steinmetz, "Towards a Generic Governance Model for Service Oriented Architectures.," in *AMCIS 2008 Proceedings*, 2008, p. 361.

C21   C. Rathfelder and H. Groenda, "iSOAMM: an independent SOA maturity model," in *Distributed Applications and Interoperable Systems*, 2008, pp. 1–15.

C22   T. G. J. Schepers, M. E. Iacob, and P. a. T. Van Eck, "A lifecycle approach to SOA governance," *Proceedings of the 2008 ACM symposium on Applied computing - SAC '08*, p. 1055, 2008.

C23   A. Zimmermann, H. Buckow, H.-J. Groß, O. F. Nandico, G. Piller, and K. Prott, "Capability Diagnostics of Enterprise Service Architectures Using a Dedicated Software Architecture Reference Model," *2011 IEEE International Conference on Services Computing*, pp. 592–599, Jul. 2011.

JOURNALS

J1   S. Aier, T. Bucher, and R. Winter, "Critical Success Factors of Service Orientation in Information Systems Engineering," *Business & Information Systems Engineering*, vol. 3, no. 2, pp. 77–88, Feb. 2011.

J2   A. Becker, T. Widjaja, and P. Buxmann, "Value Potentials and Challenges of Service-Oriented Architectures," *Business & Information Systems Engineering*, vol. 3, no. 4, pp. 199–210, Jul. 2011.

J3   A. P. Ciganek, M. N. Haines, and W. D. Haseman, "Service-Oriented Architecture Adoption: Key Factors and Approaches," *Journal of Information Technology Management*, vol. XX, no. 3, 2009.

J4   J. H. Lee, H.-J. Shim, and K. K. Kim, "Critical Success Factors in SOA Implementation: An Exploratory Study," *Information Systems Management*, vol. 27, no. 2, pp. 123–145, Apr. 2010.

J5   H. Luthria and F. Rabhi, "Service Oriented Computing in Practice: An Agenda for Research into the Factors Influencing the Organizational Adoption of Service Oriented Architectures," *Journal of theoretical and applied electronic commerce research*, vol. 4, no. 1, pp. 39–56, Apr. 2009.

J6   E. MacLennan and J.-P. Belle, "Factors affecting the organizational adoption of service-oriented architecture (SOA)," *Information Systems and e-Business Management*, Jan. 2013.

J7   P. Trkman, A. Kovačič, and A. Popovič, "SOA Adoption Phases," *Business & Information Systems Engineering*, vol. 3, no. 4, pp. 211–220, Jul. 2011.

MAGAZINE ARTICLES

M1   M. Galster, L. Lapre, and P. Avgeriou, "Service-oriented architecture in variability-intensive environments: pitfalls and best practices in the example of local e-government," *Software, IEEE*, vol. PP, no. 99, pp. 1–15, 2013.

M2   S. Inaganti, "SOA Maturity Model Scenarios," *BPTrends*, no. December, pp. 1–5, Dec-2007.

M3   S. Inaganti and S. Aravamudan, "SOA Maturity Model," *BPTrends*, no. April, pp. 1–23, Apr-2007.

M4   R. Welke, R. Hirschheim, and A. Schwarz, "Service-Oriented Architecture Maturity," *Computer*, vol. 44, no. February, pp. 61–67, 2011.

WORKING REPORTS

R1   C. Baroudi and F. Halper, "Executive Survey: SOA Implementation Satisfaction," 2006.

R2   D. Sprott and R. Veryard, "SOA Adoption in the Danish Public Sector," *CBDI Journal*, 2006.

R3   D. Sprott, "SOA in the Public Sector," *CBDI Journal*, no. December, 2005.

R4   Oracle, "SOA Maturity Model - Guiding and Accelerating SOA Success," 2013.

R5   A. Pugsley, "Assessing your SOA Program," 2006.

R6   D. Sprott, "The SOA Maturity Model," *CBDI Journal*, no. December, 2005.

THESES

T1   S. E. Mabry, "Adopting A Service-Oriented-Architecture (SOA) Strategy: The Forces of Organizational Culture and the Moderating Role of Senior Managers," Capella University, 2008.

T2   I. B. Sutawijaya and S. Chiok, "Impact of SOA Adoption with regard to Business Value: A study from South East Asia Bank," Lund University, 2010.

T3   F. Meier, "Service Oriented Architecture Maturity Models: A guide to SOA Adoption?," University of Sk¨ovde, Box 408 S-54128 Sk¨ovde, SWEDEN,, 2006.

