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Title: Examining Enterprise Architecture Definitions : Implications from Theory and Practice

Year: 2019

Version: Accepted version (Final draft)

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Please cite the original version:

Nurmi, J., Penttinen, K., & Seppänen, V. (2019). Examining Enterprise Architecture Definitions : Implications from Theory and Practice. In IRIS 41 : Papers of the 41st Information Systems Research Seminar in Scandinavia (pp. 1-12). Association for Information Systems. Selected Papers of the IRIS, 9/2018. <https://aisel.aisnet.org/iris2018/9>

Examining Enterprise Architecture Definitions – Implications from Theory and Practice

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Abstract. This study explores the evolving discipline of Enterprise Architecture (EA) and the various definitions given to EA in literature and by practitioners. Due to the potential benefits, such as business and IT alignment, academics and practitioners have maintained an interest in enterprise architecture. EA has been developed outside scientifically tested foundations, and is characterized by diversified views, seen in varied definitions given to the concept. Prior research has identified the need for conceptual strengthening as a necessity for maturing the discipline. We contribute to this ongoing discussion with a systematic literature review on the state-of-the-art of EA definitions and 26 in-depth practitioner interviews. Our study indicates that while there is still no shared definition of EA, its scope and purpose are increasingly extending from the original purpose of IT-business alignment towards a tool of holistic organizational design and development in the system-in-environment setting

Keywords: Enterprise Architecture, Definition, Literature Review, Interview

1 Introduction

Enterprise architecture (EA) has maintained the interest of academics and practitioners for thirty years. EA is often characterized as a tool for aligning business and IT [1], an issue still judged as one of the top three management concerns [22]. Recently the potential of EA has also been acknowledged as a means to cope with the increasingly challenging and continuously changing problems that emerge from, e.g., digitalization, new technological innovations, and progressive complexity of business models and environments [19].

Definition of enterprise architecture varies by its use [18, 39] and a number of definitions have been suggested [35]. Lack of common understanding concerning the scope and meaning of EA occurs among researchers and practitioners [18, 30], which leads to difficulties in structuring a baseline of knowledge in the field [31] and makes it complicated to talk about EA as a discipline [32].

The need for examining various definitions of EA has been noted by previous research. For example, [14] state that a clear academic definition should be established, as well as unified understanding of the separate terms “enterprise” and “architecture”.

[32, p. 81] state that “It is clear there are not enough relevant publications about this theme [lack of shared meaning] even within the increasing publication on EA.” In addition, [31] note that the few studies focused on the lack of common understanding have not used a systematic methodology.

EA is an evolving discipline, with its roots outside scientifically tested foundations. Recently various systems approaches have been applied in EA research, and the idea of viewing enterprises as systems has had a growing support [3, 19]. The systemic stance on the research of organizational development has a steady support in related fields, such as enterprise engineering and system of systems engineering, and similarities between EA and various systems approaches can be seen [27]. For example, some common elements covering systems thinking and systems theories are the following: systems approaches are holistic; systems consist of wholes comprising of parts, or subsystems; systems exist in the midst of their environment, are defined by their boundaries and evolve over time; system and subsystems appear hierarchical and can be “open”, i.e. they are taking inputs from and sending outputs to the environment [25].

Prior research in the field of EA (e.g. [9, 10]) discusses the systemic nature of an enterprise, and the demand to study the relations between the EA and systems approaches has been phrased [3, 19]. [15, p.93] notice that “[...] the EA trend of applying holistic systems thinking, shared language, and engineering concepts, albeit in the early stages of their application, is here to stay”. Furthermore, [30, p. 138] state the “importance of systems thinking and, especially, of adopting the open systems principle, for managing EA design and evolution”. Applying holistic principles and system-in-environment paradigm in the field of EA is discussed by Lapalme [18], according to whom the diversified views about the scope and purpose of EA can be classified as three schools of thought (see Section 4). These taxonomic classes include Enterprise IT architecting, Enterprise integrating, and Enterprise ecological adaptation. The latter two require, according to [18], holistic principles and apply system-in-environment paradigm.

