

The Development of an Instrument to Assess the Areas where Enterprise Architecture Contributes to Organizational Goals

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Abstract

In a recent survey by Bizzdesign, the respondents stated that the top priority to improve the impact of Enterprise Architecture (EA) on organizations is: improving the communication of EA's value to the business. But what is understood by the value of EA and how it can be measured are much-debated issues in the literature. This paper presents an instrument to assess the value of EA to an organization which can be used to make the architectural function in an organization more value-driven. The instrument is an operationalization of the Enterprise Architecture Value Framework. The instrument builds on EA value items as described in the literature and consists of three sets of questionnaires. With the instrument, the perceptions about the EA by three groups of stakeholders in an organization are assessed: the developers, the implementers, and the users of the EA. By comparing the outcomes with the organization's goals, gaps can be identified and recommendations made to optimize the extent to which the EA function is value-driven. The instrument has been refined and validated by interviewing architects and stakeholders of EA in three large organizations. The questions in the instrument were found comprehensible, complete, and relevant and the results obtained with the instrument were recognized by the stakeholders involved in the case studies. Based on these results, the instrument has been used in a fourth organization as a self-assessment instrument to test the instrument in practice. The results obtained with the instrument in this organization confirmed the ease of use, usefulness, and efficacy of the instrument.

Keywords

enterprise architecture, enterprise architecture value, enterprise architecture assessment, case study research, validation.

1. Introduction

Nowadays, digital transformation is probably the most important driver in creating business value (Härting et al, 2017; Skog et al., 2018; Verhoef et al., 2021). The process of digital transformation not only affects the IT department but may disrupt existing business processes in the organization, making enterprise architecture (EA) an important tool behind the process (Korhonen and Halén, 2017; Zimmerman et al., 2018; Niemi and Pekkola, 2019; Rimol, 2021). However, it is not easy to determine if in practice EA delivers value to the transformation process. As organizations want to see a return on their investments (ROI) from their EA capability in a reasonable timeframe (Gong and Janssen, 2019), the question of the value of EA is not only of academic interest but also is echoed in practice: to remain relevant to the organization, architects should constantly be aware of how they can add value to the organization (Blumberg et al., 2018; Kotusev, 2020; Bossert & van der Wildt, 2021; Bizzdesign, 2023).

While many research papers on the value of EA can be found, in most of these papers it remains undefined what exactly is meant by ‘the value of EA’. Already in 2010 Boucharas et al. (2010b) concluded from a structured literature review that in most of these research papers concepts such as goal, benefit, and value of EA are not defined and in their paper about the critical problems of EA, Kaisler and Armour (2017) discuss that it is still unclear what exactly is meant by ‘the value of EA’ and how it can be measured. Furthermore, while many publications focus on the benefits of EA, value is essentially the result of benefits and costs (Renkema & Berghout, 1997), and the costs of EA are hardly discussed in the literature (Miguens et al., 2018).

Finally, as all authors use their own classification of EA benefits, it is difficult to compare these studies. Against this background, measuring the value of EA remains a “critical challenge” (Kaisler & Armour, 2017, p. 4813), and as yet, no widely supported set of metrics exists (Lange & Mendling, 2011; Niemi & Pekkola, 2016; Kurek et al., 2017). In a recent survey by Bizzdesign (2023, p.24) this is reflected as: “*Improving the communication of EA’s value to the business*” is seen by the respondents as a “*top priority to improve EA’s organizational impact*”.

In many papers on the business value of information technology (IT), value is seen as the return on the investments (ROI) done in IT. An example of this approach can be found in Kohl and Grover (2008), who equate the business value of IT with its economic impact. However, in publications about the value of EA (to be discussed in the next section), many more benefit areas are mentioned implicating that the value of EA cannot be measured with financial figures alone but has other dimensions as well. Examples are market share, innovation capability, employee satisfaction, and sustainability of business processes. To

emphasize this broader view on value, we use the term contribution of EA in this paper.

While some contributions of EA such as cost reductions or lower risks in IT security are quantitatively measurable (given good documentation) many others, for example, an increase in agility or better decision-making, are not objectively quantifiable (Niemi, 2008; Shanks et al., 2018) and are sometimes called intangible (Niemi, 2008). A second and more fundamental limitation to measurability is the degree to which a benefit (or cost) can be attributed to the EA. For example, if a project result corresponds with the EA and leads to cost reductions, it is debatable to what extent these cost reductions can be attributed to the EA and to what extent to other factors. As a result, the overall contribution of EA cannot be measured exactly and objectively. At the same time, the need for some measure of the effectiveness and efficiency of the EA function is not new (Morganwalp & Sage, 2004; van der Raadt, & van Vliet, 2009) and continues to the present day (Gong & Janssen, 2019; Ahleman et al., 2021). Organizations want to justify their investments in EA and the projects that result from EA (Bernus et al., 2016). Especially since, with the rise of many new technologies in the last decade such as cloud-based computing, blockchain, internet of things, and artificial intelligence, many organizations struggle with the question if and how EA can help to leverage these technologies to create an advantage over their competitors. Moreover, to ensure the commitment of stakeholders, a positive perception of the contribution of EA is necessary (Gong & Janssen, 2019). Standard frameworks such as The Open Group Architecture Framework (TOGAF, 2022) do not provide the tools to address the contribution of EA to an organization. These considerations support the need to improve the “visibility of the contribution of EA to the organization” as mentioned in the survey by Bizzdesign (2023).

In this paper, we aim to show how we developed and validated the EA Value Assessment Instrument to assess the contribution of EA to an organization. The research question addressed in this paper is: *How can organizations assess the contribution of their EA function?* From a theoretical point of view, our research contributes with an instrument that is grounded in the scientific literature and can be used to express the areas where EA contributes. The instrument is based on a framework that can be used to compare research outcomes from different studies and is independent of the way the EA function is organized and the methods and tools used by the EA practitioners. As such, it can be considered a first step in the “*outputs to outcomes problem*” (Kaisler & Armour, 2017, pp. 4813).

In a practical sense, this research contributes to the questions posed above such as: to which degree does EA contribute to the business operations at hand, does it help to assure the agility of IT in a fast-changing environment, and does it contribute to a positive perception with stakeholders? As such, it is relevant for the practice of EA as architects can use it to assess their contributions to the organization and optimize the alignment of their activities to the

strategic choices of their organization.

The paper is organized as follows. The next section provides an overview of the literature on EA and EA value, followed by a section about the fundamentals of our instrument. In section 4, the research approach is presented. Section 5 discusses the development of the EA Value Assessment Instrument and section 6 its validation in four case studies. The paper ends with a discussion of the results and the conclusion.

2. Literature review

Enterprise Architecture

Despite various efforts, no commonly agreed-upon definition of EA exists (Simon et al., 2013; Jusuf & Kurnia, 2017; Kotusev, 2017). However, Saint-Louis et al. (2019) have proposed, based on a systematic literature review, a framework to classify definitions of EA which they use to chart the evolution of EA definitions.

For this study we build on several definitions, starting with the often-cited ISO/IEC/IEEE definition of architecture: “*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*” (ISO/IEC/IEEE, 2011). In EA, the system is an enterprise and Lankhorst et al. (2017, p. 3) define EA 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*”. Ross, Weill & Robertson (2006, p. 9) define EA as “*the organizing logic for business processes and IT infrastructure ... The enterprise architecture provides a long-term view of a company’s processes, systems and technologies ...*”. Lange et al. (2012, p. 4230) formulated it as: “*EA translates the broader goals and principles of an organization’s strategy into concrete processes and systems enabling the organization to realize their goals*”. Combining these definitions, we characterize Enterprise Architecture as *the organizing logic (principles, methods, and models) for the organizational structure, business processes, information systems, and IT infrastructure of an organization, in line with the business goals of the organization and providing a long-term view of the development of the organization and the products and services it delivers*. This definition includes (sub)disciplines that may be distinguished in practice such as domain architecture, business architecture, information architecture, solution architecture, systems architecture, and infrastructure architecture (Slot, 2010; TOGAF 2022).

The Value Concept

Value is “*a concept easily used but rarely defined*” (Rodrigues & Amaral, 2010b, p.28). In business, value is often understood as a financial quantity, but it remains questionable if value can be narrowed down to financial figures only (Rodrigues & Amaral, 2010a). Renkema and Berghout (1997) define value as the difference between the benefits obtained and the sacrifices or costs made to gain those benefits, including non-financial benefits and costs. In practice, as the benefits may be found in one area, while the costs may occur in another area, organizations have to find a balance between the two. For example: growth in market share may have a kickback in the satisfaction of customers due to longer delivery times or declining service.

Another aspect of value is the distinction between use value and exchange value (Bowman & Ambrosini, 2000), the first being the value perceived by the stakeholders and the second as de facto realized in some markets. This distinction is equivalent to what is called subjective versus objective value by Schuurman et al. (2009), who in the same publication discuss that instead of objectivity, reduced subjectivity might be a better aspiration. The distinction is useful in practice as well, as records of benefits and costs are not always kept, and in those cases, value judgments are usually based on interviews with stakeholders, asking about their perception of the value created. While such value assessments cannot replace directly measured value, they may give us a good indication of the value created (Bowman & Ambrosini, 2000). In such cases, it should be clear which benefits and costs are deemed relevant and how they are assessed. This is an important facet when discussing the value of EA (Rodrigues & Amaral, 2010; Kaisler & Armour, 2017).

Enterprise Architecture Value

About the value of EA, many publications can be found including several meta-studies. For this research, we selected the meta-studies that are based on a systematic literature review of EA value in scientific and professional papers, in some studies extended with interviews with experts in the field. As we are mainly interested in the areas where EA may contribute to organizations, we have refrained from conducting a systematic literature study ourselves but instead summarize the main points of these meta-studies.

The benefits and costs of EA determine its value or, to stress the non-financial aspects of EA, the contribution of EA. Discussions on the costs of EA are scarce in the literature; if costs are discussed, it is in terms of a reduction of costs by EA (Lindstrom et al., 2006; Foorthuis et al., 2010; Miguens et al., 2018), which is commonly considered an EA benefit. Poort and van Vliet (2011) address EA as a risk- and cost-driven discipline, but here again the perspective is

the reduction of costs.

On the other hand, the literature about the benefits of EA is abundant and can be divided into literature about what the benefits of EA are and how these benefits are attained. An extensive study on various models of how EA benefits originate has been published by Niemi and Pekkola (2016), who conclude that none of the existing models fully explains how EA benefits are arrived at. In a follow-up study, Ahleman et al. (2021) state that EA management (EAM) only creates value if an organization develops what they call second-order EAM capabilities: EA modeling, EA planning, EA implementation, and EA governance. Because our research concerns the contribution of EA and not how it is obtained, this topic will not be explored any further.

Many authors have published on the benefits of EA, but it is difficult to compare these studies as no common categorization of EA benefits is used. In table 1, we show the categorization of EA benefits from 12 meta-studies chronologically.

