

A Systematic Review of Enterprise Architecture Adoption Models

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Abstract

This article provides a systematic review of the Enterprise Architecture (EA) adoption model. Firstly, an analysis of the literature discussing the current EA adoption models was undertaken. The EA adoption models were reviewed to identify which adoption phase can be connected. This paper also discusses the limitations of the models. Based on the inclusion and exclusion criteria defined in the review process, 13 articles were reviewed. There are 13 different EA adoption models across the number of adoption phases which were selected from 13 articles. A total of 11 adoption models were designed for the post-adoption phase and applicable for the EA implementation phase and two (2) adoption models were formulated for adoption phase. This SLR reflected that there was relatively little research conducted in the adoption phase. Previous scholars had adopted one or a combination of different underpinning theories in their studies to identify the existing approach and perspective formulating EA adoption model. The finding also revealed the limitation of previous studies such as generalizability and fragmented perspective. Therefore, this review will provide further investigation into the potential development of EA adoption model at an early stage that could provide wide-ranging and rational views of business, information, and technology for the organisation.

Keywords: Adoption Model; Business and Technology; Enterprise Architecture; Systematic Review

1. Introduction

Enterprise Architecture (EA) imparts a holistic outlook of organisational business strategies, Information Technology (IT) initiatives as well as the supporting environments to accomplish organisational goals to support organisation efficiency and effectiveness. EA is perceived as the tool to align between business requirements and IT delivery in an organisation. EA had evolved in the early 1990s and gained attention from both academia and practitioners [1, 2]. Hence, various definitions of EA are found. EA acts as a management tool between business and IT strategies, whereby facilitating the evolution to higher level capabilities at the organisation level [3, 4] and managing changes from current state to future state [5, 6]. EA provides governance and a roadmap for business and IT alignment as well as an investment [7]. These definitions are used in different scopes and purposes. Other researchers claimed that various definitions found in the literature did not clearly stated the enterprise objectives and results such as market agility [8]. The term EA is suggested based on its beliefs which are enterprise IT architecting, enterprise integrating, and enterprise ecological adaptation [8]. However, this variation of definition allows enterprises or organisations to move to all-inclusive ways of thinking and the purpose of EA in the organisation. Indeed, EA helps the organisation in designing their various organisation facets such as business, data, application, and information to achieve organisational goal. Hence, EA

adoption is beneficial to organisations in promoting better decision-making.

The process of adopting EA is still uncertain in the organisation and as a result, this contributed to the low adoption rate of EA and acceptance resistance by organisations [9-11]. The Computer, Economic Report stated that EA is still not widely embraced, as in 2016 only 53% of IT organisations practice EA compared to its previous year at 59% [10]. According to Tom Dunlap, research director for Computer Economics, an IT research firm based in Irvine, Calif:

“Adoption requires business and IT leaders to agree on an enterprise architecture that aligns strategy with the IT infrastructure and capabilities. And that type of agreement can often be difficult to accomplish or maintain over time. While growth is possible, widespread adoption is probably a long way off [10].”

Enterprise Architecture is a time-sensitive process that requires an agreement between business and IT people for gaining mutual understanding and decision. This agreement requires a long-term commitment and maintenance over time. Hence, these may influence the declining EA adoption.

The process of adoption is divided into three (3) phases namely; pre-adoption, adoption and post-adoption [12]. Most previous researchers who studied EA adoption during the stage of post-adoption [1, 2, 13-15], and very limited studies on EA adoption at an early stage of adoption phase which is pre-adoption and adoption[6]. A specific study on EA adoption claimed that it is critical to understand and establish EA at the early stage of

adoption for organisational readiness [2]. Organisational readiness includes overcoming resistance to change, identifying and influencing stakeholders, encouraging collaboration and participation, and disclosing discrepancies between current and desired state [16]. Hence, the lack of study in EA at the early stage of pre-adoption and adoption may cause resistance to change and poor decision-making. This drives for further investigation of EA adoption model at an early stage of adoption.

This paper aims to identify the existing EA adoption models, adoption phase, the theory used and the limitation of the existing EA adoption models. In order to make this review more understandable, this paper incorporates three adoption phases namely; pre-adoption, adoption, and post-adoption as the scope for this review focuses on EA adoption model only. The articles were reviewed in the peer-review journal, theses and conferences to gain verified quality of research that are well-addressed. The remainder of the paper is organized as follows; literature review, review method, results and discussion, and conclusion.

2. Literature Review

This section reviews existing research on the adoption phase and EA cycles.

2.1. The Adoption Phase

The processes of adoption are classified into different perspectives as shown in Table 1.

