Towards Different Enterprise Architecture Project Types

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Abstract. This research is in the enterprise architecture (EA) research field. EA is a developing discipline that in broad terms emphasizes all aspects of organizational design and development, including enabling information technology. However, there are various interpretations and understandings of EA, with little agreement on them. Therefore, organizations use EA in numerous ways to achieve different goals. These vary from purely information technology- (IT) related, internal business and IT-related to business environment-related goals. Enterprise architects also have different understandings of EA, which influence the way they perform EA work and consequently EA deliverables and achievement of EA project goals. In this paper a preliminary list of different EA project types is compiled through a hermeneutic literature review, aiming to establish a comprehensive list of EA project types. It is suggested that knowledge of different EA project types assist in the selection of suitable enterprise architects to achieve specific EA project goals.

Keywords: Enterprise architecture, Project, Project type.

1 Introduction

Enterprise architecture (EA) can be defined as the components of which the enterprise is made up, how these components relate to each other and how they relate to the environment in which the enterprise operates, as well as the rules for their design and development over time [61]. However, architects do not have the same understanding of EA [20, 32] and it is not a "one-size-fits-all discipline" [64]. Perceptions vary between IT-focused, business-focused and a combination of business and IT, where business can also include the environment in which the organization operates [32].

Because of these different understandings, architects approach architecture work differently, which leads to misunderstandings and arguments about what EA processes to follow and which EA phases to perform [27]. The effect of these misunderstandings and different interpretations of EA and EA execution is that approaches to satisfy a requirement will be different, resulting in different EA designs [20]. Another implication is that architects who work together will differ on their roles and what they are responsible for. This may lead to conflict, which may complicate stakeholder engagement and EA project execution [50].

There is more than one type of EA work. Korhonen and Poutanen [29] acknowledge that for each type of architecture work a unique approach, knowledge and skills set are required. They further mention that it is unrealistic to think that one person possesses all the required skills. This implies that enterprise architects with a combination of skills, knowledge and understanding of EA are required to complete EA projects of different types. It further emphasizes the importance of selecting enterprise architects with EA understanding, knowledge and skills relevant to the type of EA project to be undertaken. In this research we focus on the preliminary identification of different types of EA projects to be used in further research that will develop a method to assist the EA project manager with the selection of enterprise architects for EA project execution.

This paper is organized in five sections. In section 1 background to the research study is provided. Section 2 gives an overview of EA, followed by section 3 that describes the research methodology followed to determine EA project types. Section 4 contains the research result, i.e. the preliminary list of different EA project types that organizations can use to understand who to assign to the projects. Section 5 contains a discussion and the conclusion.

2 Enterprise Architecture

EA is valued by organizations as a discipline and practice to help them cope with continuous change [51] and to support decisions on organizational changes and relevant technology changes in support of business [35]. Responding to ongoing change is critical for organizational success. Therefore, it is important for organizations to take note of their enterprise architects' capabilities and views on EA, as this affects the way they practice as enterprise architects. Shaanika and Iyamu [57] state that the view on EA informs how EA is executed. This in turn has an impact on how well the organization responds to environmental changes that necessitate business and IT changes. The human component of an EA service capability is crucial for successful EA project execution [58].

According to Gartner [19], the time required to establish EA in an enterprise varies between 18 and 24 months and it takes an additional 12 to 24 months to improve and refine it. Apart from the time spent on EA, organizations also invest financially in EA. This is stressed by Bernard [14], who mentions that skilled enterprise architects, who come at a large cost, are required to develop architectures.

Development of EA artefacts is a labor-intensive, costly aspect of EA [45]. The people component of EA accounts for the larger part of the cost to establish, improve and maintain EA. It further emphasizes that enterprise architects with understanding of EA relevant to what the organization wants to achieve through execution of EA projects need to be identified and employed. Therefore, knowledge about the different EA project types is essential to ensure that the EA investment contributes to the success of the specific organization.

Effective EA implementation depends on the right type of person, with relevant skills, being employed to perform EA tasks [66]. By identifying and addressing human

issues that influence the use and acceptance of EA as an organizational strategy, enterprises can prevent failure of their EA implementations [22].

Bakar and Hussien [12] identified five human-related factors that have an impact on EA execution. One of the human factors is skilled EA talent. Bakar and Hussien [12] do not provide a method to determine the required skills to perform EA work. However, Ylinen and Pekkola's [68] research focuses on identifying skills that enterprise architects themselves believe are crucial for performing EA work. They have found that the skills set to perform EA work is very broad and entails various separate tasks. In fact, 257 different skills were identified by the enterprise architects that participated in the study. This is due to different perceptions and experiences of EA. Ylinen and Pekkola [68] highlight the importance of selecting the right enterprise architect with the relevant skills for the specific EA project or phase of the project. Thus, organizations need to know what type of EA project is executed in order to select the most appropriate architects to work on it.