TABLE XI
AUTHOR AFFILIATION DETAILS

Country/Researcher	Research Institution	Article ID
Australia		
H. Luthria and F. A. Rabhi	The University of New South Wales	B2, J5
M. A. Manan and P. Hyland	University of Wollongong	C12

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Country/Researcher	Research Institution	Article ID
Croatia		
S. Geric and N. Vrcek	University of Zagreb	C17
S. Geriü	University of Zagreb	C15
India		
S. Inaganti	Wipro Technologies	M2
S. Inaganti and S. Aravamudan	Wipro Technologies	M3
Denmark		
D. Sprott and R. Veryard	CBDI	R2
Finland		
T. Kokko, J. Antikainen, and T. Systä	Tampere University of Technology	C7
Germany		
A. Zimmermann, H. Buckow, H.-J. Groß, O. F. Nandico, G. Piller, and K. Prott	Reutlingen University University of Applied Sciences Mainz	C23
C. Rathfelder and H. Groenda	FZI Research Center for Information Technology, Software Engineering	C21
J. Eckert, M. Bachhuber, A. A. Miede, A. Papageorgiou, and R. Steinmetz	Multimedia Communications Lab – KOM Technische Universität Darmstadt	C16
A. Becker, T. Widjaja, and P. Buxmann	Technical University Darmstadt	J2
M. Niemann, J. Eckert, N. Repp, and R. Steinmetz	Technische Universität Darmstadt	C20
N. Joachim, D. Beimborn, and T. Weitzel	University of Bamberg	C6
India		
R. K. Das and M. R. Patra	Berhampur University	C2
Iran		
A. Hassanzadeh and L. Namdarian	TarbiatModares University	C18
Italy		
I. Leotta, F. Ricca, M. Ribaudo, G. Reggio, E. Astesiano, T. Vernazza, and S. Dibris	University of Genoa	C11
M. Galinium	University of Rome Tor Vergata	C3
Korea		
J. H. Lee, H.-J. Shim, and K. K. Kim	Yonsei University	J4
Malaysia		
M. Abdi and P. D. D. Dominic	UniversitiTeknologi PETRONAS	C1
Morocco		
M. Kassou, L. Kjiri, and U. M. V Souissi	Universite Mohammed V	C19
Netherlands		
T. G. J. Schepers, M. E. Iacob, and P. a. T. Van Eck	University of Twente	C22
M. Galster, L. Lapre, and P. Avgeriou	University of Groningen	M1
W. Vegter	University of Twente	C14
Portugal		
P. Trkman, A. Kovačič, and A. Popovič	Universidade Nova de Lisboa	J7
Slovenia		
P. Trkman, A. Kovačič, and A. Popovič	University of Ljubljana	J7
South Africa		
E. MacLennan and J.-P. Belle	University of Cape Town	J6
S. Lavin and L. Seymour	University of Cape Town	C9
Spain		
L. Bastida, A. Berreteaga, and I. Cañadas	European Software Institute, ParqueTecnológico	B1
Sweden		
N. Shahbaz	Lund University	C3
I. B. Sutawijaya and S. Chiok	Lund University	T2
F. Meier	University of Sk¨ovde	T3
Switzerland		
C. Legner and R. Heutschi	University of St. Gallen	C10
S. Aier, T. Bucher, and R. Winter	University of St. Gallen	J1
T. Hau, N. Ebert, A. Hochstein, and W. Brenner	University of St. Gallen	C5
United Kingdom		
I. Owens and J. Cunningham	Cranfield University	C13
United States		
S. E. Mabry	Capella University	T1
R. Welke, R. Hirschheim, and A. Schwarz,	Georgia State University Louisiana State University	M4
A. Pugsley	Hewlett-Packard	R5

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Country/Researcher	Research Institution	Article ID
C. Baroudi and F. Halper	Hurwitz & Associates	R1
M. N. Haines and W. D. Haseman	Innograte LLC University of Wisconsin-Milwaukee	C4
Bob Hensle and M. Deb	Oracle	R4
S. Kumar, V. Dakshinamoorthy, and M. S. Krishnan	University of Michigan	C8
A. P. Ciganek, M. N. Haines, and W. D. Haseman	University Of Wisconsin-Whitewater ICTECT, Inc. University Of Wisconsin-Milwaukee	J3
D. Sprott	Washington State University, Pullman	R3,R6

TABLE XII
SUMMARY OF FINDINGS FROM SELECTED STUDIES

Article ID	Prerequisite		Stages of SOA Adoption In Process		Post Assessment		SOA Model Development/ Usage
	Motives	CSFs	Challenges	Strategy	Implementation	Impact	
B1	x	x					
B2	x						
C1				x			
C2	x		x	x	x		
C3		x					
C4	x					x	
C5	x						
C6	x	x					
C7	x		x		x		
C8				x			
C9						x	
C10	x				x		
C11					x		
C12		x					
C13		x					
C14		x		x			
C15	x		x		x		
C16	x			x	x	x	x
C17							x
C18							x
C19							x
C20							x
C21							x
C22							
C23							x
J1		**x**					
J2	x		x		x		
J3			x				
J4		x					
J5							
J6	x	x	x				
J7			x			x	
M1			x	x			
M2							x
M3							x
M4							x
R1	x				x		
R2	x		x		x	x	x
R3		x			x		
R4							x
R5							x
R6							x
T1						x	
T2	x			x		x	
T3							x

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