

# Service Oriented Architecture Adoption: A Systematic Review

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**Abstract:** Service Oriented Architecture (SOA) has appeared as an absorbing architectural approach that empowers the available systems to reveal their performance in the act of services without creating important changes to the systems. This approach, due to its flexibility of adoption, has been widely appreciated by the businesses. Though there are many studies that depict successful factors of SOA, a few minor cases of failure have also been reported in the literature. In spite of the availability of rich material on SOA, there is no systematic literature review on the influential aspect of SOA adoption factors. Thus, this paper presents a systematic literature review of existing studies (from 2009 to 2017) related to the SOA adoption and its success and failure. The central purpose of the study is to focus on the existing issues and share the findings with researchers. Moreover, the findings of this paper would help the IT experts in organizations focus on the most important factors highlighted in this study, so they could decide whether it is advisable to adopt SOA in their context or not.

**Keywords:** Service Oriented Architecture, SOA Adoption, Influential Factors, CSFs, and Systematic Literature Review

## 1. Introduction

In the last few years, SOA has received an increasing attention to move towards challenges associated with improvement and maintenance of diverse IT environments [1], [2]. For the reason that SOA offers flexible integration and service reusability due to its service-based modular architecture [3]. In fact, the emphasis on services makes SOA inimitable as it also offers transparency through several applications and data sources that encapsulated as a black box. In this way, an integrated pool of IT resources becomes accessible in spite of diverse IT systems, language codes, functionalities, and platforms.

So far, SOA has demonstrated itself to be a key paradigm in numerous industries such as banking, healthcare, transport and etc. As mentioned above that in spite its benefits, some of the primary studies reveal that organizations have trouble in receiving full benefits of SOA adoption for several reasons. For instance, lack of knowledge and information about critical success factors in SOA adoption and implementation are key causes of failure [4], [5]. Yet, no detailed systematic study exist that could share critical influencing criteria for successful SOA adoption. In order to fill this gap, the authors

believed that the investigation of significant factors pertinent to adoption of SOA in organizations is crucial as the understanding of these factors would help organizations to increase the benefits they get from SOA. This would help raise SOA acceptance rate, too. Accordingly, this paper concentrates on seeking the answer to the following questions of the research:

- What studies have been conducted on SOA adoption in organizations?
- What are the significant factors that impact SOA adoption in organizations?

Aiming at answering the mentioned questions, we studied a large amount of research material to extract influential factors for SOA adoption. All these findings are discussed in the following sections. The rest of the present paper is laid out in the following design. The second section focuses on the works which are interdependent works and the third one focuses on the research process that how actually this research was carried out. Section 4 shares our findings and presents discussion. Section 5 presents the result and further work on this topic.

## 2. Related Works

Before we discuss our findings in detail, it is appropriate to briefly discuss a few similar studies about SOA. One of such study was conducted by Khadka and his colleagues [6]. They reviewed about 121 early studies conducted from 2000 to 2011, systematically. They also catered a historical summary, concentrating on techniques and methods applied in a “legacy to SOA” evolution.

In another study, an SOA research agenda[7] has been developed by the Software Engineering Institute (SEI). Lewis and his teammates [7] discussed the relocation of legacy applications to SOA. The primary goal of their study was to create a taxonomy for categorizing subjects into the engineering, operations, and business features of SOA systems. According to their research, the taxonomy delivered more details on precise challenges in research associated with the maintenance and evolution of SOA systems.

A systematic survey in industry was conducted by Razavian and Lago [8] on SOA/Cloud migration. The authors identified the gap between practice of legacy to SOA migration and theory. They also synthesized the consequences according to their own reference migration framework [9]. Moreover, the authors deliberated the modifications and recognized upcoming research directions.

Based on our analysis of these previous studies, there is no detailed systematic literature review that extracted all influential factors through SOA related papers. Therefore, we initiated the endeavor to work on a SLR to find out all SOA influential factors during 2009-2017. The findings of this study would help IT managers and practitioners to realize which factors are more important in the way of implementing SOA in their organizations. It is worth mentioning that it would also assist academic researchers to understand which factors are considered critical in SOA adoption studies.

## 3. Search Process

This systematic literature review has been conducted by following the guidelines according to Kitchenham [10]. The current SOA adoption studies and their influential factors have been extracted from literature reviewed as described in the following subsections and shown in Fig. 1. with three phases.

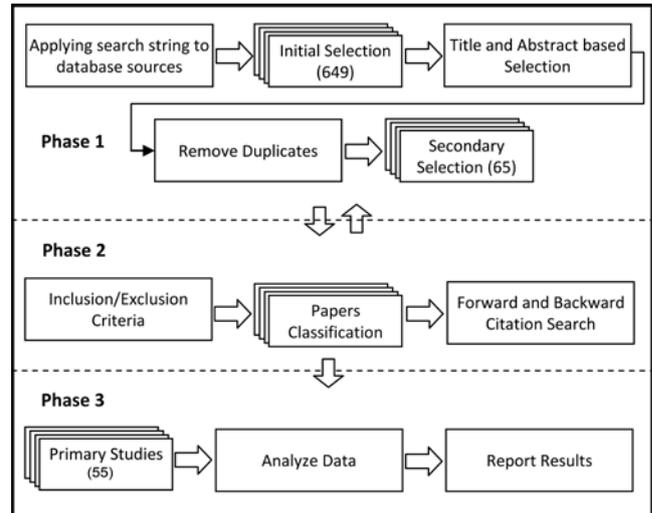


Fig. 1 Systematic Literature Review Phases.

