The Value of Enterprise Architecture

An Elusive Quantity?

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UNIVERSITY OF APPLIED SCIENCES UTRECHT

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To my parents: Ad and Annie Plessius

There is strong anecdotal evidence that Enterprise Architecture brings benefits to organizations and that organizations are investing significantly in EA initiatives. However, demonstrating the business value of EA has proven elusive.

Shanks et al., 2018

Alles was überhaupt gedacht werden kann, kann klar gedacht werden. Alles, was sich aussprechen lässt, lässt sich klar aussprechen.

Wittgenstein, L. (1922). Tractatus Logico-philosophicus, #4.116

Preface

My research into the value of Enterprise Architecture (EA) started in 2011 when I joined the research group Architecture of Digital Information Systems (ADIS). Through professor Raymond Slot I became involved with the ArchiValue project, a joint effort of various research institutes and commercial organizations into methods, approaches, and instruments for deriving the value of IT and IT projects. In this project, the first version of the value framework that is central to this thesis, the Enterprise Architecture Value Framework (EAVF), was developed and applied in a case study. In the years that followed, the framework was refined and applied in further case studies, culminating in 2014 in a survey based on the framework. The construction of an instrument to value the contribution of EA seemed close at the time!

Although it was discussed several times during this period, I did not want to start a PhD study - doing research is fun, but to delve so deeply into one theme ... So, I broadened my horizon by doing research into topics such as Green IT and IT education. However, being responsible for a bachelor course about Enterprise Architecture for part-time students, my interest in the value of EA never disappeared. In 2018, I resumed my previous research with a more fundamental approach starting with precise definitions of the key concepts behind the framework. This made a PhD study a realistic option and I set up a proposal approved in September 2020 by the Dutch Open University.

When I started this research, I felt confident that I could solve the problem of EA's value once and for all. Throughout my research, I became more humble because the topic of EA value showed many pitfalls. As shown in this thesis, EA may contribute to many areas, but not all of these contributions are quantitatively measurable. For example, it is often stated that EA leads to better decision-making, but how much better? Another problem turned out to be the attribution problem: if a project implements parts of 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 stakeholders. My solution to overcome these problems is described in this thesis.

You don't do PhD research alone. Many people have contributed to my research, papers, and thesis. Without them, I would not have completed this research and my thanks go to all of them. I cannot name them all as there are too many: colleagues in the ICT educational

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Chapter 1

General Introduction

The chapter introduces the research domain and motivates why this line of research has been chosen and discusses its relevance to the scientific community and EA practitioners. Also, the research questions are formulated, and an overview of the research approach and methods used is given. The chapter ends with an outline of the structure and content of the thesis.

1. General Introduction

1.1 Information Technology, Information Systems, and Digital Transformation

Information technology (IT) has made it possible to have any information available anywhere and at any time. The widespread availability of information has a profound influence on organizations, both profit and non-profit, driving a shift from digital support by information systems (IS) to a 'digital first' strategy, often referred to as digital transformation (Verhoef et al, 2021; Wessel et al, 2021; Kraus et al., 2022). Because digital transformation challenges 'business as usual' and may have serious effects on industries and markets, it is considered disruptive (Skog et al., 2018).

Textbox 1.1. Information technology as a disruptive force.

An example of the disruptive force of IT is the music industry where the physical carrier of music is made obsolete by iTunes, Spotify and the like. Nowadays, many young people no longer buy records or CDs, but access music via a digital outlet. As a consequence, the number of record stores has been substantively reduced.

Another example is the rise of companies such as Flink, Getir and Gorillas, which provide their customers with the opportunity to order groceries that will be delivered to their homes in a very short time (in most cases within 10 minutes). While IT makes this business model possible, IT does not necessarily replace the physical side of doing business but may give it a twist and in this way, new business opportunities arise.

The disruptive force of IT and IS (IS/IT) has developed over time. Peppard and Ward (2016) introduced a three-era model of the evolving power of IS/IT, based on its development over time. In the first era, by the authors referred to as *Data Processing*, the driving force behind investments in IS/IT is operational efficiency. The primary focus is on transaction processing and repetitive operating tasks are automated. In the second era, indicated as *Management Information Systems*, management effectiveness is the main driver. In this era, the focus shifts to the analysis of available information to give feedback to managers about the results of their department and their interventions, supporting management decisions. The third era is called *Strategic Information Systems* and is driven by the wish to improve competitiveness. Its focus is on knowledge discovery from internal and external sources. In this era, two stages can be discerned. The first stage, which we will call *e-Business*, is driven by the rise of the Internet around the turn of the century, making it necessary for companies to have a presence on the world wide web to stay competitive. The second stage in this era is characterized by the replacement of existing business models by new, IS/IT-driven business models. We will call this stage *Digital Transformation*.

In the model of Peppard and Ward (2016), the beginning of a new era does not automatically end a previous era, IS/IT is still used today to increase efficiency and effectiveness. The model shows what is considered the greatest benefit in every era and how the proliferation of IS/IT makes new ways of using IS/IT possible. We expect the

evolving possibilities of IS/IT to continue; an example is the development of artificial intelligence (AI), which is considered a highly disruptive technology, impacting the way IS/IT will be applied (Păvăloaia & Necula, 2023).

For many years, the increasing power of IT has made more powerful information systems possible. The objective was to provide better information to make business processes more efficient, effective, and integrated (Peppard & Ward, 2016). Changes induced by IS/IT were mainly internal, within an organization and did not influence the organization's strategy or position in the market. Around the turn of the century, with the rise of the Internet, new companies appeared that could create digital services without the burden of the past. New business models and new interfaces towards customers emerged. Services became directly available to customers without the intervention of other parties and existing companies had to follow or perish (Tronvoll et al., 2020). The result of all changes in the era of Strategic Information Systems is that IS/IT has evolved from an enabler to an integral part of the business (Peppard & Ward, 2016). As a consequence, the process of digital transformation not only affects the IT department but may disrupt existing business processes in the organization and create new markets. In many organizations, an important tool to manage digital transformation is Enterprise Architecture (Korhonen & Halén, 2017; Zimmerman et al., 2018; Niemi & Pekkola, 2019).

1.2 *Enterprise Architecture*

Enterprise Architecture has its origin in information systems planning methods such as James Martin's Information Engineering (Martin, 1989) and Yourdon's Systems Method (Yourdon, 1993), developed in the 80's of the previous century. These methods looked at information processing not only as a programmer's challenge but placed it in the context of the strategy and the business processes of an organization and the people who had to work with those systems. In those days, this view was propagated in the Netherlands by researchers such as Oonincx (1982) and Bemelmans (1994). This approach developed into a discipline called Enterprise Architecture (EA) by Zachman (1987), one of the founding fathers of the discipline.

By its background, EA is traditionally positioned between the business and IS/IT. The changes in the role of IS/IT as discussed in the previous section, have had its effect on EA. The consequences of the changes in the use of IS/IT can be seen in the wide variations in the scope and purpose of EA. Lapalme (2012) classified these into three schools of thought: enterprise IT architecting, enterprise integrating, and enterprise ecological adaptation. In *enterprise IT architecting*, the scope is the IS/IT within the organization and the main goal of EA is aligning the IS/IT of an organization with the strategy of the enterprise. This school is characterized by Lapalme (2012, p.29) as '*the glue between enterprise and IT*'. *Enterprise*

integrating takes a holistic view of the enterprise and is concerned with all aspects of the enterprise, including the IS/IT. The motto given by Lapalme (2012, p.29) to this school of thought is '*EA is the link between strategy and execution*'. Finally, *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*' (Lapalme, 2012, p.29).

The three schools of thought as discerned by Lapalme (2012) correspond with the three eras of Peppard and Ward (2016) as both models are derived from the increasing possibilities and the widening scope of IS/IT over time. Similar to the model of Peppard and Ward (2016), a new era does not end the previous one; the three schools of thought of Lapalme (2012) coexist. Yet, in this era of digital transformation, organizations need to be able to respond quickly to the competition. This has its effect on EA, which is moving from creating an overall view of the future IS/IT landscape towards guiding and coordinating the use of IS/IT in the organization, in line with the strategy of the organization and taking into account the ecosystem it operates in (Korhonen et al., 2016; Zimmermann et al., 2018). Instead of models, principles and rules are becoming more important 'tools of the trade'. Moving in this direction also requires excellent communication- and collaboration competencies of the architects to align the possibly different interests of the various stakeholders (Banaeianjahromi & Smolander, 2017; Proper et al., 2022).

In this way, EA can contribute to the ambidexterity of an organization, supporting both the exploitation and exploration capabilities of the organization (Raisch et al., 2009), and as a consequence, EA indirectly impacts business value (Wetering, van de, 2022). By moving in this direction, EA and its way of thinking transcend its original purpose: bridging the gap between business and IS/IT (Walraven et al., 2018).

Textbox 1.2. Some definitions of Enterprise Architecture from literature.

ISO/IEC/IEEE define architecture as: "the fundamental concepts or properties of a system in its environment embodied in its elements, relationships and in the principles of its design and evolution" (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 and 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) stated: "EA translates the broader goals and principles of an organization's strategy into concrete processes and systems enabling the organization to realize their goals".

Chapter 1. *General Introduction*

Over time many definitions have been given of EA. Common characteristics in most of these definitions are (Saint-Louis, Morency, and Lapalme, 2019): EA is in line with the strategy of the organization; EA is model-driven; EA balances business processes, information systems, and IT infrastructure, and EA provides guidelines for the future. In our work, in line with the analysis of the definitions of EA by Saint-Louis et al. (2019), we have defined 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"*.

Our definition emphasizes that EA is a discipline with its own domain and deliverables and also its intention: the development of an organization. The definition matches the enterprise integrating school of thought (Lapalme, 2012) that was current when we started with our research into EA (Plessius, Slot & Pruijt, 2012). To accentuate the role of EA in digital transformation, in later work (Plessius et al., 2023) we have shortened this definition to: *"EA is a discipline that directs enterprise transformations",* a definition that better fits the developments in EA as expressed in the third school of thought of Lapalme (2012): enterprise ecological adaptation.

The definitions given above include (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, 2018).

In practice, the main application of EA nowadays can be summarized as the alignment of business strategy, business operations, and IS/IT (Simon et al., 2013; van den Berg, 2019; Kurnia et al., 2021). To that purpose, Kurnia et al. (2021) discern eight EA activity areas: business capability modeling, road mapping and portfolio planning, IT asset management, opportunity assessment, project governance, communication and coordination, consulting and mentoring, and audit of mergers and acquisitions. Several of these EA activity areas have been found useful in other domains as well. Some examples are:

IT service management (Randone, 2012). In his 2012 paper, Randone describes how interesting opportunities emerge in the intersection of enterprise architecture, IT service management and service-oriented architecture.

Creating a foundation for execution (Ross et al., 2006). In their book *Enterprise Architecture as Strategy,* the authors describe how EA can be used to build a foundation for the execution of business processes which in turn provides a platform for innovation.

Decision support (Berg, van den, 2019). The research conducted by van den Berg reveals various success factors of how EA can be used to improve IT decisions.

Cyber security (Mayer et al., 2019). The authors claim that connecting EA practices with IS/IT security management may improve cyber security.

Building and managing digital capabilities (Korhonen & Halén, 2017). The authors investigated how EA can support digital capabilities in an organization which may bring more flexibility and resilience to organizations.

1.3 The Value Concept

Value is "*a concept easily used but rarely defined*" (Rodrigues & Amaral, 2010b, p.28). Renkema and Berghout (1997) equate value with the consequences of (human) actions. Because such consequences are manifold, stakeholders can approach the concept of value from different viewpoints (Rodrigues & Amaral, 2010; Kaisler and Armour, 2017). For example, in economic terms, value is often reduced to a financial quantity, measurable in monetary terms. But not all consequences can be caught in financial terms and in our research, we look at financial as well as non-financial consequences.

The consequences of an action can be positive and negative and value is determined by the difference between the positive and negative consequences, respectively called benefits and sacrifices by Renkema and Berghout (1997). In this thesis, we use the term 'cost' instead of 'sacrifice' to indicate negative consequences.

Value is often used to characterize the benefits and costs in situations where an exchange of goods and/or services between a producer and a consumer is on the agenda. Bowman and Ambrosini (2000) distinguish between use value and exchange value where use value is the (subjective) value perceived by the (potential) consumer and exchange value is the (objective) value realized in the transfer. As elaborated in the next section, an objective measurement of the value of EA is difficult to obtain and we will focus on the use value of EA as perceived by different stakeholder groups. Sales et al. (2017, 2018) have made an ontological analysis of use value and identified several characteristics:

Goal-related: the value perceived by a consumer depends on the extent to which the goals or needs of that consumer are met.

Relative: from its goal-related nature it follows that the value perceived may differ between consumers as goals may differ between consumers.

Related to experiences: to communicate the value perceived it is necessary to refer to experiences gained or expected from the object or service under consideration.

Context-dependent: The value perceived of an object or service can vary between contexts in which it is considered.

Positive and negative: The value perceived of an object or service may have positive and negative components.

By its nature, use value is dependent on both the stakeholder consulted and the situational context. In practice, determining the use value therefore has the character of an assessment rather than an objective measurement.

1.4 Challenges and Motivation

Around the turn of the century, a discussion arose about the value of EA and how to measure this value (Boster et al., 2000; Buchanan, 2001). This discussion continues until the present day (Kaisler & Armour, 2017; Gong & Janssen, 2019; Kurnia et al., 2020; Ahlemann et al., 2021; Tamm et al., 2022). Kaisler and Armour (2017) traced back the doubts and concerns about whether EA adds value to organizations and found that: (1) the direct output of EA (in particular its models) can be quite abstract; (2) changes induced by EA may take a long time to become visible; (3) choices made in the EA are often experienced as obstacles that stand in the way of the implementation; and (4) fast-changing technology can make choices made in the EA disputable.

Especially in agile environments, these characteristics can make project team members suspicious of EA. To stay relevant, in such environments, EA has to adapt itself and focus on the coherence and continuity of the projects at hand and keep them in line with the strategic vision of the organization (Canat et al, 2018; Horlach et al., 2020; SAFe, 2023).

The discussion about the value of EA concentrates both on which areas EA contributes to and on how to measure the added value of EA to these areas (Kaisler & Armour, 2017). The areas where EA contributes are usually referred to as EA benefits and many authors have provided a classification of these benefits, not always explaining where their classification is based upon. Meta studies in this area can be found in Morganwalp and Sage (2004), Schelp and Stutz (2007), Niemi (2008), Boucharas et al. (2010b), Foorthuis et al. (2010), Lange and Mendling (2011), Tamm et al. (2011), Wan et al. (2013), Jusuf and Kurnia (2017), Niemi and Pekkola (2019), Gong and Janssen (2019) and Kurnia et al. (2020). An overview of these classifications is given in chapter 4: *The Development of an Instrument to Assess the Contribution of Enterprise Architecture to Organizational Goals.* In this thesis, we introduce an overarching classification scheme, the Enterprise Architecture Value Framework (EAVF). In the EAVF benefits and costs of EA are classified along two axes: organizational goals and the activities related to the EA (see chapter 2: *The Enterprise Architecture Value Framework*), compliant with the analysis of use value by Sales et al (2017, 2018).

The diversity in classifications of EA benefits makes it very difficult to compare these studies. Moreover, when researching the value of EA, not only the benefits should be included, but also the costs of EA. Papers about the costs of EA are scarce in the literature (Lindstrom et al., 2006). If costs are mentioned, it is in terms of a reduction of costs by EA (Foorthuis et al., 2010; Miguens et al., 2018) and in our view, these should be classified as a benefit of EA. In chapter 2: *The Enterprise Architecture Value Framework* a more extensive discussion of EA benefits, EA costs and EA value can be found. In this thesis, we will use the terms *EA value* and *contribution of EA* to include both EA benefits and EA costs. Measuring the value of EA also has its limitations. In the first place, one of the more problematic factors in the research on EA value is that researchers often do not explain what is understood by EA value (Boucharas, 2010a; Gong & Janssen, 2019), making it difficult to measure EA value unequivocally. Secondly, while some value contributions 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 indicated as *intangible* (Niemi, 2008). A third and very fundamental limitation is the degree to which a benefit (or cost) can be attributed to EA. For example, if a project result is following the EA and leads to cost reductions, to what extent can this be contributed to the EA? Therefore, in this thesis when referring to the contribution of EA, we will rather use the term *assessment* instead of *measurement* to emphasize that no exact and objective standards exist for the contribution of EA.

Textbox 1.3. Summary of problems with (measuring) EA value.

Summarizing: Categorizing and measuring the value of EA has many problems:
1. No universal definition of value in relation to EA;
2. No commonly accepted classification of EA benefits;
3. Neglect of the costs of EA;
4. Many EA benefits are not objectively measurable;
5. To what extent can organizational benefits be contributed to EA.

The motivation for this research is to address the issues discussed and thereby guide EA practitioners towards a value-driven approach as well as support the discipline of EA with a scientifically validated foundation for EA value.

1.5 Research Questions

Based on the considerations described above, the main research question (MRQ) addressed in this research is:

> *MRQ: How can the contribution of enterprise architecture to organizations be assessed?*

The MRQ expresses our objective to deliver an instrument that can be used to determine to what extent EA contributes to the performance of an organization. By using the plural *'organizations',* we accentuate the principle that the contribution of EA should be related to the outcomes of the EA, rather than to its methods or the way the EA function is organized. In the MRQ the term *assessed* is chosen instead of *measured* because many EA benefits are intangible as discussed in the previous section.

To outline our research in more detail, several research questions (RQ) have been formulated:

> *RQ1: How can EA benefits and EA costs be defined and classified?*

The first RQ is directed at giving precise definitions of the key concepts to be used in our research that can be used to develop a classification scheme for EA benefits and EA costs.

In the previous section, we discussed that no universally accepted classification of EA benefits and EA costs exists. This may be due to the fact that EA benefits and EA costs are very diverse and lack an intrinsic common feature. Because the classification will be applied to support the assessment of the contribution of EA to an organization, defining terms are sought in organizational properties.

> *RQ2: How can a framework to assess the value of EA, that is based on a classification of EA benefits and costs, be constructed?*

The second RQ is concerned with the development of a framework on which an assessment can be based. It builds on the classification scheme constructed in the first part of our research.

As the role of EA varies in time as discussed in the previous sections, the benefits and costs attributed to EA vary in time as well. To be able to update the framework systematically, a clear and unambiguous construction path must be delineated in this research.

> *RQ3: How can an EA assessment instrument be constructed and used in practice, taking into account differences between individual organizations?*

The third RQ concerns the construction of an assessment instrument for practice, based on the developed framework; this instrument can subsequently be used to evaluate the framework itself. In the construction process, attention should be given to the construct validity.

In the construction process, questions arise such as: 'what do the outcomes of an assessment mean for the organization' and 'how can they be used to make the EA practice

more value-driven?' In answering these questions, differences between organizations should be considered.

During our research, we conducted a survey about the perceived value of EA (Plessius et al., 2023). As there exist at least two previously held surveys with the same goal (Foorthuis et al., 2010; Plessius et al., 2015), a fourth RQ arose, giving further research possibilities:

> *RQ4: In which areas can a change in the perception of EA in the Netherlands be observed?*

The three surveys mentioned divide the discussion about EA value in time frames and this RQ is aimed at changes visible over these time frames, both in the scientific literature as well as in the outcomes of the surveys.

1.6 Research Approach

The nature of our research is design-oriented (Hevner et al., 2004) as an artefact (the framework) will be developed. In their paper, Hevner et al. (2004) present 7 guidelines for design science which are reproduced in table 1.1. In chapter 8, *Discussion and Conclusion,* our research is evaluated against these guidelines.

Table 1.1. Design Science Research Guidelines (Hevner et al., 2004, p. 83)

Guideline	Description
Design as an Artefact	Design-science research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation.
Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Design Evaluation	The utility, quality and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods.
Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artefact, design foundations and/or design methodologies.
Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.
Design as a Search Process	The search for an effective artefact requires utilizing available means to reach desired ends while satisfying laws in the problem environment
Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Chapter 1. *General Introduction*

Our research has been carried out in four phases, following the four RQs:

RQ1:

How can EA benefits and EA costs be defined and classified?

Approach:

In the first phase, literature research has been used to research key concepts such as benefit, cost, and value and to identify existing classification schemes for EA benefits. The results were used to develop a classification scheme, the Enterprise Architecture Value Framework (EAVF). The first version of the EAVF has been evaluated in several case studies (Plessius et al., 2012) and a survey (Plessius et al., 2014; Plessius & van Steenbergen, 2015). From this evaluation, we concluded that the construction of this first version of the framework was lacking in rigor, so we reconsidered the value concepts, providing precise definitions of the main value concepts in a second iteration. Based on these new definitions, we were able to define the final version of the EAVF (Plessius et al., 2018).

Related chapters:

Chapter 2: The Enterprise Architecture Value Framework (Plessius et al., 2018).

Chapter 6: Towards an Enterprise Architecture Benefits Measurement Instrument (Plessius et al., 2015).

RQ2:

How can a framework to assess the value of EA, that is based on a classification of EA benefits and costs, be constructed?

Approach:

We started this phase with literature research into reported EA benefits and EA costs and mapped these in the EAVF. As the EAVF consists of only 12 categories, most categories became overcrowded. To enable a more refined categorization of EA benefits and EA costs possible, we constructed a subcategorization of the EAVF. The subcategories discerned, the EAVF categories, and their importance for EA have been validated by a group of experts in a Delphi study (Plessius & van Steenbergen, 2019).

