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The value of and myths about enterprise architecture

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ABSTRACT

Enterprise Architecture (EA) has been embraced by many organizations to improve the value of their IT. Our systematic literature review (SLR) reveals that EA is a broad concept that is interpreted and used in many different ways. This breadth can be explained by the various starting points taken, and by the content-dependent nature of many EA efforts. Unsurprisingly, the literature presents diverse views on value creation and locates the value of EA in a broad range of areas. Only half of the articles provide empirical evidence supporting the EA value claims. Frequently, values are assumed to be the result of EA efforts, but many alternative explanations are possible. Based on the SLR findings, we identify EA myths that are attributable to an overly simplistic conceptualization of EA. These myths have their basis in the claim that EA is an instrument that can solve almost any kind of enterprise problem. This fails to acknowledge that EA in itself often does not provide value, but is an instrument enabling the creation of value. Based on our findings, we recommend demystifying EA by analysing the context-dependent mechanisms behind EA that result in value creation and developing rigorous evidence-based approaches to better understand EA.

1. Introduction

Enterprise architecture (EA) offers a high-level overview of an enterprise's business and IT systems and their interrelationships (Tamm, Seddon, Shanks, & Reynolds, 2011). EA consists of enterprise models and standards that can be used to analyse the current landscape, model future states and develop roadmaps to achieve the envisioned situation (Janssen & Hjort-Madsen, 2007; Lankhorst, 2013). Enterprise models consists of descriptions of business, business processes, information, applications and infrastructure that are often organized in layers, including stakeholder views at different levels of abstraction (Architecture_Working_Group, 2000; Zachman, 1987). The use of EA is assumed to result in value for organizations (Niemi & Pekkola, 2016; Tamm et al., 2011). This includes, for example, the creation of interoperability, flexibility and agility, coherence and the realization of business-IT alignment (c.f. Foorthuis, Van Steenbergen, Brinkkemper, & Bruls, 2016; Lankhorst, 2013; TOGAF, 2011). Broadly speaking, value can be defined as 'a positive effect on the objectives and purpose of an investment' (Becker, Widjaja, & Buxmann, 2011, p. 200). Achieving the expected value from EA is often the main motivation for investing in it (Rodrigues & Amaral, 2010) and establishing an architectural function within an enterprise (Van der Raadt & Van Vliet, 2008). However, achieving this value proves to be more complicated, and there is limited insight into which EA elements result in value (Foorthuis et al., 2016).

Although the field of EA emerged 30 years ago, it still faces a credibility challenge, as many EA practitioners do not see the value returned from the investment made (Kaisler & Armour, 2017). There are numerous value claims in the literature, but these are often not explained or supported by empirical evidence (Niemi & Pekkola, 2016; Tamm et al., 2011). Due to a poor understanding of EA value, organizations also struggle to justify their EA investments (Tamm, Seddon, Shanks, Reynolds, & Frampton, 2015). EA implementation is driven by concepts which might not hold in practice. In this article, we refer to these as myths. 'Myths' are practices and procedures defined by prevailing rationalized concepts to legitimate their actions and resources, but which are not supported by evidence (Meyer & Rowan, 1977). The significant practitioner interest in EA and a poor understanding of the EA value-creation mechanism were the drivers of this study into the value of and myths about EA.

The research aims to gain a clear understanding of EA value by analysing the EA value claims and comparing them with the empirical evidence to identify myths. As we expected that grey literature would not support EA value claims, we focused on journals indexed on the Web of Science (WoS), which should reflect robust research. Based on the findings, value claims which were not supported by empirical evidence were formulated as propositions in the form of myths. These

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myths are often used to justify EA initiatives, but they remain unproven or even incorrect. Identifying myths enables us to place EA in a realistic perspective, to discover blind spots in EA research, and furthermore, to make suggestions for future research directions.

This article begins with a discussion of the origin and background of EA concepts and frameworks. The SLR research approach will then be introduced, followed by the findings of the SLR. Subsequently, the EA myths are discussed by analysing the EA value claims that are not supported by evidence. Finally, the paper concludes with recommendations for further research aimed to demystify this domain.

2. Background

2.1. Origin and development of EA

There are a variety of views and definitions of EA which are dependent on organizational and application aspects (Jallow, Demian, Anumba, & Baldwin, 2017). For example, the Office of Management and Budget (OMB), located within the Executive Office of the President of the United States, positions EA as 'the management best practice which can provide a consistent view across all program and service areas to support planning and decision-making' (OMB, 2012, p. 5). This definition focuses on unifying practices across domains and emphasizes strategic planning. EA provides a long-term view of a company's processes, systems and technology and can be viewed as a kind of destination plan (Ross, Weill, & Robertson, 2006). The ISO/IEC 42010 (IEEE Std 1471-2000) standard defines architecture as 'the fundamental organization of a system embodied in its components, their relationships to each other and to the environment, and the principles guiding its design and evolution' (ISO/IEC, 2007, p. 3). EA has also been defined as 'a coherent whole of principles, methods, and models that are used in the design and realization of an enterprise's organizational structure, business processes, information systems, and infrastructure' (Lankhorst, 2013, p. 3). EA can guide the design decisions of projects which might develop project-start architectures (PSA) (Wagter, Van den Berg, Luijpers, & Van Steenbergen, 2005). The level of abstraction in EA ranges from strategic to operational, and from short to long term.

