A Systematic Review of Enterprise Architecture Assessment Models

Nur Azaliah A.Bakar[1], Harihodin S.[2] and Nazri Kama[3]

Advanced Informatics School (AIS), Universiti Teknologi Malaysia, Kuala Lumpur, Malaysia

[1]nazaliah2@live.utm.my, [2]harihodin@ic.utm.my, [3]mdnazri@utm.my

Keywords: Enterprise Architecture; Assessment Model; Systematic Review

Abstract. This article provides a systematic review of Enterprise Architecture (EA) assessment model. The review main goal is to identify the existing EA assessment models and to categorise the models according to EA phases as well as to analyse the models limitation. The review result shows that there are 16 EA assessment models proposed across both industry and academic areas that fit in three EA phases mentioned.

Introduction

Enterprise Architecture (EA) is a tool for strategic management, which helps in unifying business process development with Information Technology (IT). EA is a hierarchical approach for aligning business and IT; and it describes how the information systems, processes, organisational units and people in an organisation function as a whole [1-3]. EA analyses an organisation 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.

Bullen and Rockart [4] stated that it is important to measure the performance status in the defined key area on a continual basis. It is predicted that EA will has high quality if it is understood, accepted, used and measured accordingly [5]. Measurement makes it possible to assess the EA value, efficiency and stakeholder satisfaction [6]. However studies shown only few EA assessment or measurement mechanisms exist [7, 8]. Hence the lack of study in EA assessment may cause the delay or failure in any EA program.

Therefore, the purpose of this study is to identify the existing EA assessment models. The models will be categorised according to EA phases defined by Christiansen and Gotze [9], which are 1) the process of establishing the enterprise architecture, 2) the established enterprise architecture, and 3) the use of the enterprise architecture. There are five processes in phase 1 which are initiate, plan, analyse and assess, design and develop and implement. Meanwhile in phase 2 and 3, both involves one process each which are maintenance and review. The phases are depicted in Fig 1.
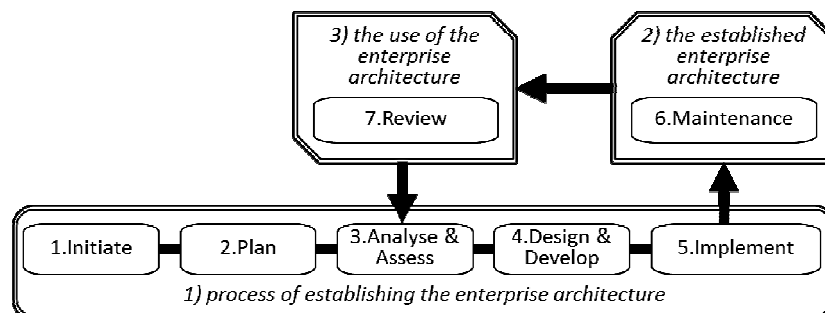

Fig. 1. EA establishment phases and processes

In this systematic review, the contextual limitation is set to research that focus on the EA assessment or measurement models only. The researcher utilise research of verified quality, which means that only articles in peer-review journals and from reputable conferences shall be addressed. The remaining sections are as follows; review method, findings, discussion and conclusion.

Review Method

This section will explain the processes of Systematic Literature Review (SLR) based on the guidelines by Kitchenham and Charters [10], and Okoli and Schabram [11]. It comprises of six subsections which are; SLR questions, data sources, search strategy, study selection, and inclusion and exclusion criteria.

The SLR guideline consists of three main phases which are planning the review, conducting the review and reporting the review phase. The review planning phase involves three mandatory stages; 1) identification of the need for a review, 2) specifying the research question(s) and 3) developing and evaluating a review protocol. The second phase is conducting the review with five stages associated with it. This phase consists of 1) identification of research; 2) selection of primary studies; 3) data extraction & monitoring; 4) study quality assessment and 5) data synthesis. Lastly, the final phase is reporting the review with two mandatory stages; 1) specifying dissemination mechanisms and 2) formatting the main report. Fig.2 describes the phases in detail.
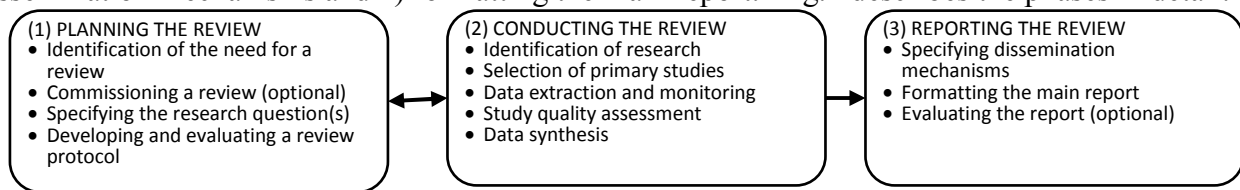


```
(1) PLANNING THE REVIEW
• Identification of the need for a
  review
• Commissioning a review (optional)
• Specifying the research question(s)
• Developing and evaluating a review
  protocol
```
```
(2) CONDUCTING THE REVIEW
• Identification of research
• Selection of primary studies
• Data extraction and monitoring
• Study quality assessment
• Data synthesis
```
```
(3) REPORTING THE REVIEW
• Specifying dissemination
  mechanisms
• Formatting the main report
• Evaluating the report (optional)
```