The framework constructed in this phase by extending the EAVF with the EAVF categories will be referred to as the *extended EAVF (eEAVF)*.

Related chapters:

Chapter 3: A Study into the Classification of Enterprise Architecture Benefits (Plessius & van Steenbergen, 2019).

RQ3:

How can an EA assessment instrument be constructed and used in practice, taking into account differences between individual organizations?

Approach:

In this phase, we operationalized the framework developed in the previous phase, the extended EAVF, to construct an assessment instrument that can be used to validate this framework. We chose to assess the contribution of EA qualitatively as many value items are intangible (Niemi, 2008). Taking into account construct validity, the extended EAVF together with the in the literature reported EA benefits and EA costs were used in the construction of a set of questions which together constitute the core of the instrument (Plessius et al., accepted for publication).

To evaluate the framework using the instrument, we carried out several case studies. Case studies were used as these make it possible to ask for evidence, compare the outcomes of the instrument when querying different persons in an organization, and differentiate between more general vs. organization-specific benefits and costs of EA (Plessius et al., accepted for publication). In the case studies, the comprehensibility, relevance, and completeness of the questions in the instrument were validated, and from the construct validity we infer the validity of the framework.

The questions in the instrument have also been used to draft a survey (Plessius et al., 2023), which again showed the comprehensibility, relevance, and completeness of the questions in the instrument.

Apart from the instrument itself, a guide on how to use the instrument in an organization has been developed, based on the outcomes of the case studies. Both the instrument and the use guide can be found in the appendices of this thesis.

Related chapters:

Chapter 4: The Development of an Instrument to Assess the Contribution of Enterprise Architecture to Organizational Goals (Plessius et al., accepted for publication in Information Systems Management).

Chapter 5: Areas where Enterprise Architecture Contributes to Organizational Goals – A Quantitative Study in the Netherlands (Plessius et al., 2023).

RQ4:

In which areas can a change in the perception of EA in the Netherlands be observed?

Approach:

To answer the fourth RQ, three surveys on the perceived contribution of EA in the Netherlands were compared: one by Foorthuis et al. (2010) and two by us: Plessius et al. (2014, 2015) and Plessius et al. (2023). An analysis is made of the changes in the perceived value of EA in the Netherlands over time and the results are used to extrapolate to changes that may occur in the near future.

Related chapters:

Chapter 5: Areas where Enterprise Architecture Contributes to Organizational Goals – A Quantitative Study in the Netherlands (Plessius et al., 2023).

Chapter 6: Towards an Enterprise Architecture Benefits Measurement Instrument (Plessius et al., 2015).
Chapter 7: A Longitudinal View on the Perceived Value of Enterprise Architecture in the Netherlands (Plessius et al., 2024).

1.7 Research Methods

To answer the research questions, a mixture of research methods, both qualitative and quantitative, were applied. The use of multiple methods contributes to more complete evaluations (Mingers, 2001), making the artefacts created more reliable and trustworthy (Hevner et al., 2004). All evaluations were started with a protocol, describing the goal, the design and the intended execution of the evaluation.

An overview of how the research methods discussed are used in evaluating the artefacts (products and half-products alike) is given in figure 1.1.
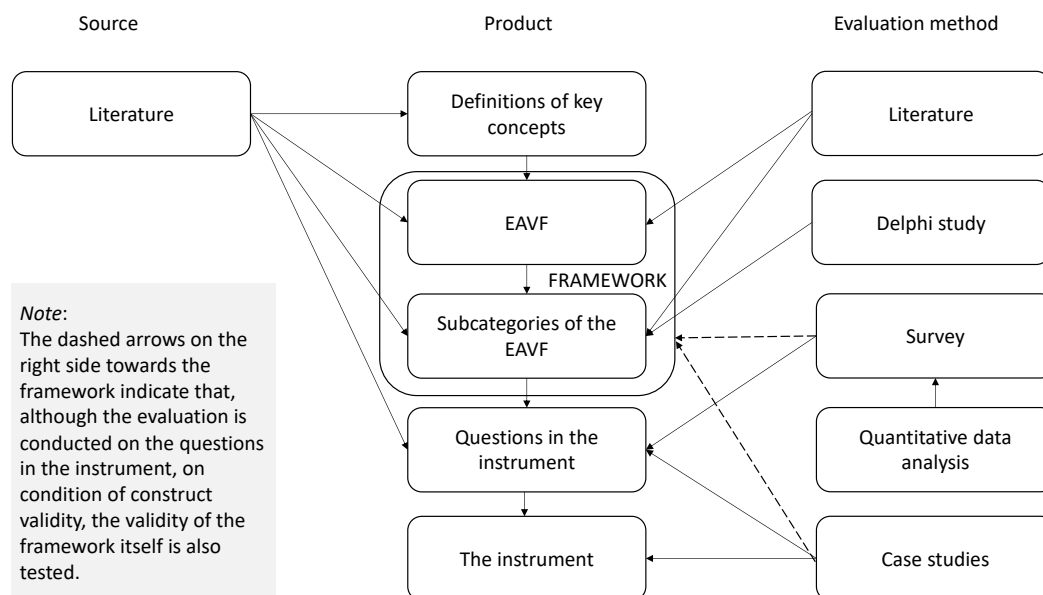
Figure 1.1. Overview of research methods used.

Literature research

Literature research is the start of every scientific research (Bell, Bryman, and Harley, 2022). A well-conducted literature review provides the foundation for further research by demonstrating that the intended research contributes to the scientific body of knowledge and/or is useful in the practice (Bandara et al., 2011).

All studies included in this thesis were started with a literature review to position the topic under study. As the main topic of this thesis centers around the value of EA, some overlap between the various literature reviews was unavoidable.

Delphi study

A Delphi study is an iterative, multi-stage process to query experts and make it possible for experts (the panel members) to react to each other, thereby working towards a common outcome on which consensus can be reached (Hasson, Keeney, & McKenna, 2000; Okoli & Pawlowski, 2004; Diamond et al., 2014; Giannarou & Zervas, 2014). A Delphi study can be carried out online with the added benefit that experts have ample time between rounds to reflect on the various answers given. To guarantee methodological rigor, care should be taken in the way the questions are formulated, the number of rounds, the minimal response rate, the background of the panel members, and the criteria for consensus (Hasson, Keeney, & McKenna, 2000).

In this research, a Delphi study has been used to refine and validate the categorization of the areas to which EA may contribute. The results can be found in chapter 3: A Study into the Classification of Enterprise Architecture Benefits.

Case study

While case studies offer a controlled environment to study phenomena in their natural context (Runeson & Höst, 2009), they are also under a lot of criticism as results are not commonly generalizable and their implementation cannot be verified (Qi, 2010; Yin, 2018). Case study research "*is particularly appropriate for certain types of problems: those in which research and theory are at their early, formative stages*" (Benbasat, Goldstein, & Mead, 1987, p.369). It is however important to apply rigorous scientific standards to be able to draw conclusions.

In this research we used case studies for evaluation purposes, focusing on the comprehensibility, relevance, and completeness of the questions, the recognizability of the outcomes, and the ease of use, usefulness, and efficacy of the instrument, and, provided construct validity, also the validity of the framework. The results from these case studies are included in chapter 4: *The Development of an Instrument to Assess the Contribution of Enterprise Architecture to Organizational Goals.*

Survey

With a survey, a lot of comparable data can be acquired in a relatively short time (Bell, Bryman, and Harley, 2022), but a survey also has its drawbacks. These include the representativeness of the results and the issue of all respondents interpreting the survey questions in the same way (Kitchenham & Pfleeger, 2002).

During our research, we used a survey twice: in 2014 (Plessius et al., 2014, 2015) and in 2021 (Plessius et al., 2023). The goal of both surveys was twofold: to gather data on the perception of the value of EA and to validate the completeness and relevance of the current framework.

Chapter 1. *General Introduction*

Quantitative data analysis

To be able to draw conclusions from a multitude of data gathered in a survey, many statistical techniques are available. Care should be taken to select techniques that fit the underlying data, especially when a Likert scale has been used and these data are ordinal (Kitchenham & Pfleeger, 2003). We applied a number of these techniques, using the well-known statistical package SPSS, versions 22 and 28, to analyze the results of our surveys and in the comparison of these surveys in chapter 7: *A Longitudinal View on the Perceived Value of Enterprise Architecture in the Netherlands.*

1.8 Contribution

As stated in the first section of this chapter, nowadays digital transformation is probably the most important driver in creating business value. Hence, the question of the value of EA is not only of academic interest but has practical implications as well: to remain relevant to the organization, architects should constantly be aware of the value they can and should add to the organization.

From a theoretical point of view, our research contributes by giving detailed definitions of the main EA value concepts and the development of a classification scheme based on these definitions, the EAVF. The EAVF classifies the benefits and costs of EA along two axes: organizational goals and EA activities. As illustrated in appendix 1 for the well-known methods of TOGAF (2022) and SAFe (2023) it can be integrated into EA methods used by architects and as such can be seen as an extension of these methods. The classification scheme of the EAVF has been extended with a subcategorization into a framework: the extended EAVF, which can be used to combine various research on EA value as illustrated in chapter 7: *A Longitudinal View on the Perceived Value of Enterprise Architecture in the Netherlands.*

The extended EAVF is operationalized in an instrument to assess the value of EA: the EA Value Assessment Instrument. This instrument is independent of the organization of the EA function and the methods and tools used by the EA practitioners. A comparison of the perceived value of EA in the Netherlands (chapter 7: *A Longitudinal View on the Perceived Value of Enterprise Architecture in the Netherlands*) shows that the expectations concerning the contribution of EA can change over time. If necessary, a new version of the instrument can be created using the same approach as used in the current version.

In a practical sense, this research contributes to questions such as: to which degree does EA contribute to the business operations at hand? Does it help to ensure the agility of IS/IT in a fast-changing environment? (Kaisler & Armour, 2017). As such, it is relevant for the practice of EA as it can be used by architects to assess their contributions to the

organization and optimize the alignment of their activities to the strategic choices of their organization. Moreover, as organizations want to see a return on their investments (ROI) from their EA capability in a reasonable timeframe (Gong and Janssen, 2019), the instrument may point to areas where this ROI can be found.

1.9 Thesis Outline

This thesis consists of several research papers previously published in scientific journals or conference proceedings. Chapters 2 to 6 each contain one of these papers integrally (except for the references which are collected at the end of this thesis) and as a consequence, there exists some overlap, especially in their introduction and literature review. The only amendments we made in these papers are (1) correcting spelling- and grammatical errors, and (2) updating section numbers and captions of figures, tables, and textboxes to comply with the format used in this thesis. We changed the reference style in chapters 5 and 6 from Springer to APA.

An overview of the publications included in this thesis is given in table 1.2 at the end of this section.

Chapter 1: Introduction

This chapter introduces the research domain and motivates why this line of research has been chosen and discusses its relevance to the scientific community and EA practitioners. In this chapter, the research questions are formulated, and an overview of the research approach and methods used is given. The chapter ends with an outline of the structure and content of the thesis.

Chapter 2: The Enterprise Architecture Value Framework

In this chapter, RQ1 is explored. Definitions of the key concepts used (organizational goal, EA activity, EA benefit, and EA cost) are given. From these definitions, it is concluded that EA benefits and EA costs can be classified by organizational goal and EA activity. In the resulting classification scheme, the Enterprise Architecture Value Framework (EAVF), organizational goals are classified using the balanced scorecard (Kaplan & Norton, 1992), which is used more often to make organizational goals explicit in practice. (Hasan & Chyi, 2017). EA activities are classified in terms of the three organizational processes: development, implementation, and exploitation (Ahleman et al., 2012). The EAVF is validated against the criteria of Nickerson, Varshney, & Muntermann (2013) and it is shown that existing classifications can be mapped into the EAVF.

The related paper was presented as research in progress at the *European Conference on Information Systems (ECIS) 2018*. June 23 - 28, 2018, Portsmouth, England.

Chapter 3: A Study into the Classification of Enterprise Architecture Benefits

As the four perspectives of the Balanced Scorecard (BSC) are still too wide-ranging for assessment purposes, in this chapter, they are extended, starting with the breakdown given by Kaplan and Norton (2001) in their strategy map. After validation by 13 Dutch EA experts in a Delphi study, 31 subcategories where EA benefits and costs may be expected, are discerned. This chapter shows how the extended EAVF is constructed and answers RQ2.

The paper was presented at the *13th Mediterranean Conference on Information Systems.* September 27 – 28, 2019, Naples, Italy. It received a best paper award.

Chapter 4: The Development of an Instrument to Assess the Contribution of Enterprise Architecture to Organizational Goals.

This chapter discusses the development and validation of the instrument to assess the value contribution of EA to organizations. The instrument is based on EA value items (items believed to contribute to EA), as discussed by both researchers and practitioners. From the EA value items, overlapping items were combined and the resulting set of EA value items were classified in the subcategories of the EAVF.

In the assessment instrument, three categories of respondents are discerned: EA developers, EA implementors, and users of EA. For each category an overall question has been formulated and a subset of relevant value items chosen. The instrument and a guide for its use can be found in the appendices of this thesis. Validations of the instrument and the extended EAVF were carried out using case studies in four organizations. This chapter answers RQ3 partly.

The paper has been accepted for publication in Information Systems Management.

Chapter 5: Areas where Enterprise Architecture Contributes to Organizational Goals – A Quantitative Study in the Netherlands

To further validate the latest version of the instrument, a survey to assess the perceived value of EA in the Netherlands was carried out. This chapter discusses how the survey was carried out and its results. The findings from this study further answer RQ3. Apart from giving an overview of the value items that are considered (very) important/ unimportant, a major observation from the outcomes of the survey is that the maturity of EA can be improved. The chapter also partly answers RQ3.

The paper was presented at the *TEAR 2022 workshop of the EDOC 2022 Conference,* held on October 3, 2022, in Bolzano, Italy.

Chapter 6: Towards an Enterprise Architecture Benefits Measurement Instrument

In December 2013 and January 2014, we conducted a survey in the Netherlands to get a picture of the perceived value of EA in organizations. The survey was based on a first version of the EAVF and as such, the results are not fully comparable with the results of the 2021/2022 survey in the previous chapter. The chapter is meant to give an overview of the evolution of the EAVF and is also used in chapter 7 where three surveys held in the Netherlands are compared.

The paper was presented at the *CAISE International Workshops* held June 8 – 12, 2015 in Stockholm, Sweden.

Chapter 7: A Longitudinal View on the Perceived Value of Enterprise Architecture in the Netherlands

Three surveys about the perceived contribution of EA in the Netherlands (Foorthuis et al, 2010; Plessius, van Steenbergen & Slot, 2015; Plessius et al., 2023) are compared using the extended EAVF and developments in the perceived contribution of EA over time are analyzed. Tentatively, implications for the near future are drawn. The chapter answers RQ4.

An extended version of this chapter has been accepted for presentation at the 28th International Conference on Enterprise Design, Operations, and Computing (EDOC 2024).

Chapter 8: Discussion and Conclusion

In this chapter, the outcomes of our research are critically reviewed and the research questions are answered. Limitations of our research and potential future work on the topic of EA value are discussed.

Appendices

In the appendices of this thesis, the instrument is covered. These consist of three parts:
1. The Enterprise Architecture Value Framework.
2. The Enterprise Architecture Value Assessment Instrument.
3. How to use the Enterprise Architecture Value Assessment Instrument.

Table 1.2. Overview of the publications included in this thesis.

Chap-ter	RQ	Reference	RQ in paper
2	RQ1	Plessius, H., van Steenbergen, M., Slot, R. and Versendaal, J. (2018). The Enterprise Architecture Value Framework. In: *Proceedings of the European Conference on Information Systems (ECIS) 2018*, Portsmouth, England, pp. 1-10 (Research in progress).	How can a classification scheme of benefits and costs of EA be constructed from definitions of these concepts?
3	RQ2	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.	How can a refinement of the four perspectives of the BSC be constructed from literature and validated against the possible contributions of EA?
4	RQ3	Plessius, H., van Steenbergen, M., Ravesteijn, P. and Versendaal, J. The Development of an Instrument to Assess the Contribution of Enterprise Architecture to Organizational Goals. Accepted for publication in *Information Systems Management.*	How can organizations assess the contribution of their EA function?
5	RQ3 RQ4	Plessius, H., van Steenbergen, M., Ravesteijn, P. and Versendaal, J. (2023). Areas where Enterprise Architecture Contributes to Organizational Goals – A Quantitative Study in the Netherlands. In: *Prince Sales, T. et al. (ed.). Enterprise Design, Operations and Computing. EDOC 2022 Workshops*. Springer, LNBIP, volume 466, pp. 149-165.	Where can the most important contribution to the value of enterprise architecture be found, according to architects and stakeholders of enterprise architecture?
6	RQ1 RQ4	Plessius, H., van Steenbergen, M. and Slot, R. (2015). Towards an Enterprise Architecture Benefits Measurement Instrument. In: *Advanced Information Systems Engineering Workshops: CAiSE 2015 International Workshops*, Stockholm, Sweden, June 8-9, 2015, Proceedings 27. Springer International Publishing. pp. 363-374.	Is it possible to develop an EA benefits measurement instrument based on the EA Value Framework?
7	RQ4	Plessius, H., van Steenbergen, M., Ravesteijn, P. and Versendaal, J. (2024). A Longitudinal View on the Perceived Value of Enterprise Architecture in the Netherlands. *Extended version accepted for presentation at EDOC 2024.*	How has the perception of EA in the Netherlands evolved over time?

Chapter 2

The Enterprise Architecture Value Framework

Enterprise Architecture (EA) is a discipline aimed at managing the complex interrelationships of business processes and IT in the continuously changing environment of organizations. Despite this ambitious agenda of EA, it is not clear what exactly constitutes the value of EA for an organization or which activities architects should initiate to maximize their effectiveness.

In this paper, we present the Enterprise Architecture Value Framework (EAVF). The EAVF is a framework for classifying the benefits and costs of EA along the dimensions of organizational goals and EA-related activities. It is derived from definitions of its underlying concepts and is independent of methods, techniques, and tools used by architects. The framework is validated both theoretically and by mapping other frameworks on the EAVF. Results support the hypothesis that it offers a framework on which all EA benefits and costs can be mapped uniquely, thus providing a means to unite previous and future research on EA benefits.

The development of the EAVF is a first step in creating a measurement instrument for EA benefits and costs. It can be used in practice to align the activities of architects with the goals of the organization, thereby optimizing their effect on the performance of the organization.

This chapter was originally published as:

2. The Enterprise Architecture Value Framework

2.1 Introduction

Enterprise Architecture (EA) is a means to translate the strategy of an enterprise into execution by providing a holistic view of the business processes, systems, and technologies of the organization (Ross, Weill, and Robertson, 2006). In this view, EA strongly influences the strategic and tactical decision-making in organizations (Simon, Fischbach, and Schoder, 2014). The proliferation of EA in organizations started just before the turn of the century (Zachman, 1997), followed by an increasing interest from the scientific community from 2003 onwards (Simon, Fischbach, and Schoder, 2013). With the growing implementation of EA in organizations, the interest in the question of its value for the organization has increased as well. One of the first authors publishing on this theme is Buchanan (2001). Since then, many more researchers have published on the benefits of EA from various perspectives, reporting benefits like *business-IT alignment, better decisions, lower (IT) costs, improved business processes, improved IT systems, better collaboration, better integration,* and *re-use of resources.* However, Boucharas et al. (2010a) conclude that though many research papers assume EA benefits, only a small percentage provides empirical proof of EA benefits and most authors do not define concepts like goal and benefit nor do they make explicit how they arrived at the benefits they present. This strongly limits the empirical as well as the theoretical foundation of their research (Rodrigues and Amaral, 2010; Espinosa, Boh, and DeLone, 2011; Lange and Mendling, 2011). Moreover, because no common classification of benefits exists (Niemi, 2008), the results of the various studies are difficult to compare. Lacking a commonly accepted classification, no agreed-upon set of metrics to measure EA benefits exists either (Schelp and Stutz, 2007; Lange and Mendling, 2011; Kurek, Johnson, and Mulder, 2017). Moreover, while the research on EA benefits continues, literature on the costs of EA is scarce and no classification of EA costs has as yet been proposed. These issues motivated us to start our research into establishing the value of EA in practice. As a first step, we have drafted a classification of the benefits and costs of EA, deduced from definitions of these concepts. The research question we address in this paper is: *How can a classification scheme of benefits and costs of EA be constructed from definitions of these concepts?*

A classification scheme of benefits and costs of EA contributes to the scientific knowledge base by providing a common language and reference framework for other studies on the value of EA, thereby enabling the comparison and combination of results of EA benefit studies. The classification scheme presented in this paper can also be applied in practice by providing a more detailed view of the actual and potential contribution of EA to various types of organizational goals. Besides, it offers a strategy for the evaluation of EA activities and gives the opportunity to (re-)align more precisely the activities of architects to the organization's strategic choices.

This paper is further organized as follows: in the next section, we discuss related literature followed by an overview of the research method in section 3. In section 4 we define the various concepts related to the value of EA and the EA Value Framework (EAVF), our classification of benefits and costs of EA. In section 5 the EAVF is theoretically validated and the paper ends with a short discussion and our plans for future research.