In practice, EA knowledge is often summarized and systematized using 'EA frameworks' (EAFs) (Schekkerman, 2003). There are over 90 EAFs in the literature or on the web (Kaisler & Armour, 2017). The origin of these EA concepts and frameworks lies in several domains. Moreover, the EAFs in these various domains were developed more or less independently of each other, as shown in Fig. 1. This explains why EAFs have quite a variety of forms and elements.

The origin of EA in the IS community can be traced back to the publication of Zachman's article *A Framework for Information Systems Architecture* (Zachman, 1987). The Zachman framework is generic and thus not limited to a certain industry. The more recently developed TOGAF (The Open Group Architecture Framework) (TOGAF, 2011) is also generic, but has a different scope and working methodology. At the same time, several domain-specific EAFs have been developed. For example, the US federal government and military have developed specific EAFs to serve their IT strategy. For example, the FEAF (Federal Enterprise Architecture Framework) emphasizes the evaluation of the federal government's IT investment (OMB, 2013), while the DoDAF (The Department of Defense Architecture Framework) aims at information sharing across departments, Joint Capability Areas (JCAs) and mission, component and programme boundaries (DoD, 2010).

A complementary process of development of EAFs can be found in the manufacturing and systems engineering community (Bernus, Noran, & Molina, 2015). In the 1990s, these communities adopted fundamental systems engineering concepts and methods, such as systems lifecycle, recursion of systems lifecycle relationships and systems modelling (Bernus et al., 1996). Various schools have codified their industrial experience in the form of architecture frameworks, such as PERA (Purdue Enterprise Reference Architecture) and CIMOSA (CIM Open Systems Architecture). Subsequently, GERAM (Generalised Enterprise Reference Architecture and Methodology) was proposed by absorbing the knowledge and experience of predecessors.

The heterogeneity of EAFs can be explained as the result of the various domains using their own concepts, leading to different sets of EA vocabulary, taxonomies, tools and methodologies. As the domains differ, the problems EA is designed to address also differ, resulting in different starting points. For example, the manufacturing industry demands methods and tools for integrating information and material flow throughout the enterprise, while governments emphasize information sharing to implement more efficient public services. The knowledge captured in the EAFs lies in the practices and understanding of EA practitioners working in different industries. Among the diverse domains there is a lack of agreement about what encompasses an EA (Dang & Pekkola, 2017; Walrad, Lane, Wallk, & Hirst, 2014). This lack of generally agreed upon terminology in EA is also a bottleneck for its efficient application, because it creates obstacles to its correct understanding in practice (Chen, Doumeingts, & Vernadat, 2008). Moreover, the predominant problem-driven nature of EA practice also makes it difficult to determine what constitutes EA (Koning & Van Vliet, 2006). This is because the content of EA is not an inherent property but is contingent on the purpose that the model is intended to serve (Johnson, Lagerström, Närman, & Simonsson, 2007).

2.2. The need to understand EA value

There are two main reasons why organizations need to have a clear understanding of EA value (Rodrigues & Amaral, 2010): 1) to access the returns of EA initiatives and understand their risk; and 2) to align various stakeholders with different value expectations. Furthermore, a clear understanding is needed to determine whether the EA will ensure that the intended value can be accomplished.

The value of EA has to be understood and demonstrated in order for organizations to justify investment in building EA capability (Bernus et al., 2016). They also need to manage their expectations of EA programmes with regard to the timeframe for seeing a return on investment (ROI). Industrial surveys have found that almost half of the respondent organizations struggle to justify investment in EA, and that EA projects may be stopped due to financial pressure or the lack of perceived value (Rodrigues & Amaral, 2010; Tamm et al., 2015). In conclusion, the value of EA remains poorly understood in many organizations.

Another important reason to have a clear understanding of EA value is related to the communication required to align different stakeholders. EA proponents argue that there are several potential values that can be achieved for the organization by realizing EA capability. A positive perception of EA value is very important to ensure the continuous commitment of stakeholders to EA efforts. It is easy to find references to a large number of claims about the value of EA in the literature, some of which are classified or grouped in different ways. For example, Nogueira, Romero, Espadas, and Molina, (2013) classify EA value into business-related and IT-related categories, while Foorthuis et al. (2016) classified EA in terms of the organization and the project perspectives. However, these demonstrations of EA value are either superficial – that is, they refer to only a number of citations and do not give a detailed account – or fragmented, with various publications referring to different values. The literature that does present explanatory insights into EA value often focuses on a single aspect, such as alignment (Alaeddini & Salekfard, 2013) or cost reduction (Kappelman & Zachman, 2013). To the best of our knowledge, a synthesis of EA value with regard to its credibility has not been reported in the literature.