3 Research Methodology

3.1 Introduction

In this research the following three steps were followed to determine EA project types: (1) the definition and characteristics of a project were determined in order to identify EA project types, (2) a method was identified to determine project types from a literature review, and (3) a preliminary list of EA project types was derived by applying the method identified in Step 2. **Fig. 1** below illustrates the process followed.

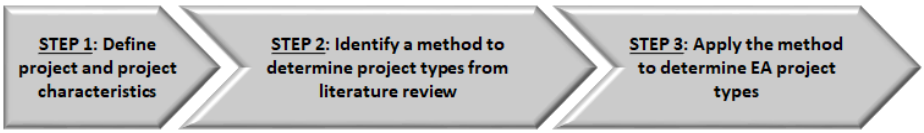

Fig. 1. Process followed to determine EA project types

3.2 Step 1: Define Project and Project Characteristics

The Project Management Institute describes a project as a "temporary endeavor undertaken to create a unique product, service, or result." Schwalbe [55] lists the unique purpose of a project as the first of six project characteristics. This unique purpose relates to the delivery of a specific product, service or result as per the Project Management Institute's definition of a project. The other project characteristics provided are that a project has a definite start and a definite end, projects can evolve over time and are performed in increments as more knowledge is gained, people and other resources are required to execute a project and a project has a key sponsor who normally dictates the project direction and provides funding. The last project feature mentioned is that there are unknown factors involved, such as time required to perform certain tasks and the availability of resources. The scope, time and cost of a project are referred to as the

"triple constraint". Of these three constraints, the scope of a project defines what the project will deliver and what will be done to deliver it [55].

3.3 Step 2: Identify a Method to Determine Project Types from Literature Review

In a study in which method engineering processes are enhanced, Bucher, Klesse, Kurpjuweit and Winter [18] distinguish between context and project type. They refer to the products that are developed through execution of projects as work systems, as their research is in the information systems subject field. It is stated that a work system includes all objects that are developed or transformed via a method. In the context of EA projects, EA project deliverables, delivered via a method, are similar to work systems.

A project type can be derived from the state of the original work system and the state of the target work system [18], which relates to the project scope as defined by [55]. By applying Bucher *et al.*'s [18] method for determining project types to the EA subject area, Aier, Riege and Winter [3] give two examples of EA project types. The first example is the establishment of business processes and supporting information systems for a new business. The other example provided is the amalgamation of information systems that support business processes that are alike. Therefore, the way to determine project types focuses on what is delivered by or achieved through EA exercises, projects or initiatives, as the project type classification can be derived from it.

3.4 Step 3: Apply the Method to Determine EA Project Types

For Step 3 a literature review was performed with the focus on what is delivered through EA projects or initiatives. The literature review followed a hermeneutic approach, which implies that data collection and data analysis were performed simultaneously. Comprehension of literature was progressively enlightened through prior understanding of other literature, without being restricted by research protocols and formal approaches with specific rules in terms of articles that may or may not be included in the study [16]. The framework for hermeneutic literature review developed by Boell and Cecez-Kecmanovic [16] was applied. This framework prescribes two inter-linked cycles, i.e. "analysis and interpretation" as the broader cycle and "search and acquisition" as the internal cycle. Each cycle consists of specific phases that are performed iteratively, resulting in progressive better understanding of the literature. With each iteration through the hermeneutic circle, understanding of the topic is improved. Numerous iterations are done until the researcher reaches the point where a thorough recording of the literature is compiled, enabling analytical evaluation of the literature. The literature review starts with a primary topic, following the first iteration through the inner circle of searching, sorting, selecting, acquiring and reading. This is followed by the mapping and classifying, critical assessment and argument development phases of the first iteration through the outer circle. The inner circle continues when new literature is identified and search criteria are refined through reading, where after the next iteration through the inner circle starts, and then the next iteration through the outer circle.

Data collection through hermeneutic literature review is intertwined with hermeneutic data analysis techniques where the complete text is comprehended, where-after the researcher understands the complete text, interprets the parts that make up the whole, and then circles back to understanding the whole. With each cycle new insight is gained [36].

For this study more than 500 papers from three databases, i.e. Scopus, ScienceDirect and IEEE Xplore, were identified in several iterations through the hermeneutic circle. Initially, papers were identified through database searches using "enterprise architecture" and "enterprise architecture" + "project" in title, abstract and keywords as search criteria. Papers were scanned for relevance and an understanding of the EA project topic was gained, which triggered selection of more papers. Information gathered was compared to information previously gathered in order to identify EA project types. The relevance of papers was determined by applying the method to identify project types as described in paragraph 3.3. First the abstract was read; if it seemed as if the original work system vs target work system could be obtained, the paper was read. Again, it was determined if the original work system vs target work system could be obtained. If it could not be obtained, the paper was rejected.