2.2 Theoretical Background

Goal, benefit, cost, and value are concepts used in business literature for discussing the performance of an organization (Berghout, Nijland, and Powell, 2011). In his classical book 'Modern Organizations', Etzioni (1964, p.6) defines a goal as: "*An organizational goal is a desired state of affairs which the organization attempts to realize*". In his vision, it follows that it can be established to what extent a goal has been reached, so goals are measurable by definition.

In order to reach the goals, organizations initiate activities. An activity is a generic term for work that a company or 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. Renkema and Berghout (1997) call the positive consequences of such activities benefits and the negative consequences sacrifices. In this paper, we will use the more commonly used term 'cost' 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 towards some goals while at the same time having negative consequences for other goals. For example, the benefit of an activity may be an increase in market share and the cost a decrease in customer satisfaction due to longer delivery times. It follows that benefits and costs can be related to goals by assigning the benefits and costs of activities to the goals they contribute to. Following this line of thought a *benefit* is the positive (financial and/or non-financial) contribution of (one or more) activities towards the desired state of affairs for an organization as stated by some goal. In the same vein, a *cost* is the negative (financial and/or non-financial) contribution of (one or more) activities towards the desired state of affairs for an organization as stated by some goal. The difference between the benefits and the costs related to the same goal (the net contribution) is defined by Schuurman, Berghout, and Powell (2009) as the value reached for that goal. It follows that value is a derived concept and as such not necessary for a classification scheme.

Since Buchanan (2001) many researchers have published on the benefits of EA from various perspectives. Though most authors present some classification of the benefits found, quite often these classifications are directly derived from their results and not

founded in a theoretical framework. Foorthuis et al. (2010), Tamm et al. (2011), and Lange et al. (2012a) are representatives of this approach, resulting in different classifications which make it difficult to compare these studies. Other authors use a more theoretical approach in classifying the benefits. Van der Raadt (2011) distinguishes benefits for the organization aimed at external factors (agility benefits) and internal factors (alignment benefits). While not independent of each other, "*due to the abstract and multi-level characteristics of these concepts*" (van der Raadt, 2011, p. 98), all benefits may be classified in one of these categories (and sometimes in both). More recently, Jusuf and Kurnia (2017) have used the benefit framework for enterprise systems of Shang and Sheddon (2002) to classify their identified EA benefits in five classes: operational, managerial, strategic, IT infrastructure, and organizational benefits.

Some authors use performance frameworks, particularly the balanced scorecard (Kaplan & Norton, 1992) - commonly abbreviated to BSC - to classify EA benefits. For example, Schelp and Stutz (2007) combine the four perspectives of the BSC with the organizational scope of the benefits. Boucharas et al. (2010a) conducted a structured literature research on EA benefits. Based on their literature review they distinguish 100 mutually exclusive benefits of EA, which they categorize in the strategy map (Kaplan and Norton, 2001), an extension of the original BSC. This decision is grounded in a review of five different frameworks for classifying benefits in terms of organizational goals from which they conclude that the BSC and its derived forms fit their requirements best. However, the choice of the BSC as a classification model for organizational goals is disputed. In a critical analysis of the assumptions underlying the BSC, Norreklit (2000) states that one of the more conspicuous shortcomings of the BSC is its underlying focus on financial results as the ultimate outcome. In a paper on the foundations of the BSC, Kaplan (2008) counters this by stating that - as financial success is not the primary objective of non-profit and public-sector enterprises - their accountability to society is the rationale for their existence and should supplement the financial outcome category. Other critics (Mooraj, Oyon, and Hostettler, 1999) point out that the BSC is not complete as it does not include categories for the contribution of suppliers and employees to the organization. This criticism seems to be based upon a rather literal interpretation of the BSC and is in line with the fact that despite many publications, there is little agreement on what a BSC essentially is (Cobbold et al., 2002; Soderberg et al., 2011). According to Norton and Kaplan (1993), a BSC can (and must) reflect the actual organization and categories may be subdivided if the need arises. In other words: the BSC may be seen as a mold from which an organization can develop its own scorecard for developing and classifying its goals.

With the exception of the model by Schelp and Stutz (2007), all these classifications are one-dimensional. However, organizational scope and the perspectives of the BSC are not mutually independent. A genuine two-dimensional model is introduced by Niemi (2008),

who conducted an in-depth literature review on EA benefits and interviewed a focus group on the results. His conclusion from the literature research is that: "*While the literature focuses on listing a multitude of benefits, it does not clearly define and describe them. Furthermore, there does not seem to be an established model for classifying the benefits in the EA context, …*" (Niemi, 2008, p. 2). Next, he identifies 27 types of EA benefits and uses the IS classification model of Giaglis, Mylonopoulos, and Doukidis (1999) to classify these along two axes: the measurability of the benefit and its attributability to EA, thereby producing four categories: hard, intangible, indirect and strategic benefits. Another two-dimensional classification is proposed by Wan et al. (2013), who performed a follow-up on the work of Tamm et al. (2011). They distinguish eight types of EA benefits, that they classify further based on two attributes: their desirability and their realizability. However, it can be argued that these can be seen as lenses through which to view EA benefits rather than as generic dimensions and they can be used in combination with any classification scheme.

As these classifications are not based on clear definitions of EA benefits (Niemi, 2008; Boucharas et al., 2010a; Niemi and Pekkola, 2016), they all seem rather arbitrary. In contrast, Lange and Mendling (2011) provide a list of EA goals derived from literature and expert interviews. They define four classes of goals: create baseline, manage complexity, drive transformation, and support innovation. As they define EA benefits as the degree to which the goals of an organization are met, these classes can be used as a classification of EA benefits as well.

Research on benefits has resulted in several EA benefit models – explanations of how EA may lead to benefits for the organization. As this paper is about the classification of benefits (and costs), we will not cover this topic but refer to the literature (Delone and MacLean 2003; Kluge et al., 2006; Steenbergen and Brinkkemper 2010; Espinosa et al. 2011; Lange et al., 2012a, 2012b; Frampton et al., 2015; Foorthuis et al., 2016). A meta-study on the various models proposed has recently been published by Niemi and Pekkola (2016) and their results indicate that none of the existing models fully explains how EA benefits are created.

Discussions on the costs of EA are very scarce in the literature. If costs are discussed, it is in terms of reduction of costs by virtue of EA, which by all authors is considered a benefit of EA. Classifications of the costs of EA have to the best of our knowledge never been proposed and already in 2006 Lindstrom et al. pointed out that even the main EA frameworks lack support for estimating and managing costs. We have no indication that this has improved since then. A possible explanation might be that the benefits and costs of EA are made at different times so there is no direct relation between the benefits and the costs of EA in a given period.

2.3 Research Method

The research as described in this paper is part of an ongoing research into the value of EA that started with Slot (2010) and can be considered as a first step into the construction of a measurement instrument for the benefits and costs of EA.

This research started with an exploratory literature review by using Google Scholar and Hugo, the search engine of the University of Applied Sciences Utrecht that indexes many databases including ACM Digital Library, AIS eLibrary, ScienceDirect, Springer, Taylor and Francis, and Wiley Online. Search terms used were 'benefits', 'cost', 'value', 'contribution', 'expense', and 'consequence' in combination with 'enterprise architecture'. From the results, besides an overview of reported benefits and costs of EA to be used in further research, literature studies from roughly the last 10 years that included some kind of classification of EA benefits were selected for this paper. The observation that these classifications did not rely on definitions of the concepts of benefits and costs and classes were not properly outlined (Niemi, 2008; Boucharas et al., 2010a; Niemi and Pekkola, 2016), led us to an analysis of what exactly is meant with these terms. From definitions of these concepts, we derived a value framework, that has been validated theoretically against the criteria as formulated by Nickerson, Varshney and Muntermann (2013) and against existing classifications by asking four experts to map existing classifications into the framework. The usability of the framework in practice will be evaluated as part of our planned future research (see section 6).

2.4 The Enterprise Architecture Value Framework

EA - with its focus on the long-term development of an organization - contributes to the performance of an organization as expressed by its goals. Benefits and costs can be attributed to EA if the contributing activities are related to EA, i.e. either creating or implementing the EA or resulting from the EA. We will call those activities: *EA activities* and the resulting benefits and costs: *EA benefits* c.q. *EA costs*, thereby defining EA benefits and EA costs as the contribution towards the goals of the organization by EA activities. Summarizing, we use the following concepts underlying our classification scheme:

- *(Organizational) Goal*: A desired state of affairs that 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 related to the EA, i.e. either creating or implementing the EA or resulting from the EA.

- *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) who call this a sacrifice).

In using these concepts, we have to distinguish between *types* and *instances*. In the literature, we do not find a benefit such as: "Company X has reached in the last year an increase of its market share for product Y with Z percent", but rather the more general "increase in market share" is presented as a benefit. This is the classical distinction between an instance and a type as used in other disciplines as well. We will rely on context for the difference, but, when necessary, we will distinguish between the two with a suffix: *-instance* and *-type*.

From the definitions given, it directly follows that EA benefits and EA costs can be classified by organizational goal and by EA activity. To classify EA benefits and EA costs in terms of organizational goals, we use Kaplan and Norton's (1992) Balanced Scorecard (BSC) as – despite its previously discussed shortcomings - the BSC has widespread use (Hasan and Chyi, 2017) and is supported by the research of Boucharas et al. (2010b). With the four perspectives of the BSC Kaplan and Norton (1992) introduce four different points of view in which goals, measures, and activities for an organization can be classified. In their original paper on the BSC, they state that these perspectives "*should provide answers to four basic questions: How do customers see us (customer perspective), what must we excel at (internal perspective), can we continue to improve and create value (innovation and learning perspective) and how do we look to shareholders (financial perspective)*" (Kaplan and Norton, 1992, p.72). More precise definitions of these perspectives have – to the best of our knowledge - never been given. In practice, this poses no problems as every organization may use the BSC as a mold to develop its own scorecard (Norton and Kaplan, 1993; Soderberg et al., 2011). However, in order to report on benefits in a uniform way, it is necessary to develop a classification scheme that can be used to unambiguously decide in which category a given EA benefit or cost belongs. We thereto define the four perspectives as follows:

- *Financial and Accountability*: goals that concern financial outcomes and/or the accountability of the organization to external stakeholders (shareholders, government, or – in the case of non-profit and public-sector organizations – members and contributors).

- *Customer*: goals that concern the market, the customers, or the supply chain to which the products and services of the organization are targeted.

- *Internal*: goals relating to the current internal (business) processes, such as production, logistics, and IT – including their support and management processes. In short: the processes necessary for the value proposition of the organization.

- *Learning and Growth* (also known as *Organizational Capacity*): goals that are targeted to improvements in the long run. Examples here are the development of employees, the culture, communication, alignment, and agility of the organization as well as the willingness to use and deploy information and technological savviness in the organization.

To relate EA benefits and EA costs to EA activities we have categorized these activities in accordance with the three main outcomes of the EA process (TOGAF, 2011; SAFe, 2016), the creation of the EA, the implementation of EA and the results after implementing the EA:

- *EA Development*: EA activities in which an Enterprise Architecture for the organization as a whole 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. This category is called *EA Adaptation* by Dang and Pekkola (2017)

We call this classification the Architectural Lifecycle (ALC) as it comprises all EA activities in a more or less 'natural order'. However, with the ALC, EA activities can be classified regardless of the order in which the actual work is organized. For example, in an agile environment, implementation decisions may give rise to the (further) development of the EA while in a linear way of working the development of the EA will precede its implementation. While the EA activities in an agile environment may take place in any order, they are still recognizable (Abrahamsson et al., 2003). So, the transition from organization-wide EA work to projects is clearly recognizable - see for example SAFe (2016). The same holds true for the change from implementation activities to the activities that take place in the operations after implementation: the exploitation.

In the Enterprise Architecture Value Framework (EAVF) the perspectives of the BSC are combined with the classes of the ALC (figure 2.1). This results in twelve cells to which we will refer as the *EAVF-categories* in which the benefits and costs of EA can be classified.

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

Figure 2.1. The Enterprise Architecture Value Framework (EAVF)

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2.5 Validation of the EAVF

The EAVF has been derived directly from our definitions of EA benefits and EA costs. To verify if this framework is in accordance with scientific quality criteria, we follow Nickerson, Varshney, and Muntermann (2013). Based on an extensive literature study, they propose five necessary conditions for a taxonomy: it should be comprehensive, concise, robust, explanatory and extendible. As we want every instance of an EA benefit or EA cost to be placed in one cell of the EAVF and in one cell only, we require the EAVF to be unambiguous as well. We tested the EAVF against these conditions:

- *Comprehensive*: by using the BSC, the EAVF covers fully the domain of organizational goals (Cobbold et al., 2002; Boucharas, 2010b). By its definition, the ALC covers all EA activities. It follows that, as EA benefits and EA costs are defined in terms of organizational goals and EA activities only, all instances of EA benefits and EA costs can be classified in the EAVF.

- *Concise and robust*: the EAVF has twelve cells in two dimensions making it easy to understand while at the same time, it offers enough detail to differentiate between various kinds of EA benefits and EA costs.

- *Explanatory and extendible*: by their nature, the EAVF categories combine instances of EA benefits and EA costs based on corresponding organizational goal and EA activity, bringing together instances with common properties. However, when necessary both axes can be subdivided further to show more detail.

- *Unambiguous*: to fulfill this condition, it is necessary to define every EAVF category precisely, including the 'borders' between the cells. This will be addressed in our further research (see paragraph 6).

Besides the five necessary conditions posed by Nickerson, Varshney, and Muntermann (2013), they also state that to be sufficient, a sixth condition should be added: a taxonomy should be useful and used in practice. As it is not possible to apply this last condition beforehand, we plan to evaluate in our further research how the EAVF can be used in practice.

From the comprehensiveness of the EAVF, it follows that it should at least be possible to map other classifications into the EAVF. By the lack of existing classifications of EA costs, we have restricted our exercise to EA benefits as presented by Niemi (2008), Tamm et al. (2011), and Boucharas et al. (2010b). In our mappings, we had to deal with the fact that EA benefits are not always clearly defined by the authors, leaving them open to different interpretations. So, we asked four EA experts to do the mappings and compared their results. For some benefits, e.g. 'reduced costs', all agreed on the mapping. Differences in the mapping of other benefits could be explained by vagueness in the description of the benefit and the fact that in some cases the effects of the benefits were mapped as well. All in all, we could explain the differences in the mappings by the four experts and we conclude

that all of the EA benefits considered can be placed in the framework. Any vagueness in how to map an EA benefit seems attributable to the way the benefit has been formulated and not to the classification scheme of the EAVF. Rather, we found it an advantage of using the EAVF as a generic framework that it forces a more precise formulation of goals, EA benefits, and EA costs.

2.6 Discussion and Further Research

The EA Value Framework is a frame of reference for discussions on organizational goals, EA activities, EA benefits, and EA costs. The EAVF is inferred from definitions of these concepts and provides a two-dimensional classification framework to categorize EA benefits and EA costs, relating these concepts to organizational goals and EA activities. We have used the BSC and the ALC as classification schemes for its axes and substantiated these choices.

An issue that needs some attention is the attribution issue (Espinosa, Boh and DeLone, 2011): what exactly is the contribution of EA activities to benefits claimed, especially in the Implementation and Exploitation categories? A way to overcome the attribution issue is to refine every goal in a part that can be influenced by EA activities and a part that is not, based on the metrics defined for that goal. Another way to deal with the attribution issue is to start with the EA activities and their outcomes and relate these to the organizational goals, using the Architecture Effectiveness Model (Steenbergen and Brinkkemper, 2010).

As it stands, the EAVF is independent of methods, techniques, and tools used to develop and implement EA, and neither is the organization of the EA function relevant for the application of the EAVF. The EAVF essentially classifies the outcomes of EA and can be used in a classical setting, as well as in a more agile environment. However, to determine what exactly is the contribution of EA activities to the organizational goals, the EAVF has to be supplemented with a measurement instrument. The construction of such a measurement instrument is the aim of our further research which includes the following steps:

- We are engaged in collecting a set of indicators and accompanying metrics based on EA benefits and EA costs as reported in the literature. We classify these indicators using the EAVF. As an added benefit, by deciding where an instance is classified, the borders between the cells of the EAVF become clear-cut, making the EAVF unambiguous. This step will result in a first version of a measurement instrument. The research question to be answered in this step is: '*Which indicators as reported in the literature can be used in a measurement instrument for EA benefits and EA costs based on EAVF*'?

- This first version of the measurement instrument will be tested in several case studies. After each case study, we will evaluate the results and, if necessary, adapt and extend the measurement instrument, so these case studies can be characterized as improving (Runeson and Host, 2009). While some EA benefits and EA costs may be recognized by specific organizations only, we expect that most EA benefits and EA costs as reported

in the literature are recognizable in every organization and can be included in a benchmark. The research question to be answered in this step is: '*Which indicators and accompanying metrics constitute a sufficient base to define a measurement instrument for EA benefits and EA costs based on the EAVF*'?

- As a third step, in order to test the usability of the instrument, we will ask architects working in practice to use the final measurement instrument in their own practice and from the results, evaluate the effectiveness of their EA. We plan to use action research as the methodology in this step. The research questions for this step are: '*Are results of measuring the value of EA with the measurement instrument independent of the measurer'? and: 'How can the EAVF be used to optimize the effectiveness of the architectural practice'*?

This research has the ambition to create an instrument that can be used in practice by architects to decide on the best 'course of action' for the EA in their organization.

Chapter 3

A Study into the Classification of Enterprise Architecture Benefits

While many authors have published on the subject, the question about the value of Enterprise Architecture (EA) remains unanswered. Using the four perspectives of the Balanced Scorecard as a starting point, 36 subcategories of organizational goals where benefits of EA could be expected were derived from literature. To validate these subcategories, an online Delphi study has been carried out. With the help of the experts contributing to the study, 24 subcategories of organizational goals are identified where the contribution of EA is assessed in the range from 'moderate' to 'very much'. The contribution allocated to these subcategories is more or less in line with other publications on the subject, with the notable exception of subcategories in the Customer perspective of the Balanced Scorecard. In our study these subcategories were deemed more important than in previous studies.

In the same Delphi study, we tried to differentiate between development-, implementation- and exploitation activities of EA with respect to the contribution of EA to these 24 subcategories, but the results are as yet inconclusive.

This chapter was originally published as:

Note:
The subcategories of the EAVF in this chapter are also referred to in this thesis as the EAVF categories (see appendix 1).

3. A Study into the Classification of Enterprise Architecture Benefits

3.1 Introduction

In a period of around thirty years, Enterprise Architecture (EA) has evolved into a means for translating the strategy of an enterprise into execution by providing a holistic view of the interactions between business operations and information technology (Ross, Weil, and Robertson, 2006; Tamm et al., 2011; Foorthuis et al., 2016; Franke, Cohen, and Sigholm, 2018). While EA has found its implementation in many organizations (Simon, Fischbach and Schoder, 2013), some 'critical problems' (Kaisler, Armour and Valivullah, 2005) still remain and new challenges have emerged (Kaisler and Armour, 2017). One of Kaisler and Armour's (2017) questions is about the value of EA, which is still uncertain despite many publications on the subject (Shanks et al., 2018). Because no common classification of benefits exists nor an agreed-upon set of metrics to measure EA benefits (Niemi and Pekkola, 2016; Kurek, Johnson and Mulder, 2017), it is difficult to compare the results of studies on the subject. Moreover, literature on the costs of EA is scarce and to our knowledge, no classification of EA costs has as yet been proposed.

The topic of the value of EA is of theoretical interest as a measurement system based on rigorous definitions of the underlying concepts provides a common language and reference framework for other studies on the value of EA and enables the comparison of results of EA benefit studies. The topic is of practical importance as well as a more precise view of the actual and potential contributions of EA to various types of organizational goals enables a more detailed evaluation of EA activities. As a result, the activities of architects can be better aligned with the organization's strategic choices.

These considerations motivated us to research the value of EA. As a first step, a benefit/cost classification model for EA based on precise definitions of the underlying concepts has been proposed (Plessius et al., 2018). This model, called the Enterprise Architecture Value Framework (EAVF), classifies the benefits and costs of EA in terms of organizational goals, using the Balanced Scorecard (Kaplan and Norton, 1992) and architectural activities. However, for practical purposes, it needs refinement as the four perspectives of the Balanced Scorecard (BSC) are still too wide-ranging for measurement purposes. In this paper, we thereto address the question: *How can a refinement of the four perspectives of the BSC be constructed from literature and validated against the possible contributions of EA?* The refinement is based on a literature study into organizational goals and benefits of EA and validated by an online Delphi study in the first months of 2019 with experts from the Netherlands. The experts have reviewed the various subcategories and assessed the degree to which EA may influence each of them. The outcome of this research is a first step toward a measurement instrument that can give an indication of the added value of architectural activities.

This paper is structured as follows: in the next section, a short overview is given of literature related to the value of EA, followed by an overview of the Enterprise Architecture Value Framework in section 3. In section 4, the research methodology chosen is accounted for and in section 5 the results of our research are presented. We end the paper with a discussion of the results and our conclusion, including limitations and planned future research.

3.2 Theoretical Background

One of the first authors who published on the benefits of EA is Buchanan (2001). Since then, many researchers have published on the benefits of EA from various perspectives. Overviews of these publications can be found in Niemi (2008), Boucharas et al. (2010b,) Tamm et al. (2011), Wan et al. (2013), Jusuf and Kurnia (2017) and Shanks et al. (2018).