Table 1: Phase of the Adoption process from different perspectives

Adoption process	Source(s)
Evaluation, Initiation, Implementation, and Routinization	[17]
Awareness, Selection, Adoption, Implementation, and Routinization	[18]
Knowledge Awareness, Attitudes Formation, Decision, Initial Implementation, and Sustained Implementation	[19]
Initiation, Development, Implementation, and Termination	[20]

Although there are different scholars that had categorized the adoption process from different perspectives, similarities are found. These similarities are grouped into three widely adoption phases namely; pre-adoption, adoption and post-adoption [12]. These phases also often referred to initiation, adoption, or decision and implementation [21].

The pre-adoption or initiation includes the following activities: recognizing a requirement; examining for solutions; awareness of existing innovations; identifying suitable new ideas and suggesting some for adoption [21, 22]. According to Meyer and Goes [23], organisational members are aware of the existence of new ideas, deliberate in its appropriateness, communicate and propose its adoption for the organisation. Hassinger [24] has a different view that the initial stage of the adoption process consists of awareness, interest, and evaluation. At the initial stage, the individual has little knowledge and learns new ideas, starts to develop curiosity in the new ideas and searches for more information about the new ideas [24]. Based on these facts, it is consistent with the perspective of the adoption process from previous scholars which are evaluation, initiation, awareness, selection knowledge awareness, and attitudes formation [17-20].

The adoption or decision refers to assessing new ideas from technical, financial and strategic perspectives. Then, the top management decides to accept these new ideas and allocate resources for its adoption [23]. In this phase, the top management such as directors, working groups, and boards have the power to make a decision. While other views had mentioned that at the adoption phase, the individual does an evaluation on its own condition and spreads over the new idea or approach on a small scale or pilot test [24]. This situation refers to two activities which are evaluation and trial [24], referring to the perspective of the

adoption process from other scholars presented in Table 1 which includes adoption, decision, and development [18-20]

The post-adoption or implementation includes the following events or activities: altering the innovation; preparing the usage for the organisation; pilot use; organisational users acceptance; and sustained of the innovation until it becomes a routine and practice of the organisation [21-23]. In this phase, the innovation becomes a routine among organisational members, clients or customers. Others claim that this phase is an acceptance of the new idea that brings the individual to a sustained practice [24]. Based on these facts, it is consistent with the perspective of the adoption process from previous scholars which are implementation, routinization, initial implementation, sustained implementation, and termination [17-20].

2.2. EA Cycle

The cycles of EA establishment includes several phases and process, as stated by Christiansen and Gotze [25] where there are three phases involved. A.Bakar, et al. [26] further enhanced these phases by incorporating seven (7) processes and grouped into three (3) phases. Phase 1 is a process of establishing the EA. This phase includes the process namely; initiate, plan, analyze and assess, design and develop, and implement processes. Meanwhile, in Phase 2 is the establishment of EA including the maintenance process. Phase 3 is the use of the EA that provides the operations of review. Fig. 1 shows the EA cycle mentioned.

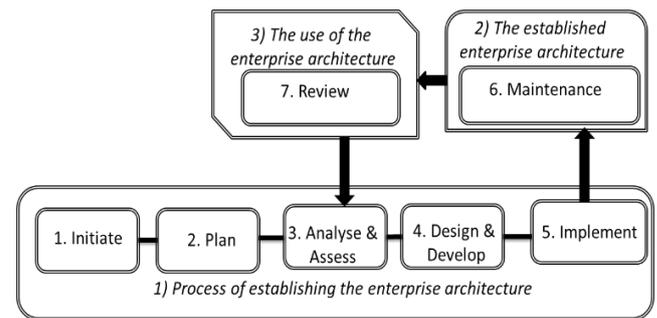


Fig. 1: EA cycles [26]

As such, it can be seen that the pre-adoption and adoption fall under Phase 1 of the EA cycle which is the process of establishing the EA. Therefore, it is necessary that this paper will further investigate studies relating to the EA adoption models. The findings will highlight the current EA adoption model, adoption phases, theory as well as to analyse the limitation of the models. It is also expected that this knowledge will generate fresh insight into developing a new EA adoption model in a different context.

3. Review Method

Systematic Literature Review (SLR) is a primary study that encompasses secondary study and individual studies. This paper adopts SLR guidelines by Barbara Kitchenham [27] to identify and review the current evidence relating to factors towards EA adoption. According to Barbara Kitchenham [27], the guidelines consist of three (3) main phases. The first phase is planning a review that includes 3 mandatory stages: the identification of the need for a review; specifying the research question(s) and developing a review protocol. The second phase is conducting the review which involves identification of research, selection of primary studies, study quality assessment, data extraction and monitoring, and data synthesis. Lastly, the final phase is reporting the review that covers stages of specifying dissemination mechanisms and formatting of the main report. The main phases of SLR is presented in Fig 2.