Table 1. Overview of the categorizations of EA benefits in meta-studies

<i>Reference</i>	<i>Categorization of EA benefits</i>
Niemi, 2008	Categorization based on the Information Systems classification model of Giaglis et al. (1999) resulting in 4 categories: (1) hard; (2) intangible; (3) indirect; (4) strategic
Foorthuis et al., 2010	9 categories are discerned: (1) EA enables management to achieve key business goals; (2) EA enables management of organizational complexity; (3) EA facilitates the integration, standardization and deduplication of processes and systems; (4) EA enables the enterprise to deal with its environment effectively; (5) EA enables effective communication between members of the organization; (6) Working with EA reduces project costs and project duration; (7) Working with EA reduces project risk and improves project success; (8) Working with EA enables projects to manage complexity; (9) Working with EA speeds up the initialization of a project. In a later publication (Foorthuis et al., 2016) these three categories are summarized into 3 categories of benefits

<i>Reference</i>	<i>Categorization of EA benefits</i>
Boucharas et al., 2010b	<p>Categorization based on the Balanced Scorecard (Kaplan & Norton, 1992) and further subdivided into the categories from Kaplan and Norton's Strategy Map (2001):</p> <p>(1) Financial outcomes; (2) customer outcomes; (3) operations management processes (4) customer management processes; (5) innovation processes; (6) human capital; (7) information capital; (8) organization capital</p> <p>No benefits were classified in the category of social processes</p>
Tamm et al., 2011	<p>Discern 12 categories:</p> <p>(1) increased responsiveness and guidance to change; (2) improved decision making; (3) improved communication and collaboration; (4) reduced (IT) costs; (5) business-IT alignment; (6) improved business processes; (7) improved IT systems; (8) re-use of resources; (9) improve integration; (10) reduce risk; (11) regulatory compliance; (12) provides stability</p>
Wan et al., 2013	<p>The categorization consists of two dimensions; the first is:</p> <p>(1) improved business-IT alignment; (2) common and integrated understanding of the enterprise; (3) better decision-making; (4) reduced complexity; (5) improved business structure; (6) improved integration and interoperability; (7) resource optimization and satisfying; (8) financial and economic result</p> <p>The second dimension the authors use is:</p> <p>(1) desirability; (2) realizability</p>
Foorthuis et al., 2016	<p>In this publication the authors summarize their earlier categorization (Foorthuis et al., 2010) into 3 categories of benefits:</p> <p>(1) EA benefits for the organization as a whole; (2) gaining insight and understanding regarding the IST and SOLL situations; (3) an increased performance of individual projects that conform to the EA</p>
Jusuf and Kurnia, 2017	<p>Categorization in the Benefit Framework for Enterprise Systems (Shang & Seddon, 2002), consisting of 5 categories:</p> <p>(1) operational benefits; (2) managerial benefits; (3) strategic benefits; (4) IT infrastructure benefits; (5) organizational benefits</p>

<i>Reference</i>	<i>Categorization of EA benefits</i>
Gong and Janssen, 2019	9 categories are discerned: (1) strategic and political; (2) transformational; (3) communicational; (4) economic; (5) flexibility and agility related; (6) integration and interoperability related; (7) inter-organizational; (8) knowledge management related; (9) others
Niemi and Pekkola, 2019	40 types of benefits are enumerated; no categorization given
Saleem and Fakieh, 2020	Categorization in 3 types of organizational benefits: (1) Business agility; (2) creating competitive advantage; (3) increasing value
Kurnia et al., 2021	Categorization by 5 objects of focus: (1) enterprise architecture; (2) EA management; (3) EA practice; (4) EA projects; (5) EA services
Denzel and Jung, 2022	6 categories are discerned: (1) collaboration; (2) transformation; (3) process optimization; (4) uncover/reveal; (5) organization; (6) simplification

Table 1 shows clearly the diversity in classifications of EA benefits which has been remarked upon before by many authors (Rodrigues & Amaral, 2010; Espinosa et al., 2011; Lange & Mendling, 2011; Niemi & Pekkola, 2016; Kurnia et al., 2020). We compared the various categorizations with the definitions of EA used by the authors of these studies, but no connection could be found between their definition and their categorization. Most definitions given comply with the Enterprise IT Architecting school or the Enterprise Integrating school of Lapalme (2012) and focus on business/IT alignment (textbox 1).

Textbox 1. Summary of the three schools of thought in EA by Lapalme (2012).

Lapalme (2012, p.39) has distinguished three schools of thought in EA:

1. *Enterprise IT architecting*: the scope is the IT/IS within the organization and the main goal of EA is aligning the IT/IS of an organization with the enterprise strategy. “EA is the glue between enterprise and IT”.
2. *Enterprise integrating*: takes a holistic view on the enterprise and is concerned with all aspects of the enterprise, including the IT/IS. “EA is the link between strategy and execution”.
3. *Enterprise ecological adaptation*: considers the organization in its environment and as a consequence, puts adaptation and organizational learning central. “EA is the means for organizational innovation and sustainability”.

Different classifications are also used in professional papers, see for example Estrach (2023) who discerns 10 benefit areas of EA, and Sheppard (2023) who mentions 5 different benefit areas. Looking at the underlying benefits in these two publications, many similarities can be found such as alignment, agility, and cost reductions.

In most publications from table 1, we found no explanation of how the authors arrived at their classification. Exceptions are the papers of Niemi (2008), Boucharas et al. (2010a), and Jusuf and Kurnia (2017) who based their classification on an existing one. Moreover, none of the studies in table 1 states what exactly is understood by an EA benefit. Indeed, in almost all papers about EA value, a definition is missing of what exactly is understood by EA value or EA benefit. An exception is a paper by Lange and Mendling (2011), who define EA benefits as the degree to which the goals of the EA are met. In the next section we will leverage this definition.

In summary, categorizing and assessing the contribution of EA has its problems:

- (1) It remains unclear what is meant by EA value and EA benefit;
- (2) No commonly accepted classification of EA benefits exists;
- (3) The costs of EA are neglected;
- (4) Many EA benefits are not objectively measurable;
- (5) It is difficult to determine to what extent organizational benefits can be attributed to the EA.

3. The EA Value Framework

In this section, we define the concepts related to the contribution of EA and introduce the EA Value Framework (EAVF), a classification of the benefits and costs of EA on which the EA Value Assessment Instrument is based. This summarizes earlier research published by the authors (Plessius et al., 2018; Plessius & van Steenbergen, 2019).

As stated in the Introduction, the contribution of EA results from the benefits gained minus the costs made. Concepts such as goal, benefit, cost, and value are typically used in business literature to discuss an organization's performance (Berghout et al., 2011). To steer the performance of an organization, goals are defined and regularly updated. In his classical book 'Modern Organizations', Etzioni (1964, p.6) defines a goal as "*a desired state of affairs which an organization attempts to realize*". In his view, it should be possible to determine to what extent a goal has been reached, so goals should be formulated measurably.

With Lange and Mendling (2011) we share the view that the value of EA to an organization

can be seen as the degree to which EA contributes to goals. But where Lange and Mendling (2011) use the goals of the EA, we relate the value of EA to the goals of the organization as in this way the value of EA is related to the strategy of the organization instead of to the priorities of the EA function (Plessius et al., 2018).

To reach the goals, activities are initiated in the organization. An activity is a generic term for work that an organization performs to create a certain output (BPMN, 2011). An activity can be thought of as a series of actions, executed by humans and/or machines. The consequences of activities can be valued by relating their outcome to the desired state of affairs, as expressed by the goals of the organization. Renkema and Berghout (1997) call the positive consequences of such activities *benefits* and the negative consequences *sacrifices*. We will use the more commonly used term *costs* for the negative consequences (financial and non-financial) instead. An activity may generate both benefits and costs, and it is not uncommon that activities may have positive consequences for some goals while at the same time having negative consequences for other goals. Benefits and costs can be assigned to the goal(s) they contribute. The difference between the benefits and the costs related to the same goal can then be defined as the value reached for that goal (Schuurman et al., 2009). The contributions (positive and negative) of EA to an organization are in turn induced by the activities carried out by the EA function of an organization.

These considerations have resulted in the following definitions of the basic EA value concepts (table 2):

Table 2. Definitions of the basic EA value concepts

<i>Concept</i>	<i>Definition</i>
(Organizational) Goal	A desired state of affairs which an organization attempts to realize (Etzioni, 1964).
EA activity	Activity, the work that a company or organization performs to create a certain output (BPMN, 2011), that is carried out by the EA function of the organization
EA benefit	The positive contribution from (one or more) EA activities towards the desired state of affairs for an organization as stated by some goal of that organization (based on Renkema and Berghout, 1997).
EA cost	The negative contribution from (one or more) EA activities towards the desired state of affairs for an organization as stated by some goal of that organization (based on Renkema and Berghout, 1997).
EA value	The net contribution from (one or more) EA activities towards the desired state of affairs for an organization as stated by some goal of that organization (based on Renkema and Berghout, 1997).

The definitions of EA benefit, EA cost and EA value as given in table 2 imply that these concepts can be classified by organizational goal and EA activity. This is applied in the EAVF, the Enterprise Architecture Value Framework introduced by Plessius et al. (2018) (figure 1).

Organizational goal EA Activity	Financial and accountability	Customer and partnerships	Internal processes	Learning and growth
EA Development				
EA Implementation				
EA Exploitation				

Figure 1. The Enterprise Architecture Value Framework (EAVF) by Plessius et al. (2018)

In the EAVF organizational goals are classified using the four perspectives of the balanced scorecard (Kaplan and Norton, 1992). The balanced scorecard (BSC) is chosen because organizational goals are often made explicit with the BSC (Peppard and Ward, 2016; Hasan and Chyi, 2017). This choice is supported by the research of Boucharas et al. (2010b) in which several frameworks for classifying organizational goals are assessed and the BSC is chosen as being most suitable in the context of EA value.

For the second axis, three types of EA activities are discerned in the EAVF: EA Development -, EA Implementation - and EA Exploitation activities. This choice is grounded in the work of Ahleman and El Arbi (2012), who discern three organizational processes: *strategic planning* in which the EA is developed, the *project life cycle* in which the EA is implemented, and *operations and monitoring* in which EA exploitation activities take place. In appendix 1 definitions of the four BSC perspectives and the three activity classes are given.

The EAVF is based solely on the concepts of EA benefit and EA cost, not on how the architectural function is organized or the methods and tools used by the architects. However, the EAVF can easily be combined with the methods used by architects in the organization via the EA Activity axis. Appendix 1 shows how this can be done for the much-used methods of The Open Group Architecture Framework (TOGAF, 2022) and the Scaled Agile Framework (SAFe, 2023).

The categories of the EAVF are too wide-ranging to function as a base for an assessment instrument, so the four BSC perspectives were subdivided into 31 subcategories (table 3), inspired by the strategy map of Kaplan and Norton (2001). These subcategories, hereinafter

referred to as the *EAVF categories*, were validated in a Delphi study, in which 13 (Dutch) experts on enterprise architecture participated (Plessius and van Steenberg, 2019). Although these experts did not propose any further subcategories, it cannot be concluded that the EAVF categories are complete in the sense that they cover all organizational goals as the focus of this study was on subcategories to which the EA contributes.

In table 3 the EAVF categories are summarized by keyword (in this table ‘Costs’ should be read as: goals concerning a reduction of costs, etcetera). Extensive descriptions of these subcategories can be found in appendix 1.

Table 3. The EAVF categories, a subcategorization of the balanced scorecard perspectives (Plessius & van Steenberg, 2019)

<i>Financial and accountability</i>	<i>Customer and partnerships</i>	<i>Internal processes</i>	<i>Learning and growth</i>
Costs	(Customer) experience	Logistics	Competences
Revenues	(Customer)	Procurement	Culture
Investments	relationships	Business processes	Communication and
Compliance	Product position	Marketing and sales	knowledge mgt
Governance	Market strategy	Service delivery	Alignment
Risk management	Ecosystem	Data management	Agility
Societal responsibility		Information management	Technology research
		Technology (non-IT)	Evaluation and re-use
		General management	
		Quality management	
		HRM	
		Innovation	

4. Research Approach

Our research has been carried out in two phases: (1) the development of the EA Value Assessment Instrument, and (2) the validation of the EA Value Assessment Instrument.

Developing the EA Value Assessment Instrument

This study extends the EAVF with an instrument that can be used to assess the contribution of EA to an organization. As a starting point for the development, we used the following criteria:

- The instrument must be based on value contributions as reported in the literature.
- The instrument must be independent of how the EA function is organized and the methods that are used.
- The instrument should be easy to use to make a (self)assessment appealing.
- The results of an assessment should be recognizable in practice and support a value-driven approach.
- The instrument should be extensible as in the future new contributions may be reported.

As discussed in the Introduction, not all benefits of EA are quantifiable and it is debatable to what extent a benefit or cost can be contributed to EA activities. So, instead of trying to quantify these, we have chosen to assess the contribution of EA intersubjectively using questions derived from literature and categorized by the EAVF categories (table 3). Inspired by the literature about the maturity of EA (for example van Steenberg et al., 2013) and with an eye to its intended ease of use, we decided to use a 5-point Likert scale for the answer options to the questions.