4 EA Project Types

Twenty different EA project types, depicted in **Table 1** below, were identified through the hermeneutic literature review.

Table 1. EA Project Types

No	EA Project Type	Source
1.	EA establishment project	[3, 46]
2.	Applying EA method to solve internal business problems	[65]
3.	Business-IT alignment	[33, 43, 5, 39, 9, 6, 69, 40, 4, 17, 34, 49, 26, 13, 50, 7, 25, 11, 48, 15, 30, 62, 60, 52, 44, 56, 21, 31, 23]
4.	Business transformation	[37, 1, 28, 44]
5.	Digital transformation	[23]
6.	Improvement of organizational agility	[23, 31]
7.	Cost saving, including reduction in the cost of IT	[23, 31, 42, 50]
8.	Risk management	[23, 31]
9.	Enhancement of interoperability	[23, 42]
10.	Improvement in the results of strategic business programmes	[23]
11.	Business process optimisation	[23]
12.	Less complex IT systems	[23]
13.	Higher utilisation of IT systems	[23]
14.	Elimination of duplication of information systems	[50, 42, 3]
15.	Standardisation	[54, 31]
16.	Governance	[54, 31]
17.	Regulatory compliance	[54, 31]
18.	Corporate strategic planning	[6, 59]
19.	Organizational development	[38, 47, 53, 14]
20.	IT decision-making	[64, 63, 62, 10]

In the following paragraphs we reflect, using the literature review conducted, on how the EA project types (**Table 1**) were obtained from the sources. We provide the results from the data collection done during the literature review.

4.1 EA Project Type: EA Establishment Project

Pulkkinen and Kapraali [46] observe an EA establishment project during their study to develop a method to obtain information from information and communication technology (ICT) business users. The method is meant to be used for the development of EA. The EA initiation project is performed in a large organization that has the vision to implement EA. The method focuses on obtaining a business view first, not only by involving business managers but also by obtaining information regarding lower-level business operations and business processes. The original work system state is an organization without an EA function and the target work system state is an organization where EA is implemented. The EA project type identified establishes and deploys EA in an organization, similar to the first type of project mentioned by Aier *et al*. [3] when they applied the Bucher *et al*. [18] method to determine project types.

4.2 EA Project Type: Applying EA Method to Understand Internal Business Problems

Sometimes EA modelling and concepts are used for purposes other than to deliver EA. One such case is where Werewka and Spiechowicz [65] apply an EA approach to pinpoint problems with a specific process step in a Scrum agile development method for developing software. This process step is called the retrospective step. An EA approach is considered suitable for this exercise, as EA provides an all-inclusive view of an organization and describes the organization's future state and how to get to the future state. Further to this, EA models are known for providing different viewpoints relevant to different participants. Through different viewpoints stakeholders understand problems experienced in the agile software development approach and can determine the reasons why the agile software development method does not always achieve its goals [65]. In this case, EA concepts and modelling are applied to gain insight into a problem. The original work system state is a situation of experiencing a problem and the target work system state is a position of understanding the problem. This type of EA project is performed to understand problems experienced in specific business situations.

4.3 EA Project Type: Business-IT Alignment

A major challenge for enterprises to stay relevant and competitive is agility, which means that an organization must be agile to be able to react to constant and unanticipated change and to be able to integrate into the changing milieu in which it operates [13, 26]. EA improves organizational agility and by implication enhances organizational performance [24]. Enterprise agility is achieved when enterprise business and IT are kept aligned, despite changes in business and changes in technology. Business-IT

alignment is achieved through enterprise engineering (EE) [23, 26]. As constant business-IT alignment is required, EE is not seen as a project, but as a continuous task [26]. EE and EA are closely related disciplines. EE is described as the use of engineering theory to develop EA [41]. For the purpose of this study, EA with the purpose to align business and IT, and EE are seen as the same. Therefore, according to this argument, EA with the purpose to align business and IT is also not viewed as a project, as it is an ongoing effort with no specific start and end date. Keeping business and IT aligned through EA can be viewed as maintenance or sustainment of EA. The research of Agievich, Taratukhin, Becker and Gimranov [2] describes a method to create an EA baseline and to keep it current and in step with new IT solutions implemented in the organization. The motivation for using such a method is that one of the key success factors for a successful business, and to gain competitive advantage, is good administration and utilization of information by means of IT. This is addressed through EA. Agievich *et al*. [2] refer to the establishment of baseline EA and the maintenance of EA that follows to keep the baseline relevant. Establishment of baseline EA relates to the EA establishment and deployment project type derived from the work of Pulkkinen and Kapraali [46], and the sustainment of EA relates to the view that EA, with the purpose to align business and IT, is a continuous activity [26]. The EA project lifecycle has four main stages, namely "Initiate, Planning, Execute and Maintain" [8].