Fig. 2. Systematic literature review phases and stages

SLR Questions. To design the SLR questions, the researcher follows the criteria by Petticrew and Roberts [12]. Table 1 shows the criteria and scope of research question structure.

Table 1. Criteria and scope of research question structure

Criteria	Scope
Population	EA assessment and measurement models from both academic and industry
Intervention	Limitation of the existing EA assessment and measurement models
Comparison	Applicability of the models according to EA phases
Outcomes	List of EA assessment and measurement models
Context	Review of any studies on EA assessment and measurement models

Based on the research question structure as shown in Table 1, the SLR questions are:
1. What are the existing EA assessments and measurement models available?
2. Which EA phases can be associated with EA assessment and measurement models identified?
3. What are underlying the theories of each EA assessment and measurement models identified?
4. What are the limitation of the existing EA assessment and measurement models?

Data Sources. The selection of online databases was based on databases that indexed "Enterprise Architecture" or "Information Technology Architecture" studies from the available online databases subscribed by the University Teknologi Malaysia's library. The research involved ten online databases as data sources which are ACM Digital Library, Australian Digital Thesis (ADT), Emerald, EthOS (UK Thesis), IEEEXplore Digital Library, ProQuest (USA Thesis), SpringerLink, Taylor & Francis, Web of Knowledge and Google Scholar.

Search Strategy. The initial search string are (*enterprise architecture*),(*information technology architecture*),(*assessment*),(*measurement*),(*model*),(*tool*) and (*mechanism*). The search string is then constructed using Boolean "AND" and Boolean "OR" to allow synonyms and word class variants of each keyword. The search string was executed in the digital libraries based on titles, abstracts and metadata, assuming that these provide a concise summary of the work.

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.

Inclusion and Exclusion Criteria. This review targeted peer reviewed articles on published between January 1, 2005 and March 31, 2014. Only articles in English were included. The search included articles that meet the research questions stated. Articles that are not written in English and did not match the inclusion criteria were excluded.

Findings

The initial phase of the search process identified 497 studies using the search term defined. Of these, only 43 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, 16 studies (37 per cent of 43 studies) were accepted for the synthesis of evidence after a detailed assessment of abstracts and full text and exclusion of duplicates. From the literature selection process, the answers for SLR questions as stated earlier are presented in Table 2.