In the EAVF, three types of architectural activities are discerned: EA Development-, EA Implementation- and EA Exploitation activities. EA Development activities concern the development and maintenance of the overall architecture of an organization and are carried out by EA developers, for example, enterprise -, information -, business - and domain architects. EA Implementation activities are related to the implementation of parts of the architecture and are the responsibility of EA implementers such as solution – and system architects and project managers, working in projects and/or agile teams (TOGAF, 2022; SAFe, 2023). EA Exploitation activities on the other hand are carried out after implementation and can be described with terms like monitoring, signaling, carrying out evaluations, looking for re-use, and governing technical debt. This type of EA activities can be carried out by both EA developers and EA implementers (TOGAF, 2022; SAFe, 2023). As the main activities of EA developers and EA implementers are different, we decided to create different questionnaires for each group.

Research by Foorthuis et al. (2010) and Plessius et al., (2014) shows a bias in the outcomes between architects and other stakeholders (called EA creators respectively EA users by

Foorthuis et al., 2010). Considering this bias, we decided not only to create two questionnaires for developers and implementers but also a third questionnaire for EA users such as product owners and business line managers. In this way, apart from the opinions of the architects, an ‘external’ view on the added value of EA becomes available as well.

Validating the EA Value Assessment Instrument

For a validation of the instrument, we need feedback on the language used in the questions, the relevance and completeness of the questions, and the recognizability of the outcomes. This feedback is qualitative, so a case study approach seems appropriate for such a validation. While case studies have been criticized as not being suitable for generalization, almost impossible to verify, and prone to researcher bias (Qi, 2010), they are also generally considered very useful for getting a deeper understanding: case study research “*is particularly appropriate for certain types of problems: those in which research and theory are at their early, formative stages*” (Benbasat et al., 1987, p.369). Moreover, case studies make it possible to ask for evidence that supports the given answers.

The validation of the instrument was carried out in a series of three case studies, sequentially conducted in three different organizations. After each case study, the instrument was adapted in line with the feedback given. Depending on the outcomes of the three case studies, the following procedure was formulated: if the results of the assessments in the three case studies validate the comprehensibility, relevance, and completeness of the questions as well as the recognizability of the outcomes, saturation is reached and a fourth case study will be held to test in practice the ease of use, usefulness, and efficacy of the instrument. Else, if after two or three case studies major modifications of the instrument are still called for, the development process of the instrument must be reconsidered.

The organizations used in the case studies have a sizable architectural function and at least four years of experience with architecture so the results of deploying architecture can be judged. In each of the three case studies, 2 EA developers, 2 EA implementors, and 2 EA users were interviewed, using the questionnaires. All stakeholders interviewed have at least two years of experience in their role within the organization and are familiar with the way of working and culture in the organization.

The focus of the interviews was on the comprehensibility, relevance, and completeness of the questions. To be able to assess the recognizability of the outcomes, the results of the interviews were compared with the goals of the organization, and recommendations were made based on differences between the results of the assessment and the goals. Both results and recommendations were reported back to the architects and feedback on the

recognizability of the outcomes and the recommendations was asked for.

In the case studies, two types of outcomes can be discerned. The first outcome, which is the *raison d'être* of this study, is the feedback the researchers get regarding the validation of the instrument. As a second outcome, the organization where the case study is conducted receives feedback on the contribution of EA and suggestions on where the contribution of EA can be optimized, based on a comparison of the outcomes of the assessment with the goals set by the organization. To classify these organizational goals in the subcategories of the EAVF, we used the value tree method as described by Rodrigues and Amaral (2010).

5. Development of the EA Value Assessment Instrument

We started the development of our instrument by setting up an inventory of items to which EA possibly contributes. To start with, the list of 100 items made by Boucharas et al. (2010b) was used as a foundation for this inventory. We extended the inventory using the items listed in the meta-studies mentioned in table 1. After deduplication, we identified 112 specific items. To reduce the number of questions in the instrument, several items were combined into one. For example, items such as 'reduced costs in general', 'reduced IS/IT costs', and 'reduced administrative costs', were combined into one: 'lower operational costs.' The resulting 58 items were categorized into the EAVF categories. As no items were found for the EAVF categories 'Procurement' and 'Technology (non-IT)', we left these two out. We also decided to combine the EAVF categories 'Costs' and 'Revenues' as a reduction of costs mirrors an increase in revenues. As a result of the three case studies, some questions were reformulated and others were split, leading to a final list of 61 questions. The items that were combined into one question, the final list of questions and their classification can be found in appendix 2.

For each of the three target groups, a base question was formulated asking how important each item is for the contribution of EA to the organization. For every item, this question can be answered on a 5-point Likert scale (ranging from 'not important at all' to 'very important') supplemented with an option 'don't know'. Various formulations of these base questions were tried in the first two case studies. It turned out that most interviewees associated 'value' with financial value so we chose to use the word 'contribution' instead. In the version for the EA developers the final base question has become: 'Please state with a score from 1 to 5 the importance of the next items in developing and updating the enterprise/domain architecture'. In the version for the EA implementers, this is replaced by: 'Please state with a score from 1 to 5 the importance of the next items in preparing solution/systems architectures during implementation processes' and in the version for EA users by: 'Please state with a score from

1 to 5 the importance of the contribution of architecture for the next items.’

Next, we selected a subset of the various items for each questionnaire, dependent on what we considered relevant for the target group. For example, EA implementers were asked about the manageability of projects, which was not asked of EA developers. In the case studies, our choices were validated by the relevance and completeness of the questions.

In appendix 2 an overview of the differences between the three question sets and references to the literature used can be found.

The overall development process of the instrument is summarized in figure 2.

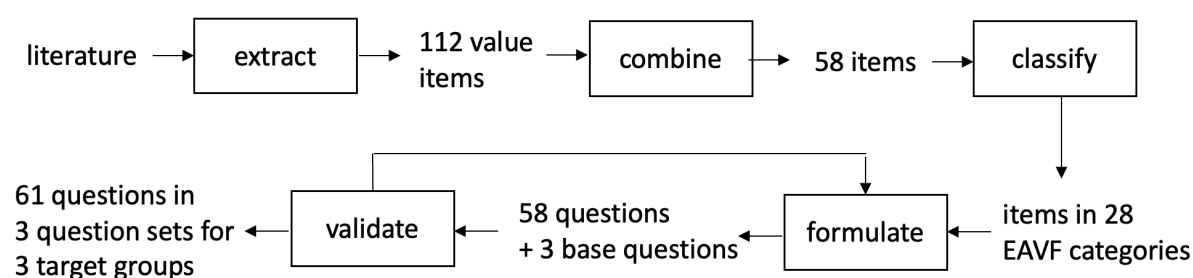


Figure 2: The development of the questionnaires

For validation purposes, two open questions were added to all three versions of the questionnaire. Each version starts with a question about what the interviewee deemed the most important contributions of EA in the considered period and – to verify whether the questionnaire is complete - ends with a question if there remain issues not or insufficiently addressed.

6. Validation of the EA Value Assessment Instrument

Case Study Organizations

In this section, we present the results of the assessments with the instrument in the four case study organizations. In table 4, we have listed the main characteristics of these organizations. For the international organizations, we have listed the characteristics of the Dutch branch where the interviews were held.

Table 4. Characteristics of the (Dutch branch of the) case organizations

	<i>Organization 1</i>	<i>Organization 2</i>	<i>Organization 3</i>	<i>Organization 4</i>
Economic sector	Government	Transport	Production	Financial
Scope	National	International	International	International
# Employees	±1,800	±19,000	±4,000	±15,000
Organization EA	Distributed over four business domains and one IT domain	Part of the IT department which is subdivided into domains	Part of the IT department which is subdivided into domains	Part of the IT department which is subdivided into domains
Role of EA	Decisive role in the realization of the IT strategy	Develop and implement the architectural vision and architectural principles. Govern compliance with the architecture	Develop and maintain the enterprise architecture and advise the IT teams on innovations within the rules and standards that apply	Develop and maintain the enterprise architecture and advise agile implementation teams
# Enterprise/ domain architects	6	±40	±20	±100
# Years of experience with EA	>10	>10	>10	>10

As the emphasis in the first three case studies was not on the outcomes but on the questions in the instrument, we present in the next subsections only a brief overview of the answers given to the questions by the interviewees. The answers were noted using the Likert scale as discussed in the previous section and the overviews are compiled by sorting and averaging these answers in the four BSC perspectives. In each case study organization, only a subset of all stakeholders was interviewed and the outcomes can not be generalized to the organization as a whole.

Note that the questionnaires and questions were adjusted between case studies and are not fully comparable.

Case Study 1: A Governmental Organization

The first case study was conducted in a Dutch governmental agency, representing the country in international fora. In the case study, representatives of two business domains were interviewed using the questionnaires: in each domain, the domain architect, a solution architect, and a product owner were interviewed. The interviews were conducted face-to-face and any vagueness or ambiguity in the questions was clarified and noted. Many comments were made during the interviews. Most comments concerned the language used in the questions. Examples are: the term 'ERP-software' was unknown to several interviewees, and the term 'big data' was found vague by almost all interviewees. The comments also led us to split some questions: the question about the alignment with partners was split into two separate questions: a question about the cooperation with partners and another about supply chain integration. The question about logistic processes and software was also split into two questions: the logistic processes themselves versus the supporting software. Additionally, the contribution to internal customers was found missing (the Customer and partnerships perspective concerns entities external to the organization), so we added a question to the Internal processes' perspective. In this way, the overall number of questions was extended to the 61 questions shown in appendix 2.

In table 5 the average and standard deviation of the answers, sorted by BSC perspective, are presented.

In domain 1 there is a substantial difference between the scores of the domain architect and the solution architect. According to the solution architect, this can be explained by the fact that in the previous year he had been working on a project that touched many aspects of the business and in which the EA proved important in giving directions. In domain 2 the Customer and partnerships perspective scores relatively low, indicating that the architects are working more 'inside-out' than 'outside-in'. In both domains, the architects score higher than the product owners. Possible explanations are a higher commitment of architects to the EA and the fact that the product owners may not see the entire picture (Foorthuis et al., 2010). Another explanation is that the architects as producers of the EA focus on the contribution of EA in answering the questions, while the product owners see EA as only one of the contributing factors, making the EA less important in their assessment of the contribution of EA.

Table 5. Organization 1: Average and standard deviation by BSC perspective

<i>Organization 1</i>	<i>Financial and Accountability (avg/ sd)</i>	<i>Customer and partnerships (avg/ sd)</i>	<i>Internal processes (avg/ sd)</i>	<i>Learning and Growth (avg/ sd)</i>	<i>Average overall (avg/ sd)</i>
Domain 1					
Domain architect 1	2.8 / 1.7	3.6 / 1.8	3.5 / 1.4	2.8 / 1.1	3.2 / 1.4
Solution architect 1	3.9 / 1.3	4.3 / 1.0	(4.1 / 1.0)	3.9 / 0.8	(4.1 / 1.0)
Product owner 1	(3.3 / 0.5)	(2.0 / 0.9)	(3.4 / 0.7)	3.5 / 0.7	(3.1 / 0.8)
Domain 2					
Domain architect 2	3.0 / 0.5	(3.7 / 1.8)	3.9 / 1.2	3.5 / 1.6	(3.5 / 1.3)
Solution architect 2	(4.4 / 0.9)	2.1 / 1.5	(2.8 / 1.7)	3.5 / 1.3	(3.2 / 1.6)
Product owner 2	(2.6 / 0.9)	X	(3.4 / 1.3)	3.3 / 0.7	(3.1 / 1.1)
<p>Legend:</p> <p>avg – average; sd – standard deviation (all answers given on a 1 to 5 Likert scale with 1 as lowest)</p> <p>() – most, but not all questions in the perspective answered</p> <p>X – (almost) none of the questions in the perspective answered</p>					

The scores for the standard deviation show that the interviewees used the ‘1’ sparingly, but the rest of the Likert scale was used broadly.