### 3.1 Phase 1: Search Strategy

In this phase, the search strategy for reviewing was defined based on keywords used in this field. According to the first research question of this study, the main search keywords used are “SOA”, “Adoption”, “influential factors”. The operators “OR” and “AND” are used to connect the primary keywords, synonyms, and some related key terms. Then, after numerous tests the below search string has been chosen which returned the most relevant papers:

(SOA or “service oriented architecture”) AND (“adoption” or “migration”, or “legacy systems”) AND (CSF or “critical success factors” or “success factors” or “significant factors” or “influential factors”)

In order to execute these keywords, we used the database engines (Fig. 2) that published journals, conference proceedings and book chapters. In the first search step, 649 articles were resulted. In the next step, titles and abstracts of the collected papers were reviewed and related papers were chosen as preliminary studies. After removing duplicated papers 65 papers were selected as secondary selection.

IEEE Xplore	• <a href="http://ieeexplore.ieee.org">http://ieeexplore.ieee.org</a>
ACM	• <a href="http://portal.acm.org">http://portal.acm.org</a>
Springer	• <a href="http://link.springer.com/">http://link.springer.com/</a>
Taylor & Francis	• <a href="http://www.tandfonline.com/">http://www.tandfonline.com/</a>
ScienceDirect	• <a href="http://www.sciencedirect.com/">http://www.sciencedirect.com/</a>
AISel	• <a href="http://aisel.aisnet.org/">http://aisel.aisnet.org/</a>
Scopus	• <a href="http://www.scopus.com/">http://www.scopus.com/</a>
Google Scholar	• <a href="http://scholar.google.com.my/">http://scholar.google.com.my/</a>

Fig.2: Online Database Resources

### 3.2 Phase 2: Inclusion and Exclusion Criteria

In order to select appropriate and related studies, we defined inclusion and exclusion criteria presented in Table 1. It should be considered that all related papers were selected for reviewing SOA adoption issues including surveys, case studies and review papers. However, for identifying the significant factors, review papers were excluded from primary studies. The most important reason is that these types of papers did not verify the factors through experimental researches such as survey and case studies. Of the 55 papers, 9 articles were identified as review papers. Moreover, we found 10 papers that did not mention any influential factors in their contents. So, 36 papers were selected for extracting influential factors among the total number of 55 primary studies.

Table 1: Inclusion and Exclusion Research Criteria

Criteria	Principle	Primary Studies	Studies Related With Factors
Inclusion	Papers must be published after 2008.	√	√
	Scientific peer-reviewed studies.	√	√
	Papers must report SOA implementing/ adopting from software engineering or information system perspectives.	√	√
Exclusion	Papers not in the English language	√	√
	Papers which did not examine factors Reviewed papers	-	√
<b>Primary Papers</b>		<b>55</b>	<b>36</b>

√ means primary studies or studies related to factors, include/exclude based on principles

It is worth mentioning that the collection of papers was extended with additional papers by analyzing the cited papers after reading the whole context of the articles, in this phase.

### 3.3 Phase 3: Primary Studies

As a result, 55 peer-reviewed papers from 2009 to 2017 were comprised in this survey (Table 2). The publication of the primary studies was focused in order to match with the objectives of this study. Table 2 shows the distribution of primary studies by publication type. As is presented in the table, most selected papers are from journals (22) while 18 papers are selected from conference papers, and 6 papers were retrieved from book chapters. It is worth mentioning that some of the selected papers are published by Springer, Taylor & Francis, Science Direct (Elsevier), and Emerald Insight while most of the conference papers are selected from IEEE conferences and AISEL online database. The rests of the

papers are from the journals indexed in Scopus and Google Scholar. Moreover, all book chapters found are published by Springer publisher.

Table 2: Publication source of primary studies

Publication Type	No
Book Chapter	6
Conference	24
Journal	25
<b>Total</b>	<b>55</b>

The following Figure (Fig. 3.) is resulted from Table 2. This Figure presents 45% of papers are published in journals and 44% published as conference papers while the rest are published as book chapters.

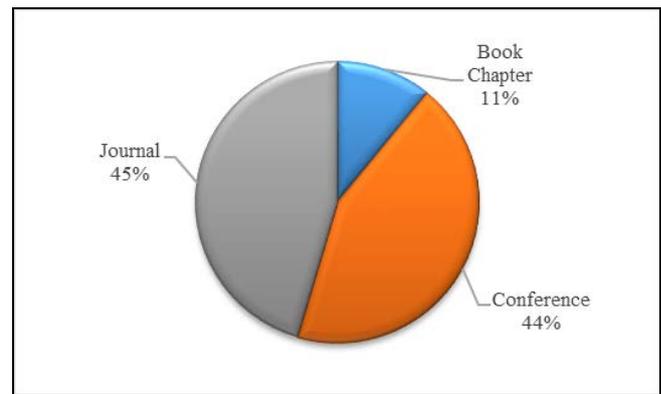


Fig. 3: Analysis on the primary studies' type (n=55)

According to Fig. 4., most of the selected papers were published in 2011. In this Figure, the numbers of published articles are demonstrated based on their type and publication year. It may be concluded that researchers' trends to study about SOA were increased during 2009 and 2013.

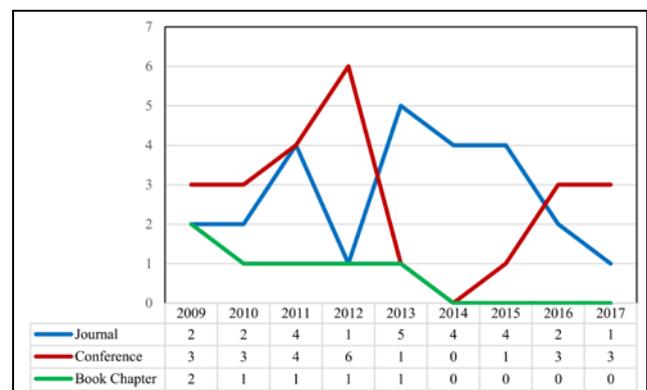


Fig. 4: Analysis on the primary studies' type based on year (n=55)

In continue, some of the selected primary studies are briefly summarized.