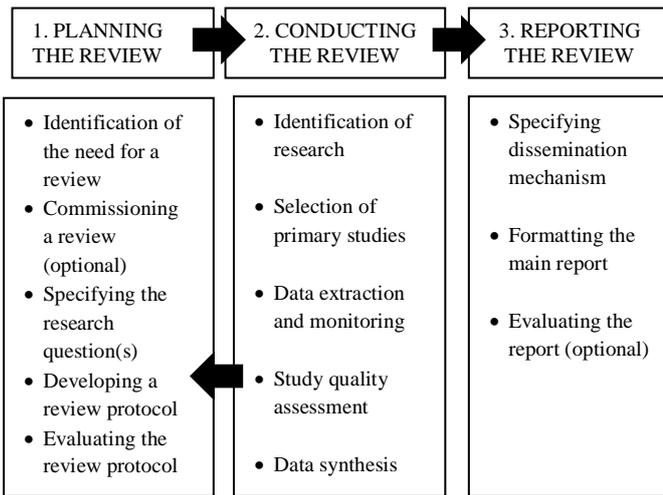


Fig 2: The three main phases and stages of SLR guidelines

3.1. Planning the Review

This paper follows the criteria suggested by Barbara Kitchenham [27] in designing SLR questions. Table 2 shows the criteria and scope of research questions structure.

Table 2: Criteria and scope of research questions structure

Criteria	Scope
Population	EA adoption models in organisations
Intervention	Limitation of the current EA adoption models
Comparison	Applicability of the current models according to adoption phases
Outcomes	List of EA adoption model
Context	Review of any studies on EA adoption models

The research questions are thus formulated grounded in the research structure as shown in Table 2.

1. What are the current EA adoption models available?
2. Which adoption phases can be connected with EA adoption models acknowledged?
3. What are the underpinning theories of each EA adoption models acknowledged?
4. What are the limitations of current EA adoption models?

3.1.1. Data Sources

In this study, published articles were reviewed from six (6) online scientific databases that have indexed "Enterprise Architecture" or "Information Technology Architecture" and have provided full-text access to relevant publications. The online databases comprised of the Science Direct, Springer Link, IEEEExplore, AISel, EBSCOhost, and online thesis.

Table 3: Categories of document review procedure

Categories	Details
Keywords	Enterprise Architecture Adoption Model
Search engines	Google, Google Scholar
Databases	Science Direct, Springer Link, IEEEExplore, AISel, EBSCOhost, online thesis
Document types	Journals, Conference, Theses, Dissertation, and Books

3.2. Conducting the Review

Search terms comprised of the following combinations; 'enterprise architecture', 'adoption', 'model', 'enterprise architecture adoption model', 'enterprise architecture adoption'. The search string is then assembled using Boolean connectors "AND" and "OR" to allow synonyms and word class variations of each keyword. The search string was fulfilled in the online database to titles, abstracts, and

metadata, assuming that these offer a short outline of the work. The sources of papers are selected based on inclusion criteria defined above from journals, conference, theses, dissertation, and books. The criteria comprised of articles in English from journals, conference, theses, dissertation, and books that fit the research questions. Articles that were not written in English and mismatched the inclusion criteria were excluded.

4. Results and Discussions

The articles were searched using predefined keywords. From the Google Scholar search engine, 176 hits concerning EA from various sources were identified. Of these, only 50 were possibly relevant to the filtering of titles and abstracts. However, while searching specifically for EA adoption models, only 13 relevant sources (26 percent of 50 studies) were revealed. Fig 3 shows the process flow of SLR. These 13 studies were then classified based on SLR questions which include the adoption model name, adoption phases, underpinning theories, and limitation. Table 4 presents the existing adoption models.