3. Research methodology

A systematic literature review (SLR) is 'a systematic, explicit, and reproducible method for identifying, evaluating, and synthesizing the

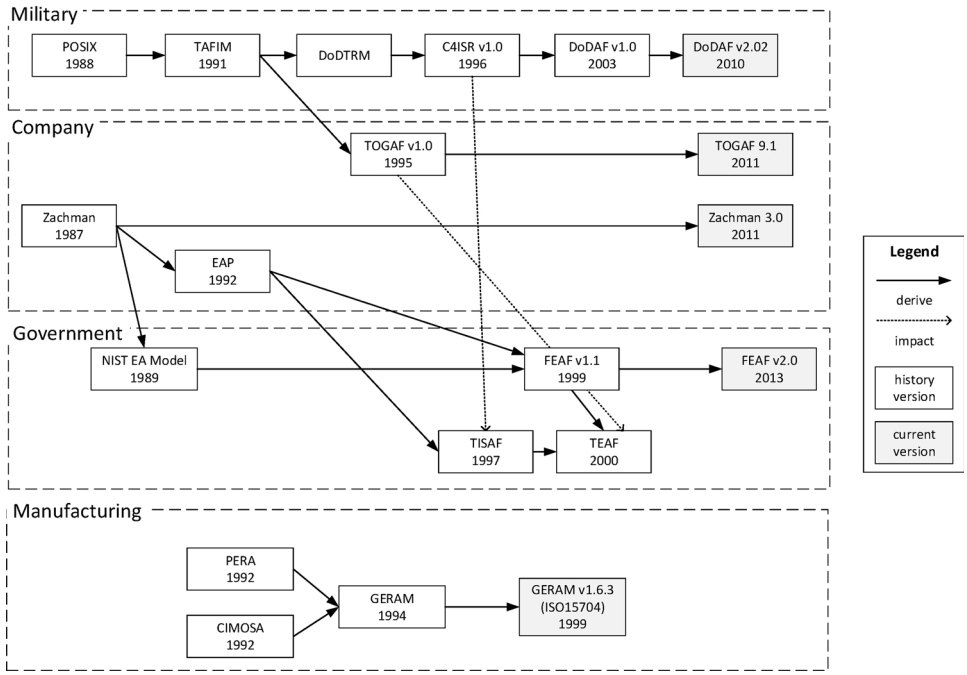

Fig. 1. The development of EA frameworks in different domains (to June 2017) (based on Bernus et al., 2015; Romero & Vernadat, 2016; Schekkerman, 2003).

existing body of completed and recorded work produced by researchers, scholars, and practitioners' (Fink, 2005, p. 3). We performed an SLR to discover which EA values are discussed in the literature, and to determine what is supported by evidence and what is not. Our SLR process followed the main guidelines provided by Okoli and Schabram (2010): 1) search for the relevant literature, 2) practical screening, 3) quality appraisal, 4) data extraction and 5) synthesis of studies.

We used the Web of Science (WoS) search engine to find high-quality journal articles in its SCIE and SSCI indexes and create a literature database. All kinds of claims about EA value can be found in the literature without any support, therefore we limited our research to WoS to ensure that only articles published in high-quality journals were included. An additional advantage of using the WoS search engine is that the system provides an additional keywords summary called KeyWords Plus. The keywords in KeyWords Plus are index terms created from significant, frequently occurring words in the titles of references cited in the articles. This enables the discovery of articles that may not have appeared in the search due to changes in scientific keywords over time. For example, some early publications might not have used the term EA but instead referred to the 'Zachman Framework' in their abstract and keyword list. The use of KeyWords Plus may minimize the impact of keyword changes on the search of literature.

The use of WoS enables a rigorous and repeatable literature review that other scholars and readers can check, and through which they can retrieve the same search results using WoS at anytime. Furthermore, as we placed strong emphasis on the credibility of the literature to be analysed, it was important to focus on publications in high-quality journals. Focusing on journal articles should ensure the quality of the SLR outlets and the representativeness of the reviewed articles (Chu, Luo, & Chen, 2018). This approach has been widely adopted in prior SLR-based research (Cao, Basoglu, Sheng, & Lowry, 2015; Chu et al., 2018; Soomro, Shah, & Ahmed, 2016). Other search engines provide a much larger number of results; however, this might also include less relevant papers. For example, Google Scholar returned more than 50,000 results in searching for 'Enterprise Architecture'. However, the Google Scholar results contain a combination of peer-review articles and books/chapters, conference articles and journal articles of various quality. Thus, one limitation of our approach is that WoS does not cover all possible articles and some values might not have been included. In the sampling a focus on including a few high quality papers was preferred over high coverage rates.

4. Process and findings of SLR

In the first step of our SLR, we used 'Enterprise Architecture' or 'IT Architecture' as the topic, searching for articles published between 2006 and 2016. This resulted in 254 journal articles that contain the above terms in their title, abstract, keywords or KeyWords Plus index.

In the second step, we examined the accessibility of the articles found and excluded those that were either not accessible to us or not written in English. This step resulted in a set of 199 articles.

In the third step, we analysed whether the 199 articles contained statements about the value of EA and the supporting evidence for this. In this step, we found that most articles only defined EA (or described the content) and/or how to use EA approaches or frameworks to design a specific solution, rather than discussing the value of EA. Only 47 (24%) of the 199 articles mentioned the value of EA. These articles were read manually to ensure that we identified and understood what types of values were being claimed, rather than using a keyword search of the text. Many articles mention the value of EA in terms of the effect, roles or goals of EA, but do not provide supporting evidence. In this step, our SLR confirmed the argument of Koning and Van Vliet (2006) that EA practices are predominantly problem-driven. The remaining 76% of the articles found mainly mentioned how to use EA to solve a specific kind of problem, rather than what value was achieved. Often values are only mentioned as the driver of EA efforts, but whether these values are realized is not discussed.