Julian Eckert and his partners [11] investigated SOA readiness and maturity in banking industry in Germany through a single case study with multiple participants. The results of their interviews showed that German banks have reached to an acceptable level of readiness and maturity. According to their study, the key inhibitor for preferable SOA maturity is the absence of alignment among IT and management parts in banks.

Migration legacy systems to SOA is one of the challenges posed in SOA adopted process. Moeini et al. [12] determined success factors based on Balanced Scorecard (BSC) form and presented a roadmap for SOA adoption by combining the existed roadmaps based on challenges and these success factors. Researchers determined the following factors as critical success factors from four perspectives: a) Financial factors: budget and leadership, b) Organization factors: business process, the potential of legacy systems, legacy architecture, technical skills, information architecture and standardization, the level of documentation, and reuse capabilities, c) Services factors: services migration strategy, abstraction of service, registry and repository services, and service discovery capabilities, d) Governance factors: center of excellence, governance SOA, and close monitoring.

Caimei Hu [13] in a study presented the Web Service technology standard system, according to the framework of TOE and examined the primary factors influencing the technology of Web Service adoption. Based on Caimei Hu, factors that influence on SOA adoption are: “a) Technology factors: advantages of web service technology standards, the complexity of Web Service technology standards, knowledge barriers in the adoption of Web Service technology standards, and standards immaturity, b) Organizational factors: technology capability of organization, organization philosophy, and organization scale, c) Environmental factors: industry concentration, stakeholder and industry technical inertia” [13].

Peter Trkman and his colleagues presented SOA influential factors through examining a single case study in a large company in Slovenian. Researchers emphasized that lack of skills, lack of expertise, and feasible business models are the most important problems during implementing SOA. Moreover, the authors offered a Hype Cycle for SOA to provide a better way to solve technological problems [14].

Marco Torchiano and his teammates [31] conducted a survey among 59 IT companies in Italy to investigate the challenges and issues during migrating information systems to SOA in practice. According to their analyses, the most important factors influencing SOA migration are as follow: “Lack of skills, reliability and scalability of existing migration approaches and tools, human factor, technological factors, Reengineering data or ensuring data consistency, testing the migrated application and project planning” [31].

In an article Gronli and Bygstad [15] offered and explained a real successful SOA implemented airline company. They emphasized three success elements

through examining the relation among SOA and business services in their case study. The first factor is implementing enterprise service bus (ESB) comprehensively and encapsulating all components in different architecture levels. The second factor is protecting a clear enterprise service bus architecture. Last but not least, allocating a developer team in each layer is another crucial factor.

Ian Owens and John Cunningham [16] determined SOA specific critical success factors on a research project through empirical study. To externally validate the critical success factors extracted from their literature review, researchers explored project managers and executers in a large international defense-related organization which was executing service oriented systems. The CSFs specified in their study are as follow: governance, organizational change, business process modelling/management, implementation methodology, and re-use/leverage.

Koumaditis et al. [4][17] identified a various number of CSFs influencing SOA implementation by critically reviewing the literature and identify individual factors that may form CSFs for SOA implementation in healthcare sector. Moreover, researchers proposed a model of SOA CSFs in their study. The model emphasized in their study includes the following CSFs: alignment, clear goals form, complexity, cost, enforce decision, culture, experience, governance, long-term planning, measurement, maturity identification, project identification, resources, roadmap, roles, standards, team, testing, risk, top management support, and funding.

In a research Basias et al. [18] developed an initial conceptual framework to categorize and examine procedural, business, technical and human potential factors of adopting SOA in banking sector. Researchers identified 16 significant factors which may affect SOA adoption in electronic banking sector. The 16 possible influential factors are: “strategy, goal, financial benefits, return on investment, IT agility – business alignment, culture, communication, risk, management, resistance to change, IT infrastructure, security, fatigue, costs, stress, and staff (experience and training)” [18].

In 2014, a survey was conducted to emphasized the significant factors influencing SOA adoption in South Africa by MacLennan and Van Belle [19]. The authors proposed an SOA adoption model based on TOE framework and diffusion of innovations (DOI) theory. Moreover, they identified the following factors as significant factors during SOA implementation/adoption process: “complexity, cost, compatibility with the EA, multiple standards and platforms, top management support, adequate human and financial resources, governance and strategy, vendor support for integration and development tools” [19].

In the same year, Basias [20] analyzed the importance of adopting SOA benefits in banking sector. The research team tried to show and analyze e-banking and service oriented advantages. They suggested a conceptual framework and examine their framework in a European Bank and revise the framework by organizing

new results. The benefits mentioned in their study are: “financial benefits, agility, efficiency and flexibility of processes, IT agility – business alignment, higher return on investment, reduced time to Market, reduced costs, improved reusability of services, easier to integrate systems and reduced system downtime” [20].

A framework has been proposed regards to decision making issues by Basias and his partners [21] to adopt SOA successfully in e-banking through a Large American Bank case study. The case approves the significant of the effective factors in the research model to adopt SOA successfully in banking industry. The following factors are recognized as potential factors according to the findings of the case study: SOA best practices, strategy, clear goal, IT and vendor, common culture among business, perceived future prospect, talent, expertise, education and training, stress, fatigue, good collaboration and communication with vendor, vendor’s expertise, IT infrastructure, security, risk management, Return on Investment (ROI), costs, and SOA governance.

In another article, Themistocleous and his fellow teammates [22] investigated the necessity of electronic banking integration through adopting SOA. The research team believed that banks failure is mostly referred to the scarcity of a technological framework and to test the effective factors in adopting SOA. To fill this gap, they proposed a technological framework and examine it via two case studies in a transition and a developed economy. Themistocleous et al. emphasized the following factors as influential SOA adoption factors in e-banking industry: Performance (benefits, barriers, costs, external pressures, organizational culture), Human (fatigue, stress, skills, resistance to change, culture), Business (business alignment, communication, goal, strategy, risk, top management support), Technical (security, IT infrastructure, vendor support, SOA governance).

