ENTERPRISE ARCHITECTURE EVALUATION: A SYSTEMATIC LITERATURE REVIEW

Completed Research

Andersen, Peter, Aarhus University, Aarhus, Denmark, andersen@badm.au.dk

Carugati, Andrea, Aarhus University, Aarhus, Denmark, andrea@badm.au.dk

Abstract

By being holistically preoccupied with coherency among organizational elements such as organizational strategy, business needs and the IT functions role in supporting the business, enterprise architecture (EA) has grown to become a core competitive advantage. Though EA is a maturing research area, little has been done to understand how e.g. projects, application or other organizational elements contribute to the overall EA. The current paper presents a literature review on EA evaluation. Different types of evaluation are a necessity in order to ensure that EA demands are being met by disparate IT initiatives. Still, EA evaluation has attracted little attention within academic literature. Thus, the aim of the current review is to get an overview of the topic, which can serve as a foundation for further development of the field. Overall, the study shows that while little research has been done within this area, research is especially lacking regarding empirical studies of how EA evaluation unfolds in practice, while holistic views on EA evaluation is almost non-existing.

Keywords: Enterprise architecture, evaluation, literature review, measurements

1   Introduction

In a world more and more driven by information technologies, and where increased efficiency through IT and enhanced decision-making through the use of data has become pivotal in order to obtain, or sustain, competitive advantages, EA, and related fields, have become more important than ever (Zachman 1997). Owing to the fact that EA, at its core, facilitates: "The analysis and documentation of an enterprise in its current and future states from an integrated strategy, business, and technology perspective" (Bernard 2012), EA enables coherence across the business – between business units, strategy, management and IT.

Traditionally, EA has been concerned with understanding and representing the fundamental component of the enterprise through modelling methods and notations. Meanwhile, little attention has been paid to the set-up and implementation of EA concepts in organizations (Löhe and Legner 2012). As also pointed out by Löhe and Legner (2012), EA management (EAM) suffers from not being properly embedded into the organization and existing IT management practices. Thus, while EA research and practice has mainly been preoccupied with the overall analysis and documentation of the enterprise, knowledge is lacking when it comes to how the ideas and architectural plans are realized through everyday projects, system implementations etc. and how these elements contribute to the architecture. As a result of this lacking operationalization of EA, architectural teams in businesses and the field in general, have often been criticized for acting as an ivory tower (Koch 2005), whose models and theoretical discussions are disconnected from the practical concerns of businesses – thus not adding any value to the organization.

Since EA is a rather new field, its attention to the conceptual levels seems like a natural point of departure. On the other hand, it also seems timely – more than 25 years after Zachman's seminal paper (1987) –now to consider how the goals and benefits defined through EA can be ensured through the operational activities that shape and transform today's enterprises. Furthermore, by moving from being a predominantly technical discipline focused on narrow technological problems and solutions towards being a business discipline, EA needs to provide more clear indications that IT initiatives are moving the business in the right direction (Fonstad and Subramani 2009).

How to link both individual projects objectives with enterprise-wide objectives has been explored by Fonstad and Robertson (2006), who stress the importance of ensuring alignment between the three levels of the business: company level, business level and project team level. This is done through for example company-wide governance and linking mechanism (Fonstad and Robertson 2006). Though these general guidelines exist, both practice and theory seems to lacks actual indications on how each project contributes to the overall architecture. This motivated the research behind the current paper, with the aim to address the lacking knowledge on how EA can be implemented by seeking to understand the ways to evaluate how different elements contribute to a given architecture. The outset of the paper was the following research question: *"What is the current knowledge and research on EA evaluation?"* and *"What are the research gaps that need to be addresses within this topic?"*

The paper is organized as follows. The next section further conceptualizes EA and EA evaluation in order to give the reader an overview of the studied field. This conceptualization of EA was additionally intended to guide the further analysis of the reviewed literature by identifying common ways to evaluate the contribution to EA. The conceptualization is followed by an elaboration of the methodology of the review, and successively the analysis of the contributions identified through the search process. Hereafter, current research on evaluating EA is discussed. Based on the analysis and discussion, a conclusion is made on the state of current research and directions for possible further research – hereby addressing the two research questions.

In order to better understand how EA can be evaluated, an overall understanding of EA and its main concepts is necessary. Accordingly, the following paragraph will provide a conceptualization of EA as a foundation for the further review.

2   Conceptualizing enterprise architecture evaluation

Since EA emerged as a field in the beginning of the 1980s with IBMs 'Business System Planning method' (Ahlemann et al. 2012; Zachman 1987) and the later development of the Zachman framework (Zachman 1987), EA has developed both within academia and practice. Still, EA as a concept is associated with a great deal of ambiguity (Kappelman 2010 p. 1). Nonetheless, finding types of evaluation relevant to EA requires an understanding and conceptualization of the topic. The following definitions of EA are used in this paper as outset for the further conceptualization.