In the fourth step, we analysed the values mentioned in the 47 articles that contained them, of which 11 articles mentioned the value of EA without providing any support materials; 25 articles provided citations to support their claims of EA value; while only 18 articles provided empirical evidence to support the claim that EA results in value. A few articles provided both citations and empirical evidence as support. The empirical evidence was mainly derived from surveys or case studies. Only a small number of articles used interviews or experiments as the source of evidence. An overview of the EA value supported by empirical evidence in the 18 articles is provided in Table A1 in the Appendix.

Table 1
The category of EA value supported by evidence from literature.

Category of EA value	Value Description	References
Strategic and political	Improved business-IT alignment	(Valorinta, 2011) (Alaeddini & Salekfard, 2013) (Smith & Watson, 2015)
	Enable governance and compliance management	(Foorthuis et al., 2012) (Simon et al., 2014) (Smith & Watson, 2015)
	Enhance the management of IT and business capabilities	(Alaeddini & Salekfard, 2013) (Simon et al., 2014) (Tamm et al., 2015)
	Facilitate decision-making in IT investments and the development of new infrastructures, capabilities and so on	(Pulkkinen, Naumenko, & Luostarinen, 2007) (Martin, 2008) (Janssen, 2012) (Tamm et al., 2015)
Transformational	Navigate from strategy to the delivery of projects and portfolio management	(Janssen, 2012) (Simon et al., 2014) (Smith & Watson, 2015) (Tamm et al., 2015)
Communicational	Improve top-down communication	(Pulkkinen et al., 2007) (Janssen, 2012) (Simon et al., 2014)
	Improve communication between business and IT professionals	(Valorinta, 2011)
Economic	Reduce IT costs	(Schmidt & Buxmann, 2011) (Kappelman & Zachman, 2013) (Smith & Watson, 2015) (Tamm et al., 2015)
	Reduce operational costs	(Bradley, Pratt, & Byrd, 2011) (Struijs, Camstra, Renssen, & Braaksma, 2013)
Flexibility and agility related	Increase IT flexibility	(Schmidt & Buxmann, 2011) (Janssen, 2012)
	Increase agility (responsiveness and speed to market)	(Bradley et al., 2011) (Janssen, 2012) (Struijs et al., 2013) (Smith & Watson, 2015)
Integration and interoperability related	Integrate business processes dispersed across the supply chain	(Marques, Borges, Sousa, & Pinho, 2011) (Struijs et al., 2013)
	Integrate IT resources across the enterprise	(Boh & Yellin, 2006) (Janssen, 2012)
	Integrate IT and human dimension	(Marques et al., 2011)
Inter-organizational	Improve acquisition management	(Toppenberg, Shanks, & Henningsson, 2015)
	Improve external relationships management	(Bradley et al., 2011)
Knowledge management related	Facilitate knowledge sharing between the IT and the business professionals	(Valorinta, 2011)
	Work as a knowledge source for requirement elicitation	(Morkevičius & Gudas, 2011)
Others	Improve end-to-end security by having a total overview	(Pulkkinen et al., 2007)
	Ensure client orientation (client satisfaction)	(Janssen, 2012)
	Enable service availability analysis	(Närman, Franke, König, Buschle, & Ekstedt, 2014)
	Increase spending on emerging technology and innovation	(Smith & Watson, 2015)
	Minimize information overlap and duplication	

In the fifth step, we synthesized the EA values mentioned in the 18 articles by categorizing, summarizing and combining similar EA value descriptions. The EA value categories that are supported by empirical evidence are presented in Table 1, with the references included in the column on the right. The SLR found that the value of EA was related to various aspects of the organization – inter-organizational or internal, strategic or operational, or communicational or transformational. This diversity of EA value perspectives reflects the diversity of EA content, function and focus. The table shows that the value of EA varies considerably, taking different forms depending on the value-creation mechanisms. This also makes EA difficult to study, as the meaning is dependent on the context and the way EA is interpreted. Although the value is often described in the literature, the mechanisms that result in the creation of value are often not mentioned. Therefore, we had to omit the value-creation mechanisms from the table and suggest that further research is required in this area.

EA value claims without having empirical evidence were analysed. Unsupported claims can result in misunderstanding and wrong perceptions on EA. This analysis resulted in formulating propositions in the form of myths, as these propositions are not based on factual evidence. Myths are based on knowledge gaps between EA perceptions and reality and these are used to arrive at further research recommendations.

Our SLR had some limitations. Firstly, the use of WoS might mean that we missed some recent publications that are online but have not yet been indexed by the SCIE or SSCI. Secondly, a large number of journal articles and conference papers are not indexed by the SCIE or SSCI, which means that we did not include them. Thirdly, the manual judgement about which articles were relevant to our study in the third step was subjective to some extent. In some cases, it was difficult to determine whether the text was implicitly referring to the value of EA. For example, Tiwana and Konsynski (2010) concluded that there is some value in IT architecture modularity, finding that an increase in EA modularity can bring benefits to the organization. Although modularity can be considered a property of EA, it is still difficult to judge whether this conclusion could be viewed value of EA. We perceived modularity as a way to create flexibility and reuse, potentially lowering costs through EA. However, we took a conservative approach and did not include this article.