In this paper, we address the call to find a steady definition of EA that would be shared by both academics and practitioners. We do this by focusing on the streams of studies that have applied systems theories or systems thinking to the EA problem domain. These are not only found as a promising branch in the EA research but also it can be assumed that the systems orientation would encourage the researchers to emphasize the conceptual accuracy. In the light of the previous considerations, the research question of this paper is: How convergent are the definitions of EA by academics and practitioners? Therefore, the goal of this paper is twofold. First, we review the previous systems-oriented EA research and compare the definitions presented therein with Lapalme’s [18] “Schools of thought on Enterprise Architecture” to see how these taxonomy classes encompass different views perceivable within the said studies. Then, we analyze the data from 26 in-depth practitioner interviews to find whether the practitioners’ perceptions regarding the current nature and objectives of EA do reflect the same ideas.

The remainder of this paper is structured as follows: first, the concept of enterprise architecture is discussed in Section 2. Then, in Section 3 the research methods of this study, i.e. the systematic literature review (SLR) and semi-structured interviews, are

discussed. Section 4 present the analysis and the discussion on the results of the SLR and the interviews. Finally, Section 5 discusses the results, concluding remarks from the presented state-of-the-art account of enterprise architecture definitions are given, and topics for the future research are presented.

2 Prior Research on the Concept of Enterprise Architecture

Some work regarding the definition of EA, or the lack thereof, exists. Previous studies have been conducted as analyses of extant literature as well as reasonably large-scale survey studies. In this section, we briefly review representative examples of the both approaches.

[35] reviewed a total of 126 EA related research papers from 1987 to 2008 and concluded that majority of these do not define enterprise architecture in a comprehensive way. Similar results have been published by [32], whose systematic mapping study discussed 171 journal articles from 1990 to 2015 and concluded that 35 % of examined articles do not define enterprise architecture in any way, 35 % mention challenges due to divergent understanding of EA, and 47 recently (2006-2014) published papers mention the lack of shared meaning in the discipline of EA. Furthermore, [31] identified and analyzed 145 definitions. According to their analysis, 42 % of the articles did not present a definition for EA. [30] conducted a literature review covering 85 articles and identified four strands of definitions: the methodology or process guiding the design of EA, the set of principles prescribing the EA design, the blueprint of an enterprise in its various facets, and the inherent structure of an enterprise.

[14] conducted a survey study with 376 responses from executives, enterprise architects and various other professions. The goal of their study was, among others, to examine how the respondents defined the purpose and function of EA. According to the results [14], the purpose and function of enterprise architecture is, respectively, to provide an organizational blueprint, to be a planning tool, to facilitate systematic change, to act as a tool for decision making or alignment, and to help in communicating organizational objectives.

Similarly, [23] compared practitioner and researcher definitions of EA with an interpretation method and conducted a LinkedIn survey of 308 participants. Their results indicated the correspondence between the views of academics and practitioners. [23] used the hermeneutic phenomenology-based interpretation method to compare these results, along with academic definitions gathered by [6] against EA definitions given in TOGAF and Zachman Framework. The results suggest that definitions presented in the latter are partially supported when compared to practitioner definitions. Regarding academic definitions collected by [6], TOGAF was found to be fully supported and Zachman Framework mostly supported.

Although there is some prior research discussing the evolving definition of EA, scholars and practitioners seem to struggle to establish a definitive and commonly agreed definition for the concept. More unsettling is that a significant number of research papers make no attempt to define EA at all. While above mentioned studies make

valid contributions on defining EA and fostering shared understanding, the definitive agreement remains still to be found, though often asked in prior research.

3 Methods of Study – Literature Review Protocol and Semi-Structured Interviews

In this section the research methods of this study, namely the systematic literature review (SLR) and semi-structured interviews, are discussed. In order to ensure a comprehensive look on the state-of-the-art account of systems-oriented EA definitions, we screened the prior literature broadly. To see whether the practitioners' perceptions regarding the current nature and objectives of EA reflect the same ideas that literature states, we conducted 26 in-depth practitioner interviews, and compared the distributions between the sources. Next, these methods of study are discussed in more detail.

3.1 Literature Review

In our literature review, we followed the guidelines suggested by [40]: formulating the problem, searching the literature, screening for inclusion, assessing quality, extracting data, and analyzing and synthesizing data.