We classified the goals as set by the organization (independent of the EA function) in the EAVF categories using a value tree (Rodrigues and Amaral, 2010). By comparing the outcomes of the assessment with these goals, we were able to indicate which EAVF categories lagged and alert the architects to topics that needed extra attention in light of the goals. For example, while in the goals of the organization the importance of staying up-to-date with technology was emphasized, the scores in the EAVF categories ‘Innovation’ and ‘Technology research’ were relatively low, indicating a backlog in researching new technologies. Additionally, by looking at the scores on the questions underlying the EAVF categories more detailed recommendations could be made. An example is the item ‘involvement of stakeholders’, which showed a discrepancy between the scores of the architects and the product owners, indicating that the product owners felt insufficiently involved in the development and implementation of EA, contrary to the architects’ judgment.

Based on this observation, we recommended that the architects regularly organize sessions for stakeholders to discuss architectural issues. The conclusions of the assessment and the recommendations were recognized by the architects and discussed in a meeting with all interviewees aimed at improving the contribution of the EA in the domains investigated.

After this first case study, we concluded that comprehensibility and completeness of the questions were not yet reached, but all questions were deemed relevant and the outcomes were recognized by the stakeholders interviewed.

Case Study 2: An Organization in the Transport Sector

The second case study was held in a large Dutch company in the transport sector. Just before the actual study started, a lockdown due to Covid-19 was imposed in the Netherlands. As face-to-face interviews became impossible, we had to adapt our way of working. After consultation with the organization, we decided to add to each question a field for comments and to distribute the questionnaires (with the adaptations based on the feedback from case study 1) to the interviewees. After having received the filled-in questionnaires, we discussed by telephone with everyone the scores that departed considerably from their average score as well as the comments made.

The questionnaires were distributed in two business domains. In both domains, a domain architect and a solution architect participated, while the user perspective was in one domain represented by a business line manager and in the other by a product owner. In case study 2 only a minor number of comments about the questions were made. Most comments asked for further clarifications, for example, what exactly is meant by quality in ‘quality of IT systems and infrastructure’. No aspects were found missing by the stakeholders. In table 6 the aggregated results are presented.

An explanation for the relatively low scores of the solution architect in domain 2 could not be given. In this organization, the difference between the overall scores of the EA users versus the architects is visible, but less than in the previous case study. In domain 2 the scores in the perspective ‘Financial and accountability’ are low, mainly due to the subcategories ‘Costs and revenues’, ‘Investments’, and ‘Societal responsibility’. Noteworthy too is the low score on the subcategory ‘Agility’ in both domains.

Table 6. Organization 2: Average and standard deviation by BSC perspective

Organization 2	Financial and Accountability (avg/ sd)	Customer and partnerships (avg/ sd)	Internal processes (avg/ sd)	Learning and Growth (avg/ sd)	Average overall (avg/ sd)
Domain 1					
Domain architect 1	(3.3 / 0.5)	3.1 / 1.0	3.0 / 1.0	3.3 / 1.2	(3.2 / 1.0)
Solution architect 1	3.9 / 1.1	3.8 / 1.2	3.5 / 0.8	3.3 / 1.0	3.6 / 0.9
Business manager	(3.0 / 1.0)	X	(3.3 / 0.6)	(3.3 / 0.5)	(3.2 / 0.6)
Domain 2					
Domain architect 2	2.8 / 1.4	3.6 / 1.4	3.4 / 1.3	3.6 / 1.2	3.4 / 1.3
Solution architect 2	2.3 / 1.0	2.1 / 1.7	2.7 / 1.4	2.1 / 1.1	2.3 / 1.3
Product owner	(2.0 / 1.2)	X	3.4 / 1.0	(3.4 / 0.8)	(3.1 / 1.1)
Legend:					
avg – average; sd – standard deviation (all answers given on a 1 to 5 Likert scale with 1 as lowest)					
() – most, but not all questions in the perspective answered					
X – (almost) none of the questions in the perspective answered					

The outcomes of the assessment were compared to the organization’s goals and based on this confrontation, recommendations were reported back to the interviewees. The feedback given was that the outcomes were recognized and the recommendations would be discussed in the EA team. As only two domains were assessed, it was not clear if the results were valid in other domains as well. It is not known if any follow-up actions have taken place.

From this second case study, we learned that our goal for comprehensibility was not yet reached, but that the questions were deemed complete and relevant and the outcomes were recognized by the stakeholders interviewed.

Case Study 3: A Production Company

Our third case study took place at a large international company in the production sector. A domain architect, a solution architect, and a product owner from one of the business domains filled in the questionnaires (slightly adapted from case study 2), supplemented with an enterprise architect, a solution architect, and a product owner from three different business domains. As in the previous case, the questionnaires were filled in by the stakeholders and we did a follow-up by telephone. This third case study did not produce many comments. The

overall feeling was that the questions were comprehensible, relevant, and complete. An interesting suggestion was to add explanations and examples to the questions as an aid in interpreting the questions in the same way by all stakeholders. We implemented this in the final version of the instrument (see appendix 2).

As the respondents in the second group are from different domains and hence their results are not comparable, only the aggregated results from the first domain are presented in table 7.

Table 7. Organization 3: Average and standard deviation by BSC perspective

<i>Organization 3</i>	<i>Financial and Accountability (avg/ sd)</i>	<i>Customer and partnerships (avg/ sd)</i>	<i>Internal processes (avg/ sd)</i>	<i>Learning and Growth (avg/ sd)</i>	<i>Average overall (avg/ sd)</i>
Domain 1					
Domain architect	3.0 / 1.2	4.4 / 0.7	4.1 / 0.8	3.4 / 1.3	3.8 / 1.1
Solution architect	3.8 / 0.9	4.0 / 0.8	4.0 / 0.8	3.6 / 0.5	3.8 / 0.7
Product owner	3.3 / 1.6	3.5 / 0.9	3.0 / 1.3	2.4 / 1.0	3.0 / 1.3
<p>Legend:</p> <p>avg – average; sd – standard deviation (all answers given on a 1 to 5 Likert scale with 1 as lowest)</p> <p>() – most, but not all questions in the perspective answered</p> <p>X – almost none of the questions in the perspective answered</p>					

From a comparison of the outcomes of the assessment and the goals of the organization, recommendations were drafted. These were discussed in a meeting with stakeholders where one of the conclusions was that the reasons for architectural proposals and decisions were insufficiently explained to the rest of the organization.

We tried to use the second set of scores to get an impression of the contribution of EA to the organization as a whole, but due to the small number of interviewees, doubts about the reliability were expressed. Although this criticism is valid (and in line with the criticism of Qj (2010) on case studies), the main purpose of the case studies was to test the comprehensibility, completeness, and relevance of the questions, not to produce statistically reliable outcomes. When using the instrument in practice, we would recommend asking all, or at least a sizable percentage of stakeholders to complete the questionnaire to avoid any doubt on the reliability of the results. Subsequently, differences in scores between stakeholders should be discussed and, in this way, a shared image of the contribution of EA to the goals of the organization can be established.

After this third case study, we concluded that our goals concerning the comprehensibility, completeness, and relevance of the questions and the recognizability of the outcomes were met. So, in line with our research approach, we started a fourth case study to test the ease of use, usefulness, and efficacy of the EA Value Assessment Instrument in practice.

Case Study 4: A Self-assessment in an Organization in the Financial Sector

The organization for this test was the Dutch branch of an international company in the financial sector. Following the intended use of the instrument, the assessment was organized and carried out by the organization itself which proved easily achievable and not very time-consuming. The details of how the assessment was carried out can be found in the report of Blackstone (2022).

The organization had adopted an agile way of working, “*but the EA practice of the [organization name withheld] has since been struggling to adjust to this agile way of working and consequently with its role and value in the organization*” (Blackstone, 2022, p.7). To get feedback on the perceived contribution of EA, all architects and EA stakeholders in the organization were sent a questionnaire from the instrument. The overall response was 12%, implicating an error margin of 10% with a confidence level of 95% (Blackstone, 2022, p.29).

In table 8 the outcomes are aggregated by BSC perspective.

Table 8. Organization 4: Averages by BSC perspective

<i>Organization 4</i>	<i>Respondents (nr / perc)</i>	<i>Financial and Accountability (avg)</i>	<i>Customer and partnerships (avg)</i>	<i>Internal processes (avg)</i>	<i>Learning and Growth (avg)</i>	<i>Average overall (avg)</i>
EA Developers	33 / 29%	4.3	4.2	4.3	4.4	4.3
EA Implementers	27 / 11%	3.3	2.9	3.2	3.5	3.2
EA Users	28 / 8%	3.0	3.3	3.5	3.4	3.3

While the EA Implementers and EA Users in general agree about the perceived contribution of EA and assess this contribution as average important, among the EA Developers the contribution of EA scores much higher (on average around 1 point higher on a 5-point scale). From the data alone, it is not clear if there are real differences between the three groups of

respondents, the EA Developers overestimate their contribution, or that the other groups of respondents have insufficient insight into the contribution of EA. However, the results confirmed the perception existing in the organization that the communication between the EA Developers and the rest of the organization is far from ideal. This was emphasized by the comments made by the respondents.

Comparing the (detailed) outcomes of the assessment with the goals of the organization showed that the EAVF categories ‘Societal Responsibility’, ‘Market Strategy’, ‘Logistics’, and ‘Technology Research’ scored low, but the different groups did not agree in their assessment of these EAVF categories, except for ‘Societal Responsibility’ which scored with all groups of respondents below par.

The outcomes were discussed with a panel group consisting of 15 (internal) professionals (Blackstone, 2022), all with ample experience with EA in various roles. Based on the considerable differences between the various groups of respondents, the panel group advised to focus on the collaboration issues between the EA Developers and the rest of the organization and provided practical interventions to steer the process. The advice of the panel group was accepted and implemented by management. It was also decided to repeat the assessment a year later. In our opinion, this decision makes sense as the collaboration issues seem dominant in this organization.

This case study shows the ease of use and the usefulness of the instrument in assessing the contribution of EA in an organization. The instrument also shows clearly where gaps can be found in the EA and as such its efficacy. Gaps indicate points for further investigation, which can be used as a starting point for improvements.

7. Discussion

The EA Value Assessment Instrument

The EA Value Assessment Instrument is inferred from value contributions reported in the literature (see table 1), independent of situational aspects such as the organization of the EA function or the methods and tools used by the architects involved. In the first three case studies, each successive assessment contributed to the comprehensibility of the questions and their completeness. The instrument proved to be easy to use and, as the fourth case study shows, a self-assessment can be carried out easily. In all case organizations the outcomes were recognized and, in at least the first and fourth case organizations, measures have been taken to increase the contribution of EA, confirming the efficacy of the instrument.

Almost all EAVF categories are represented by one or more items in the questionnaires (see appendix 2). The results in the EAVF categories and the four perspectives of the EAVF were calculated as the unweighted average of the answers given to the questions in the EAVF categories, respectively the four perspectives of the EAVF. We have experimented with two other ways of calculating these scores as well. In the first case study, for every question that was answered with a 4 or 5 (meaning that the contribution of EA was considered important to very important), we asked if there exists a document supporting this answer. We intended to give more weight to answers supported by a document. Unfortunately, interviewees often did not know if such a document existed or were quite uncertain about it. So, we decided not to ask for supporting documents anymore. In the first and second case studies, we also experimented with weighted averages. For each EAVF category, we used the weight given to that category in a previous study (Plessius and van Steenberg, 2019). Although there were minor differences between weighted and unweighted scores, the overall picture remained the same so we decided to use Occam's razor and use the unweighted average.

In interpreting the results and drawing up recommendations, it is important to compare the outcomes of the questionnaires with the goals of the organization as these goals are an operationalization of the strategy of the organization. In the case studies this was done by refining the goals of the organization into the EAVF categories by using a value tree (Rodrigues and Amaral, 2010) and comparing these with the outcomes of the assessment. In all cases, it proved possible to categorize these goals into the EAVF categories, and the results were validated by the organization, confirming the usability of the instrument.