5. Myths about EA value

Myths are appealing stories without a determinable basis in fact or evidence, and they are created to support an argument to initiate action (Janssen, Charalabidis, & Zuiderwijk, 2012). Myths are often rather simplistic and exaggerated, intended to present a clear message that cannot be ignored (Bekkers & Homburg, 2007). Organizations are often driven to incorporate the practices and procedures defined by prevailing rationalized concepts (Meyer & Rowan, 1977), thinking that by doing so, they will increase the legitimacy of their initiatives. Although myths are used to inspire collective action, they may also mystify and blur views about reality (Bekkers & Homburg, 2007). While myths might be necessary for the adoption of certain practices and procedures and are used for this purpose, they are not evidence-based. In essence, myths are fictional or unproven. It can also be argued that only after the adoption of a practice can hypotheses be developed and empirical evidence collected to determine whether the myth has real substance. In our case, limited empirical evidence is reported in the literature, while other claims related to EA value often reveal a conceptually simplistic approach to EA.

Our SLR revealed that many claims about the value of EA are not supported by evidence. Therefore, in this section, we discuss the claims of EA value that are not supported by evidence, identifying the myths about EA value. The myths are thus derived from a set of articles that claim EA value without using empirical evidence. The argument is that although some of the claims might potentially be valid, an oversimplified understanding of them might reduce them to mere myths.

Those myths are characterized as ambiguous, superficial and specious. Different practitioners may have different understandings of myths and the actions they imply. Myths often appear implicitly in publications and have limited explanations. Below, the discussion and demystification of the myths concerning EA value reveals the weakness of current EA research and indicates future research directions.

5.1. Myth 1: EA creates value

EA is sometimes viewed as a silver bullet by organizations (Hjort-Madsen, 2006). We found literature suggesting that EA provides benefits to the enterprise as whole (Kappelman & Zachman, 2013), without further explanation or specification. In contrast, others suggest a complex value chain from IT to the creation of competitive advantage supported by EA (Vargas, Cuenca, Boza, Sacala, & Moisescu, 2016). This complexity results in ambiguity and might result in superficial conceptualizations. EA is seen as a means to create value but in itself only supports the finding of opportunities for value creation or the ability to realize them. In other words, only by using the architecture models and instruments can value be created. As such, a difference between having an architecture and its actual use in value creation should be made.

The use of EA can result in various types of values (Foorthuis et al., 2016; Simon, Fischbach, & Schoder, 2014). Moreover, value creation based on EA is a complex process, and therefore EA activities should be decomposed into value-creation mechanisms. EA efforts such as modelling, for example, are likely to only be moderating variables, affecting the relationship between the activities and the resulting outcomes. Many different but fragmented views on the value-creation process can be found in the literature (Niemi & Pekkola, 2016). For example, it has been reported that an EA approach could provide value for both projects and the entire organization through project compliance, architectural insights and EA-induced capabilities (Foorthuis et al., 2016). At the same time, other research has indicated that while EA is necessary, merely having EA is not sufficient for creating value in specific application contexts, such as data management (Otto, 2012) or security management (Soomro et al., 2016).

One perspective on EA regards it as a planning rather than a development activity, and the differences between these two activities are unwittingly ignored in practice (Wang, Li, Wang, & Jones, 2012). Because they do not have a clear understanding of these differences, organizations usually focus on improper sets of issues when developing EA. In practice, two basic problems often result from improper EA planning (Wang et al., 2012):

- Having a scope for the EA that is too large. This results in an EA that is too ambitious to be successfully implemented.
- Having the EA burdened with a too low level of details.

These problems are the result of an overemphasis on the development of EA artefacts and the lack of attention to EA value-creation mechanisms. EA planning reflects systems thinking in enterprise engineering. It connects the strategy of the organization, the goal of the EA project, the time and budget constraints and the EA capability of the organization to determine the priority of transformation projects and their sequence (Tamm et al., 2015), as well as portfolio management across those projects (Smith & Watson, 2015). In other words, it is aimed at delivering transformational projects that will create value for the organization.

5.2. Myth 2: EA reduces complexity

Some of the literature argues that EA can reduce complexity (e.g. Alwadain, Fielt, Korthaus, & Rosemann, 2016; Boh & Yellin, 2006; Cardwell, 2008; Kang, Lee, Choi, & Kim, 2010). However, EA itself does not reduce complexity; instead it is a way of dealing with complexity, and programmes may be initiated to reduce complexity. However, EA programmes might also increase complexity. Therefore, some scholars have nuanced their argument, claiming that EA can manage complexity (e.g. Chen et al., 2008; Foorthuis et al., 2016; Niemi & Pekkola, 2016; Nogueira et al., 2013). The paradox is that although EA is intended to deal with complexity, it introduces new organizational complexities as new capabilities are introduced. This requires governance of the architecture, the development and maintenance of models, and the communication of its function and connection with the organization. The integration of EA capability into the organization can be challenging and there is a risks that the EA function will not be used in decision-making processes (Tamm et al., 2015).