To ensure a comprehensive look into the state-of-the-art of systems-oriented EA research, relevant literature was searched from Google Scholar, Scopus and IEEE Xplore Digital Library, and to ensure broad enough literature coverage, journal and conference articles as well as books were considered. [40] also make a notion that the review process should be described. This study had the following inclusion criteria. First, we used the following search string: "enterprise architecture" AND ("system thinking" OR "systems thinking" OR "system theory" OR "systems theory"). Second, as the EA is an evolving research area, we excluded all the work not published in the 21st century. Third, the studies had to be written in English and accessible. Due to limited options in filtering the search results in Google Scholar, the amount of initial results was extensive, a total of 3457 results was found. Even the advanced search in Google Scholar allows only two options for search terms to appear: either in the title of the article, or anywhere in the article. We chose to allow the search terms to appear anywhere in the article, and manually screened the titles, abstract and keywords of the articles, until the research material was saturated. As we aimed to review particularly the previous systems-oriented EA research and compare the definitions presented therein with Lapalme's [18] "Schools of thought on Enterprise Architecture", we included articles, that explicitly defined enterprise architecture and mentioned some systems approach.

By using these criteria, 156 studies were chosen for a more thorough inspection. After excluding articles which did not contribute to our research question, we found 35 papers that presented an EA definition suited for the further analysis, were included to the study.

3.2 Practitioner Interviews

This study is part of a qualitative longitudinal research project researching the implementation of the Finnish national enterprise architecture method. The research constitutes of two rounds of semi-structured, in-depth interviews. The aim is to understand different stakeholders' views in a particular context. This study is a cross-sectional analysis of the meanings interviewees have on the EA concept in the second-round interviews.

The second round of data was collected from 26 semi-structured interviews during the summer 2017. The interviewees represented stakeholders from different levels and sectors of Finnish public administration and IT companies (Table 1). The selection of interviewees was based on purposeful sampling [28] in order to capture variation in the data in terms of both assumed information intensiveness and stakeholder population. In one interview there were two representatives of one city simultaneously.

The interview questions concerned the respondents' views of current and future condition of the Finnish national EA. The interview themes and related questions were derived from the results of our previous studies. The interview questions were divided into four parts: questions of 1) background information of interviewees, 2) previous situations, 3) current situation, and 4) future of EA. The questions covered macro- and micro-level issues. Past- and future-related questions covered issues of Finnish national EA and interviewees' perceptions of how it has affected their own work. Current situation questions were different for the interviewees from the public and private sectors. Interviewees from the public sector we asked questions about EA in the organizations they represented, and interviewees from the private sector we asked questions about their public-sector client organizations. The interviews lasted from 36 to 100 minutes, the average being 63 minutes. The interviews were transcribed and analyzed with the ATLAS.ti software.

Table 1. Interviewees' occupational position and experience

Organizational level	ID	Experience in EA (years)
State administration	PSstate1	14
	PSstate2	12
	PSstate3	10
	PSstate4	8
Administrative sector	PSsector1	15
	PSsector2	15
	PSsector3	15
Civil service department	PSdepartment1	10
	PSdepartment2	16
	PSdepartment3	40
	PSdepartment4	10
City	PScity1a	10
	PScity1b	20
	PScity2	10
	PScity3	3

	PScity4	10
IT company manager	ITmanager1	13
	ITmanager2	15
	ITmanager3	17
	ITmanager4	15
	ITmanager5	18
IT company worker	ITworker1	15
	ITworker2	10
	ITworker3	33
	ITworker4	27
	ITworker5	10
	ITworker6	14

4 Analysis and Results

As seen in previous research, EA is characterized by lack of shared meaning and absence of theory. Recently, the relations between EA and systems approaches have been discussed, and the idea of viewing enterprises with a systemic stance seems to have a growing support. Lapalme [18], has presented the "three schools of thought on enterprise architecture", each of which differ in scope and purpose given to the EA. These taxonomic classes include Enterprise IT Architecting, Enterprise Integrating, and Enterprise Ecological Adaptation. While for the first one a mechanistic stance can be applied, [18] argues that the other two require principles of holistic and systemic approaches. According to [18], each of the classes constitutes a different definition to EA, as well as concerns, assumptions, and limitations towards the discipline and its practice. [18, p. 37] also argues that this taxonomy "creates a starting point for resolving terminological challenges to help establish enterprise architecture as a discipline." Moreover, the taxonomy classes serve as a solid basis for examining the recent trend of applying systemic approaches on EA. To examine how convergent are the definitions of EA by academics and practitioners, and how well different schools of thought represent them, we base the analysis of our qualitative data on the taxonomy's classes, which can be summarized as follows (c.f. [18]):