Yong Cen [23] provides a methodology to evaluate SOA implementation critical success factors to help managers for making proper SOA investment strategies. Through an extensive review of SOA articles fifteen CSFs related to SOA implementation are identified. The researcher used DEMATEL approach to formulate the structure of difficult causal relationships among the identified critical success factors and gain the effective level of these factors. The following factors are the significant success factors identified in Young Cen study: “deepening of enterprise-wide perception of SOA, long-term planning and step-by-step evolution planning with consideration of current capacity, enterprise-wide management support, project team, and standardization of business process, clear goal-setting based on business value, framing an organizational model for SOA management, fostering a partnership culture between business and IT, generating standard definitions of SOA technology, defining scope of technology application/security foundation, definition of SOA-based development methodology, strengthening business service-oriented design process, managing SOA policy processes, establishing a service development/ operation management process, risks management” [23].

A precise literature review was carried out by Koumaditis and Themistocleous [24] to examine SOA organizational studies in a public healthcare case study in Greek. The researchers emphasized the CSFs for implementing SOA to assist academic researchers to focus on the essential benefits of SOA organizational studies through implementing SOA. The CSFs stated in their research are as follow: “alignment, clear goals, complexity, cost, culture, experience and training, governance, project identification, risk, standards, team” [24]. The last reviewed article carried out a survey to investigate CSFs for implementing SOA in Big Data structure systems in India. The authors believed that the following factors are critical for implementing SOA in Big Data systems: “SOA migration strategy, potential of legacy systems, SOA governance, business process of an organization, and business plan for SOA migration” [25].

#### 4. Findings and Discussions

In this section, we are analyzing the findings of this systematic literature review. It is worth mentioning that “n” refers to a number of articles related to each analyzing parts. Table 3 is created to show the reference of articles based on their research design. According to our analysis, 15 articles used multiple case studies, 17 articles applied single case study, 13 articles used survey and 1 paper was employed filed study strategy. The rest of articles were reviewed papers (9 papers).

Table 3: Articles’ Reference Based On Data Collection Strategies

Research Design	Numbers	Reference of papers
Multiple Case Studies	15	[26], [27], [28], [29], [30], [31], [32], [33], [34], [22], [35], [36], [37], [12], [38]
Single Case Study	17	[39], [40], [11], [14], [15], [41], [17], [18], [20], [21], [24], [4], [42], [43], [44], [45], [46]
Survey	13	[47], [48], [49], [50], [51], [52], [53], [54], [16], [5], [25], [19], [55],
Field Study	1	[56]

According to Fig. 5. and Table 4, of the total number of primary studies, 44 articles explained about their research approach. The rest of articles (9 papers) were review papers and a paper did not mention its research approach. Based on this analysis, it could be concluded that most of the articles used qualitative approach for collecting data (51%) while 21 percent of papers used quantitative method and 11 percent of them used mixed method. It should be noted that mixed method is the combination of both qualitative and quantitative approaches.

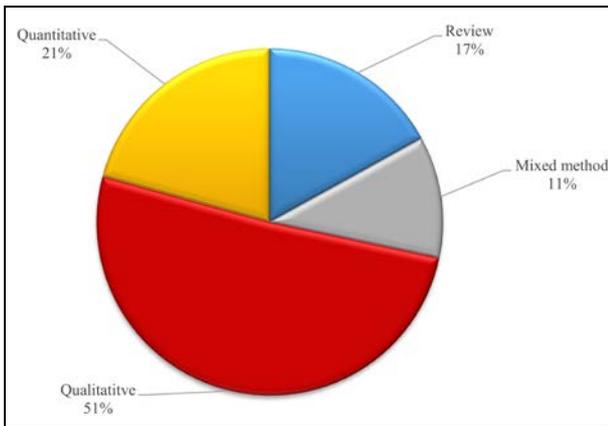


Fig. 5: The Research approach of primary studies (n=53)

Table 4: The research approach of primary studies

Research Approach	Numbers	Reference Of Papers
Mixed Method	6	[26], [33], [49], [38], [39], [40], [34], [22], [57], [36], [37], [27], [28], [30], [32], [21], [24], [42], [43], [44], [45], [46], [58], [15], [41], [17], [18], [20], [56], [29], [5], [11]
Qualitative	27	[47], [48], [50], [51], [25], [19], [52], [53], [16], [54], [55]
Quantitative	11	[13], [59], [60], [61], [62], [63], [23], [64], [65]
Review	9	

As is shown in Fig. 6., we have classified data collection tools into 6 groups, namely: questionnaire, interview, documentation, observation, literature review, and archival records. Based on this analysis, most researchers used interview (38%) to collect data in their studies. The next most used tools are questionnaire, literature review, observation, and documentation respectively 19%, 17%, 12%, and 10%. Only a few studies applied archival records for collecting data.

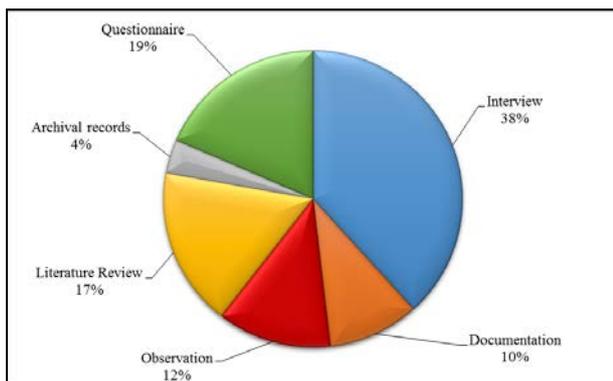


Fig. 6: analysis of data collection tools (n=43)

The data collection tools and their related primary studies are summarized in Table 5. Based on the finding of this part, 31 papers collected data by interviewing, 14 papers by reviewing literature, 14 papers by distributing questionnaires, 10 papers by observing, 8 papers by using documentations, and 3 papers by utilizing archival records.