Recurring themes in publications on EA benefits are: improved business-IT alignment, better compliance, better decisions, lower (IT) costs, improved business processes, improved IT systems, better collaboration, increased agility, and re-use of resources. However, in most publications, basic concepts like goal and benefit are not defined nor do these publications make clear where the claimed benefits originate (Boucharas et al., 2010a). This limits the empirical as well as the theoretical foundation of their research (Rodrigues and Amaral, 2010; Espinosa, Boh, and DeLone, 2011; Lange and Mendling, 2011). There exists no agreed-upon set of metrics to value the results of EA (Schelp and Stutz, 2007; Lange and Mendling, 2011; Kurek, Johnson and Mulder, 2017) nor a commonly accepted classification of benefits of EA (Niemi, 2008; Boucharas et al., 2010b; Niemi and Pekkola, 2016). Most authors classify their reported benefits in a way that is directly derived from their results and as such, these classifications are not founded in a theoretical base, making it difficult to compare their results. "While the literature focuses on listing a multitude of benefits, it does not clearly define and describe them. Furthermore, there does not seem to be an established model for classifying the benefits in the EA context, …" (Niemi, 2008, p. 2).

If a classification is derived from existing literature, authors mainly use the IS classification model of Giaglis, Mylonopoulos, and Doukidis (1999), the benefit framework for enterprise systems of Shang and Sheddon (2002), or a performance framework like Kaplan and Norton's (1992) Balanced Scorecard (BSC) and its extension, the strategy map (Kaplan and Norton, 2001). Based on a review of five different frameworks for classifying the benefits of EA, Boucharas et al. (2010b) conclude that the BSC and its derived forms best fit their requirements, despite the criticism of the BSC as a classification model for organizational goals. Norreklit (2000) for example argues that the focus of the BSC on financial results as the ultimate outcome does no justice to non-profit and public sector enterprises. As a reaction, Kaplan (2008) extends the financial perspective of the BSC with

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'accountability to society'. Other critics (Mooraj, Oyon, and Hostettler, 1999) emphasize that the BSC does not include categories for the contributions of suppliers and employees to the organization. However, following Norton and Kaplan (1993) a BSC can (and must) reflect the actual organization and if necessary, categories can and may be subdivided. Effectively this makes the BSC a mold that may be adapted by an organization to stress the goals that are most important to the organization.

A more fundamental criticism on most classifications of benefits of EA is that these are not based on clear definitions of the underlying concepts (Niemi, 2008; Boucharas et al., 2010a; Jusuf and Kurnia, 2017). An exception is the work done by Lange and Mendling (2011), who define EA benefits as the degree to which the goals of an organization are met.
   Finally, when discussing value, it is important to realize that value can be seen as the difference between benefits and costs. But while the literature on EA benefits is abundant, discussions on EA costs are very scarce in literature and the main EA frameworks offer no support in estimating and managing costs (Lindstrom et al., 2006).

3.3 The Enterprise Architecture Value Framework

As stated in the introduction, in an earlier publication (Plessius et al, 2018) we have derived a classification model for the benefits and costs of EA based on precise definitions of the value concepts. These definitions, together with their source, are summarized in table 3.1 below.

Table 3.1. Definitions of the EA value concepts (Plessius et al, 2018)

Concept	Definition
(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 directly related to the EA, i.e. either creating or implementing the EA or resulting from the EA.
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) who call this a sacrifice).

In these definitions, EA benefits (and EA costs) are characterized by both organizational goal and EA activity so it follows that they can be classified by these concepts. This is

expressed in the Enterprise Architecture Value Framework EAVF (Plessius et al., 2018) where we have used the BSC to classify organizational goals and have discerned three types of EA activities: EA development-, EA implementation- and EA exploitation activities (figure 3.1). In the same publication, we have also shown that the EAVF is in accordance with the necessary conditions for a taxonomy (Nickerson, Varshney, and Muntermann, 2013).

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

Figure 3.1. The The Enterprise Architecture Value Framework EAVF (Plessius et al., 2018)

As can be seen in figure 3.1, we extended the original BSC perspectives 'Financial' and 'Customer' into 'Finance and accountability' and 'Customer and partnerships', in order '*to customize the BSC for its purpose*' (Norton and Kaplan, 1993, p. 135). Table 3.2 provides short descriptions of the goal categories and activity types in the EAVF.

Table 3.2. Categorizations used in the EAVF (from Plessius et al., 2018)

Category name	Category description
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 Development	EA activities in which an Enterprise Architecture for the organization as a whole 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

3.4 Research Methodology

In the long run, we want to develop a measurement instrument for the benefits and costs of Enterprise Architecture, based on the EAVF. To that purpose, the EAVF needs refinement as each of its cells covers a lot of ground. Starting with the organizational goals, we formulated - incorporating the necessary criteria for a taxonomy as described by Nickerson, Varshney, and Muntermann (2013) – the following conditions for refinement:

- derived from literature,

- recognizable in EA practice,

- unambiguous,

- complete.

Based on the literature on EA benefits, we derived 36 different subcategories in the four perspectives of the BSC as explained in the next section. In order to validate this refinement, we decided to consult experts in the field of EA as we wanted the subcategories as derived from literature (condition 1) to be recognizable in EA practice (condition 2). Furthermore, we wanted the experts to react to each other, thereby working towards a result on which all (or at least a qualified majority) could agree. Given the large number of subcategories, we decided that an online Delphi study would fit best our purpose. A Delphi study is particularly useful '*to determine or develop a range of possible [program] alternatives*' and '*to seek out information which may generate a consensus on the part of the respondent group*' (Delbecq, van de Ven and Gustafson, 1975, as quoted by Hsu and Sandford, 2007). A Delphi study makes it possible to query experts and makes it possible for experts to react to each other as well, thereby working towards a common outcome on which consensus is reached (Hasson, Keeney and McKenna, 2000; Okoli and Pawlowski, 2004; Diamond et al., 2014; Giannarou and Zervas, 2014). The online variant of a Delphi study gives the experts ample time to reflect on the various subcategories and their unambiguity and completeness (conditions 3 and 4).

In an online Delphi study, a series of structured questionnaires is presented to a number of experts (the expert panel). A Delphi study typically consists of several rounds where in each round anonymous feedback on the results of the previous round is given and participants (the expert panel) are invited to rethink their earlier answers set against the answers of the other participants. To guarantee methodological rigor, care should be taken (Hasson, Keeney, and McKenna, 2000):

- Clearly defined question(s)

- Number of rounds and minimal response rate

- The number, background, and expertise of the participants

- Criteria for consensus

As explained above, the goal of our Delphi study is to validate the derived subcategorization of organizational goals in terms of unambiguity, completeness, and relevance toward the benefits of EA. To that end, we formulated the following questions to be answered in the Delphi study:

1) *Are the subcategories fully disjunct from each other?*

2) *Is the set of 36 subcategories complete, i.e. do they together fully cover the domain of organizational goals?*

3) *Can EA benefits be found in every subcategory?*

4) *Is it possible to classify most (>= 80%) benefits of EA in a subset of the subcategories and if so, which subcategories should be included in this subset?*

The first two questions ask for the completeness and unambiguity of the subcategorization while the last two questions concern the relevance of the subcategories for classifying the benefits of EA. In order to classify the possible benefits of EA in the EAVF, which uses architectural activities as a second classification axis, we added two more questions concerning the relation between the subcategories and architectural activities.

5) *What are the most important activities of the EA function (classified in development -, implementation - and exploitation activities) to create benefits to the organization?*

6) *To which subcategories of organizational goals can these activities be linked?*

As most Delphi studies consist of 2 or 3 rounds (Diamond et al., 2014), we decided to conduct 3 rounds in our study with rounds 1 and 2 focusing on the subcategorization (questions 1 to 4 above) and rounds 2 and 3 on the activities (question 5 and 6 above). Furthermore, to maintain academic rigor, we decided on a response rate of at least 70% in each round (Hasson, Keeney, and McKenna, 2000).

According to Diamond et al. (2014), the number of participants in a Delphi study can vary from less than 10 to over 100. There exists no consensus on an optimal number of participants, but in an overview study of the literature on the Delphi technique, Hsu and Sandford (2007) state that to minimize the amount of data analysis, researchers should use a minimal number of participants. If their background is more or less homogenous, 10 to 15 persons can be sufficient, but if various reference groups are involved, more participants are needed. Diamond et al. (2014) found in their research that in most studies the number of participants varied between 10 and 25. For our purpose, we needed experts who have considerable experience with EA from various perspectives. Therefore, we focused on enterprise architects, solution architects, information managers, project managers, and business line managers as participants in the expert group. Additionally, we used the following criteria:

- Academic way of thinking

- Working knowledge of EA

- At least three years of experience in their current profession

- In the expert group experience with the development, implementation, and exploitation of EA should be present

- In the expert group, at least four different economic sectors should be present.

We started with 16 experts from which 13 participated in all three rounds (81%), well within the set response rate. The 13 participants came from the following economic sectors: industry and construction (1), education and research (2), health and community work (2) government (4), finance and insurance services (2), and information, communication, entertainment, and recreation (2). None of the 13 participants was at the time of the study working as a solution architect or business line manager, but expertise on those topics had been gained in previous jobs so experience with the three types of activities as discerned in the EAVF was guaranteed.

To determine if consensus was reached, various methods are applied in literature ranging from formal, statistical methods to subjective decisions (Diamond et al., 2014). In our study, we used three characteristics (out of the eleven described by Diamond et al., 2014) for the 5-point Likert-scale questions:

- Inter-quartile deviation <= 1

- Over 2/3 of the answers are in one, or two consecutive, categories

- After condensation of the 5-point Likert scale to a 3-point scale, more than 60% of the answers are in one of the three categories.

If two or three of these characteristics indicated that consensus was reached, it was decided that overall consensus was reached. Because of the relatively small number of respondents, one response can make a crucial difference in these characteristics. So, if only one characteristic indicated that consensus was reached, we looked at the frequency distribution of the answers: if the distribution clearly had one maximum when a continuous line was drawn over the frequency distribution, it was decided that consensus was reached. In all other cases, it was decided that as yet consensus was not reached.

For the yes/no answers, consensus was established if 75% or more of the answers were either yes or no (Diamond et al., 2014).

3.5 Results

We started the refinement with a literature study of the benefits and costs of EA. Using the breakdown given by Kaplan and Norton (2001) in their strategy map, we adapted their

subcategories in the following way, based on the four conditions set in the previous section:

- *Financial and accountability*: In their elaboration of the BSC towards the strategy map, Kaplan and Norton (2001) differentiate between the following financial subcategories: 'shareholder value', 'costs,' 'asset utilization', 'revenues', and 'customer value'. We decided to omit 'customer value' as this may cause confusion with the Customer and partnerships perspective. In the strategy map, the regulatory processes 'environment' and 'safety and health' from the Internal perspective only partly cover accountability. We renamed these to 'sustainability' and 'risk control' and added 'compliance' and 'governance' as subcategories of accountability as these are mentioned frequently in the literature on EA benefits and in the practice of EA.

- *Customer and partnerships*: in the strategy map, this perspective is subdivided in eight subcategories. As the number of reported EA benefits in this perspective is quite modest, we have summarized these in four subcategories: '(customer) experience', '(customer) relationships', '(product) position', and '(market) strategy'. As nowadays many products/services are the result of a value chain of suppliers and distributors, organizations have to maintain relationships with other organizations in a customer role. We decided to incorporate this in the Customer and partnerships perspective with the subcategories 'collaboration' and 'supply chain'.

- *Internal processes*: for this perspective, we combined the subcategories of the strategy map with the categories of Porter's value chain model (Porter, 2008), creating nine subcategories: 'logistics', 'operations', 'marketing and sales', 'service', 'technology and infrastructure', 'administration', 'procurement', 'innovation' and 'HRM'. As IT-related topics occur very frequently in the literature on EA benefits and in the practice of EA, we decided to split 'technology and infrastructure' into 'data', 'information systems', 'information technology', 'information support', 'project management' and 'technology (non-IT)', thereby creating overall 14 subcategories in this perspective.

- *Learning and growth*: in the strategy map, a subdivision is made in 'human-, information- and organization capital' where the last subcategory in turn is divided into 'culture', 'leadership', 'alignment', and 'teamwork'. We decided to combine 'human capital' with 'leadership' and 'teamwork' into 'competencies' and split 'information capital' into 'communication', 'knowledge management', and 'evaluation'. Finally, based on benefits as reported in literature and practice, we added 'agility' and 'technology use'.

So, with the strategy map as a starting point, we created 36 subcategories in the four perspectives of the BSC in which the benefits of EA as reported in the literature can be mapped.

Next, we started an online Delphi study to validate the unambiguity and the completeness of this subcategorization and test their recognizability in practice. As stated in the previous section, the first round focused on the subcategorization of the BSC: are the subcategories disjunct and complete? To what extent can EA contribute to the subcategory?

For each of the 36 subcategories, the following two questions were asked:

- *In your opinion, to what extent can Enterprise Architecture contribute to this subcategory (you may use the comment field to explain your answer)?*

- *Is the description of the subcategory as given above clear and unambiguous? If not, please explain in the comment field.*

Furthermore, for each of the four perspectives of the BSC, the following two questions were asked:

- *In your opinion, is there any overlap between the various subcategories as given above? If so, in your opinion, which subcategories overlap?*

- *In your opinion, do these subcategories cover all organizational goals in this perspective of the BSC? If not, what kind of organizational goals from this perspective cannot be classified in these subcategories?*

In the first round, 13 out of the initial 16 respondents completed the questionnaire fully and 2 partially; well within the set response rate of 70%. Various changes in subcategories were made in this round, based on the remarks made by the respondents; these changes are summarized in table 3.3 below.

Table 3.3. Changes in the subcategories made after round 1

BSC perspective	Subcategory	Adaptation
Finance and accountability	Shareholder value	Removed as it is the result of the (financial) subcategories in this perspective
	Asset utilization	Removed as there is overlap with the subcategories 'operations' and 'logistics' in the perspective Internal processes'
	Investments	Added, based on the remarks
	Ethics	Added as a broader subcategory including 'sustainability'
	Risk control	Renamed to 'risk management'
Customer and partnerships	Position	Renamed to 'product position'
	Strategy	Renamed to 'market strategy'
	Collaboration & Supply chain	Combined into 'ecosystem'

BSC perspective	Subcategory	Adaptation
Internal processes	Operations	Renamed to 'production'
	Service	Renamed to 'service delivery'
	Data	Renamed to 'data management'
	Information systems & Information technology & information support	Combined into 'information management' as according to the expert panel it is difficult to separate these subcategories
	Administration	Renamed to 'management'
	Quality management	Added as a broader subcategory including 'project management'
Learning and growth	Knowledge management	Removed and included in the existing subcategory 'communication'
	Evaluation	Renamed to 'evaluation and re-use'

All in all, in this round 10 subcategories were deleted or replaced by a new subcategory, and 5 new subcategories were added. After round 1 the number of subcategories was 31 and several subcategories had been given a slightly adapted description, based on the comments given with the second question.

As for the first question, consensus was reached on 21 of the 36 initial subcategories corresponding with 17 of the final 31 subcategories. In table 3.4 below an overview is given of all (final) subcategories and the results.

Round 2 was completed by 13 respondents (81%), again well within the set response rate. In the first part of round 2, the first two questions of round 1 were repeated for the 14 subcategories where as yet no consensus was reached. These subcategories were presented together with the remarks made in round 1, so the respondents would be able to rethink their previously given answer based on the remarks made by the other respondents. In this round consensus was reached on 8 more subcategories (see table 3.4). Furthermore, the subcategory 'ethics' was renamed to 'societal responsibility' and 'technology use' to 'technology research', based on the remarks of the respondents.

In the second part of round 2, the subcategories on which consensus had been reached in round 1, were linked to architectural activities. For each of these subcategories, the question was asked if EA Development, EA Implementation, and/or EA Exploitation activities could contribute and if so:

- *In your opinion and to the best of your knowledge, can you specify the architectural activities that can contribute to this subcategory of organizational goals?*

For support a (non-limiting) overview of possible architectural tasks was provided.

Consensus on the question if EA could contribute to a given subcategory/activity class was reached in 19 of the 17*3 subcategory/activity class combinations presented; mainly (11 out of 19) on the EA Development activities. The question to specify architectural activities on the whole, did not result in very useful answers; most answers focused on conditions instead of activities.

In round 3, the same 13 respondents completed the questionnaire fully. In the first part of this round, for the six remaining subcategories where as yet no consensus had been reached the contribution question was repeated, together with the comments made in round 2. As a result, in this round on 4 more subcategories consensus was reached, so only 2 subcategories remained undecided (see table 3.4).

In the second part of this round, the subcategories where the contribution of EA was at least scored moderate, were linked with EA activity types:

- *In your opinion, to what extent can architectural activities in the three subclasses [EA Development, EA Implementation, and EA Exploitation] contribute to this kind of organizational goals?*

In many subcategory/activity combinations, consensus on the contribution of EA was reached (55 out of 27 * 3 combinations). However, differentiating between the three types of activities proved not possible as the contribution scores given to the three activity types were quite close for most organizational subcategories.

A conspicuous result of this round concerns the subcategory 'technology (non-IT)'. Where no consensus was reached in the first part of this round on the subcategory, in the second part consensus was reached on this subcategory for activities concerning EA Development and EA Exploitation (both moderate).

To summarize, our research resulted in a refinement of the four perspectives of the BSC in 31 subcategories. In table 3.4, the final set of subcategories is presented together with their potential contribution by EA, according to the expert group.

Table 3.4. Subcategories of the BSC with the contribution of EA to these subcategories

(Sub)category	Short description (Goals related to …)	Consensus (round and contribution)	
Finance and accountability			
Costs	… the expenses made by the organization (usually a reduction)	1	Moderate/ quite a lot
Revenues	… the income that an organization has from its activities (usually an increase)	3	A little bit/ moderate

(Sub)category	Short description (Goals related to …)	Consensus (round and contribution)	
Investments	… the commitment of capital in an asset with the expectation of obtaining additional revenues	3	Moderate
Compliance	… how the organization operates in accordance with laws and regulations	1	Very much
Governance	… how rules, norms and actions are structured, sustained, regulated and held accountable in the organization	1	Very much
Risk management	… how risks are identified, minimized, prevented and controlled by the organization	1	Moderate/ quite a lot
Societal responsibility	… the moral justifiability and sustainability of the processes, products and services of the organization	3	A little bit
Customer and partnerships			
Experience	… how customers experience their interactions with the organization	1	Quite a lot
Relationships	… how current and future interactions with customers are structured by the organization	2	Quite a lot
Product position	… the place that the products and services of the organization occupies in the minds of their customers and how these are distinguished from the products and services of competitors	-	No consensus reached
Market strategy	… the strategies chosen by the organization to approach markets and customers	2	Moderate/ quite a lot
Ecosystem	… a network of organizations that creates products and services for customers and where the organization takes part in	1	Very much
Internal processes			
Logistics	… managing the flow of products and services from suppliers to customers by the organization	1	Very much
Production	… the creation of the products and services of the organization	2	Quite a lot
Procurement	… finding and acquiring materials and services from external sources	3	Moderate

(Sub)category	Short description (Goals related to …)	Consensus (round and contribution)	
Marketing and sales	… the processes responsible for promoting, pricing and selling the products and services of the organization to customers	1	Moderate
Service delivery	… the activities carried out by the organization after delivering their products and services to customers	2	Moderate
Data management	… to the processes and means that store, maintain, retrieve and safeguard data important to the organization	1	Very much
Information management	… the processes and means used to collect, organize, manipulate, store and distribute information by the organization	1	Very much
Technology (non-IT)	… the (non-IT) techniques, skills, methods and processes used in the production of the goods and services of the organization	-	No consensus reached
Management (or Administration)	… deciding on the strategy of the organization and coordinating the efforts of the employees to accomplish the objectives	2	A little bit/ moderate
Quality management	… ensuring that outputs, benefits, and the processes by which they are delivered, meet stakeholder requirements and are fit for purpose	2	Quite a lot
HRM	… the recruitment, management and development of employees in the organization	1	A little bit
Innovation	… implementing renewal of the products, services and processes of the organization	1	Moderate
Learning and growth			
Competences	… developing the potential of individuals to perform tasks within the organization	2	Moderate
Culture	… the system of shared assumptions, values, and beliefs, governing how people behave in the organization	1	Not at all

(Sub)category	Short description (Goals related to …)	Consensus (round and contribution)	
Communication	… how information and knowledge are gathered and shared between individuals and groups	1	Quite a lot
Alignment	.. adjusting subsystems (e.g. strategic/operational or business/IT) in the organization	1	Very much
Agility	… the ability of the organization to respond to change or initiate change for competitive advantage	1	Very much
Technology research	… evaluating the possibilities of (new) technology for the organization	1	Very much
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	2	Quite a lot

3.6 Discussion

The results show clearly that according to our respondents, EA can contribute to almost all subcategories, albeit in different degrees (table 3.4). The exceptions are the more social subcategories like 'societal responsibility', 'culture', and 'HRM'. It seems that the majority of the respondents do not regard EA as a means to affect the social aspects of the organization.