Each EA project will have these four phases. Where EA is seen as a continuous task [26] or reference is made to sustainment of EA [2], it relates to the maintenance phase in the EA project life cycle and is not considered a different type of EA project.

Lehong, Dube and Angelopoulos [33] and Olsen [43] confirm that EA plays a large role in business-IT alignment. Business-IT alignment is achieved through EA when business, data, application and technology architecture is analyzed and understood. This refers to the business processes in support of organizational objectives, the information that will be created, replaced, updated and deleted by these business processes, applications that can manipulate the information, and the technology on which the applications execute [5, 39]. Antunes, Bakhshandeh, Mayer, Borbinha and Caentano [9] state that business-IT alignment can be achieved through EA models reflecting the business and IT components of the organization. Aldea, Iacob, Quartel and Franken [6] identify EA development as a solution to align business and IT. They further stress the importance of this alignment, as it improves enterprise competitive advantage and organizational performance and ensures that strategic goals are supported and achieved through EA. A systematic literature review on research regarding business-IT alignment through EA points out that EA is perceived as a method to address business-IT alignment problems [69]. By utilizing the Zachman framework EA can be developed that ensures alignment of business objectives and IT [40]. Alaeddini, Asgari, Gharibi and Rad [4] mention that EA is a way to achieve business-IT alignment. They evaluate and measure the impact of executing EA on maturity of business-IT alignment. Their study confirms the positive effect of performing EA on business-IT alignment. Then again, EA maturity enhances business-IT alignment [17]. EA, specifically performed through a process-focused method, benefits business-IT alignment [34]. EA planning can be used to develop an architecture or ICT master plan that ensures integrated systems to support business goals [49, 67]. Business-IT alignment through EA is further

recognized by several other authors, namely Alwadain *et al*. [7], Bakar *et al*. [11], Bhattacharya [15], Ernst [21], Hafsi and Assar [23], Hiekkanen *et al*. [25], Kotusev *et al*. [30], Lange and Mendling [31], Olsen and Trelsgård [44], Rouhani *et al*. [48], Schekkerman [52], Sessions [56], Tamm *et al*. [60] and Urbaczewski and Mrdalj [62].

Hence, one type of EA project is to achieve business and IT alignment. Although Hinkelmann *et al*. [26] argue that EE is not a project, their argument that EE (and thus also EA with the purpose to align business and IT) ensures business-IT alignment supports the business-IT alignment EA project type.

4.4 EA Project Type: Business Transformation

Nardello, Lapalme, Toppenberg and Gøtze [37] investigate how EA supports innovation. They view EA according to the three schools of thought on EA [32] and have found that the enterprise ecological adaption (EEA) school of thought is the only school of thought on EA that supports innovation. The reason for this is that the EEA school of thought includes the enterprise, the environment in which it operates and interaction between the enterprise and its environment.

Enterprises need to adapt to a changing environment; this transformation may be required due to internal or external incidents, such as emerging and disrupting technologies or new governance requirements. Enterprise transformation has an impact on more than one organizational unit, and it affects the enterprise relationships with one or more key stakeholders. Common understanding among the various role players in enterprise transformation is required. EA models contain the necessary information to establish common understanding between the different stakeholder groups. EA models contain information that spans stakeholder views, providing a holistic view of the organization [1]. EA is thus used for business transformation [44]; in fact, it is seen as a process that simplifies business transformation and integration [28]. EA is further viewed as a solution for enterprise integration into the changing environment in which it operates [13, 50]. The EA project type, business transformation, is derived from enterprise adaptation and integration into the dynamic environment and the need for agility and innovation.

4.5 EA Project Type: Digital Transformation

Related to the business transformation project type is the project type EA as a tool in support of digital transformation episodes. This type is derived from work done by Hafsi and Assar [23] to determine how EA can be used in support of digital transformation. They emphasize four areas where EA can contribute to digital transformation based on The Open Group Architecture Framework (TOGAF). These areas are the holistic view of all initiatives, the architecture vision that determines the scope of the project and ensures that business goals are addressed, the architecture repository and stakeholder management.

4.6 EA Project Type: Nine EA Project Types Derived from EA Benefits

Another product that was delivered as part of Hafsi and Assar's [23] study is a list of EA benefits obtained through a literature review. These benefits are improvement of organizational agility, business and IT alignment, a reduction in the cost of IT, better risk management and interoperability, improvement in the results of strategic business programs, business process optimization, less complex IT systems and higher utilization of these IT systems. In this study, each benefit is taken as a different EA project type, as each benefit represents what is achieved through an EA project. Of these EA project types business-IT alignment, organizational agility, cost saving and better risk management were included as EA goals when Lange and Mendling [31] extended Schöenherr's [54] list of EA goals. EA goals are realized through execution of EA projects and therefore each goal represents an EA project type. Ojo *et al*. [42] identify the realization of interoperability as a reason to perform EA in the public sector. Thus, it strengthens the concept of the EA project type, enabling interoperability.