Table 5: Primary studies based on data collection tools

Data Collection Tools	Numbers	Reference Of Papers
Interview	31	[27], [28], [29], [30], [11], [32], [41], [35], [26], [34], [18], [15], [20], [21], [33], [5], [47], [39], [66], [22], [17], [56], [49], [14], [4], [42], [43], [44], [45], [36], [37]
Documentation	8	[18], [15], [20], [21], [22], [17], [56], [4]
Observation	10	[18], [20], [33], [21], [22], [17], [56], [40], [4], [46]
Literature Review	14	[26], [34], [5], [66], [49], [16], [13], [59], [60], [61], [67], [63], [23], [68]
Archival Records	3	[18], [17], [4]
Questionnaire	14	[33], [47], [39], [49], [16], [48], [50], [52], [53], [54], [25], [19], [51], [55]

Table 6 presents theories and approaches that the primary studies of this systematic review are used. Diffusion of Innovations (DOI) [69] and Technology-Organization-Environment framework (TOE) [70] are two theories that are frequently used to investigate the acceptance of IT adoption in organizations[71]. In line with [71] as is shown in Table 6, two papers [19], [13] used both TOE and Innovation of diffusion theories together. Moreover, we identified that most studies used TOE framework for classifying SOA significant factors [27], [59], [68], [19], [13].

Table 6: Primary studies' theories and approaches

Theory/Approach	Reference Of Papers
TOE	[27], [59], [68], [19], [13]
Innovation Diffusion Theory	[13], [19]
SIMM- IBM	[47]
The Gartner Hype Cycle	[14]
Grounded Theory	[28], [29]
Methodology	
Evolution Process	
Framework- EPF4SOA	[31]
Punctuated Equilibrium	
Theory (PET)	[51]
Theory Building	[51]

Theory/Approach	Reference Of Papers
BEA Domain Model	[56]
CSF Scorecard	[41]
DEMATEL	[23]

To answer the second research question of this systematic literature review, we extracted all factors from primary studies. Since in literature review papers, the factors were not evaluated through case studies or surveys we excluded them from primary studies for extracting

SOA influential factors. Fig. 7. represents extracted factors which are mentioned more than 3 times in primary studies. It shows that SOA governance is the most controversial factors among researchers, since 21 papers mentioned it as influential factors in adopting/ implementing SOA. The next most influential factor based on primary studies is education and training (11 papers).

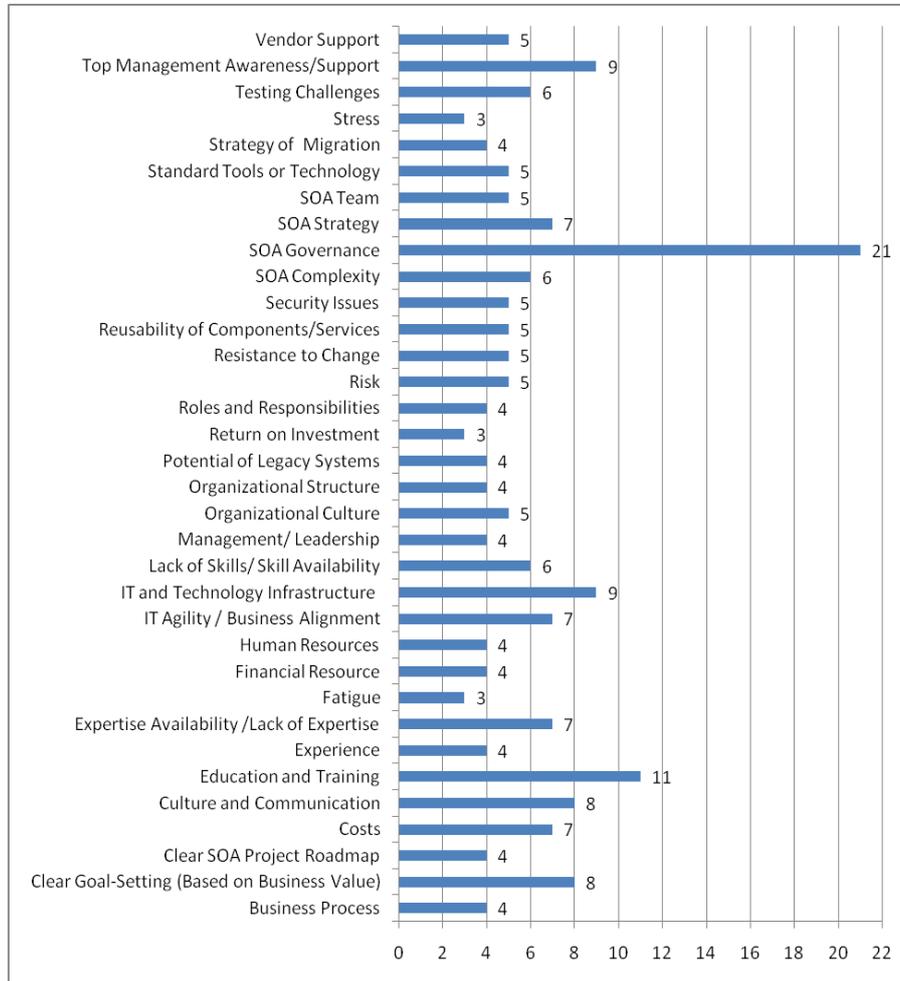


Fig. 7: Extracted factors

### 5. Conclusion

As far as we have aimed at doing our best in reviewing the related literature, we could conduct the first systematic background for the study which extracted all factors influencing SOA adoption/implementation during 2009-2017. It should be noticed, since this study is done during 2017 the authors cannot claim that this systematic review covers all publications in 2017. Through an extensive search, 55 papers were selected as primary studies in this survey. Due to lack of space, of the total number of factors (around 180), we analyzed 34 factors as the most important factors as these were repeatedly perused at least 3 times in previous studies. Among these factors, according to our analysis, SOA governance

appeared to be the most important factor in a way that it is cited 21 times as CSF or influential factor in adopting/implementing SOA. Moreover, based on our findings, researchers and experts in the banking sector are the most interested groups in conducting SOA survey. We also found out many researchers believed that using mixed method can explain research problem more comprehensible than using quantitative or qualitative methods singly [72]. Based on the findings of this study, most researchers used quantitative or qualitative methods in their study. So, there is a need to mix both methods for collecting and analyzing data as future work.