In the case studies, recommendations were made by comparing the outcomes in each EAVF category with the average score over all EAVF categories. If an EAVF category was found reflected in the goals and the category scored considerably higher or lower than this average score, that category was a possible candidate for improvement. In the case studies, we quantified 'considerably' as a difference of 0.5 points as this brings the score to another Likert scale level. A possible other procedure might be to score the (categorized) organizational goals on the same scale from 1 to 5 and compare the outcomes of the assessment with these scores. This asks for a more in-depth analysis of the goals than was possible in the case studies. However, to decide on a course of action more information is needed. It may be helpful to ask for a short explanation with each question, but this is a lot more time-consuming for the respondents and during the analysis. In the case studies, the (numerical) outcomes were analyzed in a meeting, before further action was taken.

In the instrument, the view of EA users is used as an extra viewpoint as they have to deal with the results of the EA. This proved quite valuable in interpreting the outcomes of the assessments and it may be argued that these outcomes should be the starting point for a more

in-depth analysis (Foorthuis et al., 2010). However, EA users have quite different backgrounds and it may prove worthwhile to allow for these differences in the analysis. The same goes for EA implementers: solution and system architects may have quite a different view on the EA than for example project leaders.

In the last case study, the outcomes were calculated by taking the average of the individual responses (Blackstone, 2022). It is worthwhile not only to look at the average outcomes but – like we did in the first three case studies - at variations in outcomes as well. Large differences in scores may indicate a fundamental disagreement about the contribution of EA within a stakeholder group.

As the literature shows, value topics are not static. For example, in Boucharas (2010b), hardly any contributions can be found in the Customer perspective. In contrast, various value topics are found in this perspective in later studies (e.g., Jusuf and Kurnia, 2017) and these are incorporated into the instrument. When new value items are reported in the literature, a new version of the instrument can be released with extra questions about these items. In the same way, an organization can easily add extra questions if a more fine-grained view on some topic is called for.

Validation

As the second and third case studies resulted in only minor changes in the questionnaire and the results in all case studies were recognized by the stakeholders, following the procedure as described in the research approach, we tentatively concluded that the instrument gives a valid and recognizable picture of the contribution of EA to the goals of the organizations assessed.

Completing the questionnaire asked on average 20 to 40 minutes from the stakeholders. Asking for a short explanation with every score may however easily double this time. In three of the four case organizations, the results were discussed with stakeholders and used to bring about changes as described in the previous section; in the second case study, due to COVID-19, a follow-up was not organized, but the outcomes were accepted by the architects.

The final formulation of the questions was considered clear and understandable by the stakeholders and after the first case study, no additional topics were given, neither in the comments nor in the follow-up telephone calls. This is in line with the fact that all topics are derived from claims as published in the literature, so again we tentatively conclude that the final list of topics is complete regarding the current state of EA but the instrument can be adapted to reflect changes by adding new topics and – if necessary – new EAVF categories.

Concerning the external validity of the study, there are limitations. Although all four organizations came from different economic sectors, they are large organizations located in the Netherlands, so it cannot be guaranteed that the instrument is valid for smaller organizations and/or organizations in other countries. However, the results make us confident that the instrument can be used in other settings as well, provided a clear distinction can be made between architects who are involved with development activities and architects involved with Implementation activities. For smaller organizations, it may be necessary to combine and adapt the questionnaires of the architect groups; something to be researched in a follow-up study.

Duplicating this research in other organizations in the way described in case study 4 can support the external validity of the instrument. Another route is to combine the results as described in this paper with other research approaches like a survey as “*using multiple methods, including survey, case study, and experimentation, provides evidence that results are not method-specific*” (Gable, 1994, p. 123). In a survey, stakeholders from a broad range of organizations can assess the EA in their organization and give their opinion on the reliability and completeness of the instrument. The outcomes of a survey may also be applied using factor analysis to get feedback on the relative weight of the questions in each EAVF category and of the EAVF categories in the BSC perspectives.

The assessment of EA value is considered one of the critical problems of EA by Kaisler and Armour (2017). They discern two areas where problems arise: quality attributes (the EA benefits or value items) and metrics. While the categorization of EA benefits differs between authors, underlying we find many common value items. In our instrument, these value items are used to assess the value of EA. The issue of metrics is still an open question: the instrument does not measure the value of EA but assesses the *perceived* value of EA by stakeholders.

8. Conclusion

This research was guided by the research question: ‘*How can organizations assess the contribution of their EA function?*’ In this paper, we demonstrated how the contribution of EA to the goals of an organization can be assessed using the instrument developed. The EA Value Assessment Instrument is validated in several case studies, showing the usefulness and usability of the instrument. By comparing the outcomes of the questionnaires with the goals of the organization, gaps can be found and from there, recommendations can be made to increase the contribution of EA.

The instrument is an extension of the EAVF which builds on concise definitions of the EA

value concepts (Plessius et al., 2018). It categorizes contributions in those subgoals of the BSC where EA can contribute (Plessius & van Steenbergen, 2019).

The scientific contribution of this research is twofold. In the first place, the instrument developed is based on value contributions as reported in the literature (see table 1), which we have integrated and brought under the common denominator of the EAVF. In the second place, as the instrument is developed independent of the organization of the EA function and the methods and tools used by the EA practitioners, the instrument may be used as a common foundation to evaluate the EA and the artifacts it creates (Kaisler and Armour, 2017). Such a common foundation also makes it easier to compare research results and to build on previous research.

To the practice of EA, the instrument contributes by showing how value contributions as described in the literature, can be used in an instrument to assess the value of EA, independent of the way this value is arrived at. By comparing the results gathered with the instrument with the goals of the organization, gaps can be found and recommendations can be given to make the EA function more value-driven, as shown in the various case studies above.

As with many other disciplines, EA constantly adapts itself to changes in its environment. An example is the emergence of so-called agile implementation methods, which has led to a different scope for EA in many organizations (SAFe, 2023). Adaptations in the scope of EA influence what is expected of EA. So over time, new value items may be reported and old ones may become obsolete. The instrument can be updated to account for such developments.

This study has its limitations. Most conspicuous is the small number of case studies and the restrictions on the feedback due to Covid-19. However, the results from this validation make us confident that in future case studies, no essential drawbacks in the instrument will be found, which is confirmed in the fourth case study. We expect that the EA Value Assessment Instrument as introduced in this paper, can contribute to *“Improving the communication of EA’s value to the business”* (Bizzdesign, 2023).

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References

- Ahlemann, F., Legner, C., & Lux, J. (2021). A resource-based perspective of value generation through enterprise architecture management. *Information & Management, 58(1)*, pp. 1-17
- Benbasat, I., Goldstein, D. K., & Mead, M. (1987). The case research strategy in studies of information systems. *MIS quarterly 11(3)*, pp. 369-386.
- Berghout, E., Nijland, M., & Powell, P. (2011). Management of lifecycle costs and benefits: Lessons from information systems practice. *Computers in Industry, 62(7)*, pp. 755-764.
- Bernus, P., Goranson, T., Götze, J., Jensen-Waud, A., Kandjani, H., Molina, A., Noran, O., Rabelo, R., Romero, D., Saha, P. & Turner, P. (2016). Enterprise engineering and management at the crossroads. *Computers in industry, 79*, pp. 87-102.
- Bizzdesign. (2023). State of Enterprise Architecture 2023. Publication by Bizzdesign. Retrieved from www.bizzdesign.com on January 22, 2024.
- Blackstone, A. (2022). Agile Traits for Enterprise Architecture. Thesis Master of Informatics University of Applied Sciences Utrecht. Retrieved from https://www.researchgate.net/profile/ArthurBlackstone/publication/361816152_Agile_traits_for_Enterprise_Architecture/links/62c6cfd36042a063b2807d60/Agile-traits-for-Enterprise-Architecture.pdf on Nov. 29, 2022.
- Blumberg, S., Bossert, O. & Sokalski, J. (2018). Five enterprise architecture practices that add value to digital transformations. Retrieved from <https://www.mckinsey.com/~media/McKinsey/Business%20Functions/McKinsey%20Digital/Our%20Insights/Five%20enterprise%20architecture%20practices%20that%20add%20value%20to%20digital%20transformations/Five-enterprise-architecture-practices-that-add-value-to-digital-transformations-vF.pdf> on January 22, 2024.
- Bossert, O., Fehskens, L., Manwani, S., & Sokalski, J. (2017). Business value of enterprise architecture—why CEOs should recognize and empower their EA departments: key takeaways from the McKinsey & Company and Henley Business School EA Survey. *Journal of Enterprise Architecture 2017*.
- Boucharas, V., van Steenbergen, M., Jansen, S., & Brinkkemper, S. (2010a). The contribution of enterprise architecture to the achievement of organizational goals: a review of the evidence. In: *Trends in Enterprise Architecture Research*. Springer, Berlin-Heidelberg, pp. 1-15.
- Boucharas, V., van Steenbergen, M., Jansen, S., & Brinkkemper, S. (2010b). The contribution of enterprise architecture to the achievement of organizational goals: Establishing the enterprise architecture benefits framework. *Technical Report UU-CS-2010-014, Department of Information and Computing Sciences, Utrecht University*.

- Bowman, C., & Ambrosini, V. (2000). Value creation versus value capture: Towards a coherent definition of value in strategy. *British Journal of Management*, 11(1), pp. 1-15.
- BPMN (2011). Business Process Model and Notation, version 2.0. OMG document number: formal/2011-01-03.
- Denzel, J., & Jung, J. A Literature Study on Benefits Provided by Enterprise Architecture Management. *Enterprise Architecture Professional Journal vol. Vi*, 2022, pp. 1-14.
- Espinosa, J., Boh, W. & DeLone, W. (2011). The organizational impact of enterprise architecture: a research framework. In: *System Sciences (HICSS), 2011 44th Hawaii International Conference on System Sciences*, Hawaii, pp. 1-10.
- Estrach, P. (2023). Key Benefits of Enterprise Architecture. Retrieved from <https://www.mega.com/blog/key-benefits-of-enterprise-architecture> on January 22, 2024
- Etzioni, A. (1964). *Modern Organizations*. Foundations of modern sociology series. Prentice Hall, Englewood Cliffs, New Jersey.
- Foorthuis, R., van Steenbergen, M., Mushkudiani, N., Bruls, W., Brinkkemper, S., & Bos, R. (2010). On Course, but not There Yet: Enterprise Architecture Conformance and Benefits in Systems Development. In: *ICIS 2010 Proceedings*, pp. 1-19.
- Foorthuis, R., Van Steenbergen, M., Brinkkemper, S., & Bruls, W. A. (2016). A theory building study of enterprise architecture practices and benefits. *Information Systems Frontiers*, 18, pp. 541-564.
- Gable, G. (1994). Integrating case study and survey research methods: an example in information systems. *European Journal of Information Systems* 3(2), pp. 112-126.
- Gong, Y., & Janssen, M. (2019). The value of and myths about enterprise architecture. *International Journal of Information Management*, 46, pp. 1-9.
- Härting, R. C., Reichstein, C., & Jozinovic, P. (2017). The Potential Value of Digitization for Business – Insights from German-speaking Experts. In: Eibl M, Gaedke M.: *Informatik 2017, 47. Jahrestagung der Gesellschaft für Informatik, Lecture Notes in Informatics (LNI)*, Gesellschaft für Informatik, Bonn 2017, pp. 1647-1656.
- Hasan, R., & Chyi, T. (2017). Practical Application of Balanced Scorecard - A Literature Review. *Journal of Strategy and Performance Management*, 5(3), pp. 87-103.
- ISO/IEC/IEEE (2011). ISO/IEC/IEEE 42010:2011: Recommended Practice for Architecture Description of Software-Intensive Systems.
- Jusuf, M., & Kurnia, S. (2017). Understanding the Benefits and Success Factors of Enterprise Architecture. In: *Proceedings of the 50th Hawaii International Conference on System Sciences*. Hawaii, pp. 4887-4896.