1. Enterprise IT Architecting: Here the scope predominantly covers the IT assets of an enterprise and the various operations that use the IT capabilities. The purpose is to reduce IT costs through technology reuse and by eliminating duplicate functionality.
2. Enterprise Integrating: Here the scope extends to cover all the facets of an enterprise with the purpose to support the strategy execution by maximizing the coherency of the interwoven structure of various aspects within an enterprise including, but not focusing only, on the IT.
3. Enterprise Ecological Adaptation: Here the scope reaches to the surrounding environment of an enterprise with the purpose to enable organizational learning, innovation and system-in-environment adaptation.

Definitions found from literature and given by practitioners were classified to the schools of thought. If certain definition did not, in terms of scope and/or purpose, particularly represent any of the three classes, it was classified as “Other”. As seen in Table 2, definition of EA varies by the source.

Table 2. Classification of the EA definitions presented in the literature and proposed by practitioners

	Enterprise IT Architecting	Enterprise Integrating	Enterprise Ecological Adaptation	Other	Total
Literature	[8]; [9]; [12]; [38]; [43]; [45]; [46]	[4]; [7]; [17]; [20]; [21]; [33]; [34]; [36]; [41]; [42]; [50]	[3]; [5]; [16]; [19]; [29]; [44]; [47]; [48]; [49]	[1]; [10]; [11]; [13]; [15]; [24]; [26]; [37]	35
Practitioner	ITworker1	ITmanager1; ITmanager2; IT-worker2; ITworker5; PScity1; PScity2; PScity4; PSdepartment3; PSdepartment4; PSsector2; PSstate4	PSdepartment2; PSsector1; PSsector3; PSstate1; PSstate3	ITmanager3; ITmanager4; ITmanager5; ITworker3; ITworker4; ITworker6; PScity3; PSdepartment1; PSstate2	26
Total	8	22	14	17	61

The definitions found in the literature and given by the interviewed practitioners appear to distribute somewhat similarly over the classes. Neither does the chi-square analysis (4.4711, $p = .215$) of the contingency table suggest that the variables would be dependent. There is no statistically significant difference between the distribution of the definitions presented in the literature and of those proposed by the interviewees.

Seven literature definitions and one practitioner definition were classified to Enterprise IT Architecting school of thought. In this school of thought EA was defined e.g. as addressing the integration of the IT resources and of business resources [45]; as a discipline that addresses the alignment of IT systems with business [46]; and as a framework or tool through which systems can communicate and function together (ITworker1).

Eleven literature and eleven practitioner definitions were classified to Enterprise Integrating school of thought. The definitions included e.g. the following: EA refers to a comprehensive description of all the key elements and relationships that fully describe an enterprise [17]; EA is the planning of all resources under the control of an enterprise, not just IT resources [50]; EA describes the whole and the interconnections, it discusses development, operation, IT systems and technology (ITworker5); EA is a method that concerns wholes and its interconnections, a systematic approach to organizations, business processes, knowledge and systems (PSstate4); and EA is a catalyst between

strategy and execution (PSsector2). Two definitions from the literature [20, 21] were included to Enterprise Integrating school of thought, because they applied systemic stance as opposed to mechanistic stance, although they defined EA as a mean to integrate IT and business resources.

Nine definitions from the literature and five from the practitioners were classified to Enterprise Ecological Adaptation school of thought. Here EA was defined e.g. in the following ways: the goal of an EA project is to define and implement the strategies that will guide the enterprise in its evolution [44]; as the fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution [48]; as thinking and acting, with the implication that “thinking is good design and describing and acting is making things and changes to happen, and leading the change” (PSdepartment2); and as a design idea which concerns the whole and takes different aspects into account (PSstate1).

Eight literature definitions and nine practitioner definitions were classified as “Other”. These definitions, although had much of the same features as other definitions, did not accurately represent any single schools of thought regarding the scope and/or purpose of enterprise architecture. These include, for example, EA as a tool for developing documentation for decision makers (PSdepartment1) and EA as a system formed of specific components with distinct attributes [24].