## References

- [1] R. L. Baskerville, M. Cavallari, K. H. Madsen, J. P. Heje, M. Sorrentino, and F. Virili, "The strategic value of SOA: a comparative case study in the banking sector," *Int. J. Inf. Technol. Manag.*, vol. 9, no. 1, p. 30, 2010.
- [2] C. Dierks-Ventling, A. L. Cone, and S. P. Bessman, "The attachment of glutamine synthetase to brain membranes.," *Biochem. Med.*, vol. 13, no. 3, pp. 213–23, Jul. 1975.
- [3] R. Hirschheim, R. Welke, and A. Schwarz, "Service – oriented architecture: myths, realities, and a maturity model," *MIS Q. Exec.*, pp. 37–48, 2010.
- [4] K. Koumaditis, M. Themistocleous, V. Mantzana, and K. Souliotis, "A Proposition of Critical Success Factors Influencing SOA Implementation in Healthcare," in *European Conference on Information Systems (ECIS)*, 2012.
- [5] S. Emadi and R. H. Hanza, "Critical Factors in the Effectiveness of Service-Oriented Architecture," *Adv. Comput. Sci. an Int. J.*, vol. 2, no. 3, pp. 26–30, 2013.
- [6] R. Khadka, A. Saeidi, A. Idu, J. Hage, and S. Jansen, "Legacy to SOA evolution: A systematic literature review," *Migrating Leg. Appl. Challenges Serv. Oriented Archit. Cloud Comput. Environ.*, no. March, pp. 40–70, 2012.
- [7] G. A. Lewis and D. B. Smith, "A Research Agenda for Service-Oriented Architecture ( SOA ): Maintenance and Evolution of Service-Oriented Systems," no. March, 2010.
- [8] M. Razavian and P. Lago, "A survey of SOA migration in industry," *Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes Bioinformatics)*, vol. 7084 LNCS, pp. 618–626, 2011.
- [9] M. Razavian and P. Lago, "Towards a conceptual framework for legacy to soa migration," *Serv. Comput. ICSOC/ServiceWave ...*, pp. 445–455, 2010.
- [10] B. Kitchenham, "Procedures for performing systematic reviews," *Keele, UK, Keele Univ.*, vol. 33, no. TR/SE-0401, p. 28, 2004.
- [11] J. Eckert, M. Bachhuber, A. Miede, A. Papageorgiou, and R. Steinmetz, "Readiness and maturity of service-oriented architectures in the German banking industry," *4th IEEE Int. Conf. Digit. Ecosyst. Technol.*, pp. 270–274, 2010.
- [12] A. Moeini, N. Modiri, and T. Azadi, "Service oriented architecture adoption management roadmap," *7th Int. Conf. Digit. Content, Multimed. Technol. its Appl.*, pp. 119–124, 2011.
- [13] C. Hu, "Main Factors Affecting the Adoption and Diffusion of Web Service Technology Standards," *Springer-Verlag Berlin Heidelb.*, pp. 81–87, 2011.
- [14] P. Trkman, A. Kovačič, and A. Popovič, "SOA adoption phases: A case study," *Bus. Inf. Syst. Eng.*, vol. 3, no. 4, pp. 211–220, 2011.
- [15] T.-M. Gronli and B. Bygstad, "A Successful Implementation of Service Oriented Architecture," *Adv. Inf. Netw. Appl. Work. (WAINA), 2012 26th Int. Conf.*, pp. 41–46, 2012.
- [16] I. Owens and J. Cunningham, "The Identification of Service Oriented Architecture-Specific Critical Success Factors," *6th Eur. Conf. Inf. Manag. Eval.*, pp. 267–273, 2012.
- [17] K. Koumaditis, M. Themistocleous, and P. R. Da Cunha, "SOA implementation critical success factors in healthcare," *J. Enterp. Inf. Manag.*, vol. 26, no. 4, pp. 343–362, 2013.
- [18] N. Basias, M. Themistocleous, and V. Morabito, "SOA adoption in e-banking," *J. Enterp. Inf. Manag.*, vol. 26, no. 6, pp. 719–739, 2013.
- [19] E. MacLennan and J. P. Van Belle, "Factors affecting the organizational adoption of service-oriented architecture (SOA)," *Inf. Syst. E-bus. Manag.*, vol. 12, no. 1, pp. 71–100, 2014.
- [20] N. Basias, "An Investigation of Benefits Affecting SOA Adoption in e-Banking," *Int. J. e-Education, e-Business, e-Management e-Learning*, vol. 4, no. 3, 2014.
- [21] N. Basias, M. Themistocleous, and V. Morabito, "A Decision Making Framework for SOA Adoption in e-Banking: A Case Study Approach," *J. Econ. Bus. Manag.*, vol. 3, no. 1, pp. 48–53, 2015.
- [22] M. Themistocleous, N. Basias, and V. Morabito, "A Framework for Service-oriented Architecture Adoption in e-Banking: the Case of Banks from a Transition and a Developed Economy," *Inf. Technol. Dev.*, vol. 21, no. 3, pp. 460–479, 2015.
- [23] Y. Cen, "Analysis of the Critical Success Factors of SOA Implementation in China Tobacco Company Based on DEMATEL Approach," in *International Conference on Automation, Mechanical Control and Computational Engineering (AMCCE 2015)*, 2015, no. Amcce, pp. 630–637.
- [24] K. Koumaditis and M. Themistocleous, "Organizational structures during SOA implementation: the case of a Greek healthcare organization," *Transform. Gov. People, Process Policy*, vol. 9, no. 3, pp. 263–285, 2015.
- [25] C. Annamalai and A. V. Ramani, "Critical Success Factors (CSFs) of Service- Oriented Architecture (SOA) in BIG DATA Systems," *Int. J. Res. Manag. Sci. Technol.*, vol. 3, no. 3, pp. 23–27, 2015.
- [26] J. P. Lawler, H. Howell-barber, V. Benedict, and A. Joseph, "Critical Success Factors in the Planning of a Service-Oriented Architecture ( SOA ) Strategy for Educators and Managers," *Inf. Syst. Educ. J.*, vol. 7, no. 94, p. 94, 2009.
- [27] A. P. Ciganek, M. N. Haines, and W. D. Haseman, "SERVICE-ORIENTED ARCHITECTURE ADOPTION : KEY FACTORS AND APPROACHES," *J. Inf.*