Table 2. Existing EA assessment and measurement models

Article ID	Year	Creator/ Origin	Assessment Method Name	EA Phase Applicability	Theory	Limitation of the Models
A1[13]	2013	Andrzej Sobczak	Methods of the Assessment of Enterprise Architecture Practice Maturity in an Organization	Phase 7:Review	Own TOPAZ (based on TOGAF & CMMI)	Analysis of effectiveness of architecture processes and quality of architecture deliverables only
A2[14]	2012	Lange, Mendling, Recker	A comprehensive EA benefit realization model	Phase 7:Review	DeLone & McLean IS success model	Focused on the domain of EA only, do not consider organisational and political problems exist internally
A3[15]	2012	Meyer et al.	Enterprise Architecture Business Value Assessments	Phase 7:Review	Design Science Research (DSR)	High level inspection and assessment scope too broad
A4[16]	2012	Weiss and Winter	Measurement Items for the Institutionalization of EAM	Phase 4:Design & Development	Institutional theory	Measurement items base on EA Management design only
A5[17]	2012	Pruijt, Leo Slot, Raymond Plessius, Henk Bos, Rik Brinkkemper, Sjaak	The Enterprise Architecture Realization Scorecard: A Result Oriented Assessment Instrument	Phase 6:Maintenance	CobiT, TOGAF	Focus on realization process of an EA management function only
A6[18]	2010	Van der Raadt et al.,	EA effectiveness measurement model	Phase 7:Review	Standard CMMI Appraisal Method for Process Improvement (SCAMPI)	Scope only focus on measure EA effectiveness and stakeholder satisfaction to get a complete picture of the performance of the EA function
A7[19]	2010	Jahani et al	Measurement of enterprise architecture readiness within organizations	Phase 3:Analyse & Asses	Own algorithm to assess readiness level	Model is used to assess the EA readiness of the organizations only
A8[20]	2009	Velitchkov	Enterprise Architecture Metrics in the Balanced Scorecard for IT	Phase 6:Maintenance Phase 7:Review	Balanced Scorecard	Focus on technology assessment, lack of business assessment
A9[21]	2009	Prakash et al.,	Measurement of Public Value of Enterprise Applications	Phase 7:Review	Based on consolidated existing EA value	Measure on the public value of EA only
A10[22]	2009	Kamogawa and Okada	Return on Enterprise Architecture	Phase 7:Review	Own methodology	May be difficult to understand b others due to own methodology
A11[23]	2008	Katja Liimatainen, Jukka Heikkilä and Ville Seppänen	Framework for evaluating program initiative's compliance with GEA	Phase 3:Analyse & Assess Phase 4:Design & Development	Quality assurance and Interoperability mechanism	Incur more cost
A12[24]	2007	Schelp, J., Stutz, M	A Balanced Scorecard Approach to Measure the Value of Enterprise	Phase 6: Maintenance	Balanced Scorecard	Only assess the value contribution of the EA
A13[25, 26]	2006	Schekkerman,	Enterprise Architecture Score Card	Phase 3:Analyse Phase 4:Design & Development	Extended Enterprise Architecture Framework (E2AF)	Only applicable to those who implement Extended Enterprise Architecture Framework (E2AF)

Article ID	Year	Creator/ Origin	Assessment Method Name	EA Phase Applicability	Theory	Limitation of the Models
A14[6]	2004	Vasconcelos et al.	Information System Architecture (ISA) Evaluation and IS/Business Alignment Measurement	Phase 3:Analysis	Own algorithm	Focus on IT and Business alignment only, not design for end user used
A15[27]	2003	National Association of State Chief Information Officers (NASCIO)	NASCIO Enterprise Architecture Maturity Model	Phase 6:Maintenance Phase 7:Review	Capability Maturity Model Integration (CMMI)	Best to perform review after a year of EA in practice
A16[28]	2001	Office of Management and Budget (OMB), US	Enterprise Architecture Assessment Framework (EAAF)	Phase 5:Implement Phase 6:Maintenance Phase7:Review	Federated Enterprise Architecture (FEA)	Only applicable to those who implement Federated Enterprise Architecture (FEA) in US

Conclusion

From the review of EA assessment models, it can be concluded that there is gaining research interest in this area. Starting from year 2010, there are increasing numbers of models proposed by academic researchers. These EA assessment models will guide EA project team in selecting, collecting, defining, analysing, and reporting specific EA issues. However most of the existing assessment models only applicable for the EA establishment phase 2 and 3. The models also focus on assessing the EA value and closely tied to EA product. Therefore it neglects the aspect of assessment during early establishment process of EA and the idea of platform-free models. This concludes that, currently the EA planning, management and evaluation mechanism are not being emphasised in EA establishment process. Realising this gap, for future research the researcher will focus on investigating the potential development of EA assessment model during the early phase of EA establishment.

Acknowledgements

References

[1]   H. A. F. Fernández, "Enterprise Architecture Review," Vínculos, vol. 7, pp. 58-69, 2013.
[2]   K. Hjort-Madsen, "Architecting Government: Understanding Enterprise Architecture Adoption in the Public Sector," IT-Universitetet i KøbenhavnIT-Universitetet i København, 2009.
[3]   H. Wan, B. Johansson, X. Luo, and S. Carlsson, "Realization of Enterprise Architecture (EA) Benefits," in Practice-Driven Research on Enterprise Transformation, ed: Springer, 2013, pp. 92-105.
[4]   C. V. Bullen and J. F. Rockart, "A primer on critical success factors," Massachusetts Institute of Technology (MIT), Sloan School of Management 1981.
[5]   T. Ylimäki, "Potential critical success factors for enterprise architecture," Evaluation of enterprise and software architectures, 2008.
[6]   A. Vasconcelos, C. M. Pereira, P. M. A. Sousa, and J. M. Tribolet, "Open Issues on Information System Architecture Research Domain: The Vision," in ICEIS (3), 2004, pp. 273-282.
[7]   J. W. Ross, P. Weill, and D. C. Robertson, Enterprise architecture as strategy: Creating a foundation for business execution: Harvard Business Press, 2006.
[8]   A. Ojo, T. Janowski, and E. Estevez, "Improving Government Enterprise Architecture Practice--Maturity Factor Analysis," in 45th Hawaii International Conference on System Science (HICSS), 2012 2012, pp. 4260-4269.
[9]   P. Christiansen and J. Gotze, "International Enterprise Architecture Survey–Trends in Governmental Enterprise Architecture on a National Level," 2006.