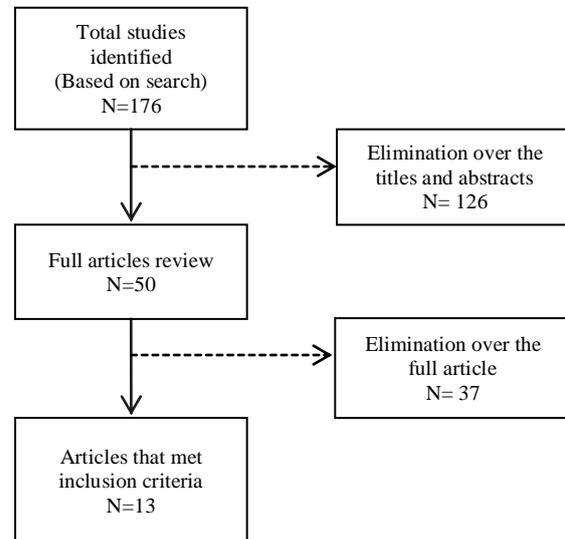


Fig 3: SLR process flow

The article started with determining the requirements for the systematic literature review. The aim of this article is to identify current EA adoption models and which adoption phase can be connected. This paper also discusses the limitation of the models. The discussion of findings is presented in Table 4 and reported based on the corresponding research questions as follows:

RQ1: What are the current EA adoption models available?

There is a total of 13 EA adoption that currently exists, such as a 3D model [2], an improved EA Adoption Method (EAAM) [28], the framework for analysing change and influence the EA programs and their institutionalisation [29], the model of resistance during EA adoption process (REAP) [30], Knowledge Relationship Model of Enterprise Architecture and Top Management Roles [14]. Table 4 presents the overview of the related literature and existing adoption models.

It is evident that previous studies had investigated and analysed the topic from fragmented contexts. For example, some researchers investigated EA adoption from the context of organisational pressure such as government regulations, mandate or politics, whereas others from the context of the organisational environment such as lack of top management support. Previous studies also proposed a model to avoid application duplication problem [15] and to recognize the diversity of different adoption projects of EA [2]. Other studies suggested an integrated model of

IT assets, roles, responsibility and IT spend focusing only on social and technical impact [13]. This model is only applicable for organisations which had implemented the Australian Government Architecture (AGA) Reference Framework.

On the other hand, the Enterprise Architecture Adoption Method (EAAM) was proposed to reduce the resistance in the EA adoption process affected by the deficiency of understanding EA concepts [28]. Furthermore, the proposed models are applicable to a specific context or line of business such as Finnish Higher Educational Institutions (HEIs) and Norwegian Higher Education sectors. However, these entire models as presented in Table 4 are formulated based on different perspectives and issues such as social, organisational change and technical impact. As such, other problems or issues are needed to be undertaken too.

RQ2: Which adoption phases can be connected with EA adoption models acknowledged?

The analysis of the result reflected articles from various adoption processes. These identified EA adoption models are grouped into three (3) adoption phase as proposed in section 2. From the result shown in Table 4, a sum of 11 existing EA adoption models is focussed in the post-adoption phase. At this stage, EA adoption models were also designated mainly in EA implementation process followed by EA development and maintenance.

On the other hand, two (2) studies were in the stage of adoption phase. These models were proposed for EA planning. None of these studies had focussed on the pre-adoption phase. Overall previous studies have put much attention only a post-adoption phase and applicable for EA implementation.

RQ3: What are the underpinning theories of each EA adoption models acknowledged?

The review identified the system theory, the complex idealism, contingency theory, the grounded theory, Critical success factor

(CSF), an organisation and management theory, organisational change and change resistance theory, acceptance model and theory, Gartner's activity cycle, institutional theory, the Balanced Scorecard (BSC), a Configurable Process Model (CPM), and the Balanced Scorecard (BSC).

Previous scholars used one or a combination of different theories as the underpinning theory or model used in their studies. The logic argument could be inferred that the combination of different theories can give a different perspective and approach on the research process, resulting in factors that influenced EA adoption. It can thus be inferred that the combination of different theories not only give a different perspective on the research process but also contribute to the body of knowledge on the topic studied.

RQ4: What are the limitations of current EA adoption models?

The last SLR Research Question is on the limitation of existing EA adoption models. From the result shown in Table 4, it is apparent that each paper revealed the limitation of existing studies that need to be investigated further. Many studies have given much attention during the post-adoption process and EA implementation phase [1, 13, 14, 30]. The model or framework proposed by the previous researcher is limited to factors from a single or two contexts such as environmental and organisational context, or technological context [2, 13, 28-30]. On the other hand, the model is analysed and formulated in a different research design such as a case study and interviews to gain influential factors of EA adoption [1, 26, 31]. The generalizability of EA adoption research is an issue.

As such, this scenario indicated that there are 2 main limitations of existing EA adoption models. Although the number of studies had increased from 2010, there is a lack of EA adoption models from the wide-ranging perspectives. Furthermore, these models were developed and applied for the post-adoption phase and EA implementation process which is the late stage of EA establishment phase 1.