- Technol. Manag.*, vol. XX, no. 3, 2009.
- [28] J. Antikainen and S. Pekkola, "Factors influencing the alignment of SOA development with business objectives," *17th Eur. Conf. Inf. Syst.*, p. 2579–2590 ST–Factors influencing the alignment, 2009.
- [29] T. Kokko, J. Antikainen, and T. Systä, "Adopting SOA - Experiences from nine finnish organizations," *Proc. Eur. Conf. Softw. Maint. Reengineering, CSMR*, pp. 129–138, 2009.
- [30] 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," *Lect. Notes Bus. Inf. Process.*, vol. 23 LNBIP, pp. 94–107, 2009.
- [31] P. Bhallamudi and S. Tilley, "SOA migration case studies and lessons learned," in *2011 IEEE International Systems Conference*, 2011, pp. 123–128.
- [32] M. A. Manan and P. Hyland, "Enterprise SOA Implementation Readiness: a Case Study in Malaysia," *22nd Australas. Conf. Inf. Syst.*, pp. 1–11, 2011.
- [33] K. A. Nasr, H. Gross, and A. Van Deursen, "Realizing service migration in industry — lessons learned," *J. Softw. Evol. Process*, vol. 25, no. 6, pp. 639–661, 2011.
- [34] M. Galinium and N. Shahbaz, "Success factors model: Case studies in the migration of legacy systems to Service Oriented Architecture," *2012 Ninth Int. Conf. Comput. Sci. Softw. Eng.*, pp. 236–241, 2012.
- [35] M. Galinium and N. Shahbaz, "Case Studies: Business and Technical Perspectives in Migration of Legacy Systems to Service Oriented Architecture," *ECTI Trans. Comput. Inf. Technol.*, vol. 7, no. 2, 2014.
- [36] J. J. Du Plessis and G. Mwalemba, "Adoption of emerging technologies into ERP systems landscape: A South African study," *2016 IEEE Int. Conf. Emerg. Technol. Innov. Bus. Pract. Transform. Soc. EmergiTech 2016*, pp. 395–399, 2016.
- [37] R. R. Jr, "Interoperability Framework for Government E- Services of the Philippines Interoperability Framework for Government E-Services of the Philippines," 2017.
- [38] J. H. Lee, H.-J. Shim, and K. K. Kim, "Critical Success Factors in SOA Implementation: An Exploratory Study," *Inf. Syst. Manag.*, vol. 27, no. 2, pp. 123–145, 2010.
- [39] W. Vegter, "Critical success factors for a SOA implementation," 2009.
- [40] K. A. Nasr, H. G. Gross, and A. Van Deursen, "Adopting and evaluating service oriented architecture in industry," *Proc. Eur. Conf. Softw. Maint. Reengineering, CSMR*, pp. 11–20, 2010.
- [41] M. Abdul-Manan and P. Hyland, "A Framework for Assessing Enterprise-Wide SOA Implementation Readiness," *Int. J. Intell. Inf. Technol.*, vol. 9, no. 2, pp. 21–37, 2013.
- [42] V. Alkkioimäki and K. Smolander, "Anatomy of one service-oriented architecture implementation and reasons behind low service reuse," *Serv. Oriented Comput. Appl.*, vol. 10, no. 2, pp. 207–220, 2016.
- [43] V. Alkkioimäki, "The role of service-oriented architecture as a part of the business model," *Int. J. Bus. Inf. Syst.*, vol. 21, no. 3, pp. 368–387, 2016.
- [44] B. Alghamdi, L. E. Potter, and S. Drew, "Identifying best practices in organisational soa governance adoption: case study of saudi arabia's e-government programme," *Proceeding 20th Pacific Asia Conf. Inf. Syst. (PACIS 2016)*, pp. 1–15, 2016.
- [45] S. Pulparambil, Y. Baghdadi, A. Al-Hamdani, and M. Al-Badawi, "Exploring the main building blocks of SOA method: SOA maturity model perspective," *Serv. Oriented Comput. Appl.*, vol. 11, no. 2, pp. 217–232, 2017.
- [46] Y. F. Hernandez-Julio, M. A. J. Paba, N. E. L. Narvaez, H. M. Hernandez, and W. N. Bernal, "Framework for the development of Business intelligence using computational intelligence and service-oriented architecture," *2017 12th Iber. Conf. Inf. Syst. Technol.*, pp. 1–7, 2017.
- [47] H. L. Chang and C. P. Lue, "An exploratory study of risk factors for implementing service-oriented IS projects," *Lect. Notes Bus. Inf. Process.*, vol. 22 LNBIP, pp. 83–95, 2009.
- [48] W. F. Boh and D. M. Yellin, "Enablers and Benefits of Implementing Service-Oriented Architecture: An Empirical Investigation," *Int. J. Inf. Technol. Manag.*, vol. 9, no. 1, pp. 3–29, 2010.
- [49] K. Antlova, "Critical success factors for the implementation of ICT projects," *Commun. Comput. Inf. Sci.*, vol. 109 CCIS, no. PART 1, pp. 151–157, 2010.
- [50] S. Gerić, "The potential of service-oriented architectures," *Inf. Technol. Interfaces (ITI), 2010 32nd Int. Conf.*, pp. 471–476, 2010.
- [51] S. Aier, T. Bucher, and R. Winter, "Critical success factors of service orientation in information systems engineering: Derivation and empirical evaluation of a causal model," *Bus. Inf. Syst. Eng.*, vol. 3, no. 2, pp. 77–88, 2011.
- [52] M. Torchiano, M. Di Penta, F. Ricca, A. De Lucia, and F. Lanubile, "Migration of information systems in the Italian industry: A state of the practice survey," *Inf. Softw. Technol.*, vol. 53, no. 1, pp. 71–86, 2011.
- [53] M. Leotta, F. Ricca, M. Ribauda, G. Reggio, E. Astesiano, and T. Vernazza, "An exploratory survey on SOA knowledge, adoption and trend in the Italian industry," *Proc. IEEE Int. Symp. Web Syst. Evol. WSE*, no. SEPTEMBER 2012, pp. 21–30, 2012.
- [54] M. Leotta, F. Ricca, M. Ribauda, G. Reggio, E.