Interestingly, twelve interviewed practitioners defined EA as a tool, but only one literature source [29] considered EA from this point of view, i.e. as a practical appliance. This might indicate differences between the orientations of academic research and practitioner usage of EA. As noted by [23], from a practitioner perspective, a thing, such as EA, has the value based on its applications, whereas from an academic perspective, a scientific meaning is also of value. Therefore, practitioners might see EA more from a practical perspective, as a tool and the affiliated value propositions.

Many practitioners seem to define EA as a business-oriented tool to design and develop organizations, concerning the whole organization from a holistic perspective, and not just its IT-related aspects. Also, several practitioners pointed out that the EA should not only be the concern of the IT management but rather an organization-wide issue. This notion is also made in prior research. For example, the results by [30] challenge the association of EA being solely an IT-related subject and conclude that the definitions of the scope of EA can be divided into three strands: EA concerns IT elements; EA concerns business capabilities and IT elements; and EA concerns business strategy, business capabilities and IT elements. Although our results are in the same vein, regarding the scope, our practitioner results differ from the results of [30]. Where majority of the research cases in [30] seemed to associate the scope of EA as an IT issue, our results indicate that the scope of EA is extending to more broadly cover the organizational design and development. Although there seems to be differing opinions about the scope and purpose of EA, our results indicate that a systemic stance, as opposed to a mechanistic stance, in defining EA seems to be dominating.

5 Discussion and Conclusions

The aim of this study was to contribute to the discussion concerning the evolving definition of enterprise architecture. We conducted a systematic literature review, evaluated prior research and discussed the findings from 26 in-depth practitioner interviews. We compared the EA definitions presented in the literature and by practitioners with Lapalme's [18] schools of thought to see how well these encompass different views perceivable in the EA research. Our study indicates that while Lapalme's schools of thought represent the majority of found definitions, also differing definitions could be found. Notably, the two schools of thought applying holistic thinking and systemic approach, Enterprise Integrating and Enterprise Ecological Adaptation, covered the major part of the presented definitions. Enterprise IT Architecting was the class into which the smallest number of definitions fitted, and only one practitioner considered EA from this perspective. It seems that the scope and purpose of the EA are increasingly extending from the original purpose of IT and business alignment towards a tool of holistic organizational design and development in the system-in-environment setting.

There are few limitations to our study. The literature analysis was done solely by the first author. The data from the practitioner interviews were analyzed by the first two authors, yet the intercoder reliability was not tested. Therefore, it is possible that the results reflect some accents of the individual researchers. Also, due to the extensive volume of definitions given to the enterprise architecture, we could not include all of these in our analysis. In terms of the literature coverage, we could have used different or more general search terms. Still, we believe that the included articles well represent various definitions given to EA, and that the research material was saturated [40]. To ensure the reliability, we described the methods of our study as transparently as possible. As EA is an evolving discipline, also the definitions are expected to evolve. This means that with the same search phrases, different results could occur in the future. Similarly, the interviewees uttered their individual views at the time the research was conducted.

Concerning the recent trend of applying systems approaches in the field of EA, their characteristic elements seem to resonate with the identified EA definitions. One common trait of various systems approaches is to consider systems as wholes, consisting of interrelated subsystems. Similarly, Lapalme's Enterprise Integrating school sees enterprise holistically, where "different aspects of the organization form a complex fabric of reinforcing and attenuating dynamics". Several practitioners and definitions presented in the literature stated that EA should concern the whole enterprise, including interconnections between different parts. Furthermore, a common trait of different systems approaches is to consider systems to evolve over time. Enterprise Ecological Adaptation school of thought sees EA as means of "fostering organizational learning by designing all facets of the enterprise - including its relationship to its environment - to enable innovation and system-in-environment adaptation" According to the interviews, EA is frequently seen as a tool for organizational design and development.

Although Lapalme's taxonomy classes seem to represent current definitions of EA moderately, the inclusion criteria for different taxonomy classes are not entirely unambiguous, and several included definitions did not fit to any particular class either by the

scope or the purpose. Future research should examine if these classes accurately represent the evolving definitions of different EA communities, and possibly suggest a different taxonomy. According to the results from practitioner interviews, EA was frequently seen as a tool, a supporting function or a method amongst other methods, with which to design and develop organizations. This practical viewpoint is not distinctly included in the examined taxonomy classes. Also, while definitions are scattered, both academic and practitioner communities seem to favor a systemic stance. There is a clear need for further research discussing the implications of systems thinking in EA.

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