The cost-saving EA project type is also derived from a study where reduction in business and IT cost through elimination of duplicate information systems and business processes is mentioned as a reason why EA is performed in the public sector [42]. A systematic mapping study of literature on various ways and reasons why EA is conducted confirms that EA can be performed to eliminate duplication in functionality and to enhance reuse of functionality in order to reduce IT cost [50]. Thus, elimination of duplication of information systems is another EA project type that is derived. Elimination of duplication of information systems relates to amalgamation of information systems that support business processes that are alike, as identified by Aier, Riege and Winter [3] when they applied Bucher *et al*.'s [18] method for determining project types to the EA subject area.

4.7 EA Project Types: Three EA Project Types Derived from EA Goals

The list of EA goals compiled by Schöenherr [54] was extended by Lange and Mendling [31]. Apart from the EA goals already mentioned with the EA benefits identified by Hafsi and Assar [23], standardization, governance and regulatory compliance complete the extended list of EA goals [31]. Each of these goals signifies what is achieved through EA and may therefore represent an EA project type.

4.8 EA Project Type: Corporate Strategic Planning

Facilitation of strategic business planning is identified as an application of EA [6, 59], and therefore corporate strategic planning is identified as a potential EA project type.

4.9 EA Project Type: Organizational Development

Närman, Johnson and Gingnell [38] developed a framework that increases the application of EA to address organizational structure development. Enterprises use EA for or-

ganizational structuring in order to overcome business challenges [47]. EA is recognized as a discipline that aids in organizational structuring by delivering agile enterprise designs [53, 14]. Hence, another EA project type derived is organizational development.

4.10 EA Project Type: IT Decision-making

One more application of EA is to assist in IT decision-making. EA improves the quality of IT decisions [64], as well as decisions on investments in IT [63]. EA projects are further used for IT decision-making by delivering blueprints for IT solutions [62] and providing a common understanding of the overall design of enterprise IT solutions [10].

5 Discussion and Conclusion

Table 1 reflects the 20 EA project types that were identified. The 20 different EA project types can further be categorized and similar types may be combined. One categorization that may be considered, as provided by Korhonen and Poutanen [29], is to categorize the project types as "technical, socio-technical or ecosystemic". An EA project classification framework can be developed using the identified EA project types. The EA classification framework, including skills required per project type, will benefit organizations in the selection of architects with skills and knowledge relevant to a specific EA project. Because of the many perceptions of EA [20], employing architects that match the requirements of the EA project type may enhance successful project execution.

Different perceptions of EA lead to different approaches to EA project execution, resulting in different EA designs and deliverables. Because of the immense cost and time invested in EA projects, and the large impact that EA has on organizations, it is not affordable to select architects to work on a project that do not match the requirements of the project. It is therefore necessary to be aware of the different EA project types that exist. Additional research must be done to determine characteristics of each EA project type, which will further aid in identifying enterprise architects with understanding of EA and the knowledge and skills relevant to the EA project type being executed.

References

1. Abraham, R., Aier, S. & Winter, R. 2015. Crossing the line: Overcoming knowledge boundaries in enterprise transformation. Business & Information Systems Engineering, 57(1): 3–13. doi: 10.1007/s12599-014-0361-1.
2. Agievich, V., Taratukhin, V., Becker, J. & Gimranov, R. 2013. A new approach for collaborative enterprise architecture development. In Proceedings - 2012 7th International Forum on Strategic Technology, IFOST 2012. 1–5. doi: 10.1109/IFOST.2012.6357672.