In earlier research (Boucharas et al., 2010b; Plessius, van Steenbergen and Slot, 2014) hardly any benefits were reported from the Customer and partnerships perspective. In this study, the expert panel indicates that EA benefits can (and should) be found in the Customer and partnerships perspective. Apparently, the outside world has become more important for EA – at least in the eyes of our respondents. This is emphasized by their consensus –reached in the first round - that EA contributes very much to goals in the subcategory 'ecosystem'.

Overall, according to our respondents, the contribution of EA to the goals of the organization seems to be quite strong. The subcategories where the contribution of EA is scored as 'very much', are: 'compliance', 'governance', 'ecosystem', 'logistics', 'data management', 'information management', 'alignment', 'agility', and 'technology research'. These seem rather uncontentious as on all these subcategories consensus was reached in the first round. With the exception of 'ecosystem' (as mentioned above), these are all

mentioned in at least one publication on the benefits of EA (Niemi, 2008; Boucharas et al., 2010b; Tamm et al., 2011; Wan et al., 2013; Jusuf and Kurnia, 2017 and Shanks et al., 2018). Other important benefits in these publications can be mapped into the subcategories 'costs', 'quality management', and 'communication' which have scored 'moderate' to 'quite a lot' in our research. The high score on 'quality management' in our research may be explained by the major influence of EA on project management that other publications show; it may make sense to include 'project management' as a separate subcategory again.

Not included in our research, but often mentioned in literature, is the fact that EA leads to better decisions. We have intentionally not included such a subcategory as it is too broad to be useful for classification purposes: decision-making is presumed in (almost) every subcategory.

For the second part of our research, in which we tried to combine organizational goals with EA activities, the results were not conclusive. The participants hardly made any difference between the three types of activities regarding the contribution of EA. A possible explanation may be that in the eyes of the respondents, all kinds of EA activities yield benefits and as a result, they did not make much difference between the three types of activities. In practice the difference for a given organization may be greater as in a given period of time, the distribution of activities over development-, implementation- and exploitation activities is not necessarily equal. Moreover, the outcomes and results of EA activities can be important in establishing the subcategories in which benefits can be found.

3.7 Conclusion

In this research, we have created and validated a refinement of the BSC consisting of 31 subcategories relevant to EA. According to the experts who have validated this subcategorization, in 24 of the subcategories at least a moderate contribution of EA to the goals concerned may be expected. These 24 subcategories will form the base of our intended measurement instrument for the value of EA. Of course, not for every organization all subcategories are equally important. However, the list in table 3.4 may help to determine where (most) EA benefits can be found in an organization.

This research has its limitations. In the first place it has been conducted in the Netherlands only but as the results are in line with other studies (Niemi, 2008; Boucharas et al., 2010b; Tamm et al., 2011; Wan et al., 2013; Jusuf and Kurnia, 2017 and Shanks et al., 2018), we expect the results to be valid in other countries as well. A second limitation may stem from the fact that all respondents were (c.q. had been) actively involved in EA, which may have given rise to an overestimation of the contribution of EA to the various subcategories.

However, the relative importance of the subcategories is not affected by a possible overestimation and the 24 subcategories will still be the most likely candidates when looking for the contribution of EA to organizational goals.

In future research, we plan to identify indicators for each of the subcategories in the list with which we can establish the achieved EA benefits in an organization. We expect that the results of an earlier survey (Plessius, van Steenbergen and Slot, 2014, 2015) may be helpful in this process. The indicators will then be used in a set of case studies to determine the contribution of EA to the various subcategories as discerned in this study.

Chapter 4

The Development of an Instrument to Assess the Contribution of Enterprise Architecture to Organizational Goals

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 exactly 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 goals of the organization, 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.

4. The Development of an Instrument to Assess the Contribution of Enterprise Architecture to Organizational Goals

4.1 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 (Bossert et al., 2017; Blumberg et al., 2018; Kotusev, 2020; 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 complies 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.

4.2 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 4.1, we show the categorization of EA benefits from 12 meta-studies chronologically.

Table 4.1. Overview of the categorizations of EA benefits in meta-studies

Reference	Categorization of EA benefits
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
Boucharas et al., 2010b	Categorization based on the Balanced Scorecard (Kaplan & Norton, 1992) and further subdivided into the categories from Kaplan and Norton's Strategy Map (2001): (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 (No benefits were classified in the category of social processes)
Tamm et al., 2011	Discern 12 categories: (1) increased responsiveness and guidance to change; (2) improved decision making; (3) improved communication and collaboration;

Reference	Categorization of EA benefits
	(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
Wan et al., 2013	The categorization consists of two dimensions; the first is: (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 The second dimension the authors use is: (1) desirability; (2) realizability
Foorthuis et al., 2016	In this publication the authors summarize their earlier categorization (Foorthuis et al., 2010) into 3 categories of benefits: (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
Jusuf and Kurnia, 2017	Categorization in the Benefit Framework for Enterprise Systems (Shang & Seddon, 2002), consisting of 5 categories: (1) operational benefits; (2) managerial benefits; (3) strategic benefits; (4) IT infrastructure benefits; (5) organizational benefits
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; 93) 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 4.1 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 4.1. 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 4.1, 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 4.1 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.

4.3 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 4.2):

Table 4.2. Definitions of the basic EA value concepts

Concept	Definition
(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 4.2 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 4.1).

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

Figure 4.1. 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 4.3),

Table 4.3. The EAVF categories, a subcategorization of the balanced scorecard perspectives (Plessius & van Steenbergen, 2019)

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

inspired by the strategy map of Kaplan and Norton (2001). These subcategories, from now on referred to as the *EAVF categories*, were validated in a Delphi study, in which 13 (Dutch) experts on enterprise architecture participated (Plessius and van Steenbergen, 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 4.3 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.

4.4 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 4.3). Inspired by the literature about the maturity of EA (for example van Steenbergen 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).

4.5 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 4.1. 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 enterprise architecture in the next items 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 4.2.
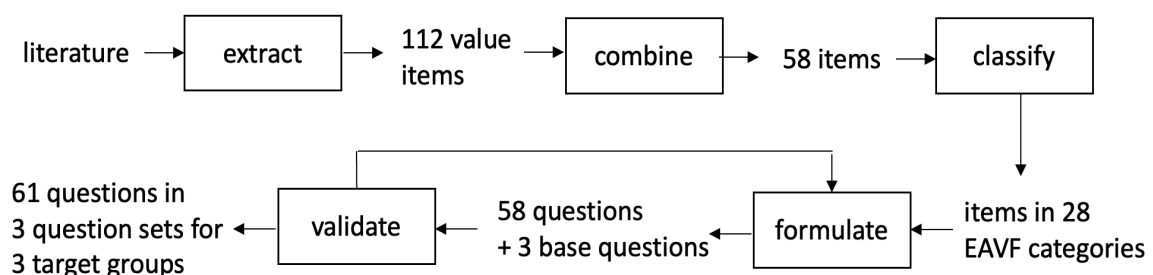
Figure 4.2: The development of the questionnaires

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.

4.6 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 4.4, 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 4.4. Characteristics of the (Dutch branch of the) case organizations

	Organization 1	Organization 2	Organization 3	Organization 4
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
# Enterprise/ domain architects	6	±40	±20	±100
# Years of experience with EA	>10	>10	>10	>10
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

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 4.5, the average and standard deviation of the answers, sorted by BSC perspective, are presented.

Table 4.5. Organization 1: Average and standard deviation by BSC perspective

Organization 1	Financial & Accountability (avg/ sd)	Customer & partnerships (avg/ sd)	Internal processes (avg/ sd)	Learning & Growth (avg/ sd)	Average overall (avg/ sd)
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)

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

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.

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 4.6 the aggregated results are presented.

Table 4.6. Organization 2: Average and standard deviation by BSC perspective

Organization 2	Financial & Accountability (avg/ sd)	Customer & partnerships (avg/ sd)	Internal processes (avg/ sd)	Learning & 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

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.

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 4.7.

Table 4.7. Organization 3: Average and standard deviation by BSC perspective

Organization 3	*Financial & Accountability (avg/ sd)*	*Customer & partnerships (avg/ sd)*	*Internal processes (avg/ sd)*	*Learning & Growth (avg/ sd)*	*Average overall (avg/ sd)*
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

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

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 4.8 the outcomes are aggregated by BSC perspective.

Table 4.8. Organization 4: Averages by BSC perspective

Organization 4	Res-pondents (nr / perc)	Financial & Account-ability (avg)	Customer & partner-ships (avg)	Internal processes (avg)	Learning & Growth (avg)	Average overall (avg)
Developers	33 / 29%	4.3	4.2	4.3	4.4	4.3
Implementers	27 / 11%	3.3	2.9	3.2	3.5	3.2
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.

4.7 Discussion

The EA Value Assessment Instrument

The EA Value Assessment Instrument is inferred from value contributions reported in the literature (see table 4.1), 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 Steenbergen, 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.

4.8 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 4.1), 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).

Chapter 5

Areas where Enterprise Architecture Contributes to Organizational Goals – A Quantitative Study in the Netherlands

Nowadays, many organizations have adopted an agile way of working where agile teams are responsible for the architecture, design and implementation of transformations in business processes. To get some recent empirical data on how this influences the value of EA as perceived in organizations, a survey has been created based on the Enterprise Architecture Value Framework (EAVF), a model to categorize value items. The survey has been distributed among (enterprise) architects and stakeholders of EA. Only small differences were found between the answers of these groups and the overall picture is that the respondents find the contribution of EA (average) important. A more detailed exploration of the outcomes shows that in areas which have a long-standing tradition with EA such as compliance, risk prevention, data management and information systems, the contribution of EA is perceived as (very) important, while in areas such as sustainability, market strategy and technology research the contribution of EA is assessed as less important. The results also suggest that the maturity of the EA processes can be improved.

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5. Areas where Enterprise Architecture Contributes to Organizational Goals - A Quantitative Study in the Netherlands

5.1 Introduction

Since the proliferation of agile practices in organizations, the discussion about the usefulness and value of Enterprise Architecture (EA), has revived (Canat et al., 2018; Hylving & Bygstad, 2019). Some authors claim that EA has to adapt itself to new ways of working (Duijs et al., 2018; Daoudi et al., 2020; Kotusev (2020), while others state that members in agile teams should be able to think like an architect (Horlach et al., 2020) or even that EA has outlived its usefulness (McLeod, 2017). The discussion about the value of EA originated around the turn of the century with the emergence of EA as a means to achieve better alignment between the business and the information technology function in an organization (Niemi, 2008; Gong & Janssen, 2019). In practice EA has many interpretations that result in major differences between the way EA is organized and governed in organizations (Ross et al., 2006; Ansyori et al., 2018), making the value of EA, in the words of Shanks et al. (2018), an 'elusive question'.

In discussions about the value of EA, it is important to keep in mind that value is not restricted to financial value alone, but has many more dimensions (Renkema & Berghout (1997). EA can bring value in areas such as risk reduction, innovation capability, logistics management, compliance, and many more. While some of these areas are measurable (given adequate accounting), many are not quantifiable (Niemi, 2008). Moreover, while the visible outcomes of EA are mainly documents, its real value lies in what is done with the artifacts created (Kotusev, 2019). Because many different stakeholders are involved in the process leading to implementation, it is difficult to say to what extent success can be explained by EA alone (Niemi, 2008). To mitigate these limitations, we decided to ask (enterprise) architects and stakeholders of architecture how they assess the value of EA. While the results of such an approach are subjective, literature shows us that self-assessments are a reliable instrument (Ramos-Villagrasa et al., 2019) and can be quite useful in practice where architects get feedback on their efforts and may use the results to optimize the alignment of their activities to the strategy and goals of their organization. Moreover, as empirical data about the value of EA are scarce (Shanks et al., 2018; Gong & Janssen, 2019), the results may provide a detailed insight in the current state of EA, especially in an agile world. Motivated by the need for empirical data, this paper addresses the research question: "*Where can the most important contribution to the value of enterprise architecture be found, according to architects and stakeholders of enterprise architecture*"?

To answer the research question, we created a survey consisting of 62 questions about the perceived value of EA, complemented with 10 questions about the background of the respondents. The questions about the perceived value of EA are based on our previously

published Enterprise Architecture Value Framework (EAVF) (Plessius et al., 2018; Plessius & van Steenbergen, 2019), in which benefits and costs of EA are classified along two axes: organizational goal and architectural activities. We discuss this model in the next section, followed by a short overview of relevant literature. In section 4, the research method including the construction of the questionnaire is explained and section 5 is dedicated to the outcomes of the survey. We end the paper with a discussion of the results.

5.2 The Enterprise Architecture Value Framework

After a structured literature research, Boucharas et al. (2010a) conclude that EA value concepts such as goal, benefit, and cost are not defined in most research papers and that the way in which EA benefit categories are derived lacks transparency. This makes it almost impossible to compare studies into the value of EA or to develop a common set of metrics (Schelp & Stutz, 2007; Boucharas et al., 2010a; Lange & Mendling, 2011; Niemi & Pewkkola, 2016; Kurek et al., 2017). Hence, we started our earlier research into the value of EA (Plessius et al, 2018) with definitions of the basic concepts of EA value, based on definitions of these concepts in business literature, particularly the definitions given by Renkema and Berghout (1997). For example, an EA benefit/cost is defined as "*The positive/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*" where an EA activity is defined as: "*The work that a company or organization performs to create a certain output that is carried out by the EA function of the organization*".

From this definition, we concluded that EA benefits and EA costs can be classified by organizational goal and EA activity. Peppard and Ward (2016) argue that organizational goals and performance measures are often made explicit by means of a balanced scorecard (BSC) analysis (Kaplan & Norton, 1992), so we decided to use the four goal perspectives of the BSC to classify organizational goals. This decision is supported by the fact that the BSC is widely used in practice (Hasan & Chyi, 2017) and by the research of Boucharas et al. (2010b) who have assessed several frameworks for classifying organizational goals and found the BSC the most suitable in the context of EA value.

To classify EA activities, we used the three organizational processes to which EA activities according to Ahleman and El Arbi (2012) are closely related*:* 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. Based on these classifications we have created a two-dimensional framework to classify EA benefits and costs: the Enterprise Architecture Value Framework (EAVF) as depicted in figure 5.1.

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

Figure 5.1. The Enterprise Architecture Value Framework Plessius et al., 2018)

A more substantial discussion on the EAVF and its background can be found in a previously published paper (Plessius et al., 2018). In that study, it is also shown that the EAVF complies with the necessary conditions for a taxonomy as formulated by Nickerson, Varshney, and Muntermann (2013) and that it can be used as a reference model for other classifications of EA benefits as well. An important aspect of the EAVF is that it is based on the outcomes of EA activities and not on the way these activities are carried out, making the EAVF independent of how the EA function is organized or which methods and tools architects use.

Table 5.1. Abbreviations of the goal subcategories in the EAVF (Plessius & van Steenbergen, 2019)

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

In a follow-up study (Plessius & van Steenbergen, 2019), the four categories of organizational goals were subdivided in 31 goal subcategories where a contribution of EA

may be expected. In table 5.1 these goal-subcategories are summarized (in this table 'Costs' should be read as: goals concerning costs', etcetera). Definitions of the various goal subcategories can be found in Plessius & van Steenbergen (2019), including their validation by a panel of 13 (Dutch) EA experts in a Delphi study. While, according to these experts, EA may contribute to all goal subcategories, it remains unsure whether they are complete.

5.3 Related Work

As stated in the introduction, there are many interpretations of what EA is (or should be), both in practice as well as in the literature. Interesting overviews can be found in Bean (2010) and Saint-Louis et al. (2019). In this study, building on the definitions given by Saint-Louis et al. (2019), we view EA as '*a discipline that directs enterprise transformations*', which implicates that we are effectively accepting a very broad range of interpretations of the concept of EA. This is in line with the diversity of EA implementations in practice (Ansyori et al., 2018).

When studying the value of EA, we have to take into account both the benefits of EA and the costs of EA (Rodrigues & Amaral, 2010; Berghout et al., 2011). Papers on the benefits of EA are numerous, including a number of meta-studies. However, papers on the costs of EA are almost non-existent. If costs are mentioned, it is in the context of cost reductions by the implementation of EA (Foorthuis et al., 2010; Poort & van Vliet, 2011; Miguens et al., 2018), that we consider a benefit of EA.

As a complete overview of all that is written about EA benefits is out of scope for this paper, we will limit ourselves to meta-studies about the topic. One of the first papers giving an overview of existing literature on the subject of EA benefits was by Niemi in 2008. In an extensive literature study, he identified 27 classes of EA benefits, which were validated by a focus group. Next, Niemi uses the IS classification model of Giaglis, Mylonopoulos, and Doukidis (1999) to classify these benefits, resulting in 4 classes of EA benefits. Somewhat later, Boucharas et al. (2010a, 2010b) conducted a systematic literature review and they identified 100 mutually exclusive benefits which they classified in the strategy map (Kaplan & Norton, 2001) - an extension of the balanced scorecard (Kaplan & Norton, 1992). Tamm et al. (2011) counted 213 benefits in a systematic literature review which they classify into 12 different types of EA benefits, but they do not explain how these categories were developed. More recently, Yusuf and Kurnia (2017) identified 40 different types of EA benefits which they classify into 5 categories, based on the benefit framework for enterprise systems of Shang and Sheddon (2002). Niemi and Pekkola (2019) discerned 250 EA benefits which they– without further explanation – classify into 40 types. In the same year, Gong and Janssen (2019), based on a structured literature research, discerned 9 different categories of EA benefits, without explaining what this classification is based upon.

The meta-studies above are grounded in literature research. However, only a small number of authors have used a survey as a means to get empirical data on EA value. Shanks et al. (2018) found eight publications where a survey was used as the research method. Only the survey conducted by Foorthuis et al. (2010) and an earlier survey by us (Plessius et al., 2014) are aimed at gathering data about the perceived value of EA. The other studies focus primarily on how EA benefits are achieved, rather than on the benefits themselves.

5.4 Research Design

As shown in the research of Shanks et al. (2018), older literature on EA value/EA benefits is mainly conceptual in nature. Empirical studies about how the value of EA is perceived in organizations are still scarce (Shanks et al., 2018) and we did not find any recent empirical studies even though in the last decade a proliferation of agile implementation methods has occurred (Canat et al., 2018). In order to get an overall picture of the current perception of the value of EA and at the same time get an impression of the adaptation of EA to agile implementation methods, we decided to use a survey as our research method. Based on the EAVF, we decided to discern three target groups:

- 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.

As there may exist some overlap between the three groups, in the survey we let respondents decide for themselves whether they are developing, implementing, or using EA (or none of these) and in this way choose their viewpoint towards EA.

The survey for each of these groups consists of two parts: the first part contains general questions about the background of the respondents (this part is the same for all respondents) while the second part implements the questions about the value of EA. As we wanted the questionnaire to be based on value items as reported in the literature, we started the construction of the second part of the survey with an inventory of EA benefits, using studies as mentioned in the previous section. In this way, we gathered 112 specific EA benefits, which were categorized into the 31 goal subcategories as depicted in table 5.1. In order to keep the survey comprehensive, in the overloaded subcategories we combined various benefits into one value item. For example, benefits such as 'reduce costs in general',

'reduce specific costs like IS/IT costs' and 'reduce administrative costs', were combined in one item 'lower operational costs.' This resulted in 62 unique value items where each item is a statement about the contribution of EA, for example 'lower operational costs c.q. higher revenues', 'the (expected) effects on customer experience and customer satisfaction', or 'the willingness and ability to cooperate in the organization'.

Next, for each item, we established the relevance for the three groups of potential respondents. For example, an item about the manageability of projects is relevant for EA implementers, but not for EA developers. The value items and their distribution over the three groups can be found with the outcomes of the questions (see section 5.5).

The value items can be scored on a 5-point scale ranging from 'not important at all' (score 1) to 'very important' (score 5), supplemented with the option 'don't know' for items where the respondents are not aware of the value delivered by EA to that item. For each of the three groups of respondents, a base question was formulated asking for the perceived value of EA on the value items. In the version for the EA developers this base question is: 'Please state with a score from 1 to 5 the importance of the next items in developing and updating the overall 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 with respect to the next items'. The items were ordered within the four goal perspectives of the EAVF and to each set of questions an open question was added asking for the completeness of the questions in the eyes of respondents. To prevent a systematic bias from weariness, the four sets of questions were presented to the respondents in random order. After all questions were answered, the questionnaire ended with the calculated average scores on the four goal perspectives from the EAVF and respondents could comment on this feedback. Finally, the questions were made ready for distribution using the online tool LimeSurvey.

The survey was tested by 2 persons and based on their remarks, 'contribution' was used instead of 'value' as to the testers, 'value' was too strongly associated with financial value alone.

After completion, the survey was accessible for a period of two months in the spring of 2021. In this period potential respondents were approached via different channels such as the 'Nederlands Architectuur Forum NAF', a community of practice for architects, the research groups 'Digital Ethics' and 'Process Innovation and Information Systems' of the University of Applied Sciences Utrecht as well as via colleagues of the authors. Furthermore, it was brought to the attention of LinkedIn groups on architecture.

The survey was conducted anonymously, but after completion of the survey respondents were given the possibility to receive the analysis and conclusions. To guarantee anonymity, the email address of the respondents was stored separately from the survey data.

5.5 Results

In the period the survey was accessible, 256 people opened the link to the survey but only 136 of these started with the questionnaire. This resulted in 105 full responses from which 7 indicated that they were not in any way involved with architecture. All questions and their outcomes can be found at https://doi.org/10.17026/PT/EY5TYH.