	Definition	Main concepts
CISR (2014)	"the organizing logic for business process and IT capabilities reflecting the integration and standardization requirements of the firm's operating model."	Integration and standardization of core processes
Lankhorst (2005 p. 3)	"a coherent whole of principles, methods, and models that are used in the design and realisation of an enterprise's organisational structure, business processes, information systems, and infrastructure"	Design and realization of organizational structure, business processes, information systems and infrastructure.
Bernard (2012 p. 31)	"The analysis and documentation of an enterprise in its current and future states from an integrated strategy, business, and technology perspective"	Integrated view of strategy, business and technology.

Table 1.   Common enterprise architecture definitions

From the above definitions, it is evident that EA is a broad concept. For this reason, it can be challenging to grasp all the elements of EA and how they relate to each other. Because of this, a number of EA frameworks exists which describe the key elements of the EA. These frameworks are often divided into different subdomains which in some cases can be further subdivided (Kappelman 2010 p. 247). For example business architecture, information architecture, and technical architecture (Kappelman 2010 p. 247), or data architecture, application architecture, and technology architecture (Spewak and Hill 1993). This allows a level of abstraction for the EA architects. However, the definitions above (Table 1) also stress how EA is concerned with not only the different technical levels of the organization, but also the tactical and strategic levels of the organization. By being involved in e.g. organizational policy and strategic coherence, the contribution of EA is often related to non-quantifiable elements, and is often valuated in other ways than financial measurements, but instead through evaluation of realized benefits (Plessius et al. 2012a). Some of the benefits identified in literature by Tamm et al. (2011) are reduced risk, improved integration, stability, improved business processes, and increased responsiveness and guidance to change.

Accordingly, EA on the one hand focuses on technological solutions and how technology can help support standardizing existing processes. Thus EA enables alignment between IT and the rest of the business. Through this alignment EA is seen as a driver for enhanced business execution by digitizing routine processes and capabilities (Ross et al. 2006 p. 3-4; Weill and Ross 2009 p. 1-20). But, on the other hand, in order to not only drive efficiency of current processes, but also drive ongoing effectiveness, EA also needs to consider the organizational strategy, and the future state of the organization. For this reason, EA is both concerned with the as-is and the envisioned to-be architecture of the enterprise.

To get an overview of both the current state of the organisation's EA and the envisioned future state, enterprise architects often describe and view their architecture as going through a number of different architectural stages or maturity levels (Open-Group 2009; Ross et al. 2006; Weill and Ross 2009). As enterprises shift from one maturity stage to another, they also shift their investments in IT and business process redesign (Ross et al. 2006 p. 71-72), and with this, their architectural goals and priorities.

Having established a general conceptualization of EA, sufficient to use as an outset to structure the search process for EA evaluation and select the most fitting contributions, the following subsection is intended to give the reader an overall understanding of the plurality of EA evaluation as it is seen in this study.

2.1 Types of evaluation for enterprise architecture

As it has been described in the above paragraph, EA is a broad concept. For this reason, evaluation in relation to EA can take a number of different forms, and can be difficult to conceptualize. In this study, evaluation is understood as it has been defined in the Oxford Dictionary of English which is to: *"form an idea of the amount, number or value of"* (Stevenson 2012). This implies that this study considers types of evaluation of both qualitative and quantitative character. Additionally, evaluations of EA can have a technology focus, but can also focus on strategic or business aspects. All these aspects are, according to the above conceptualization, included in the holistic view on EA. On the one hand, the technology focused evaluations are mainly concerned with systems properties, for example data accuracy (Narman et al. 2011), modifiability (Lagerström et al. 2010), and usage (Närman et al. 2012). These evaluations are usually done using tangible, quantitative measurements. On the other hand, the strategically focused evaluations are mainly concerned with the level of achievements of for example different strategic/business goals (Doumi et al. 2013; Quartel et al. 2012), benefits (Niemi and Pekkola 2009) and the more qualitative aspects. Furthermore, EA evaluations can be considered at a number of different levels. Interoperability, for example, can be viewed from a business, process, service or data level (Elmir et al. 2011). Evidently, one cannot evaluate this concept the same way at the different levels as data interoperability is concerned with semantic properties while other aspects would be relevant in relation to service interoperability. The same holds true for concepts such as agility, which is often considered a strategic goal, but can come from a number of different providers such as technology, people, innovation etc. while covering a number of different capabilities such as responsiveness, competency, flexibility and speed (Sharifi and Zhang 1999; Sherehiy et al. 2007).