3. Aier, S., Riege, C. & Winter, R. 2008. Classification of enterprise architecture scenarios - An exploratory analysis. Enterprise Modelling and Information Systems Architecture, 3(1): 14–23.
4. Alaeddini, M., Asgari, H., Gharibi, A. & Rad, M.R. 2017. Leveraging business-IT alignment through enterprise architecture — An empirical study to estimate the extents. Information Technology and Management, 18(1): 55–82. doi: 10.1007/s10799-016-0256-6.
5. Alaeddini, M. & Salekfard, S. 2013. Investigating the role of an enterprise architecture project in the business-IT alignment in Iran. Information Systems Frontiers, 15(1): 67–88. doi: 10.1007/s10796-011-9332-y.
6. Aldea, A., Iacob, M.E., Quartel, D. & Franken, H. 2013. Strategic planning and enterprise architecture. In Proceedings of the First International Conference on Enterprise Systems, ES 2013. IEEE: 1–8. doi: 10.1109/ES.2013.6690089.
7. Alwadain, A., Rosemann, M., Fielt, E. & Korthaus, A. 2011. Enterprise architecture and the integration of service oriented architecture. In PACIS 2011 - 15th Pacific Asia Conference on Information Systems: Quality Research in Pacific.
8. Anajafi, F., Nassiri, R. & Shabgahi, G.L. 2010. Developing effective project management for enterprise architecture projects. In ICSTE 2010 - 2010 Second International Conference on Software Technology and Engineering, Proceedings. IEEE: V1-388-V1-393. doi: 10.1109/ICSTE.2010.5608867.
9. Antunes, G., Bakhshandeh, M., Mayer, R., Borbinha, J. & Caetano, A. 2013. Using ontologies for enterprise architecture analysis. In 2013 17th IEEE International Enterprise Distributed Object Computing Conference Workshops. 361–368. doi: 10.1109/EDOCW.2013.47.
10. Armour, F.J., Kaisler, S.H. & Liu, S.Y. 1999. A big-picture look at enterprise. IT Professional, Jan/Feb: 35–41.
11. Bakar, N.A.A., Harihodin, S. & Kama, N. 2016. Enterprise architecture implementation model: Measurement from experts and practitioner perspectives. In 4th IEEE International Colloquium on Information Science and Technology. 1–6.
12. Bakar, N.A.A. & Hussien, S.S. 2018. Association of people factors with successful enterprise architecture implementation. International Journal of Engineering & Technology, 7(4.31): 52–57.
13. Banaeianjahromi, N. & Smolander, K. 2016. What do we know about the role of enterprise architecture in enterprise integration? A systematic mapping study. Journal of Enterprise Information Management, 29(1): 140–164. doi: 10.1108/JEIM-12-2014-0114.
14. Bernard, S.A. 2012. An introduction to enterprise architecture. AuthorHouse.
15. Bhattacharya, P. 2017. Modelling strategic alignment of business and IT through enterprise architecture: Augmenting Archimate with BMM. Procedia Computer Science, 121: 80–88. doi: 10.1016/j.procs.2017.11.012.
16. Boell, S.K. & Cecez-Kecmanovic, D. 2014. A hermeneutic approach for conducting literature reviews and literature searches. Communications of the Association for Information Systems, 34(12): 257–286. doi: 10.17705/1CAIS.03412.
17. Bradley, R. V., Pratt, R.M.E., Byrd, T.A., Outlay, C.N. & Wynn, D.E. 2012. Enterprise architecture, IT effectiveness and the mediating role of IT alignment in US hospitals. Information Systems Journal, 22(2): 97–127. doi: 10.1111/j.1365-2575.2011.00379.x.
18. Bucher, T., Klesse, M., Kurpjuweit, S. & Winter, R. 2007. Situational method engineering: On the differentiation of ‘context’ and ‘project type’. In IFIP International Federation for Information Processing. 33–48. doi: 10.1007/978-0-387-73947-2_5.
19. Burke, B. & Blosch, M. 2015. ITScore Overview for enterprise architecture. Gartner Analysis, (July): 1–6.