Table 4: Existing EA adoption models

Year	Adoption phase	EA phase	Adoption method name	Theory	Limitation
2010 [13]	Post-adoption	Implementation	An integrated model of IT assets linked to roles, responsibility, and IT spend	System theory and Complex Idealism	Focused on Social and technical impact. Only applicable to those implementing The Australian Government Architecture (AGA) reference framework
2012 [1]	Post-adoption	Development	Analysis framework that contains exhaustive dimensions for analysing EAM designs and considering context-dependent EAM adoption	Contingency theory	An analysis of the framework contains an exhaustive dimension from EA phases, and too broad. This can lead to a lack of observation while conducting a case study and semi-structured interview. The framework complements governance, architecture paradigms, or core applications when adoption EAM. This study focused on EA planning and EA development
2012 [15]	Post-adoption	Implementation	The Critical Success Factor (CSF) leading to successful EA implementation	Own algorithm	The critical success factor is influencing EA adoption of EA governance only. This study gives a solution to avoid application duplication problem
2014 [2]	Post-adoption	Implementation	A 3D model of CSFs of EA introduction for public organisations	The grounded theory. Critical success factor (CSF)	The detailed content of the CSF is specific to an organisational environment. The 3D model is formulated to recognize the diversity of different adoption projects
2015 [28]	Adoption	Planning	An improved EA Adoption Method (EAAM)	Organisation and management	Its purpose is to reduce the resistance in the EA adoption process affected by the deficiency of understanding of EA concepts. As such, other problems need to be addressed
2015 [30]	Post-adoption	Planning and execution	The model of resistance during EA adoption process (REAP)	Organisational Change and Change resistance	Focused only on dynamic organisational change and absent from a technology perspective.
2015	Adoption	Planning	Work level	Acceptance model and	Focused on individual human elements.

Year	Adoption phase	EA phase	Adoption method name	Theory	Limitation
[6]			classification of human factors related to EA acceptance	theory	The factors formulated are based on majority responses from different profitable entities
2015 [14]	Post-adoption	Maintenance	Knowledge Relationship Model of Enterprise Architecture and Top Management Roles	Gartner's activity cycle	The analysis is focused on the areas that are linked only to the role of top management and roles of the EA function to support assimilation. The model focuses on developing a universally applicable EA knowledge
2016 [32]	Post-adoption	Implementation	Not mentioned	Not mentioned	This case explores the implementation of enterprise architecture (EA) in the Norwegian HE sector
2016 [29]	Post-adoption	Implementation	Framework for analysing change and influence the EA programs and their institutionalization	Institutional theory	Focused on the environmental context which is external pressure (normative, coercive and mimetic)
2016 [26]	Post-adoption	Implementation	A balanced scorecard to identify the challenges occurs during EA development and implementation process in the public sector agencies	Balanced scorecard (BSC)	Focused on the challenge that has possibly influenced the successful EA development and implementation in an organisation. No solution mentioned. The framework designed for EA development and implementation assessment mechanism
2016 [33]	Post-adoption	Implementation	The Critical Success Factor (CSF)	Configurable Process Model (CPM) and Balanced Scorecard (BSC)	The critical success factors are impacting the implementation process only for one case study in the Ministry of Health Malaysia
2017 [34]	Post-adoption	Implementation	Institutional pillars in solving their EA deployment challenges	Institutional theory	The solution is applicable to challenges related to the organisation, the EA team, EA user and EA concept

5. Conclusion

This review has identified that the number of studies in this area is increasing from the year 2010. Different names of the model have been proposed from various factors and fragmented perspectives. Besides, overall studies have put much attention on post-adoption process and EA implementation phase. Previous scholars used one or combination of different theories to identify the existing approach and perspective for formulating EA adoption model. These models will give the information in understanding perspectives of EA adoption that need to be undertaken by the organisation.

However, most of the current adoption models are applicable for post-adoption phase. These models also focus only during the late process of phase 1 of the EA cycle which is implementation. Therefore, it is obvious that there is an absence of EA adoption models during the adoption phase and early process of establishing the EA. Furthermore, previous researchers had identified and analysed the topic from a fragmented perspective, for example, in the context of organisational pressure, individual human, technology, and organisational environment.

Realising all the discussions within the SLR were undertaken by this researcher, not much studies were emphasized during the stage of the adoption phase. Currently, EA adoption model was also being emphasized in EA implementation. Notwithstanding these limitations, the researcher will further be investigating the possible development of EA adoption model during the adoption phase and early phase of the EA cycle. This can provide wide-ranging and rational views of business, information, and technology for the organisation.

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