The statistical analysis of the data has been done with the statistical package SPSS, version 28.

Characteristics of the Organizations of the Respondents

Almost all economic sectors were present in these responses, with an emphasis on the governmental sector (table 5.2). Compared to other surveys on EA value in the Netherlands (Foorthuis et al., 2010; Plessius et al., 2014), we see more respondents from the industrial sector, but less in the financial and insurance sector. As over the past decade, the financial and insurance sector in the Netherlands has diminished considerably, we assume the distribution to be representative.

Table 5.2. Distribution over the economic sectors

The organization I work for can be classified in the following economic sector:	This survey	Foorthuis et al. (2010)	Plessius et al. (2014)
No answer	0%	0%	0%
Agriculture, fishing, forestry and mining	0%	1%	2%
Industry (nutrition and manufacturing) and construction	13%	6%	3%
Energy, water and waste production/ processing	4%	5%	5%
Education and research	7%	2%	6%
Health and community work	11%	3%	5%
Government (including Defense)	28%	31%	24%
Financial and insurance services	14%	30%	35%
Information, communication, entertainment, and recreation	7%	12%	6%
Trade, transport, and other services	15%	10%	13%

In line with other research (Foorthuis et al., 2010; Plessius et al., 2014), in terms of size larger organizations are in the majority (table 5.3), which is to be expected as smaller organizations usually do not employ architects.

Table 5.3 on the next page also shows the distribution of the number of architects over architectural task areas.

As we expect the number of architects to grow with the size of the organization, we performed a correlation test on the variables 'organizational size' against 'number of architects'. In correspondence with the ordinal character of the variables, we used Spearman's rank correlation and found moderate positive correlations: $\rho_s = 0.435$ for organizational size vs. number of enterprise/domain architects and $\rho_s = 0.524$ for organizational size vs. number of solution/systems architects; both with $p < 0.001$.

Table 5.3. Distribution over organizational size and architectural task area

How many employees are there in the organization you work for?		How many architects does the organization you work for employ?	enterprise/ domain architects	solution/ system architects
Don't know / No answer	0%	Don't know / No answer	4%	7%
Less than 10	2%	0	4%	11%
10 to 100	6%	1	15%	9%
101 to 500	14%	2 to 5	22%	16%
501 to 2000	27%	6 to 10	22%	11%
More than 2000	50%	11 to 20	14%	15%
		More than 20	19%	31%

Almost half of the organizations (49%) have more than 10 years of experience with architecture, but still 7% of the respondents state that the organization they work for has less than 1 year of experience with architecture. Most respondents (60%) have ample (over 6 years) of experience in their current function but we found no significant correlation with the architectural experience of the organization. Finally, in about 10% of the organizations the focus of architecture is on business and information only, while in one-third the focus is on application and infrastructure. In the remaining half of the organizations, the respondents indicate an equal focus on business/information and application/ infrastructure architecture. These results are comparable to those of Plessius et al., 2014).

Of the 105 respondents, 56 (53%) indicated they are EA developer, 27 (26%): EA implementer and 15 (14%): EA user. The remaining 7 respondents found they have no or insufficient experience with architecture. Their responses will not be used in the next

sections as they did not answer the questions about the contribution of EA. The number of respondents is relatively low, especially in the group of EA users, but when taking the three groups together we have in our outcomes - with a confidence level of 95% - a margin of error of less than 10% (using the sample size calculator of SurveyMonkey on https://www.surveymonkey.com/ mp/sample-size-calculator/).

Perceived Contribution of EA

In the survey, the questions about the contribution of EA are divided over the four goal-perspectives of the BSC. In table 5.4 the averaged results in these goal-perspectives, categorized by group of respondents, are given, together with the percentage of the respondents who found the contribution of EA important to very important (score 4 or 5).

Table 5.4. Averaged results and positive percentages by group and goal-perspective

Category	Num-ber	Finance & accountability	Customer & partnerships	Internal processes	Learning & growth
EA Developers	56	3.6 / 56%	3.4 / 54%	3.6 / 59%	3.6 / 59%
EA Implementers	27	3.6 / 58%	3.4 / 53%	3.5 / 56%	3.3 / 49%
EA Users	15	3.4 / 50%	3.3 / 53%	3.5 / 54%	3.4 / 52%
All	98	3.5 / 55%	3.4 / 53%	3.6 / 57%	3.5 / 55%

As the differences between the values in table 5.4 are very small, not much can be concluded from these results - except the fact that in all four goal perspectives and for all three groups the contribution of EA to the organizations of the respondents is considered between average important and important. Although the averages of the EA developers are marginally higher than those of the other two groups, the differences are very small, and due to the relatively small number of respondents, no hard conclusions can be drawn from the outcomes.

More can be learned by looking at the answers to the individual questions – especially the outstanding ones, the positive (average score >= 4, important to very important) as well as the negative results (average score < 3, less than average important). These results are shown in tables 5.5 and 5.6 and they give a good picture of the items where the contribution of EA to the goals of the organization is perceived as high (table 5.5) or low (table 5.6).

   The outstanding positive scores (table 5.5) show that the contribution of EA to the goals of the organization is found in particular with value items that are linked to information management and with compliance, risk prevention, and providing insight into planned developments; areas that have a long-standing tradition with enterprise architects and can

already be found in older meta-studies on EA benefits (Niemi, 2008; Boucharas et al., 2010a; Tamm et al., 2011).

Table 5.5. Outstanding positive scores

Items with average score >=4	Dev N=56	Imp N=27	Exp N=15	All N=98
Finance and Accountability				
Compliance with laws, regulations and internal standards	4.4	4.7	(3.9)	4.4
Prevention of risks in business and information processes	(3.9)	4.2	(3.6)	(3.9)
Customer and Partnerships				
The exchangeability of data with partners	(3.9)	(3.8)	4.1	(3.9)
Internal processes				
Digitization of business processes	4.1	(3.7)	4.2	4.0
The quality of stored data	4.3	(3.9)	(3.9)	4.1
The interoperability of data between information systems	4.3	4.2	(3.9)	4.2
The quality of information systems and IT infrastructure	(3.7)	4.4	(3.8)	(3.9)
The security of information, systems and infrastructure	4.4	4.6	(3.5)	4.3
'Outsourcing' and 'cloud'	(3.9)	4.1	(3.4)	(3.9)
The involvement of stakeholders	4.0	(3.6)	(3.4)	(3.8)
Learning and Growth				
Insight into current and desired situation and the road map	4.2	4.1	(3.7)	4.1

On the other hand, the outstanding negative scores (table 5.6) where the contribution of EA to organizational goals is perceived as low, are concentrated in more recent areas of interest to architecture such as societal responsibility, markets and market strategy, organizational culture, (agile) project management and technology research. However, value items from evaluation and re-use are found here as well, which may indicate that the maturity of the EA processes can be improved.

In both tables we observe a reasonable agreement between the three groups. To research if a consensus between the three groups is supported and can be found for all value items, we performed a Spearman's correlation test. We found moderate positive correlations between the three groups: $\rho s = 0.689$ for EA developers vs. EA implementers, $\rho s = 0.538$ for EA developers vs. EA users and $\rho s = 0.487$ for EA implementers vs. EA users – all with $p < 0.001$, so a moderate degree of agreement between the three groups may be assumed.

Table 5.6. Outstanding negative scores

Items with average score < 3	Dev N=56	Imp N=27	Exp N=15	All N=98
Finance and Accountability				
Sustainability	(3.1)	2.7	(3.0)	(3.0)
Decent working conditions (internally and with partners)	(3.2)	2.7	(3.5)	(3.1)
Customer and Partnerships				
The expected effects on markets and market shares	2.5	2.4	2.3	2.4
Alignment with the market strategy of the organization	(3.4)	(3.0)	2.7	(3.2)
Supply chain integration	2.9	(3.5)	(3.6)	(3.2)
Internal processes				
The support of business processes with logistics software	2.8	2.8	(3.4)	2.9
The "time-to-market" of new products and services	(3.1)	2.9	(3.1)	(3.0)
The use of customer journeys in modelling	-	2.8	-	-
Support with 'agile' project implementation	(3.3)	(3.3)	2.9	(3.2)
Learning and Growth				
The professionalization of project management	-	2.9	(3.4)	-
The culture in the organization	-	-	2.9	-
Research of and gaining experience with new technology	(3.2)	2.8	(3.4)	(3.1)
Experiences with previous results of architecture	2.8	2.9	-	-
Evaluations of project results	-	2.7	2.9	-
The creation of artifacts for reuse	(3.1)	2.8	-	-

Another way to look at the scores is to classify the responses in the goal subcategories of the EAVF (table 5.1). To test whether the outcomes are not the result of coincidence, we performed a one-sided binomial test on these goal subcategories. We divided the responses by goal subcategory in two sets: the first set being the responses corresponding with a clearly positive perceived contribution of EA (responses 4 and 5) and the second set where no clearly positive contribution was perceived (responses 1, 2, and 3). We then tested the hypothesis: no positive effect of EA is perceived versus the alternative hypothesis: a positive effect of EA is perceived by the respondents. The hypothesis is accepted when in the first set (responses 4 and 5) the percentage of responses is not significantly more than 40%. The alternative hypothesis is accepted if significantly more than 40% can be found in this set.

Table 5.7. Distribution of answers over all respondents (legend below table)

Goal subcategories	<=3	>3	0	<=3	>3	Sig	<3	<3
	#	#	#	%	%		%	#
Financial and accountability								
Costs and revenues	38	58	2	39.6	60.4	<0.001	24.0	23
Investments	37	55	6	40.2	59.8	<0.001	16.3	15
Compliance	16	80	2	16.7	83.3	<0.001	5.2	5
Governance	34	61	3	35.8	64.2	<0.001	23.2	22
Risk management	35	62	1	36.1	63.9	<0.001	8.2	8
Societal responsiblity	46	42	10	52.3	47.7	0.086	34.1	30
Customer and partnerships								
Customer experience	35	57	6	38.0	62.0	<0.001	18.5	17
Customer relationships	40	53	5	43.0	57.0	<0.001	19.4	18
Product position	68	21	9	76.4	23.6	>0.999	52.8	47
Market strategy	48	46	4	51.1	48.9	0.049	37.2	35
Ecosystem	29	66	3	30.5	69.5	<0.001	25.3	24
Internal processes								
Logisitics	43	52	3	45.3	54.7	0.003	31.6	30
Business processes	18	80	0	18.4	81.6	<0.001	12.2	12
Marketing and sales	63	33	2	65.6	34.4	0.891	34.4	33
Service delivery	39	58	1	40.2	59.8	<0.001	26.8	26
Data management	19	77	2	19.8	80.2	<0.001	13.5	13
Information management	15	82	1	15.5	84.5	<0.001	9.3	9
General management	42	54	2	43.8	56.3	<0.001	19.8	19
Quality management	32	64	2	33.3	66.7	<0.001	19.8	19
HRM	43	53	2	44.8	55.2	0.002	11.5	11
Innovation	41	55	2	42.7	57.3	<0.001	21.9	21
Learning and growth								
Competences	33	63	2	34.4	65.6	<0.001	19.8	19
Culture	34	62	2	35.4	64.6	<0.001	20.8	20
Alignment	18	79	1	18.6	81.4	<0.001	11.3	11
Agility	27	71	0	27.6	72.4	<0.001	18.4	18
Technology research	63	34	1	64.9	35.1	0.864	24.7	24
Communication and KM	45	52	1	46.4	53.6	0.004	17.5	17
Evaluation and reuse	58	38	2	60.4	39.6	0.572	41.7	40

(Legend on next page)

Legend:

 <=3 # - number respondents scoring 1, 2 or 3

 > 3 # - number respondents scoring 4 or 5

 0 # - number respondents scoring 0

   (unknown / no answer)

 <=3 % - perc. respondents scoring 1,2 *or 3*

 >3 % - perc. of respondents scoring 4 or 5

 Sig - significance

 <3 % - perc. respondents scoring 1 or 2

 <3 # - number respondents scoring 1 or 2

Given the relatively low number of respondents, especially in the group EA users, we tested on the total population as there are moderate positive correlations between the three groups. In table 5.7 the results are given. In the tests, responses 0 (unknown/no answer) were excluded.

For most value items, the tested hypothesis can be dismissed with certainty > 95% in favor of the alternative hypothesis with the exception of the goal subcategories: societal responsibility, product position, marketing and sales, technology research, and evaluation and reuse. These results match with the outcomes found with the outstanding negative scores (table 5.6) as in these areas the scores given are generally low.

Perceived Value and the Characteristics of the Respondents

To determine if a relation exists between the outcomes on the questions about the perceived value of EA and the characteristics of the respondents and their organizations (as discussed above), we performed chi-square tests. In these tests, we combined again the three groups of respondents and tested against the four goal perspectives. Given the relatively low number of responses, the number of 0's in the cells of SPSS crosstabs was in all cases above the threshold for a Pearson's chi-square test, so we used the Fisher-Freeman-Halton Exact Test instead. We found only three relations with $p < 0.05$ (table 5.8) which could by all means be accidental.

Table 5.8. Relations between the respondents' background and goal-perspective

Respondents' background	Goal-perspective	p (2-sided)
Economic sector	Internal processes	0.008
Number of employees	Financial and accountability	<0.001
Number solution architects	Learning and growth	0.018

Chapter 5. *Areas where Enterprise Architecture Contributes to Organizational Goals*

The outcomes on the questions about the perceived value of EA seem independent of the characteristics of the respondents. Whether this also holds true for the three groups separately cannot be established due to the relatively low number of responses.

Open Questions

After each of the questions in the four goal perspectives, an open question was added asking if any items were missing that could be important in determining the value of the contribution of EA. A few suggestions were given: privacy, deprecating old-fashioned technologies, large projects with specific architectures, commitment of stakeholders, and development of architecture as a competence throughout the organization. The current survey is based on benefits as found in literature, but these may change and some of these items could be added in a new version of the survey.

   After the questions about the value items, feedback was given on the scores averaged by goal perspective. Almost 20% of the respondents found these scores did not give a valid and reliable view of the contribution of EA. An interesting remark made here is: '*the average is not interesting, the differences are'.* While this may be true within an organization, in a survey like this we see in many items the full range of possible answers (with the exception of items where the average score is quite high or low), so we choose to show these outstanding high and low scores (tables 5.5 and 5.6) instead.
Other examples of remarks made here are: '*I think having an architect is a bit of old school*', '*the summary above reflects how we value and approach architecture, but not necessarily the priorities*' and '*EA in my organization is an ivory tower, out of touch with customers and stakeholders, only concerned with their own bureaucracy and artifacts, self-serving*'. Comments like these suggest a lack of communication between the enterprise architects and the rest of the organization resulting in low scores as well.

5.6 Discussion and Conclusions

In this paper, we have presented the outcomes of a survey concerning the contribution of EA to organizations. When relating these outcomes to the results of other surveys, it should be noted that the questions used in Foorthuis et al. (2010), Plessius et al. (2014), and this survey are not the same, so detailed conclusions cannot be drawn. However, Boucharas et al. (2010a) found no benefits in the customer perspective of the balanced scorecard but in our earlier survey (Plessius et al., 2014) and in this survey, we see an increasing contribution of EA to value items concerning the customer in this goal-perspective. This could be an indication that the focus of EA has shifted from the internal workings of the organization alone to include the organization's environment as well. The same could happen in the future with areas such as 'societal responsibility', '(organizational) culture', and 'technology research'. This would be in line with the trends identified in recent EA publications in Gampfer et al. (2018). However, the low scores in the goal-subcategory

'evaluation and re-use' cannot be explained by the available data but could point to a low maturity of the EA processes; in the words of Robertson et al.(2018): "*an EA programme exists but it is executed without complete structure and accountability*".

Foorthuis et al. (2010) found that EA creators (EA developers and EA implementors) were more positive about the contribution of EA than EA users. In contrast – and in line with our earlier results (Plessius et al., 2014), we found only small differences between these groups, but a clear conclusion in this aspect cannot be drawn as the number of EA users in this survey is small. Also, we did not find convincing relations between the characteristics of the respondents and the outcomes as categorized in the four goal-perspectives of the balance scorecard (table 5.8), which suggests a commonly accepted view on what may be expected of EA, independent of the organizations the respondents work for.

As empirical data on EA value are scarce (Shanks et al., 2018), this research contributes to the scientific community by providing empirical data about the value of EA, as perceived by architects and stakeholders of architecture. Based on these data, insights about the value items that currently score high and those that score low is gained. Value items where the contribution of EA to organizations scores high (table 5.5) may be characterized as belonging to areas that have a long-standing tradition within EA such as compliance, risk prevention, providing insight, and information management. It seems that architects put much effort in these areas. The value items where in the eyes of the respondents the contribution of EA is below average such as societal responsibility, markets, culture, project management, and technology research cover in majority the areas that are more recently recognized as potential areas of interest to EA. These areas may become more important with time as discussed above.

In practice, organizations can use the questionnaires to assess the contribution of EA as perceived by their architects and stakeholders of architecture. Using the questionnaires in this way gives an organization the opportunity to prioritize some items and/or to add extra questions about aspects that are of interest to that organization. In upcoming research, we have elaborated this line of thought by developing an instrument to assess the contribution of EA in organizations. We are testing this instrument in case studies, where more in-depth qualitative research may give insight into the 'why' of the answers.

Overall, the results give a picture of the current state of EA in the Netherlands: in areas that have a long-standing tradition with EA, the contribution of EA is perceived as (very) important, while in areas that have more recently come into the focus of EA the contribution of EA is assessed as less important. We also found indications that the maturity of the EA processes can be improved.

This research has its limitations. First of all, as already stated above, the relatively low number of respondents is responsible for a relatively high margin of error and makes it impossible to say anything reliable about the group of EA users. Secondly, the respondents to our survey are self-selected and as such are not necessarily a random sample of those working in or with EA. As a consequence, some bias in the answers may be present, moreover so as the questions ask for the *perceived* value of EA. Finally, as the survey involves only respondents from the Netherlands, care must be taken in generalizing the results.

Chapter 6

Towards an Enterprise Architecture Benefits Measurement Instrument

Based on the Enterprise Architecture Value Framework (EAVF) - a generic framework to classify benefits of Enterprise Architecture (EA) - a measurement instrument for EA benefits has been developed and tested in a survey with 287 respondents. In this paper, we present the results of this survey in which stakeholders of EA were questioned about the kind of benefits they experience from EA in their organization. We use the results of the survey to evaluate the framework and develop a foundation for the measurement instrument. The results of the survey show moderate support for the assumptions underlying the framework. Applying ordinal regression, we derived sets of questions for ten out of the twelve classes in the framework. These sets constitute the first step in defining a final EA measurement instrument for establishing actual benefits in the classes of the framework.

This chapter was originally published as:

Note:
This publication was written before the publications in the other chapters and the EAVF presented in this paper is an earlier version of the EAVF as used in the remainder of this thesis.

6.   Towards an Enterprise Architecture Benefits Measurement Instrument

6.1 Introduction

Enterprise Architecture (EA) is an instrument for decision-makers to structure and manage organizations from an integral perspective. EA provides a holistic view of the organization, including customer offerings, business processes, information systems, technical infrastructure, and the relations between these aspects. The purpose of EA is twofold: on the one hand, it provides insight into the actual state of the organization, enabling the organization to determine the impact of changes. On the other hand, it gives direction to such changes by sketching the design principles and designs that best fit the organization's ambitions and goals. EA is the bridge between strategy and execution (Cameron & Malik, 2013).

EA is seen as an instrument for organizations to achieve their business goals. The argument behind this view is that a well-structured, well-aligned organization is more cost-effective, agile, and effective. The actual benefits of EA have been subject to academic research by different authors. The number of benefits claimed by authors is large, though proof of actual benefits is less abundant (Boucharas et al., 2010b; Tamm et al., 2008). For example, Boucharas et al. (2010b) found in a structured literature review 107 academic publications mentioning benefits, of which 33 were found relevant to the question of relating EA to benefits but only 14 fulfilled the qualitative requirements of the literature review. In these 14 publications, 100 different benefits are mentioned. In recent years various literature studies (Boucharas et al., 2010b; Tamm et al., 2011; Niemi, 2008; Schelp & Stutz, 2007; Lange et al., 2012; Wan et al., 2013) as well as empirical studies on actually achieved benefits have appeared (Foorthuis et al., 2010; Steenbergen et al., 2011; Plessius et al., 2014). In these publications, all authors define EA benefits in their own way. Where most authors introduce some kind of categorizing of benefits, these categorizations differ between authors as well. This lack of a common framework of EA benefits makes it difficult to compare different studies and is an obstacle in augmenting other research results.

In an earlier paper (Plessius et al., 2012) we introduced a generic framework for classifying EA benefits, the Enterprise Architecture Value Framework (EAVF). We have used this framework as a starting point for a survey concerning perceived benefits in organizations. The first results of this survey (Plessius et al., 2014) not only provide an interesting insight into the kind of benefits that are actually perceived within organizations, but they can be used to develop the EAVF into an EA benefits measurement instrument as well.

The research question we aim to answer in this paper is: *Is it possible to develop an EA benefits measurement instrument based on the EA Value Framework*?

In the next section of this paper, we sketch the theoretical background to our research question, followed in section 6.3 by an overview of the research method used in further developing the EAVF and the derived benefits measurement instrument. The results are presented and discussed in sections 6.4 and 6.5 and followed by conclusions, limitations, and further research in section 6.6.