20. Du Preez, J.A. 2016. Understanding the architect in enterprise architecture: The Daedalus instrument for architects. Doctoral thesis. Pretoria: University of Pretoria. [Online] Available from https://repository.up.ac.za/handle/2263/57172 [Accessed: 2020-03-04].
21. Ernst, A.M. 2008. Enterprise architecture management patterns. In 15th Conference on Pattern Languages of Program (PLoP). 1–20.
22. Gilliland, S., Kotzé, P. & Van Der Merwe, A. 2015. Work level related human factors for enterprise architecture as organisational strategy. In 2015 International Conference on Enterprise Systems (ES). IEEE: 43–54. doi: 10.1109/ES.2015.12.
23. Hafsi, M. & Assar, S. 2016. What enterprise architecture can bring for digital transformation? An exploratory study. In IEEE 18th Conference on Business Informatics. 83–89. doi: 10.1109/CBI.2016.55.
24. Hazen, B.T., Bradley, R. V., Bell, J.E., In, J. & Byrd, T.A. 2017. Enterprise architecture: A competence-based approach to achieving agility and firm performance. International Journal of Production Economics, 193(July): 566–577. doi: 10.1016/j.ijpe.2017.08.022.
25. Hiekkanen, K., Korhonen, J.J., Collin, J., Patricio, E., Helenius, M. & Mykkanen, J. 2013. Architects' perceptions on EA use - An empirical study. In Proceedings - 2013 IEEE International Conference on Business Informatics, IEEE CBI 2013. 292–297. doi: 10.1109/CBI.2013.48.
26. Hinkelmann, K., Gerber, A., Karagiannis, D., Thoenssen, B., Van Der Merwe, A. & Woitsch, R. 2016. A new paradigm for the continuous alignment of business and IT: Combining enterprise architecture modelling and enterprise ontology. Computers in Industry, 79: 77–86. doi: 10.1016/j.compind.2015.07.009.
27. Iyamu, T. 2013. Institutionalisation of enterprise architecture: The actor-network perspective. In Social and Professional Applications of Actor-Network Theory for Technology Development. IGI Global: 144–155.
28. Kaddoumi, T. & Watfa, M. 2016. A proposed agile enterprise architecture framework. In The Sixth International Conference on Innovative Computing Technology. 52–57.
29. Korhonen, J.J. & Poutanen, J. 2013. Tripartite approach to enterprise architecture. Journal of Enterprise Architecture (February): 28–38.
30. Kotusev, S., Singh, M. & Storey, I. 2015. Investigating the usage of enterprise architecture artifacts. In 23rd European Conference on Information Systems (ECIS). 1–12.
31. Lange, M. & Mendling, J. 2011. An experts' perspective on enterprise architecture goals, framework adoption and benefit assessment. In 2011 IEEE 15th International Enterprise Distributed Object Computing Conference Workshops. IEEE: 304–313. doi: 10.1109/EDOCW.2011.41.
32. Lapalme, J. 2012. Three schools of thought on enterprise architecture. IT Professional, 14(6): 37–43. doi: 10.1109/MITP.2011.109.
33. Lehong, S.M., Dube, E. & Angelopoulos, G. 2013. An investigation into the perceptions of business stakeholders on the benefits of enterprise architecture: The case of Telkom SA. South African Journal of Business Management, 44(2): 45–56.
34. Malta, P. & Sousa, R.D. 2016. Process oriented approaches in enterprise architecture for business-IT alignment. Procedia Computer Science, 100: 888–893. doi: 10.1016/j.procs.2016.09.239.
35. Microsoft. 2015. [Online] Available from https://msdn.microsoft.com/en-us/library/ms978007.aspx [Accessed: 2015-10-30].
36. Myers, M.D. 2013. Qualitative research in business and management. Sage.
37. Nardello, M., Lapalme, J., Toppenberg, G. & Gøtze, J. 2015. How does enterprise architecture support innovation? In 2015 Third International Conference on Enterprise Systems. 192–199. doi: 10.1109/ES.2015.26.

38. Närman, P., Johnson, P. & Gingnell, L. 2014. Using enterprise architecture to analyse how organisational structure impact motivation and learning. Enterprise Information Systems, (June 2015): 1–40. doi: 10.1080/17517575.2014.986211.
39. Niemi, E. & Pekkola, S. 2017. Using enterprise architecture artefacts in an organisation. Enterprise Information Systems, 11(3): 313–338. doi: 10.1080/17517575.2015.1048831.
40. Nogueira, J.M., Romero, D., Espadas, J. & Molina, A. 2013. Leveraging the Zachman framework implementation using action–research methodology – a case study: Aligning the enterprise architecture and the business goals. Enterprise Information Systems, 7(1): 100–132. doi: 10.1080/17517575.2012.678387.
41. Nurcan, S. & Schmidt, R. 2013. Service oriented enterprise architecture for enterprise engineering. In 2013 17th IEEE International Enterprise Distributed Object Computing Conference Workshops. IEEE: 91–93. doi: 10.1109/edocw.2013.49.
42. Ojo, A., Janowski, T. & Estevez, E. 2012. Improving government enterprise architecture practice - Maturity factor analysis. In Proceedings of the Annual Hawaii International Conference on System Sciences. IEEE: 4260–4269. doi: 10.1109/HICSS.2012.14.
43. Olsen, D.H. 2017. Enterprise architecture management challenges in the Norwegian health sector. Procedia Computer Science, 121: 637–645. doi: 10.1016/j.procs.2017.11.084.
44. Olsen, D.H. & Trelsgård, K. 2016. Enterprise Architecture adoption challenges: An exploratory case study of the Norwegian higher education sector. Procedia Computer Science, 100(1877): 804–811. doi: 10.1016/j.procs.2016.09.228.
45. Perez-Castillo, R., Ruiz-Ggonzalez, F., Genero, M. & Piattini, M. 2019. A systematic mapping study on enterprise architecture mining. Enterprise Information Systems, 13(5): 675–718. doi: 10.1080/17517575.2019.1590859.
46. Pulkkinen, M. & Kapraali, L. 2015. Collaborative EA information elicitation method: The IEM for business architecture. In Proceedings - 17th IEEE Conference on Business Informatics, CBI 2015. IEEE: 64–71. doi: 10.1109/CBI.2015.33.
47. Rajabi, Z., Minaei, B. & Seyyedi, M.A. 2013. Enterprise architecture development based on enterprise ontology. Journal of Theoretical and Applied Electronic Commerce Research, 8(2): 85–95. doi: 10.4067/S0718-18762013000200007.
48. Rouhani, B.D., Mahrin, M.N., Nikpay, F. & Ahmad, R.N. 2015. A systematic literature review on enterprise architecture implementation methodologies. Information and Software Technology, 62: 1–20. doi: 10.1016/j.infsof.2015.01.012.
49. Ruldeviyani, Y., Wisnuwardhani, E. & Sucahyo, Y.G. 2017. Designing enterprise architecture: Case study of the Ministry of Energy and Mineral Resources. Journal of Engineering and Applied Sciences, 12(8): 2185–2188.
50. Saint-Louis, P. & Lapalme, J. 2018. An exploration of the many ways to approach the discipline of enterprise architecture. International Journal of Engineering Business Management, 10: 1–26. doi: 10.1177/1847979018807383.
51. Saint-Louis, P., Morency, M.C. & Lapalme, J. 2017. Defining enterprise architecture: A systematic literature review. In 2017 IEEE 21st International Enterprise Distributed Object Computing Workshop. 41–49. doi: 10.1109/EDOCW.2017.16.
52. Schekkerman, J. 2004. How to survive in the jungle of enterprise architecture frameworks: Creating or choosing an enterprise architecture framework. Victoria B.C.: Trafford.
53. Schelp, J. & Stutz, M. 2007. A balanced scorecards approach to measure the value of enterprise architecture. In Trends in Enterprise Architecture Research Workshop. 5–12.
54. Schöenherr, M. 2009. Towards common terminology in the discipline of Enterprise Architecture. In Lecture Notes in Computer Science vol. 5472. 400–413.
55. Schwalbe, K. 2014. Information technology project management. 7th ed. Course Technology, Cengage Learning.