- Kaisler, S., & Armour, F. (2017). 15 Years of Enterprise Architecting at HICSS: Revisiting the Critical Problems. In: *Proceedings of the 50th Hawaii International Conference on System Sciences*. Waikoloa, Hawaii, 2017, pp. 4807-4816.
- Kaplan, R., & Norton, D. (1992). The Balanced Scorecard - Measures that Drive Performance. In: *Harvard Business Review*, 1992, pp.71-79.
- Kaplan, R. and Norton, D. (2001). Transforming the balanced scorecard from performance measurement to strategic management: Part I. In: *Accounting horizons*, 15(1), pp. 87-104.
- Kohli, R., & Grover, V. (2008). Business value of IT: An essay on expanding research directions to keep up with the times. *Journal of the Association for information systems*, 9(1), pp. 23-39.
- Korhonen, J. J., & Halén, M. (2017). Enterprise architecture for digital transformation. In: *IEEE 19th Conference on Business Informatics (CBI) Vol. 1*, pp. 349-358.
- Kotusev, S. (2017). Enterprise architecture: what did we study? *International Journal of Cooperative Information Systems*, 26(04), pp. 1-84.
- Kotusev, S. (2020). Enterprise Architecture: Forget Systems Thinking, Improve Communication. *Journal of Enterprise Architecture*, 1 (2020), pp. 12-20.
- Kurek, E., Johnson, J., & Mulder, H. (2017). Measuring the value of Enterprise Architecture on IT-projects with CHAOS Research. In: *MSCI, Orlando, USA*.
- Kurnia, S., Kotusev, S., Dilnutt, R., Taylor, P., Shanks G., & Milton, S. (2020). Artifacts, activities, benefits and blockers: Exploring enterprise architecture practice in depth. In: *Proceedings of the 53rd Hawaii International Conference on System Sciences*, pp. 5584-5592.
- Kurnia, S., Kotusev, S., Shanks, G., Dilnutt, R., Taylor, P., & Milton, S. K. (2021). Enterprise architecture practice under a magnifying glass: linking artifacts, activities, benefits, and blockers. *Communications of the Association for Information Systems*, 49(1), pp. 668-698.
- Lange, M., & Mendling, J. (2011). An experts' perspective on enterprise architecture goals, framework adoption and benefit assessment. In: *Enterprise Distributed Object Computing Conference Workshops (EDOCW), 2011*. 15th IEEE International, pp. 304-313.
- Lange, M., Mendling, J., & Recker, J. (2012). A comprehensive EA benefit development model--An exploratory study. In: *45th Hawaii International Conference on System Sciences*, pp. 4230-4239. IEEE.
- Lankhorst, M. (editor) (2017). *Enterprise Architecture at Work: Modelling, Communication and Analysis*. 4th ed. Springer Verlag. Berlin Heidelberg.
- Lapalme, J. (2012). Three schools of thought on enterprise architecture. *IT professional*, 14(6), pp. 37-43.

- Lindström, Å., Johnson, P., Johansson, E., Ekstedt, M., & Simonsson, M. (2006). A survey on CIO concerns-do enterprise architecture frameworks support them? *Information Systems Frontiers*, 8(2), pp. 81-90.
- Miguens, J., da Silva, M. M., & Guerreiro, S. (2018). A Viewpoint for Representing Costs in Enterprise Architectures. In: *2018 IEEE 20th Conference on Business Informatics (CBI) (Vol. 1)*, pp. 10-19.
- Morganwalp, J., & Sage, A. (2004). Enterprise architecture measures of effectiveness. *International Journal of Technology, Policy and Management (1)*, pp. 81-94.
- Niemi, E. (2008). Enterprise architecture benefits: Perceptions from literature and practice. In: *Proceedings of the 7th IBIMA Conference Internet and Information Systems in the Digital Age, 2006*. Brescia, Italy, pp. 1-8.
- Niemi, E., & Pekkola, S. (2016). Enterprise Architecture Benefit Development: Review of the Models and a Case Study of a Public Organization. *ACM SIGMIS Database*, 47(3), pp. 55-80.
- Niemi, E., & Pekkola, S. (2019). The benefits of enterprise architecture in organizational transformation. *Business & Information Systems Engineering*, pp. 1-13.
- Peppard, J., & Ward, J. (2016). *The strategic management of information systems: Building a digital strategy*. 4th edition. John Wiley & Sons, Chicester (UK).
- Plessius, H., Steenbergen, M. van & Slot, R. (2014). Perceived Benefits from Enterprise Architecture. In: Mola, L., Carugati, A., Kokkinaki, A. and Pouloudi, N. (eds.). *Proceedings of the 8th Mediterranean Conference on Information Systems*, Verona, Italy, pp. 1-14.
- Plessius, H., van Steenbergen, M., Slot, R., & Versendaal, J. (2018). The Enterprise Architecture Value Framework. In: *Proceedings of the European Conference on Information Systems (ECIS) 2018*, Portsmouth, England, pp. 1-10.
- Plessius, H. & Steenbergen, M. van. (2019). A Study into the Classification of Enterprise Architecture Benefits. In: *Proceedings of the 13th Mediterranean Conference on Information Systems*, Naples, Italy, pp. 1-14.
- Poort, E. R., & van Vliet, H. (2011). Architecting as a risk-and cost management discipline. In: *2011 Ninth Working IEEE/IFIP Conference on Software Architecture*, pp. 2-11.
- Raadt, van der, B., & van Vliet, H. (2009). Assessing the efficiency of the enterprise architecture function. In *Advances in Enterprise Engineering II: First NAF Academy Working Conference on Practice-Driven Research on Enterprise Transformation, PRET 2009, held at CAiSE 2009*, Amsterdam, The Netherlands. Proceedings 1, pp. 63-83. Springer Berlin Heidelberg.
- Renkema, T. & Berghout, E. (1997). Methodologies for information systems investment evaluation at the proposal stage: a comparative review. *Information and Software Technology*, 39(1), pp. 1-13.

- Rimol, M. (2021). Enterprise Architecture Enables Digital Transformation. Retrieved from <https://www.gartner.com/smarterwithgartner/enterprise-architecture-enables-digital-innovation> on January 22, 2024.
- Rodrigues, L. & Amaral, L. (2010). Issues in Enterprise Architecture Value. *Journal of Enterprise Architecture*, 6(4), pp. 27-32.
- Ross, J., Weill, P., & Robertson, D. (2006). *Enterprise architecture as strategy: Creating a foundation for business execution*. Harvard Business Press. Boston, Massachusetts.
- SAFe (2023). The Scaled Agile Framework, version 6.0. On: <https://scaledagileframework.com>. [Accessed June, 1, 2023].
- Saint-Louis, P., Morency, M.C., & Lapalme, J. (2019). Examination of explicit definitions of enterprise architecture. *International Journal of Engineering Business Management*, 11, pp. 1-18.
- Saleem, F., & Fakieh, B. (2020). Enterprise architecture and organizational benefits: a case study. *Sustainability*, 12(19), 8237, pp. 1-23.
- Schuurman, P., Berghout, E. & Powell, P. (2009). Benefits are from Venus, Costs are from Mars. University of Groningen, Netherlands. Sprouts: *Working Papers on Information Systems*, 9(3). pp. 1-14.
- Shanks, G., Gloet, M., Someh, I.A., Frampton, K., & Tamm, T. (2018). Achieving benefits with enterprise architecture. *Journal of Strategic Information Systems*, 27(2), pp. 139-156.
- Sheppard, N. (2023). 5 Benefits of Enterprise Architecture for your Company. Retrieved from <https://www.leanix.net/en/blog/benefits-enterprise-architecture> on January 22, 2024
- Simon, D., Fischbach, K. & Schoder, D. (2013). An exploration of enterprise architecture research. *Communications of the Association for Information Systems*, 32(1), pp. 1-72.
- Skog, D. A., Wimelius, H., & Sandberg, J. (2018). Digital disruption. *Business & Information Systems Engineering*, 60(5), pp. 431-437.
- Slot, R. G. (2010). *A method for valuing Architecture-Based Business Transformation and Measuring the value of Solutions Architecture*. PhD Thesis, University of Amsterdam, Amsterdam.
- van Steenberg, M., Bos, R., Brinkkemper, S., van de Weerd, I., & Bekkers, W. (2013). Improving IS Functions Step by Step: the Use of Focus Area Maturity Models. *Scandinavian Journal of Information Systems*, 25(2), 2, pp. 35-56.
- Tamm, T., Seddon, P., Shanks, G., & Reynolds, P. (2011). How does enterprise architecture add value to organisations. *Communications of the Association for Information Systems*, 28(1), pp. 141-168.

- TOGAF (2022). TOGAF Version 10. The Open Group. On: <https://www.opengroup.org/togaf> [Accessed June 1, 2023].
- Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, 122, pp. 889-901.
- Wan, H., Luo, X., Johansson, B., & Chen, H. (2013). Enterprise architecture benefits: the divergence between its desirability and realizability. In: *14th International Conference on Informatics and Semiotics in Organizations (ICISO2013, IFIP WG 8, 1 Working Conference)*. SciTePress, pp. 62-71.
- Yin, R. K. (2018). *Case study research and applications: Design and methods*. 6th ed. Sage Books, Los Angeles.
- Zimmermann, A., Schmidt, R., Sandkuhl, K., Jugel, D., Bogner, J., & Möhring, M. (2018). Evolution of enterprise architecture for digital transformation. In: *IEEE 22nd International Enterprise Distributed Object Computing Workshop (EDOCW)*. pp. 87-96.

Appendix 1. The Enterprise Architecture Value Framework

Introduction

The Enterprise Architecture Value Assessment Instrument, developed and validated as described in this thesis, builds on the Enterprise Architecture Value Framework (EAVF) as described in Plessius et al. (2018). In the EAVF, the benefits and costs of EA can be classified using two axes: one axis classifies the benefits and costs of EA into organizational goals using the Balanced Scorecard (Kaplan and Norton, 1992) and the other axis classifies these into the activities of the EA function using, based on the work of Ahleman and El Arbi (2012) a division in development-, implementation- and exploitation activities. The categories in both axes are defined by us in the original paper (Plessius et al., 2018) and repeated in table A1.1 below.

Table A1.1. The categories of the EAVF (Plessius et al., 2018)

<i>Dimension</i>	<i>Category name</i>	<i>Category description</i>
Organizational goal	Finance and accountability	goals that concern financial outcomes and/or the accountability of the organization to external stakeholders
	Customer and partnerships	goals that concern the market and the customers to which the products and services of the organization are targeted as well as the partnerships in which the organization participates
	Internal processes	goals relating to the current internal (business) processes, such as production, logistics and IT – including their support and management processes
	Learning and growth	goals that are targeted to improvements in the long run
EA Activity	EA Development	EA activities in which an Enterprise Architecture for the organization as a whole (or a sizeable part thereof) is developed and maintained
	EA Implementation	EA activities in which the implementation of (parts of) the Enterprise Architecture is carried out in the organization, usually via projects
	EA Exploitation	EA activities when changes in the operations corresponding with the EA have been implemented and are in operational use

Both axes can be refined to correspond in more detail respectively with the goals of the

organization and the activities of the EA function.

A Refinement of the Organizational Goals in the EAVF

In Plessius and van Steenberg (2019) a set of 31 subcategories of the Balanced Scorecard perspectives in the Enterprise Architecture Value Framework (EAVF) has been introduced. These EAVF categories are derived from the breakdown of the four perspectives of the balanced scorecard using the strategy map (Kaplan and Norton, 2001) and were validated in a Delphi study (Plessius and van Steenberg, 2019). The EAVF categories are categories of organizational goals to which EA may potentially contribute and are not necessarily a complete breakdown of all organizational goals. In table A1.2 below, brief descriptions of the EAVF categories are given.

Table A1.2. Brief descriptions of the EAVF categories.