[10] B. A. Kitchenham and S. Charters, "Guidelines for performing systematic literature reviews in software engineering," Technical Report EBSE-2007-01, School of Computer Science and Mathematics, Keele University. 2007.

[11] C. Okoli and K. Schabram, "A Guide to Conducting a Systematic Literature Review of Information Systems Research". Sprouts. Working Papers on Information Systems, 10(26). http://sprouts.aisnet.org/10-26, 2010

[12] M. Petticrew and H. Roberts, Systematic Reviews in the Social Sciences: A Practical Guide: Wiley, 2008.

[13] A. Sobczak, "Methods of the Assessment of Enterprise Architecture Practice Maturity in an Organization," in Perspectives in Business Informatics Research, ed: Springer, 2013, pp. 104-111.

[14] M. Lange, J. Mendling, and J. Recker, "A comprehensive EA benefit realization model--An exploratory study," in System Science (HICSS), 2012 45th Hawaii International Conference on, 2012, pp. 4230-4239.

[15] M. Meyer, M. Helfert, B. Donnellan, and J. Kenneally, "Applying design science research for enterprise architecture business value assessments," in Design Science Research in Information Systems. Advances in Theory and Practice, ed: Springer, 2012, pp. 108-121.

[16] S. Weiss and R. Winter, "Development of Measurement Items for the Institutionalization of Enterprise Architecture Management in Organizations," in Trends in Enterprise Architecture Research and Practice-Driven Research on Enterprise Transformation, ed: Springer, 2012, pp. 268-283.

[17] L. Pruijt, R. Slot, H. Plessius, R. Bos, and S. Brinkkemper, "The Enterprise Architecture Realization Scorecard: A Result Oriented Assessment Instrument," in Trends in Enterprise Architecture Research and Practice-Driven Research on Enterprise Transformation, ed: Springer, 2012, pp. 300-318.

[18] B. Van der Raadt, M. Bonnet, S. Schouten, and H. Van Vliet, "The relation between EA effectiveness and stakeholder satisfaction," Journal of Systems and Software, vol. 83, pp. 1954-1969, 2010.

[19] B. Jahani, S. R. S. Javadein, and H. A. Jafari, "Measurement of enterprise architecture readiness within organizations," Business Strategy Series, vol. 11, pp. 177-191, 2010.

[20] I. Velitchkov, "Integration of IT strategy and enterprise architecture models," in Proceedings of the 9th International Conference on Computer Systems and Technologies and Workshop for PhD Students in Computing, 2008, p. 69.

[21] N. Prakash, M. Jaiswal, and U. Gulla, "A conceptual framework for measuring public value of enterprise applications," Electronic Government, An International Journal, vol. 6, pp. 307-326, 2009.

[22] T. Kamogawa and H. Okada, "Enterprise architecture create business value," in Ninth Annual International Symposium on Applications and the Internet, 2009. SAINT'09. , 2009, pp. 205-208.

[23] K. Liimatainen, "Evaluating benefits of government enterprise architecture," in 31st Information Systems Research Seminar in Scandinavia, 2008.

[24] J. Schelp and M. Stutz, "A balanced scorecard approach to measure the value of enterprise architecture," Journal of Enterprise Architecture, vol. 3, pp. 8-14, 2007.

[25] J. Schekkerman, "Enterprise Architecture Assessment Guide Version 2.2," Institute for Enterprise Architecture Developments, the Netherlands, 2006.

[26] J. Schekkerman, "Extended Enterprise Architecture Maturity Model Support Guide (Version 2.0)," Institute for Enterprise Architecture Developments, the Netherlands, 2006.

[27] NASCIO, "NASCIO Enterprise Architecture Maturity Model," ed, 2003.

[28] U. S. OMB, "Enterprise Architecture Assessment Framework (EAAF)," O. o. M. a. Budget, Ed., ed, 2001.