Seemingly, evaluating EA is no simple task and requires a range of different evaluation types. However, this gets even more complex if one starts to consider how dissimilarities between organizations can affect which elements should be evaluated and how. As already described, different enterprises can operate at different architectural maturity levels. For this reason, evaluating enterprise agility might not be equally relevant for a low maturity level enterprise – trying to build up their fundamental capabilities, as it might be to a high maturity level enterprise which has already sufficiently standardized their technology, integrated their processes and achieved operational efficiency (Ross et al. 2006). At the same time, other factors such as the size of the enterprise, its current sector, strategy etc. additionally influence which types of evaluation is relevant and how the evaluation can be done. Moreover, evaluations that are done in relation to EA are often not measuring the architecture itself, but elements that are related to EA. For example, services (Närman et al. 2013a), applications (Närman et al. 2012), processes, enterprise systems (Lagerström et al. 2010), architectural candidates (Razavi et al. 2010; Razavi et al. 2009) or projects (Quartel et al. 2012). By covering so many aspects of the business, it is also possible that literature relevant in relation to evaluating delimited EA elements such as process modelling (vom Brocke et al. 2010), might not be explicitly linked to the concept of EA in the written contribution.

Another important distinction for evaluation is whether it is intended for an evaluation of the current situation – through for example service performance (Närman et al. 2013b) or existing processes (Setiawan 2013) – or whether one is trying to evaluate for example project business cases or scenarios representing a future to-be architecture (Gammelgåd et al. 2007; Lange and Mendling 2011). Evidently, types of evaluation used to assess the current situation can be quite different from the ones used to evaluate a future state.

Looking at types of evaluation in relation to EA from a broad perspective, the literature search was conducted on the topic with the aim to identify current research approaches, methods and existing measurements for EA in order to get an overview of how the concept of EA can be evaluated, and in which areas

knowledge is lacking concerning the evaluation of EA. This research process will be further elaborated in the following paragraph.

3   Methodology

Overall, this study followed a process similar to the one described through the framework by vom Brocke et al. (2009). Accordingly, the outset of the study was a definition of the review scope by considering the focus, goals, perspective, coverage, organization and audience of the review (vom Brocke et al. 2009). Regarding scope, it was decided to look after contributions concerned with evaluating elements related to EA, for example, by identifying measurements or methods for evaluation.

 The definition of scope was followed by a conceptualization of the topic and the subsequent literature search and analysis. As illustrated in Figure 1, this happened in an iterative fashion where search and analysis in some cases revealed insights that resulted in changes to the initial decisions about review scope and conceptualization of the topic.
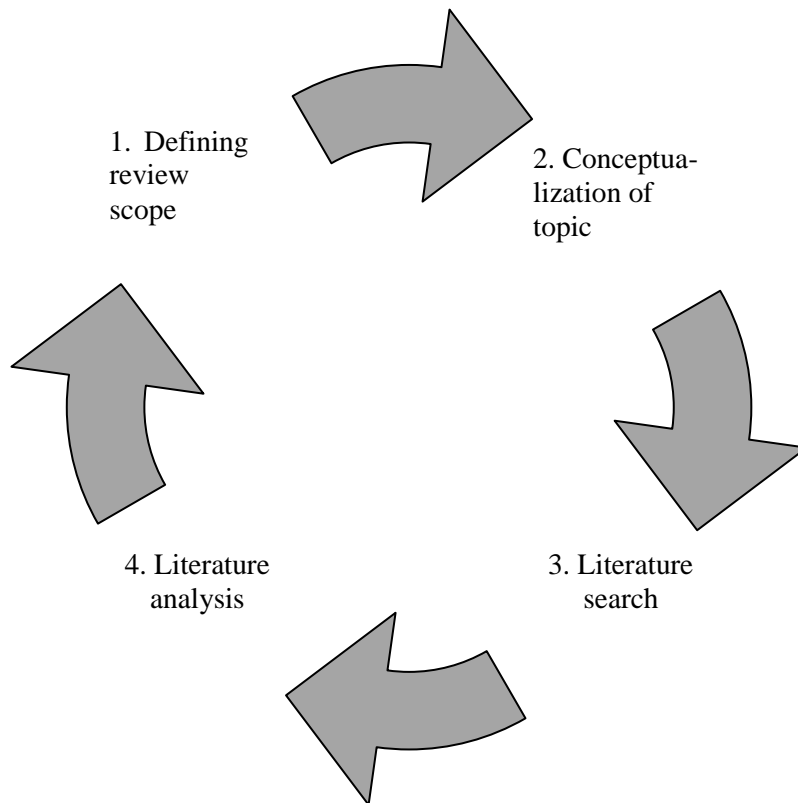
Figure 1. The research process adapted from (Andersen and Svejvig 2013)

Though the conceptualization of the topic did change as new insights were gained through the process depicted above (Figure 1), the initial conceptualization served as an important overall direction and structure through the process. Having established the review scope and conceptualization of the topic, the following step was to conduct the literature search as described in the following.