6.2 Theoretical Background

In the literature, no common framework for classifying EA benefits can be found. The framework we developed in our research (Plessius et al., 2012) is based on two theses:

1. Organizations benefit from EA when EA contributes towards their business goals.

2. Benefits may evolve from the inception of the architecture towards the implementation of architectural designs.

For the contribution towards business goals, we decided to use the four well-known categories of the Balanced Scorecard (Kaplan & Norton, 1992; Kaplan & Norton, 2004): the Financial, Customer, Internal, and Learning & Growth perspectives as many organizations use these to classify their goals and it has been used by other authors to classify benefits as well (Boucharas et al., 2010b; Schelp & Stutz, 2007).

In order to follow the evolution of benefits in time, we introduce the lifecycle of EA in which we distinguish three main phases:

- the Development of the architecture where principles and models are developed and registered. In this phase, usually the architects are leading;

- the Realization phase where architectural designs are implemented and projects have to comply with the architecture. In most enterprises, project managers are in the lead in this phase;

- the Use phase, where (parts of) the new architecture have been implemented and used in operations. In this phase, the actual operational benefits are obtained and the lead is with business line managers.

The idea of benefits developing in time can be found in other authors as well. For example, Foorthuis et al. (2010) explicitly distinguish benefits in the project execution phase from other benefits whereas Tamm et al. (2011) distinguish between benefits flowing directly from EA and benefits resulting from the implementation of EA plans.

Combining the two mutually independent axes results in the EA Value Framework (EAVF) as depicted in figure 6.1. The EAVF essentially divides the field of EA benefits in twelve classes of EA benefits: four perspectives times three phases.

BSC Perspective Phase	Financial	Customer	Internal	Learning & Growth
Development				
Realization				
Use				

Figure 6.1. The Enterprise Architecture Value Framework

The EA benefits measurement instrument we are developing is based on this framework and essentially consists of a series of questions that may be used to determine the perceived and realized benefits in every cell of the framework. These questions are derived from benefits as reported in the literature, especially from the work of Boucharas et al. (2010b). Examples of these questions are given in Plessius et al. (2012).

6.3 Research Method

In order to validate the EAVF and the EA benefits measurement instrument we conducted a survey. In this survey, we defined for each cell in the EAVF one overall statement representing the class of benefits corresponding with that cell, as well as several questions representing the specific benefits belonging to that class. For instance, for the Learning and Growth perspective in the Realization phase, we defined the main (class-representing) statement as:

- By applying Enterprise Architecture in projects, the learning and innovative capacity of the organization is better.

with the following questions on specific benefits in the class:

- Projects carried out under architecture provide a better understanding of the limitations of the solution.

- Projects carried out under architecture feature a more substantive decision-making process.

- Projects carried out under architecture feature better sharing of knowledge.

- Projects carried out under architecture more often produce results that fit the operational management.

- Projects carried out under architecture produce more agility (flexibility).

The questions that ask about specific benefits, can be regarded as reflective measures of each main statement, giving a generic view of that class of benefits. In section 6.5 we will examine which questions are most representative for each class.

All statements and questions were scored on a 5-point Likert scale. The survey was targeted at stakeholders of architecture in organizations. We included a question to be able to discern between the three roles that correspond with the rows of the EAVF:

- *Developers* of architecture such as enterprise and domain architects.
- *Implementers* of architecture, such as solution architects, designers, developers, and project managers.
- *Users* of architecture such as business line managers, IT managers, and staff.

Based on their answer to this question, the respondents were presented with the questions on benefits related to the corresponding row. We included some questions on the background of the respondents as well. The survey consisted of 97 questions and in this way, less than 50 questions were presented to all respondents.

From over 3000 mailings we received 287 fully completed responses where 110 respondents answered the questions on the Development of architecture, 68 on the Realization of architecture, and 109 on the architecture in Use. Based on the general questions on their background, we found the characteristics of the respondents congruent with the results found in other surveys (see for example Foorthuis et al., 2010; Obitz et al., 2004) as they are encountered in practice.

For the statistics in the next sections, we have used SPSS edition 22 (Statistical Package for the Social Sciences, nowadays an IBM product). In most questions, the extremes of the Likert scale were hardly used and in order to reduce the number of possibilities - especially for the regression analysis (as described in section 6.5) - we decided to bundle the answers in three categories:

- (very) negative benefits reported (Likert categories 1 and 2);
- neutral, neither positive nor negative benefits reported (Likert category 3);
- (very) positive benefits reported (Likert categories 4 and 5).

By combining the original answers in these three categories we reduced the original questions to questions if benefits could be reported and if these benefits were deemed positive, negative or neutral. Given the small number of extremes in the original answers, we consider this reduction justified.

The survey has been carried out in the Netherlands with statements and questions in Dutch. For this paper, all statements and questions have been translated into English, but there may be slight differences in meaning between the translated statement or question and the original one.

6.4 Benefits Perceived

In this section, we present the results of the survey providing an overall picture of the kinds of EA benefits (positive and negative) that are actually perceived by organizations. Next, in section 6.5, we will use the survey results to validate the EAVF and the survey questions as a measurement instrument for the twelve EA benefit classes.

Statements on the benefits classes

All respondents – regardless of their role - answered the twelve generic statements for the twelve classes of the EAVF. The results are presented in table 6.1 where the numbers in each cell are the percentage of respondents who found that EA had a positive effect in that particular area, respectively found no effect of EA or found a negative effect of EA. The numbers are statistically significant as shown in Plessius et al. (2014).

Table 6.1. Perceived benefits of enterprise architecture in the EAVF

BSC Perspective Phase		Financial (%)	Customer (%)	Internal (%)	Learning & Growth (%)
Development	+	78.1	48.4	78.2	82.1
	0	21.5	51.2	19.6	15.7
	-	0.4	0.4	2.2	2.2
Realization	+	75.9	47.5	50.0	53.0
	0	21.7	50.2	42.9	43.0
	-	2.4	2.3	7.1	4.0
Use	+	47.8	29.8	57.9	77.6
	0	50.0	67.6	38.8	21.2
	-	2.2	2.6	3.3	1.2

From table 6.1 it is clear that – except in the Customer perspective – respondents perceive an overall positive effect of EA. Even where the percentage of positive responses is less than fifty percent, the overall effect is neutral rather than negative. These effects are consistent over the three roles: it seems there is consensus between stakeholders on the benefits of EA in each cell of the framework.

Questions on specific benefits

In all, we asked 70 questions about the occurrence of specific benefits distributed over the twelve cells. Of these questions, 17 questions did not show a significant result in the one-sided binominal test we performed (p < 0.05). These questions are not included in this section. In the following tables we present for each row in the EAVF the 3 questions that received the highest percentage of (very) positive answers and the 3 questions that received the lowest percentage of (very) positive answers.

In the development phase (table 6.2) we find that the benefits perceived by most respondents are concerned with providing insight. The benefits perceived the least are

related to the effect of EA on governance. One might conclude that the development phase provides insight, but that to turn these insights into decision-making lags behind. This is in line with previous research (Foorthuis et al., 2010). Still, more than fifty percent of the respondents indicate perceived benefits for each of the bottom 3 benefits.

Table 6.2. Top and bottom benefits perceived in the Development phase

Perspective	Question	+ (%)	0 (%)	- (%)
Top 3				
Internal	By developing Enterprise Architecture more insight into the target architecture has been gained	88.7	11.3	0.0
Internal	By developing Enterprise Architecture, the organization has more grip through a coherent set of principles	85.3	12.7	2.0
Financial	By developing Enterprise Architecture, the risks involved in business processes and IT are more evident	81.6	17.4	1.0
Bottom 3				
Learning & Growth	By developing Enterprise Architecture, the governance structure of the organization has become better	51.5	48.5	0.0
Internal	The final products of the Enterprise Architecture (baseline, target architecture, goals, principles) have received much support from the accountable management	54.1	36.7	9.2
Financial	By developing Enterprise Architecture compliance with laws and regulations is better	59.8	38.2	2.0

In the realization phase (table 6.3) we find a similar distinction. The top 3 contains benefits concerned with insight, while the bottom 3 consists of benefits related to actual project performance. Architecture does seem to contribute to better decision-making at the project portfolio level, but at the level of cost and time of individual projects, EA does not seem to generate improvements.

In the use phase (table 6.4) we find a less clear-cut situation. The alignment between business processes and IT is in the top 3, but better cooperation within the organization is in the bottom 3. It seems as though business and IT have started to communicate with each other, but there is still space for improvement. Clearly, the respondents see no effect from EA on market shares for most organizations.

Table 6.3. Top and bottom benefits perceived in the Realization phase

Perspective	Question	+ (%)	0 (%)	- (%)
Top 3				
Internal	In projects carried out under architecture the architecture has contributed to making the project's impact on the organization more clear	89.2	10.8	0.0
Learning & Growth	Projects carried out under architecture provide a better understanding of the limitations of the solution	84.4	14.0	1.6
Internal	In portfolio decisions architecture contributes to good decision-making	83.6	16.4	0.0
Bottom 3				
Financial	Projects carried out under architecture have lower cost than other projects	19.5	43.9	36.6
Internal	Projects carried out under architecture have a better record of on-time completion	23.5	56.9	19.6
Internal	Projects carried out under architecture have a better record of staying within budget	24.1	59.2	16.7

Table 6.4. Top and bottom benefits perceived in the Use phase

Perspective	Question	+ (%)	0 (%)	- (%)
Top 3				
Customer	Since the organization has been using Enterprise Architecture supply chain integration has been better	71.4	23.5	5.1
Internal	Since the organization has been using Enterprise Architecture the alignment between the business processes and IT has been better	70.5	25.3	4.2
Internal	Since the organization has been using Enterprise Architecture the IT infrastructure has been utilized better	68.4	26.5	5.1
Bottom 3				
Customer	Since the organization has been using Enterprise Architecture market share has grown	8.6	84.3	7.1

Perspective	Question	+ (%)	0 (%)	- (%)
Internal	Since the organization has been using Enterprise Architecture cooperation within the organization has grown	48.9	44.7	6.4
Financial	Since the organization has been using Enterprise Architecture compliance with laws and regulations has been better	49.5	49.4	1.1

The results shown in tables 6.1 to 6.3 are in line with previous research (Foorthuis et al., 2010) As the responses seem representative for the field, they present a good starting point for validating the EAVF and the measurement instrument based on the EAVF. We will discuss this in the next section.

6.5 Evaluation

Propagation of Benefits

From the meaning of the EAVF dimensions it may be expected that there exist positive relationships:

- Horizontally from right to left as the Balanced Score Card argues that results in the learning and growth perspective should impact the customer and internal process perspectives, whereas the latter two should impact the financial perspective.

- Vertically from top to bottom as the Architecture life cycle implies that results from the development phase should impact the realization phase and the results from the realization phase should impact results in the use phase.

We tested if these relationships hold in the EAVF as well by calculating the correlations between cells horizontally and vertically. Figures 6.3 and 6.4 show the Spearman's rho values found with $p < 0.05$.

Table 6.5. Horizontal correlations between cells in the Use phase

	Spearman's Rho
Customer -> Financial	0.486
Internal -> Financial	0.349
Learning & Growth -> Customer	0.332
Learning & Growth -> Internal	0.261

The horizontal relationships (between the perspectives of the Balanced Scorecard) were only tested for the use phase, as this is the phase in which the end results of EA are realized. The results in table 6.5 show a moderate correlation from the customer and internal

perspectives with the financial perspective. The relationship between customer and financial is the largest. This stresses the importance of the customer perspective, which in practice often gets little exposure (see table 6.1).

Looking at correlations between the phases we find correlations with a Pearson's rho > 0.300 between most phases. The correlation between development and realization in the internal perspective is the lowest.

The correlation results seem to support the underlying assumptions of the EAVF (EA benefits can be related to organizational goals and the benefits may evolve over time).

Table 6.6. Vertical correlations between phases

	Financial	*Customer*	*Internal*	*Learning & Growth*
Development -> Realization	0.484	0.586	0.140	0.359
Realization -> Use	0.224	0.292	0.362	0.362

The EA Benefits Measurement Instrument

In order to develop the benefits measurement instrument, we researched if the questions defined for each class cover the main statement of that class, or, stated differently, can we predict the outcome of the main statement (the view on the EAVF-class as a whole) from the corresponding questions (the actual benefits in that class)? If this is possible, the questions form a sound basis for a questionnaire.

To research this question, we used the method of ordinal regression for each cell with the main statement as the dependent variable and the questions as independent variables. The link variable used is the logit as the distributions were varying across different cells and we wanted to use the same link function for every cell.

For each cell we built several models; starting with individual questions we took the best-fitting question and added questions while the prerequisites were satisfied. The prerequisites we used to accept a question in the model are the significance of model fit < 0.05, Pearson's goodness of fit > 0.05 and the significance of parallel lines > 0.05.

In ten out of the twelve cells of the EAVF, we found a relation between the dependent variable (the overall statement) and some of the independent variables (the questions). As a threshold for acceptance, we used a Nagelkerke pseudo R^2 > 0.250, which in itself is low but can be defended as this is a first try at validating the instrument and we did not want to reject possible relations prematurely. For discussion purposes, we present here one of the results (table 6.7), corresponding with the Learning & Growth perspective in the Realization phase. All results can be requested from the authors.

As can be seen from table 6.7, from four out of the five questions around 50% of the overall statement can be explained, whereas for the fifth question, no statistical evidence was found, as adding this question gave rise to a quasi-complete separation of data.

Table 6.7. Model Example

Phase	Realization
View	Learning & Growth
Statement (dependent variable)	By applying Enterprise Architecture in projects, the learning and innovative capacity of the organization is better
Questions included in model	- Projects carried out under architecture provide a better understanding of the limitations of the solution - Projects carried out under architecture feature better sharing of knowledge - Projects carried out under architecture more often produce results that fit the operational management - Projects carried out under architecture produce more agility (flexibility)
Questions not included in model	- Projects carried out under architecture feature a more substantive decision-making process
Statistics	Nagelkerke: 0.499 Significance of model fit: 0.000 Pearson's goodness of fit: 0.256 Significance parallel lines: 0.812

In most cells, adding the excluded questions to the model made the model fit statistically not significant (p >= 0.05) or the test of parallel lines failed. Adding more responses could help to overcome this. In table 6.8 we have summarized the results in the framework, where the number gives the Nagelkerke pseudo R^2 of the best-fitting model found.

Table 6.8. Model fit in the cells of the EAVF

Phase	Financial	Customer	Internal	Learning & Growth
Development		0.299	0.371	
Realization	0.363	0.444	0.620	0.499
Use	0.399	0.301	0.549	0.303

In the empty cells there seemed to be a quasi-complete data separation for all individual questions, so we could not use ordinal regression for model building.

6.6 Conclusions and Further Research

The contribution of this paper is twofold: we introduce a framework, the EA Value Framework, for classifying EA benefits that combines the aspects of goal and time. To be able to compare results from different EA benefit research initiatives and to enlarge our knowledge base on EA benefits by building on each other's research, it is important to share a common framework. Supplementing this framework we show the current state regarding EA benefits in the Netherlands, based on a survey held in the first months of 2014.

The results of this survey show the kind of benefits organizations experience at the moment. The main conclusions we can draw from the results are first of all that regarding the customer perspective, benefits reported are low. This is consistent with findings in the literature (for example, Boucharas et al. (2010b) found only two benefits in the Customer perspective out of 100 benefits) and our observation that many architects are focused on the internals of the organization (processes and information) and not on the relation with the outside world. Secondly, we found that most benefits seem to occur in the Development phase, which may be caused by the fact that in the Realization phase project managers may perceive EA primarily as a constraint instead of a support, and in the Use phase results can not be attributed to EA only. In future research, we want to explore these hypotheses in case studies.

The results of the survey appear to be representative of the EA field (as discussed in section 6.3), so we used them to evaluate the EAVF as well. We found moderate support for the assumed underlying relations between the cells of the framework which in turn give support to the validity of our framework.

Finally, we used the results to continue the development of an EA benefits measurement instrument based on the EAVF. This instrument consists of a series of questions for every cell in the EAVF, which are derived from benefits as reported in the literature. These questions have been used to predict the overall outcome in the cell, as measured in an overall statement for that cell. Using ordinal regression, we found valid models for ten of the twelve cells. These models constitute the first step in defining a final questionnaire to measure actual benefits for a specific cell.

Our research has its limitations. As our survey asks for the perception of the respondents concerning EA benefits, the outcome is subjective. This is a frequently occurring phenomenon with evaluative surveys but there are indications that this kind of survey leads to reliable results. For example, Wall et al. (2004) show that perceptions are a reliable indicator of actual organizational performance. Secondly, the respondents to our survey are self-selected and therefore are not a random sample of the EA community. As a consequence, some bias in the answers may be present. Moreover, as the survey is

conducted in the Netherlands, care must be taken in generalizing the results. Finally, as the twelve main statements are generic by nature, they leave room for different interpretations.

In order to examine if the overall statements cover the cells fully and to further refine the results from our survey, we plan to perform case studies in organizations with the EA benefits measurement instrument. In that way, we expect to get a better understanding which benefits are most important for organizations and gather 'best practices' on how to maximize the benefits of EA.

Chapter 7

A Longitudinal View on the Perceived Contribution of Enterprise Architecture in the Netherlands

Since the rise of Enterprise Architecture (EA) in the first decade of this century, three surveys about the perceived contribution of EA have been conducted in the Netherlands. In this paper, these three surveys are compared and developments in the perceived contribution of EA over time are analyzed. We found that there exists a set of EA benefit areas labeled the core EA benefit areas) that are mentioned in most of the literature about EA benefits and score (relatively) high in all three surveys.

In the last two surveys, we found high scores in many benefit areas and we conclude that in the last decade, a clear contribution of EA to organizations is perceived by the respondents. From the observed evolution in EA benefit areas, we conclude that the areas where a contribution of EA to the organization is perceived, are not static, but are influenced by the role expected of EA. Based on the outcomes we extrapolate where changes in the perception of the contribution of EA may be expected in the future.

An extended version of this chapter has been accepted for presentation at the 28th International Conference on Enterprise Design, Operations, and Computing (EDOC 2024)

Note:
The goal areas in this chapter are equivalent to the EAVF categories used in the other chapters and the appendices.

7. A Longitudinal View on the Perceived Contribution of Enterprise Architecture in the Netherlands

7.1 Introduction

In the literature, many benefits of Enterprise Architecture (EA) can be found, but most of the claimed benefits are not supported by empirical evidence (Niemi & Pekkola, 2016; Shanks et al, 2018; Gong & Janssen, 2019; Ahleman et al., 2021). To illustrate: Shanks et al. (2018) found only 12 publications with empirical evidence about EA benefits, among them 8 surveys, and three years later, Ahleman et al. (2021) counted 13 surveys about EA benefits, EA practices, and EA success factors. To obtain more empirical evidence about EA value, we conducted a survey into the perceived contribution of EA in the Netherlands. The outcomes of this survey are discussed in Plessius et al. (2023).

Including this survey, three surveys tailored to the perceived benefits of EA have been conducted in the Netherlands: by Foorthuis et al. (2010), by Plessius et al. (2015), and by Plessius et al. (2023). These three surveys divide the discussion about the contribution of EA in timeframes. In this paper, we look at changes visible across these timeframes, both in the literature about EA value and in the outcomes of the three surveys. A challenge in comparing these three surveys is that no commonly accepted classification of EA benefits exists (Niemi, 2008; Boucharas et al., 2010; Niemi & Pekkola, 2016; Saleem & Fakieh, 2020) and as a result, the constructs used in the three surveys are different. To address this problem, we used the classification from Plessius et al. (2023) as this was the best documented, and defined a mapping procedure to represent the benefits of the other two surveys in this classification.

This research contributes by providing insight into the changes in the areas where a contribution of EA to organizations is perceived and in which direction these changes may continue in the future. The research question addressed is: *How has the perception of the contribution of EA in the Netherlands evolved over time?*

The paper is structured as follows. In the next section, we discuss the background of the classification used, followed in section 7.3 with the research approach chosen, including the mapping procedure. In section 7.4, the results of the comparison are discussed by timeframe, followed in section 7.5 with a discussion of the results including an extrapolation of our findings into the future.

7.2 Background

For a benefit to be credited as a contribution of EA, it is important that this benefit can (at least partly) be attributed to the activities of the EA function and is relevant for the organization. In previous research we have defined 'relevant' as contributing to the goals

of the organization (Plessius et al., 2018). These properties can be used to define a classification of EA contributions: by organizational goal and by activity of the EA function as elaborated in Plessius et al. (2018). When compiling an overview of EA contributions, we want to see to which organizational goals they contribute so the classification by organizational goal is more important than by which EA activity they were established. In a Delphi study (Plessius & van Steenbergen, 2019), with the help of 13 Dutch EA experts, a set of 31 areas was discerned, that together cover all organizational goals where a contribution of EA may be expected. In table 7.1 these areas are summarized by keyword and categorized in the four perspectives of the balanced scorecard (Kaplan & Norton, 1992) the starting point for this classification. In this table, 'Costs' should be read as goals concerning a reduction of costs, etcetera. A full definition of all areas can be found in appendix 1.

Table 7.1. Areas where a contribution of EA may be expected (Plessius & van Steenbergen, 2019)

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

This classification was used in the survey of Plessius et al. (2023) and will be used as a 'common denominator' to compare the three surveys mentioned in the Introduction.