EA models are often very large because they cover a wide range of concerns and views (Balabko & Wegmann, 2006). Therefore, EA capabilities are sometimes found to be valuable only to large organizations (Närman, Holm, Höök, Honeth, & Johnson, 2012; Van der Raadt, Bonnet, Schouten, & Van Vliet, 2010). There have been attempts in the EA community to simplify EA tools and methods to facilitate the implementation of EA in less complex environments, for example in small and medium-sized enterprises (Bernaert, Poels, Snoeck, & De Backer, 2016). Some EA approaches include many activities and need descriptions that require many resources. For example, version 9.1 of TOGAF (2011) is 629 pages long. In contrast, some EA frameworks take a lightweight approach. For example, the essence of the Zachman Framework (Zachman, 2011) can be explained in a one-page document. Both of these EA approaches have been used in many large organizations (Tamm et al., 2011).

If the complexity of an EA model depends on the EA approach used, complex approaches will not find a place in the market. EA is seen as offering ways to steer and guide the design and evolution of an enterprise. It provides an overview of the IT landscape to enable the design of strategy implementation at a more detailed level. In this sense, the level of complexity of an EA model will reflect the level of complexity of the organization's IT environment. In a complex environment, the role of design efforts is to control the complexity, not to make the environment simpler (Norman, 2010). EA has the same role in strategy implementation, decomposing a complex system into simpler modules (Janssen, 2012). In this way, even if a specific model concerned with a certain issue looks simple, the overall EA model will still be complex. If both the business and IT environment are so simple that it results in a simple EA model, practitioners probably do not need EA because the level of complexity is very low and thus no control over complexity is required.

5.3. Myth 3: EA evaluates all aspects of an enterprise

There are articles suggesting that EA can be used for analysing almost all aspects of an organization (Lagerström, Johnson, & Ekstedt, 2010; Lagerström, Johnson, ö Höök, 2010; Safari, Faraji, ö Majidian, 2016). This might cause another misunderstanding on what constitutes EA and how EA can be used. The literature often emphasizes the importance of having an overall picture and being able to manage the IT landscape as a whole (e.g. Janssen, 2012; Löhe ö Legner, 2014; Närman et al., 2012). This does not mean that all elements are taken into account in detail. Some parts might contain more detail, while a black-box approach is taken for other parts. Detailed descriptions are sometimes needed to create value, while in other situations an abstract description is sufficient. This also means that EA cannot evaluate every detail and every aspect. EA is often developed for a certain purpose and the data collected cannot be used for other purposes.

The ambiguous point of this claim is that it often implies that practitioners should collect as much information as possible. Textbooks and many EA frameworks also prescribe the coverage of all domains/layers or views in architecting. Some arguments are even threatening. For example, Zachman has been known to say: 'One day you [or your enterprise] will regret not having completed the schema' (Avancier,

2015). By 'completed' he means that every cell of the framework should contain a related architecture description, every level of architecture description should be completed and every level should be completed to the highest possible level of detail (Avancier, 2015).

In our SLR, no evidence was found to support this claim. Furthermore, the literature suggests that the landscape is changing and an overall picture of it might become inadequate over time (Simon et al., 2014). One study demonstrated that the Zachman Framework is not comprehensively applicable in organizations, and simplification of the framework is often necessary in practice (c.f. Ylimäki ö Halttunen, 2005). Finally, describing everything is a waste of resources and money, and might not be useful at all. Not all domains (e.g. not all data, interfaces, software and their relationships) need to be described. Description always requires a trade-off between the effort required to do so and the potential value. A comprehensive and detailed description of the landscape is often neither feasible nor desirable (Martin, Dmitriev, ö Akeroyd, 2010).

5.4. Myth 4: EA should only capture the situation envisioned

In the literature, EA has two major functions (Foorthuis, Hofman, Brinkkemper, ö Bos, 2012): to provide decision-makers with a clear and comprehensive descriptive overview of the IT landscape, and to provide a prescriptive framework to guide and constrain the subsequent development of business and IT solutions. While the descriptive function relates to the 'as-is' situation, the prescriptive function focuses strongly on the 'to-be' situation. The to-be situation often receives attention as it addresses the innovation of IT with new technologies (Iyamu, 2012), standards (Boh ö Yellin, 2006) or IT management methods (Löhe ö Legner, 2014). In a literature study by Hsing and Souza (2013), 79 out of 101 (78%) EA articles presented prescriptive models. Some researchers have even stated that architecture should only be prescriptive and no description of the current situation is necessary to develop a strategy (Hoogervorst, 2004). However, if these claims appear in isolation, it might lead to an overemphasis on the future situation. Moreover, there is often no greenfield, and creating new systems might only make the landscape less coherent and result in more fragmentation. If you do not know where you stand, you also do not know which direction you should take in order to reach your destination.

Descriptive EA is important due to the need to deal with a complex landscape. The underlying theoretical notion of path dependence explains how the set of decisions one faces in any given circumstance is limited by the decisions one made in the past (Djelic ö Quack, 2007). The concept of path dependence originates from the field of economics, where it is used to explain how technologies are accepted in society; such as the adoption of the QWERTY keyboard (Arthur, 1989; David, 1985). Contemporary research indicates that path dependence at the level of the individual organization can occur not only as a result of technological considerations, but also based on the institutional framework chosen or set of rules adopted (Heffernan, 2003). Path dependences are important; for example, data stored in legacy systems might need to be used in the future, while the resources and competences of people limits which opportunities can be realized.

Organizations can transform the as-is architecture to a planned to-be architecture through all kinds of implementation projects (Goethals, Snoeck, Lemahieu, ö Vandenbulcke, 2006). The evolution of an organization is impacted by its current IT technology strategic decision, organizational design, rules in management and other factors. In this sense, the as-is EA serves as an input to build the to-be EA. The foundation of any to-be EA initiative must be an adequate documentation of the as-is EA (Schmidt ö Buxmann, 2011).