<i>Main goal perspective</i>	<i>EAVF category</i>	<i>Brief description (Goals related to ...)</i>
Financial and Accountability	Costs ¹	... the reduction in expenses made by the organization
	Revenues ¹	... the increase in income that an organization generates from its activities
	Investments	... the commitment of capital to a resource with the expectation of obtaining additional revenues in the future
	Compliance	... how the organization operates in accordance with laws and regulations as well as internal standards
	Governance	... how rules, norms and actions are structured, sustained, regulated and held accountable in the organization
	Risk management	... how risks are identified, minimized, prevented and controlled by the organization
	Societal responsibility	... the moral justifiability to society of the processes, products and services of the organization (includes sustainability)
Customer and Partnerships	(Customer) Experience	... how customers experience their interactions with the organization (at all stages of the customer journey)
	(Customer) Relationships	... how (current and future) interactions with customers are structured by the organization
	Product position	... how the products and services of the organization fit in the marketplace and how these are distinguished from the products and services of competitors

<i>Main goal perspective</i>	<i>EAVF category</i>	<i>Brief description (Goals related to ...)</i>
	Market strategy	... the long-term plan(s) chosen by the organization to approach markets and customers
	(Business) Ecosystem	... the network of partner organizations that are involved in the delivery of products and services of the organization to customers
Internal processes	Logistics	... managing the storage and flow of products and services into, within and out of the organization (extends from supplier to customer)
	Procurement ²	... finding and acquiring materials and services from external sources
	Business (production) processes ³	... the tasks and activities with which the organization creates its products and services
	Marketing and sales	... the processes responsible for promoting, pricing, selling and delivering the products and services of the organization to customers
	Service delivery	... the supporting activities around the products and services to internal and external stakeholders (customers)
	Data management	... the processes and resources used that store, maintain, retrieve and safeguard data important to the organization
	Information management	... the processes and resources used to define, collect, organize, manipulate, store and distribute information by the organization
Internal processes	Quality management ⁴	... ensuring that outputs and the processes by which they are delivered, meet the stated requirements and are fit for purpose
	General management	... deciding on the strategy of the organization and coordinating the efforts of the employees to accomplish the goals of the organization
	Human Resource Management (HRM)	... the recruitment, management, deployment and development of employees in the organization
	Innovation	... the implementation of ideas that result in the introduction of new or improved products, services and processes in the organization
	Technology (non-IT)	... the (non-IT) techniques, skills, methods, resources and processes used in the production of the goods and services of the organization
Learning and Growth	Competences	... developing and utilizing the potential of individuals to perform tasks within the organization

<i>Main goal perspective</i>	<i>EAVF category</i>	<i>Brief description (Goals related to ...)</i>
	Culture	... the system of shared assumptions, values, and beliefs, governing how people behave in the organization
	Communication and knowledge management (KM)	... how information and knowledge are gathered and shared between individuals and groups
	Alignment	... arranging components of a business to best support the fulfilment of its long-term goals
	Agility	... the ability of the organization to respond to changes in its environment or initiate changes for competitive advantage
	Technology research	... evaluating the possibilities of (new) technology for the organization
	Evaluation and re-use	... the systematic determination of the value of processes and results, using criteria governed by a set of standards and indicating for re-use artifacts that comply with these standards
Notes:		
1) Because reduction of costs and revenues are – from an EA viewpoint - mirror images of each other, they are combined in one EAVF category: Costs and Revenues		
2) Often combined with Logistics in one category: Logistics and Procurement		
3) Called Production in chapter 3 (and the original paper)		
4) Includes project management		

Although the EAVF is complete (Plessius et al., 2018), it is not always easy to map a different classification of EA benefits on these EAVF categories as in many cases, descriptions of the categories in other classifications are not available. An example of these difficulties and a mapping procedure can be found in chapter 7: A Longitudinal View on the Perceived Contribution of Enterprise Architecture in the Netherlands.

A Refinement of the Activity Classes in the EAVF

The second axis of the EAVF relates the benefits and costs of EA to the activities of the EA. Currently, no refinement of this axis exists within the EAVF. In practice, the activities of the architects are largely determined by the method(s) and tools used by the architects. Along the activities as discerned in the method(s) used, a refinement of this axis can be made and in this way, the EAVF can be linked to that method. Without going into the details, we demonstrate

this with the often-used methods of The Open Group Architecture Framework TOGAF (TOGAF, 2022) and the Scaled Agile Framework SAFe, (SAFe, 2023).

In TOGAF, architectural activities are described in the ADM, the Architecture Development Method (figure A1.1). The ADM is considered the core of the TOGAF standard (TOGAF ADM, 2022, p1) and is divided into 8 iterative phases (and a preliminary phase which describes the steps to be taken when starting with architecture). In the documentation of TOGAF (TOGAF ADM, 2022), activities in the 8 phases (A to H in figure A1.1) are described. Based on these descriptions, we mapped in figure A1.1 the activity classes of the EAVF onto the phases of the ADM. The figure shows that some ADM phases (notably A, F, and H) overlap with two activity classes.

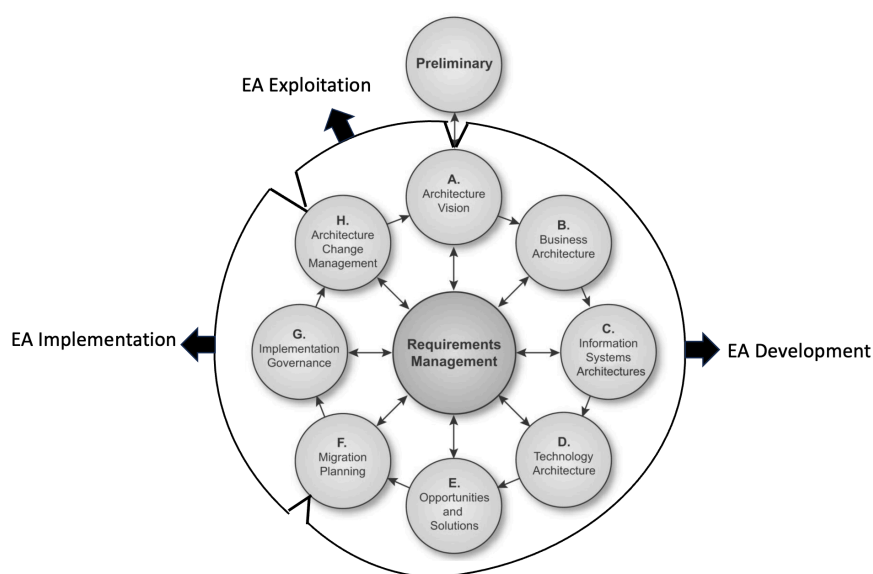


Figure A1.1. Mapping of the activity classes of the EAVF onto the Architecture Development Method from TOGAF (2022)

The mapping shown in figure A1.1 is general, based on the documentation provided by the Open Group (TOGAF ADM, 2022). In practice, the ADM may be modified to the specific situation of the organization and differences in mapping may be the result.

In the Scaled Agile Framework (SAFe,2023) a distinction is made between the roles of Enterprise Architect and System Architect. This distinction is in line with the distinction between EA Development and EA Implementation in the EAVF. Activities of the Enterprise Architect can be mapped onto the EA Development activity class and activities of the System Architect can be mapped onto the EA Implementation activity class. SAFe is not very explicit about Exploitation activities, but these EA activities are in general initiated by the Business Owners (see figure A1.2) and – as far as they concern the architectural aspects – are executed

by both the Enterprise Architect and the System Architect.

Note: in the full version of SAFe, targeted to very big organizations, also a Solution Architect is mentioned. This role is situated between the roles of Enterprise Architect and System Architect.

Appendix 2. The Enterprise Architecture Value Assessment Instrument

The instrument to assess the contribution of Enterprise Architecture (EA) to an organization, consists of three questionnaires to be used for three different groups of stakeholders:

EA Developers: Architects who create, adapt, and maintain (parts of) the enterprise architecture such as enterprise architects, domain architects, business architects, and information architects.

EA Implementers: Architects and non-architects who are accountable for the implementation of parts of the enterprise architecture, usually in projects. Examples are solution architects, system architects, program- and project managers.

EA Users: Non-architects who in their line of work are confronted with the results of enterprise architecture, such as business line managers, staff, and project owners.

All three questionnaires are preceded by a common set of instructions.

Textbox A2.1. Example of instructions for the questionnaires.

With this questionnaire, we aim to gain insight into the contribution of architecture to the organization: in which areas does architecture score high and in which low? The results may be useful in sharpening the focus of the architecture.

The questionnaire is divided into a number of sections, corresponding to the perspectives of the Balanced Scorecard, but you don't have to be familiar with this Balanced Scorecard to be able to answer the questions.

8.1

Please score your answers to the questions with the period from until in mind.

8.2

All questions can be scored on a scale from 1 to 5 or an X if you cannot or do not want to answer the question. The meaning of numbers 1 through 5 is:

- 1 - not important at all
- 2 - slightly important
- 3 - average important / has been considered
- 4 - important
- 5 - very important

8.3 X - don't know/ unknown

Please use only whole numbers when scoring; if you want to make nuances or explain your answer, please use the Comments column. In this column you can also indicate that a question is unclear, is open to multiple interpretations, etc.

Each questionnaire consists of a main question, followed by a series of items that should be scored on a scale from 1 to 5 (or X) as explained in textbox A2.1. The main questions are:

- *EA Developers*: Please state with a score from 1 to 5 the importance of the next items in developing and updating the enterprise/domain architecture
- *EA Implementers*: Please state with a score from 1 to 5 the importance of the next items in preparing solution/systems architectures during implementation processes
- *EA Users*: Please state with a score from 1 to 5 the importance of the contribution of architecture for the next items

In table A2.1, all value items that are part of the instrument, are included, sorted by EAVF category. In the questionnaires, the EAVF categories are not included, but the four perspectives of the balanced scorecard are. The column with the heading D I U indicates for which group of stakeholders the item is meant where D stands for EA Developers, I for EA Implementers, and U for EA Users. The descriptions of the items have been kept concise, but in the column with the heading Details additions and examples are given. These may be used to provide a Help-text with each item/question.

In the column 'Included from literature' the contributions found in the literature that were combined into one item in the questionnaires, are enumerated. All included contributions are shown only once, with the item that in our opinion corresponded best.