- Astesiano, and T. Vernazza, "SOA adoption in the Italian industry," *Proc. - Int. Conf. Softw. Eng.*, pp. 1441–1442, 2012.
- [55] W. F. Abbas, N. H. Musa, K. A. Kamaruddin, W. N. A. W. Hariri, and H. Haron, "Service Oriented Architecture adoption model for ICT office in Malaysia," *2017 Int. Conf. Res. Innov. Inf. Syst.*, pp. 1–6, 2017.
- [56] E. Hustad and L. Staverløkk, "Implementing a Service-Oriented Architecture: A Technochange Approach," in *Information Systems Development*, Springer Science+Business Media New York 2013, 2013, pp. 527–538.
- [57] M. Galinium and N. Shahbaz, "Case Studies : Business and Technical Perspectives in Migration of Legacy Systems to Service Oriented Architecture," pp. 135–145.
- [58] P. Trkman, A. Kovacic, and A. Popovic, "SOA Adoption Phases," *Bus. Inf. Syst. Eng.*, vol. 3, no. 4, pp. 211–220, 2011.
- [59] N. Joachim, "A Literature Review of Research on Service- Oriented Architectures ( SOA ): Characteristics , Adoption Determinants , Governance Mechanisms , and Business Impact," *Am. Conf. Inf. Syst.*, 2011.
- [60] A. Seth, A. R. Singla, and H. Aggarwal, "Service Oriented Architecture Adoption Trends: A Critical Survey," in *International Conference on Contemporary Computing*, 2012, pp. 164–175.
- [61] M. Sulong, A. Koronios, J. Gao, and A. Abdul-Aziz, "Driving the Initiative of Service-Oriented Architecture Implementation," *J. Softw. Syst. Dev.*, vol. 2012, pp. 1–10, 2012.
- [62] M. Waris, "Factors Effecting Service Oriented Architecture Implementation," in *Science and Information Conference (SAI)*, 2013, pp. 1–8.
- [63] N. A. Abu Bakar, H. Selamat, and M. N. Kama, "Service-Oriented Enterprise Architecture ( SoEA ) Adoption and Maturity Measurement Model: A Systematic Literature Review," *Int. J. Comput. Electr. Autom. Control Inf. Eng.*, vol. 7, no. 12, pp. 334–345, 2013.
- [64] N. Niknejad, I. Ghani, and A. R. Che Hussin, "Organizational factors affected by SOA adoption: A critical overview (2008-2013)," *J. Theor. Appl. Inf. Technol.*, vol. 64, no. 2, 2014.
- [65] N. Niknejad, I. Ghani, A. R. C. Hussin, and A. Saedi, "Proposing a new framework for service oriented architecture adoption," in *2016 3rd International Conference on Computer and Information Sciences (ICCOINS)*, 2016, pp. 148–152.
- [66] J. Erickson and K. Siau, "Critical Success Factors in SOA Implementation," in *Americas Conference on Information Systems (AMCIS)*, 2008, vol. 27, no. 2, pp. 123–145.
- [67] M. Waris, S. Ahmad Khan, and M. Zaman Fakhra, "Factors Effecting Service Oriented Architecture Implementation," *Sci. Inf. Conf.*, pp. 1–8, 2013.
- [68] N. Niknejad, I. Ghani, and A. R. C. Hussin, "Organizational Factors Affected by SOA Adoption A Critical Overview (2008-2013)," *J. Theor. Appl. Inf. Technol.*, vol. 64, no. 2, pp. 356–365, 2014.
- [69] E. M. Rogers, *Diffusion of innovations*, 4th ed. New York: The Free Press, 1995.
- [70] R. Depietro, E. Wiarda, and M. Fleischer, "The context for change: Organization, technology, and environment," in *The processes of technological innovation*, L. G. Tornatzky and Mitchell Fleischer, Eds. Lexington, Mass.: Lexington Books, 1990, pp. 151–175.
- [71] T. Oliveira and M. Martins, "Literature Review of Information Technology Adoption Models at Firm Level.," *Electron. J. Inf. ...*, vol. 14, no. 1, pp. 110–121, 2011.
- [72] J. W. Creswell, *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*, vol. 3. 2012.