5.5. Myth 5: EA is a one-time effort

EA requires continuous effort to be kept actual due to developments in the environment and within the organization. EA should not be viewed as a one-time exercise. The literature reports that the typical project setting in IT development (Alaeddini ö Salekfard, 2013; Lê ö Wegmann, 2013) and the hierarchical structure of management (Kuk ö Janssen, 2013) often make the creation of different EA artefacts (e.g. models and principles) a one-time effort or disposable. However, the environment is not stable and many projects influence the shape of an EA. Research often emphasizes the value of EA in governing the changes in projects (e.g. Foorthuis et al., 2012; Simon et al., 2014; Smith ö Watson, 2015). EA needs to accommodate change, evolving with the application of new technologies and with developments in the business environment (Chen et al., 2008). Projects also shape EA (Van der Raadt et al., 2010).

EA should not be approached as a system that is built and, once finished, provides the value. Just as the Tower of Babylon was not built in one day, EA requires a continuous effort to reap the value. An initial document can often be created within a short period of time, and it should be incrementally extended to create value. EA practice evolves gradually over time and needs to be institutionalized.

Building an architecture is not a single activity that has a clear beginning and end. EA is influenced by its use, as the people who use it, interpret it, provide feedback for improvement and are involved in reviewing EA (Janssen, 2012). Furthermore, EA should change over time. Objectives might shift, and there might be a need to refocus EA efforts to align with the strategy and environment. The environment is dynamic and changing; for example, new areas might appear, principles might become outdated or new technology might appear. Because of these dynamics, the one-time construction or optimization of an EA is generally inappropriate, if not unfeasible (Schmidt ö Buxmann, 2011). Thus, EA evolves over time. This complicates the identification of the value created by EA, as the type of value changes over time.

6. Conclusions

A clear understanding of EA value is critical to organizations in their decision-making on EA investment. Although much is written about EA value, little research has focused on the empirical evidence for the claims of EA value. There are many EA value propositions, but only a limited number are supported by empirical evidence. The contribution of this study is twofold. On the one hand, it provides a systematic overview of the value that can be generated by EA which is supported by empirical evidence. This enables a realistic consideration of EA investment for practitioners. On the other hand, it advocates a rigorous and evidence-based approach to understanding EA value by discussing and demystifying the value propositions that need further investigation. This indicates future study directions.

Five myths were identified that often appeal to decision-makers and managers, but which are not based on facts or evidence. The first is the belief that simply by introducing EA, value will be created. Instead, EA must be used and operated appropriately to create value. The second myth suggests that EA reduces complexity, failing to understand that EA is an instrument which can deal with complexity rather than reduce it. EA is highly context specific, which makes it difficult to arrive at generalizable results. Conditions such as project compliance, architectural insight and EA-induced capabilities play a major role in realizing the value of EA. These factors are largely independent of the EA function and are related to the political reality. If the facilitating conditions are not right, even an EA function might result in limited value creation. Also the circumstances might necessitate another approach to EA. In volatile situations, flexibility and the ability to respond quickly might be more important, while in more stable situations the ability to harmonize data and to create interoperability might be dominant. Without taking the facilitating conditions and context into account, the results of research are likely to have limited predictive power.

The three remaining myths concern what EA should capture. The myth of EA being a silver bullet that is able to deal with all aspects of an enterprise is not realistic. Again, the focus of EA should be on the

problem at hand. This requires contextualization. The fourth myth emphasizes the need to understand path dependences, suggesting that EA should capture the current, as well as the envisioned, situation. Analysis of the current situation reveals the starting point and enables the development of a plan for gradual change. The fifth myth suggests that EA should not be approached as a system that is built and, once finished, provides the value, but as a continuous effort operating in a volatile environment.

Future research should further investigate the five myths identified. The following topics could be researched to gain more insight into EA value.

1 EA value-creation mechanisms. A comprehensive causal model of EA value realization is yet to be developed. A number of EA value-creation mechanisms are reported in the literature. These models could be the starting point of future research. As different EA values might be created through different mechanisms, it would be interesting to further investigate which values might be created by which mechanisms.
2 Complexity theory and its application in EA for creating value for organizations. The current EAFs enable the management of complexity in architecting by providing methods to facilitate EA development activities, namely the creation and management of EA artefacts. However, to realize the value of EA, we also need to know the methods required to manage the value-creation process. EA value creation could relate to various organizational activities that directly or indirectly deliver value to the organization. The ever changing environment of the organization will make such a process complex and dynamic. Complexity theory, like the concept of the complex adaptive system (CAS), can be used to characterize the phenomenology of organizations in the interconnected world (Merali, 2006). It is, therefore, an interesting new realm for investigation.
3 EA modelling methodology which relates organizational goals to their budget and time constraints. EAFs provide practitioners with various modelling methods or tools to describe current and future situations. Some of them, such as the Architecture Development Method (ADM) of TOGAF, could help in the management of the artefact's lifecycle. However, these methods and tools often focus on the goal of the development, rarely including a consideration of budget and time constraints. This might result in unrealistic EA programmes. Connecting budget and time constraints to the goal of EA modelling will allow for the prioritization of EA development tasks and avoid the inclusion of unnecessary aspects.
4 Based on the theory of path dependence, methods to measure or control the variety of future situations are needed. EAFs provide the same models for practitioners whether they are describing the current or future situation. The idea is that architects should manage the mapping between the two models; for example, between the application architecture for the current and future states. To the best of our knowledge, there is no tool or method that allows architects to compare and control the various future situations by measuring their impact on the organization. Tools such as the balance score card could be used, but they are not integrated with the architecting process. It is, therefore, valuable to develop methods for checking path dependence between the current situation and various future situations. This would allow the feasibility of a future system to be established at the architecture level.
5 Governance of EA evolution across various projects. EA artefacts should evolve alongside the organization through various implementation projects. Governance mechanisms should be in place in EA evolution. The final future direction of research, therefore, concerns the development of EA governance principles and processes that ensure ongoing EA value creation through various projects.