In the last column, with the heading Literature, references are given to the source(s) of the items. All references point to meta-studies about the value of EA and in these meta-studies, further references can be found. The numbers refer to the following papers:

[1] Niemi, 2008

[2] Foorthuis et al., 2010

[3] Boucharas et al., 2010a

[4] Tamm et al., 2011

[5] Wan et al., 2013

[6] Jusuf and Kurnia, 2017

[7] Gampfer et al, 2018

[8] Niemi and Pekkola, 2019

[9] Gong and Janssen, 2019

[10] Saleem and Fakieh, 2020

[11] Denzel and Jung, 2022

Table A2.1. Items in the questionnaires, sorted by EAVF category

<i>EAVF category</i>	<i>Item (as included in the questionnaires)</i>	<i>Details (can be used for clarification)</i>	<i>Included from literature (combined into one item)</i>	<i>D I U</i>	<i>Literature (references)</i>
Financial and Accountability					
Costs and Revenues	Lower operational costs and/or higher revenues	The (expected) influence on operational costs and revenues after changes proposed in the EA have been implemented. Includes both business and IT costs/revenues	-reduced costs in general -reduced IS/IT costs -reduced administrative costs -increased revenues in general -increased IS/IT revenues -increased business performance	D I U	[1][3][4][5][6][8][9][10][11]
	Reduction in costs that must be made to implement the desired changes	The costs of change management stemming from the implementation of the EA such as project costs, costs for training, development of software, etcetera (no investments)	-reduced costs of change	D I U	[1][2][6]
Investments	The investments that must be made to implement the desired changes	Expenses needed for the implementation of the EA that are done all at once, but are amortized over a longer period; for example, computer equipment	-better substantiation of investments	D I U	[1][3][4][5][6][8][9]

<i>EAVF category</i>	<i>Item (as included in the questionnaires)</i>	<i>Details (can be used for clarification)</i>	<i>Included from literature (combined into one item)</i>	<i>D I U</i>	<i>Literature (references)</i>
Compliance	Compliance with laws and regulations as well as internal standards	Compliance means acting in accordance with established guidelines and specifications	-improved compliance	D I U	[2][3][6][8][9]
Governance	Directions from the architecture supervising board (governance)	An architecture supervising board may give directions that overrule architectural regulations and instructions	-improved governance structure	D I -	[2][11]
	Alignment of the architecture with the strategy of the organization	The mechanism that takes care the architecture is demonstrable in line with the strategy of the organization	-governed alignment with strategy	D - U	[1][2][3][4][5][6][8][9][10]
	Prevention of undocumented deviations from the architecture	Including a mechanism to deal with documented deviations	-reduced deviations from architecture	- I -	[2][6]
	Coordination with other projects	The mutual coordination between projects that implement parts of the EA (especially important in agile development)	-supervised coordination between projects	- I U	[3][4]
Risk management	Prevention of risks in business processes and information processing	Risks in business and IT processes are addressed and reduced via the architecture	-improved risk management	D I U	[1][3][4][5][6][11]
Societal responsibility	Sustainability	The use of energy and raw materials, including the way the organization deals with waste materials	-increased environmental care	D I U	[3][6][7][8]

<i>EAVF category</i>	<i>Item (as included in the questionnaires)</i>	<i>Details (can be used for clarification)</i>	<i>Included from literature (combined into one item)</i>	<i>D I U</i>	<i>Literature (references)</i>
	Decent working conditions	Not only internal working conditions but also with partners, suppliers and customers	-good working conditions	D I U	[3][8]
	Alignment with the CSR strategy (Corporate Social Responsibility) of the organization	The mechanism that takes care the architecture is demonstrable in line with the CSR of the organization	-strengthened alignment with CSR	D - U	[7]
Customer and Partnerships					
(Customer) experience	The (expected) effects on customer experience and customer satisfaction	Customers are people / organizations outside the own organization.	-improved customer satisfaction -strengthened brand awareness -strengthened customer loyalty -strengthened impact of products/services on customers	D I U	[3][6][8][10][11]
(Customer) relationships	The interaction with customers	The effects on how the organization interacts with customers, for example the communication channels used	-improved interaction with customers -new customer channels	D I U	[1][5][6]

<i>EAVF category</i>	<i>Item (as included in the questionnaires)</i>	<i>Details (can be used for clarification)</i>	<i>Included from literature (combined into one item)</i>	<i>D I U</i>	<i>Literature (references)</i>
Product position	The (expected) effects on markets and market shares	How a product is perceived by customers in relation to the products of competitors. It determines the market value of the product	-strengthened brand awareness -increased market share -new markets	D I U	[1][5][6][8][11]
Market strategy	Alignment with the chosen market strategy of the organization	The mechanism that takes care the architecture is demonstrable in line with the market strategy of the organization, for example is the focus on price, quality and/or service	-clear market approach chosen -strengthened chosen market approach	D I U	[3][4][10]
Ecosystem	The cooperation with partners in partner networks	How well suppliers and consumers in a supply chain (a network of companies and people that are involved in the production and delivery of a product or service) work together	-strengthened partner management	D I U	[2][3][6][9]
	The exchangeability of data with partners	the arrangements with partners about the kind of data and their quality attributes such as availability, reliability, timeliness, etcetera	-improved interoperability between partners	D I U	[3]

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	Supply chain integration	the extent to which business processes of the organization and its partners are connected to each other	-improved supply chain integration	D I U	[5][9]
	The alignment of architecture, solutions and systems with the architecture, solutions and systems of partners	the extent to which information systems of the organization and its partners are mutually and demonstrable in line	-solutions and systems with partners integrated better	D I U	[1][3][5][6][8][9][11]
Internal processes					
Logistics and Procurement	The way business processes are connected	Business processes in the organization follow each other seamlessly regarding the flows of materials and/or information	-improved resource management	D I U	[6][8]
	The support of business processes with logistics software	The flow of goods, services and information is supported by software such as enterprise resource planning (ERP) software and workflow software	-better supported business processes with IS/IT	D I U	[6][8]
Business (production) processes	The overall quality of business processes	Examples of quality attributes are functionality, reliability, efficiency, interoperability and standardization	-standardized and generalized business processes -improved interoperability of business processes	D I U	[1][2][3][4][5][6][8][11]

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Marketing and sales	Business process performance	The effectiveness and efficiency of business processes. Commonly measured with key performance indicators (KPI's)	-more efficient business processes	D I U	[1][3][4][6][8][11]
	Digitization of business processes	The extent to which business processes are supported or replaced by IT systems	-business processes replaced by IT	D I U	[3][11]
	The time-to-market of new products and services	Time-to-market is the length of time it takes to offer a product or service to customers, starting with the first idea	-reduced time-to-market	D I U	[5][10]
	The use of customer journeys to model how customers make contact with the organization	A customer journey is the path of interactions a (potential) customer has with the products and services of the organization	-customer journeys clarifying the customer perspective	- I -	[10]
Service delivery	Support for external customers with the products and services of the organization	Examples are the support via a helpdesk (live or via chatbots), a frequently asked questions (faq) page on the website, etcetera	-improved service delivery -expanded service portfolio	D I U	[9]
	Support for colleagues (internal customers) with the procedures and systems of the organization	Id.	Id.	D I U	[8][9][11]

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Data management	The quality of stored data	Examples of quality attributes are completeness, availability, standardization, timeliness and redundancy	-improved data integration -reduced data redundancy	D I U	[3][4][5][6][8][11]
	The interoperability of data between information systems	Interoperability refers to the ease with which data can be exchanged between information systems	-increased data interoperability	D I U	[2][3][5][6][8][9][11]
	The ability to make connections between all kinds of – often very extensive – data files (big data)	Big data refers to the ability of the organization to combine structured, semi-structured and unstructured data that can be mined for information	-better integrated internal and external data sources	D I U	[7]
Information management	Coordination of IT processes	Examples of IT processes are asset management, backup and recovery, testing and software development	-improved requirements -reduced IS development time -consolidation on applications chosen -improved coordination in IT and security management	D I U	[1][3][4][6][9][10][11]

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	The quality of information systems and IT infrastructure	Examples of quality attributes are availability, accessibility, adaptability and reusability	-improved interoperability of information systems -improved utilization of IT infrastructure -improved IT integration -improved quality of IT infrastructure -reduced complexity of IT infrastructure -innovated IS/IT infrastructure	D I U	[2][3][4][5][6][8][9][10][11]
	The security of information, information systems and infrastructure	IT security is the set of strategies that prevents unauthorized access to organizational assets such as computers, networks, and data	-improved IT security	D I U	[3][6][8][9][11]
	Outsourcing and cloud	Outsourcing is the outplacement of IT processes to third parties; cloud refers to the outplacement of IT assets such as data and applications	-improved outsourcing decisions	D I U	[7]

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Technology (non-IT)	-	No topics found in literature			
General management	Support for decision-making	IT-tools for management supporting decision-making activities by the reduction of complexity	-improved decision making -improved strategic planning	D I U	[1][2][3][4][5][6][8][9][11]
	The requirements from portfolio management	Portfolio management is the selection, prioritization and control of the programs and projects of the organization	-improved portfolio management	D I -	[3][6][9]
Quality management	The involvement of stakeholders	The completeness and extent to which stakeholders (people who are impacted by the outcome of a project) are involved	-improved stakeholder management	D I U	[3]
	The quality of the design, the implementation and the (intended) results of projects	Prior to, during and after the implementation, including the quality of change management	-reduced impact of changes in the organization	D I U	[1][2][3][5][6][8][9][10][11]
	The manageability of projects	Examples of quality attributes are time, money, scope and risks	-improved project quality -reduced project realization time -reduced project budget exceedance -reduced project risks	- I U	[2][3][5][6][9]

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			<ul style="list-style-type: none"> -improved project scoping -improved management of ambiguous goals -project resources used more effectively 		
	Support with agile project management	Agile project management is an iterative approach to managing software development projects that focus on continuous releases and incorporating stakeholder feedback with every iteration	-agile project management better supported	D I U	[7]
HRM	The satisfaction with information systems and infrastructure and the contribution to IT support	The satisfaction of users and management with IT systems and the recruitment and deployment of IT staff	<ul style="list-style-type: none"> -improved satisfaction with IS and IT -improved management satisfaction -improved workforce satisfaction 	D I U	[1][3][4][6][8][9]
Innovation	The innovation of products and services	Innovation aimed at the world outside the organization	-new products/services for existing markets	D I U	[1][3][6][7][8][9]

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	The innovation of business processes, information systems and infrastructure	Innovation aimed internal, within the organization	-innovated business processes, IS and IT -innovation fostered	D I U	[1][3][6][7][8][9][11]
Learning and Growth					
Competences	The professionalization of the organization	Competencies refer to the skills, knowledge, education and personal characteristics employees possess in performing their task	-more professional organization created	D I U	[3][4][10][11]
	The professionalization of the architectural function	Id.	-improved architectural capabilities	D I -	[2]
	The professionalization of project management	Id.	-improved project management	- I U	[2][3]
Culture	The willingness and ability to cooperate in the organization	Cooperation refers to the formal way of interacting with one another in the organization	-improved intra-organizational trust and collaboration -reduced organizational stovepipes -improved enterprise integration	D I U	[3][4][5][6][8][10][11]

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Communication and knowledge management	The culture in the organization	Culture refers to the informal way of interacting with one another in the organization	-improved interaction within organization	- - U	[3][5][6][11]
	Communication and knowledge sharing	The influence of the architecture on the support of communication and knowledge sharing	-improved intra-organizational communication -improved inter-organizational communication -improved communication on project investments -improved communication on changes in IT infrastructure -improved communication on solution concepts -improved communication on future direction -improved sharing of the baseline architecture -improved sharing of the target architecture -improved sharing of the roadmap	D I U	[1][2][3][4][5][6][8][9][11]

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Alignment	Alignment of business processes (business / business alignment)	How well the (internal) business processes work together and support each other	-improved information and knowledge sharing in general -improved business/business alignment -corporate services better in line with expectations	D I U	[1][3][8]
	Alignment of business processes and IT (business / IT alignment)	How well the business processes and IT work together and support each other	-improved business/IT alignment	D I U	[1][2][3][4][5][6][8][9][10][11]
	Providing insight into the current and the desired situation as well as into the road map	Does the architecture give insight in what to change and when?	-better insight in the current and desired situation	D I U	[1][2][3][6][8][11]
Agility	The ability to respond to changes in the environment of the organization in a controlled way	Agility is the ability of an organization to respond to external changes	-improved ability to deal with changes	D I U	[1][2][3][4][6][7][8][9][10][11]

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	The ability to respond to changes in business processes and IT within the organization	The ability to respond to internal changes is also called the resilience of the organization	-better insight in current and potential agility -improved ability to deal with changes -improved business and process flexibility -improved IT change responsiveness	D I U	[1][3][4][5][6][7][8][9][11]
Technology research	Research of and gaining experience with new technology	Evaluating the possibilities of new technology for the organization. May in time lead to innovation	-better insight in possibilities of new technologies -better insight in technological evolvability	D I U	[7][10]
Evaluation and re-use	Experiences with previous results of architecture	Previous results of architecture are documented and used for learning	-reused business artifacts -reused IT artifacts	D I -	[3][8][11]
	Evaluation of project results	Previous results of projects are documented and used for learning	-increased frequency of project evaluations	- I U	[3][8][11]

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	Solving technical debt	Technical debt refers to the costs an organization has to make to fix shortcuts taken in the past (commonly used in relation to software development)	-improved quality of project evaluations -technical debts solved	- I -	[3]
	Creation of artifacts for reuse	Architectural artifacts are the tangible architectural designs, principles and decisions	-reused architectural artifacts -reused IT artifacts	D I -	[1][3][4][5][6][8][11]