56. Sessions, R. 2007. A comparison of the top four enterprise architecture methodologies. Msdn: 1–31.
57. Shaanika, I. & Iyamu, T. 2014. Developing enterprise architecture skills: A developing country perspective. In International Federation for Information Processing (IFIP). 52–61.
58. Shanks, G., Gloet, M., Someh, I.A., Frampton, K. & Tamm, T. 2018. Achieving benefits with enterprise architecture. Journal of Strategic Information Systems, 27(March): 139–156. doi: 10.1016/j.jsis.2018.03.001.
59. Simon, D., Fischbach, K. & Schoder, D. 2014. Enterprise architecture management and its role in corporate strategic management. Information Systems and e-Business Management, 12(1): 5–42. doi: 10.1007/s10257-013-0213-4.
60. Tamm, T., Seddon, P.B., Shanks, G. & Reynolds, P. 2011. How does enterprise architecture add value to organisations? Communications of the Association for Information Systems, 28(10): 141–168.
61. The Open Group. 2018. The TOGAF® Standard, Version 9.2.
62. Urbaczewski, L. & Mrdalj, S. 2006. A comparison of enterprise architecture frameworks. Issues in Information Systems, VII (2): 18–23.
63. Van den Berg, M., Slot, R., Van Steenbergen, M., Faasse, P. & Van Vliet, H. 2019. How enterprise architecture improves the quality of IT investment decisions. Journal of Systems and Software, 152: 134–150. doi: 10.1016/j.jss.2019.02.053.
64. Van Den Berg, M. & Van Vliet, H. 2016. The decision-making context influences the role of the enterprise architect. In IEEE 20th International Enterprise Distributed Object Computing Workshop (EDOCW). 1–8.
65. Werewka, J. & Spiechowicz, A. 2017. Enterprise architecture approach to SCRUM processes, sprint retrospective example. In Proceedings of the 2017 Federated Conference on Computer Science and Information Systems. 1221–1228. doi: 10.15439/2017f96.
66. Wißotzki, M., Timm, F. & Stelzer, P. 2017. Current state of governance roles in enterprise architecture management frameworks. In International Conference on Business Informatics Research. 3–15. doi: 10.1007/978-3-319-64930-6_1.
67. Wikusna, W. 2018. Enterprise architecture model for vocational high school. International Journal of Applied Information Technology, 02(01): 22–28. doi: 10.25124/ijait.v2i01.925
68. Ylinen, M. & Pekkola, S. 2018. Looking for a five-legged sheep: Identifying enterprise architects' skills and competencies. In 19th Annual International Conference on Digital Government Research: Governance in the Data Age. [1-8]. doi: 10.1145/3209281.3209353.
69. Zhang, M., Chen, H. & Luo, A. 2018. A systematic review of business-IT alignment research with enterprise architecture. IEEE Access, 6: 18933–18944. doi: 10.1109/ACCESS.2018.2819185.