Thus, we call for the demystification of EA value by analysing the mechanisms behind EA and identifying how these mechanisms result in value creation for organizations. These mechanisms should take into account the idiosyncratic nature of organizations, the type of problems that need to be addressed by EA and the drivers of value.

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Appendix A

Table A1

Table A1
EA value supported by empirical evidence in literature.

EA value mentioned	Source of evidence	Article
• Improves the sharing and integration of IT resources across the enterprise	A survey completed by 90 organizations	(Boh & Yellin, 2006)
• Coordinates the planning and design of the solutions to security problems • Guides the decision-making and provides a means to communicate the decisions to be diffused in the enterprise, and also the changes to be addressed	Single case study	(Pulkkinen et al., 2007)
• Helps high-level managers understand the elements of the enterprise they manage	A case study on EA for the earth science activities of NASA	(Martin, 2008)
• Addresses concerns with the integration of the human dimension in information systems • Integrates business processes dispersed over the supply chain	A case study on a pulpwood producing company in Portugal	(Marques et al., 2011)
• The source of knowledge for requirement elicitation	A citation and an experiment on a given EA fragment	(Morkevičius & Gudas, 2011)
• Serves as a boundary object in boundary management and is associated with improved IT alignment • Helps organizational actors cross their boundaries by establishing a shared language and joint practices for knowledge sharing • Facilitates the collaboration between the IT and the business professionals and helps them manage and develop increasingly large and complex information systems	A survey among the CIO and IT managers of Finland's 500 largest companies	(Valorinta, 2011)
• Significantly higher degrees of IT flexibility • Positive impact on IT efficiency: the additional costs of an EA are typically outbalanced by the long-term savings	A field survey within the international financial services industry, involving 85 organizations in 17 countries	(Schmidt & Buxmann, 2011)

(*continued on next page*)

Table A1 (*continued*)

EA value mentioned	Source of evidence	Article
• Manages external relationships • Lowers the cost of business operations • More strategically agile – such as increasing the speed of entering new markets	A survey among 140 CIOs of US hospitals	(Bradley et al., 2011)
• Provides input for compliance assessment of projects	Two empirical evaluations at the Dutch national statistical institute	(Foorthuis et al., 2012)
• Creates and enables interoperability • Ensures client orientation (client satisfaction) • Creates flexibility and agility • Aligns strategy and technology (organizational structure and business processes), including communication • Supports decision-making (making IT investments, design decisions guiding design of new infrastructures, and developing capabilities) • Enables transformation (change support, vision and strategy, and new infrastructures)	Citations and 39 interviews conducted in the Netherlands	(Janssen, 2012)
• Helps to increase responsiveness to new information needs and reduces the response burden • Production processes run more smoothly, cost less, are better integrated into the existing environment and are more transparent, which in turn enhances quality and speed and reduces risks	A study of the EA programme at Statistics Netherlands	(Struijs et al., 2013)
• Harmonizes an organization's business and IT when they are misaligned or have a low degree of alignment • Creates the right perspective on IT capabilities that divisions need to meet their goals • Enhances business and IT alignment maturity	A survey of 31 organizations in Iran that ran and completed an EA project between 2005 and 2010	(Alaeddini & Salekfard, 2013)
• Reduces IT costs	A story from the authors	(Kappelman & Zachman, 2013)
• Enables service availability analysis	7 case studies	(Närman et al., 2014)
• Facilitates strategy analyses by contributing to the possible structured capturing of the business context and supports definition of business capabilities • Breaks down strategy into the business model as the basis for designing the future business execution • Navigates the paths from strategy to execution, and vice versa • Strategic governance and strategy communication	7 semi-structured, guideline-based interviews	(Simon et al., 2014)
• IT cost savings • More effective IT decision-making processes • Successful delivery of transformation projects • Strategic capability arising from a better digital business platform built during the transformation	A case study of an Australian retailer	(Tamm et al., 2015)
• Contributes to the four phases of the acquisition process: pre-acquisition preparation, acquisition selection, acquisition integration and post-integration management	A case study of Cisco Systems	(Toppenberg et al., 2015)
• Delivers total business-IT alignment • Reduces IT total cost of ownership • Improves application, information and technology portfolio management • Minimizes information overlap and duplication • Increases IT responsiveness and speed to market • Regulatory compliance • Increases spending on emerging technology and innovation	Quotation from the chief development officer of the company studied	(Smith & Watson, 2015)

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