We expected that differences in questions and outcomes of the three surveys could (at least partly) be explained by changes in the perception of EA as expressed by Lapalme

(2012) in his three schools of thought: Enterprise IT architecting, Enterprise integrating, and Enterprise ecological adaptation.

Textbox 7.1. Summary of the three schools of thought in EA by Lapalme (2012).

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

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"*.

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"*.

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"*.

7.3 Research Approach

The three surveys mentioned in the previous section were conducted from (1) October 2009 to May 2010 (Foorthuis et al., 2010), (2) December 2013 to January 2014 (Plessius et al., 2015), and (3) April 2021 to May 2021 (Plessius et al., 2023). These surveys end three timeframes:

1. Up to 2010, including the survey of Foorthuis et al. (2010).

2. From 2010 until 2014, including the survey of Plessius et al. (2015).

3. From 2014 until 2021, including the survey of Plessius et al. (2023).

To be able to compare the three surveys, they must be (made) comparable. This encompasses both the background characteristics of the respondents as well as the questions asked in the surveys. The questions about the contribution of EA turned out to be quite different in the three surveys. To make the outcomes comparable, as explained in the previous section, we used the classification from table 7.1. These areas of organizational goals were already used in the third survey (Plessius et al., 2023) but for the other two surveys (Foorthuis et al., 2010; Plessius et al., 2015), a mapping was defined. As such a mapping is many to many, meaning that a survey question may map onto more goal areas and several survey questions may map on the same goal area (figure 7.1), two decisions had to be made:

1. A 'cut-off' limit. If a survey question maps marginally on some goal area, what is the limit below which this mapping can be neglected?

2. An arithmetic. How to weigh the various mappings on the same goal area?
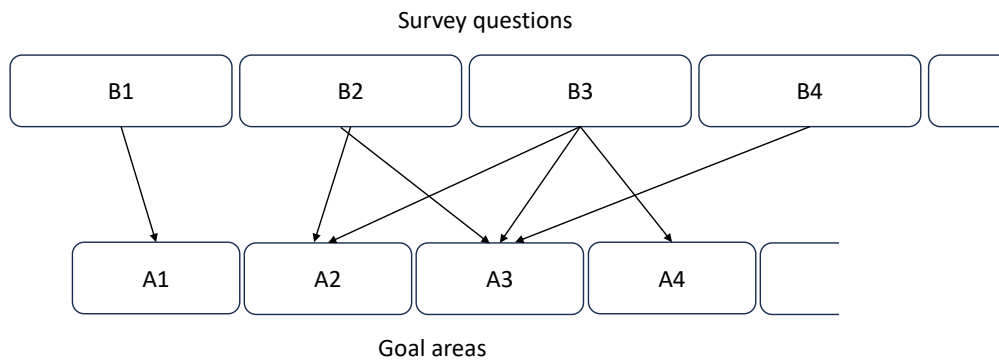
Survey questions

Figure 7.1. Mapping of survey questions on goal areas

To decide whether the mapping of a survey question on a goal area can be neglected, we consecutively ask ourselves:

• do the survey question and the definition of the goal area cover some *common ground*?

• is the mapping *necessary* or *desirable* in the context of the question?

A mapping is deemed necessary when it covers an essential part of the question and desirable if it complies with the intention of the question, both at the discretion of the person who conducts the mapping. As such, depending on the documentation available, a mapping can be subjective and should preferably be done by more than one person.

If the answer to the questions posed above is yes, the mapping is included but when any of the answers is no, it is not included. If there is reasonable doubt about an answer, a decision should be made in discussion with another expert.

An example from the survey by Foorthuis et al. (2016) is the question: *EA turns out to be a good instrument to integrate, standardize, and/or deduplicate related processes and systems.* It is not a priori clear which areas are included in the survey question. After the discussion with an expert who had been involved with the survey, we decided that the question is related mainly to the definitions of the goal areas 'information management', 'data management', 'and 'business processes' and it seems necessary to include these goal areas. While there is some overlap with processes in goal areas such as 'logistics' and 'marketing and sales', we found these mappings neither necessary nor desirable (to avoid giving this question too much weight) and decided to map this benefit only in the three goal areas mentioned above.

Ideally, the weighting of various mappings on the same goal area should balance the contribution of the various mappings to that goal area. However, we found no way to balance the various contributions so we decided to weigh all mappings on the same goal area equally and average the scores given.

To be able to compare the surveys with the literature, for each timeframe, we chose the papers about the contribution of EA that were mentioned in the corresponding survey, supplemented at our discretion with other meta-studies on EA benefits from that timeframe. The benefits as mentioned in the papers were mapped in the goal areas in the same way as the mapping of the questions in the surveys. But whereas in the surveys a valuation is given to the benefits in the goal areas, in the papers they are only listed. While some contributions were mentioned in only one paper consulted, others were mentioned in several, sometimes all, papers. To reflect the degree of agreement between the various papers, we used the following rating: if a goal area is mentioned in at least one of the papers but in less than 25% of the papers, it is scored with a '+'. If it is mentioned in 25% to 75% of the papers, we rate the area with a '++' and if it is found in at least 75% of the papers, we rate that area with a '+++'.

7.4 Results

Background of the Respondents

In table 7.2, we have listed the number of respondents in the three surveys, together with the calculated error margin for a confidence level of 95%. The error margins in the first two surveys are comparable, but the error margin in the last survey is greater, due to a (much) smaller sample size.

Table 7.2. Survey size and calculated margin of error

	Foorthuis et al. (2010)	Plessius et al. (2015)	Plessius et al. (2023)
Number of respondents	293	287	105
Margin of error *	6%	6%	10%

*) Confidence level 95%

In table 7.3 the economic sector that is registered by the respondents is listed. Again, we see comparable numbers in the first two surveys, while in the third survey the percentage of respondents in the industry sector is higher and the percentage in the Financial and insurance sector is much lower. In Plessius et al. (2023) this is explained by the fact that the sector 'Financial and insurance services' has diminished considerably in the Netherlands in the last decade.

Table 7.3. Distribution over economic sector

The organization I work for can be classified in the following economic sector:	Foorthuis et al. (2010)	Plessius et al. (2015)	Plessius et al. (2023)
No answer	0%	0%	0%
Agriculture, fishing, forestry and mining	1%	2%	0%
Industry (nutrition and manufacturing) and construction	6%	3%	13%
Energy, water and waste production/ processing	5%	5%	4%
Education and research	2%	6%	7%
Health and community work	3%	5%	11%
Government (including Defense)	31%	24%	28%
Financial and insurance services	30%	35%	14%
Information, communication and entertainment/recreation	12%	6%	7%
Trade, transport and other services	10%	13%	15%

As a final reference point, we looked at the reported organizational size in the three surveys. As table 7.4 shows, the percentage of organizations with at least 2000 employees has diminished over time, which may be explained by the fact that EA has become more generally implemented since 2010, even in smaller organizations (Carr & Else, 2018).

Table 7.4. Organizational size

Number of employees	Foorthuis et al. (2010)	Plessius et al. (2015)	Plessius et al. (2023)
< 2000	28 %	38 %	50 %
2000 – 5000	27 %	23 %	22 %
>= 5000	44 %	38 %	29 %

We conclude that because all three surveys are considered representative (Foorthuis et al., 2010; Plessius et al., 2015 and Plessius et al., 2023) and differences in the background of the respondents can be explained, they are mutually comparable. However, it should be taken into account that the third survey, due to the lower number of respondents, has a greater error margin.

First timeframe: Up to 2010

For the first timeframe, we collected EA benefits from the papers by Morganwalp & Sage (2004), Ross et al. (2006), Niemi (2008), and Kappelman et al. (2008) and mapped these on the goal areas as discussed in section 7.3. The results are summarized in table 7.5.

Table 7.5. Importance of the goal areas in the literature consulted and in the surveys

Perspective from the Balanced Scorecard	Timeframe 1			Timeframe 2			Timeframe 3		
		%	%		%	%		%	%
Goal area	Lit	4,5	3	Lit	4,5	3	Lit	4,5	3
Financial and Accountability									
Costs and revenues	+++	13.4	49.4	+++	37.6	36.5	+++	51.5	24.6
Investments	++			+++			++	59.6	24.2
Compliance	+++	55.6	31.0	+++	51.9	38.7	++	83.0	11.4
Governance	+++	52.7	31.3	+++	72.3	23.6	+++	57.5	24.0
Risk management	+++	51.1	43.1	++	46.8	22.4	+	63.9	27.8
Societal responsibility				+				40.0	30.0
Customer and Partnerships									
(Customer) experience				++	32.1	59.3	++	61.6	19.3
(Customer) relationships	+			++	53.6	34.6	++	56.9	23.6
Product position	++			++	42.9	53.7	++	23.8	23.0
Market strategy	+			++				50.1	13.7
Ecosystem	+	28.2	55.9	++	69.2	27.3	+++	59.2	17.5
Internal processes									
Logistics and Procurement	+			+				49.7	23.9
Business (production) processes	+++	55.6	31.0	+++	50.3	45.9	++	65.7	21.9
Marketing and sales				++			+	32.3	33.7
Service delivery							++	48.8	27.0
Data management	+++	55.6	31.0	++	68.0	29.9	++	68.4	17.1
Information management	+++	55.6	31.0	+++	61.5	35.6	+++	64.3	21.6
General management	+++	56.2	24.4	+++	52.8	40.7	+++	52.0	28.3
Quality management	+++	38.7	44.4	+++	51.4	39.9	+++	57.4	22.7
HRM	++			++	42.9	43.9	+++	55.3	33.2
Innovation	++			++	55.5	36.9	+++	50.9	28.7
Technology (non-IT)									
Learning and Growth									
Competences	++			+++	67.6	31.9	+++	60.9	19.3
Culture	+	28.5	46.4	+++	62.2	34.5	++	64.5	15.3
Alignment	+++	57.4	30.8	+++	75.4	22.0	+++	65.1	23.8
Agility	+++	25.3	50.2	+++	57.1	33.1	+++	60.1	24.3
Technology research							+	35.1	40.1
Communication and KM	+++	46.2	40.1	+++	42.9	33.1	+++	53.6	28.9
Evaluation and re-use	++			+++	38.2	60.0	++	33.6	29.9

(Legend on next page)

Legend:

  Lit: the relative importance of the area in the literature of that timeframe

  % 4,5: the percentage of respondents who considered the contribution of EA (very)
           important

  % 3:   the percentage of respondents who considered the contribution of EA neutral

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Empty cells in this table mean that no references to that goal area were found in the literature consulted or that there are no survey questions that could be mapped into that goal area.

From the literature consulted we learned that EA benefits in this timeframe are mainly found in the Financial and Accountability perspective, in the Internal processes perspective in goal areas concerning business processes, IT and management, and in the goal areas 'alignment', 'agility', and 'communication and knowledge management' from the Learning and Growth perspective. Areas related to the environment of the own organization are hardly mentioned as a source for EA benefits which is most obvious in the Customer and Partnerships perspective. This is in line with the objectives of EA practice in that timeframe: flexibility, adaptability, and reliability according to Rohoff (2005) or alignment, agility, interoperability, and standardization in the words of Winter et al. (2010). It is also consistent with the Enterprise IT architecting and Enterprise integrating schools of Lapalme (2012) in which EA is focused on internal business and IT processes, not on the interaction with the outside world.

The survey of Foorthuis et al. (2010) follows the literature from this period and no questions were asked concerning the customer or the market. It follows that no conclusions can be drawn on the perceived importance of these areas.

   The relatively low scores in the goal areas 'costs and benefits', 'ecosystem', 'culture', and 'agility' stand out. The low scores on 'costs and benefits' may be explained by the fact that in this timeframe, EA is a relatively new discipline and has in most organizations not yet produced tangible results. The low scores on 'ecosystem', 'culture', and 'agility' are in line with the focus on business/IT alignment in this timeframe (Lapalme, 2012). It is quite possible that in those days agility in business practice was not yet recognized as important as it is nowadays, which is in line with the increasing importance of the goal area 'agility' in the surveys of the next two timeframes. In the other goal areas, relatively high scores are found, supporting the attention of EA on 'internal affairs' in that timeframe, but no scores stand out particularly.

Second timeframe: From 2010 until 2014

For the second timeframe, we collected EA benefits from the papers of Boucharas et al. (2010), Tamm et al. (2011), Raadt, van der (2011), Lange et al. (2012), and Wan et al. (2013). In the literature consulted about this timeframe we discern, compared to the first timeframe, an increasing agreement that EA benefits can be found in areas related to the outside world. The increasing interest to include the outside world in the EA is evident in the Customer and Partnerships perspective (see table 7.5). It seems that EA has started to look 'outside in', possibly influenced by the interest in customer journeys (Rawson, Duncan, & Jones, 2013), which connect the outside world with internal business processes and IT, areas that were already recognized as EA benefit areas. Besides the growing attention towards EA benefits from the Customer and Partnerships perspective, in the Learning and Growth perspective, EA benefits are also mentioned more often than in the preceding timeframe, marking a beginning transition towards the Enterprise ecological adaptation school of Lapalme (2012).

The increased attention to the outside world is reflected in the survey of Plessius et al. (2015) that ends this timeframe and in which most goal areas in the Customer and partnerships perspective are present (albeit with a relatively low percentage of respondents who think the contribution of EA to the customer experience is (very) important).

Noteworthy are the still low scores in the goal area 'costs and benefits'. While increasing in comparison to the previous survey, it is only in the third timeframe that EA seems to pay out. On the other hand, very high scores are given on the goal areas 'governance' and 'alignment,' two areas that in a way are supplementary as governance includes monitoring the alignment with the strategy of the organization.

The scores on most areas in the Learning and Growth perspective are among the highest given in this timeframe, which is in line with the increased interest in this perspective in the literature consulted as listed above. This perspective scores higher than in the first timeframe – an increase that persists into the third timeframe. The exception is the goal area 'evaluation and reuse' which does not score very high. An explanation may be that in practice there often is no time for evaluations because the next challenge is already presenting itself, but not much empirical research has been done in this field (Anderson & Carugati, 2014).

Third timeframe: From 2014 until 2021

For the third timeframe, we used the EA benefits that can be found in the publications by Jusuf and Kurnia (2017), Niemi & Pekkola (2019), Gong & Janssen (2019), Kurnia et al. (2020) and Saleem & Fakieh (2020). In table 7.5 we see that in the literature the agreement about the importance of some areas in the perspective of Financial and Accountability has

decreased. The goal areas 'service delivery' and 'technology research' are mentioned for the first time in the literature consulted and the increase in the goal area 'innovation' stands out, which may point to an increasing interest in this timeframe towards digital transformation.

This increased interest in digital transformation in the literature is not reflected in the outcomes of the survey that ends this timeframe. 'Innovation' scores lower than in the survey of the second timeframe and the outcome on 'technology research' is also not very high. It seems that in practice EA has not yet discovered its role in the digital transformation.

In the survey of Plessius et al. (2023), almost all goal areas are present, and in many areas, we see outcomes that are a bit higher than in the previous timeframe. Exceptions (a decrease of 10% or more in the high scores) are the goal areas 'governance', 'product position', 'ecosystem', and 'alignment', but it is not clear why these goal areas score so much lower.

Interesting is the increased perceived contribution of EA in the goal areas 'costs and benefits' and 'customer experience'. In both goal areas, the trend from previous timeframes is continued. A very high score is given to 'compliance', but it is not clear why; maybe, following timeframe 2, it can be explained by stricter regulations. Furthermore, in the survey, a new area, not yet mentioned in the literature consulted, is included: 'societal responsibility' – in line with the increased interest in sustainability and fair trade in society.

7.5 Conclusions, Outlook, and Limitations

In the previous section, we have shown that some benefits of EA are mentioned in almost all the literature that we consulted about EA benefits consulted; we will call these the *core EA benefit areas* (table 7.6).

Table 7.6. Core benefit areas

Financial and Accountability	Internal processes	Learning and Growth
Costs and benefits	Business processes	Communication and KM
Compliance	Data management	Alignment
Governance	Information management	Agility
Risk management	General management	
	Quality management	

Except for the areas 'costs and benefits' and 'agility', as discussed in the previous section, the core EA benefits score high in all three surveys. They also reflect the internal orientation of EA in the early days as discussed above and are comparable to the EA goals identified by Lange and Mendling (2011). In line with this internal orientation, we observe an absence of questions about customers and markets and a relatively low score on 'agility' in the survey of Foorthuis et al. (2010).

Starting in the second timeframe, we see an extension of the areas where benefits are found, both in the literature and in the outcomes of the surveys. At the same time, there are no areas that disappear; it seems that more is expected from EA. Over time, enterprise architects are becoming more focused on the Customer and partnerships perspective as the starting point for their modeling (van Steenbergen, Plessius & Slot, 2014) which is reflected in the areas where EA benefits are found. As a result, we also see an increase in the scores for 'agility'.

In the third timeframe, we see a further extension of both internal ('competences', 'culture') and external ('technology research', 'innovation', 'service delivery', 'societal responsibility') oriented goal areas. A driving factor behind the extension in internal areas may well be the rise of agile implementation methods in organizations (Horlach et al., 2020). The extension into more externally oriented areas may be driven by digital transformation which asks for a much more flexible approach to EA (Korholen & Halen, 2017).
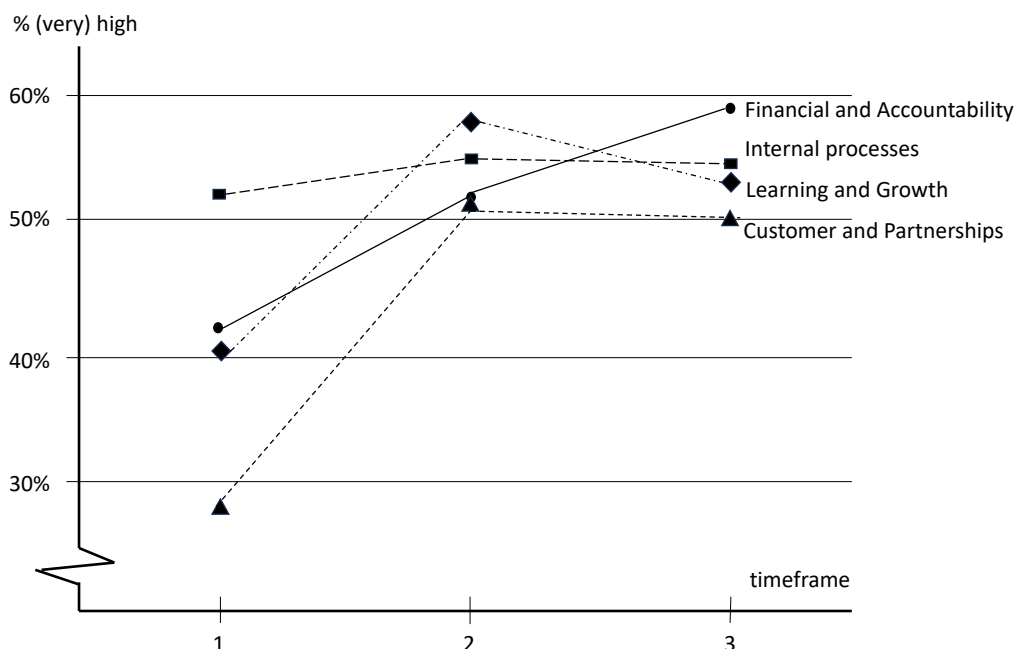

Figure 7.2. Evolution of the contribution of EA over time in the Netherlands

In figure 7.2 we have averaged the high outcomes (4 or 5 on the Likert scale) of the surveys in the four perspectives of the balanced scorecard and plotted these against the

timeframes. Overall, we see a clear increase from timeframe 1 to timeframe 2 indicating that the contribution of EA is much more appreciated. From timeframe 2 to timeframe 3 the image is more diffuse, in some perspectives there is a clear increase (Finance and Accountability), but other perspectives stay more or less equal (Customer and Partnerships, Internal processes) or show a small decrease (Learning and Growth). In the last two timeframes, the high scores averaged by perspective are given by 50% or more respondents and we conclude that from about 2015 onwards, a distinct contribution of EA to organizations is perceived by the respondents.

From the above outlined evolution of EA benefits, we conclude that the areas where a contribution of EA to the organization is perceived, are not static, but are influenced by the role expected of EA. Based on this observation and supported by the literature, we expect these changes will continue and that this may lead to the following changes in the near future:

1. In most organizations, software development takes place in agile teams. The proliferation of agile practices in organizations has revived the discussion about the usefulness and value of Enterprise Architecture (Canat et al., 2018; Hylving & Bygstad, 2019). The outcome of this discussion may well be that EA has to reinvent itself: from a prescriptive role to a supporting role (Kotusev, 2020; Horlach et al., 2020). This may implicate that the core EA benefit areas become less important, while the areas from the Learning and Growth perspective (together with the areas from the Customer and partnerships perspective) become more important.

2. The contribution of EA to 'societal responsibility' will become more important under the influence of the worldwide attention to sustainability and working conditions. This area has already been indirectly mentioned by Jusuf and Kurnia (2017) and is explicitly incorporated as a trend in Gampfer et al. (2018).

3. In IT, new technologies emerge at an increasing pace and enterprise architects are expected to advise on the usability of new technologies (Gong and Janssen, 2019) such as cloud, big data, internet of things, and blockchain in the recent past and currently artificial intelligence (Mühlroth & Grottke, 2020; Păvăloaia & Necula, 2023). We expect that this will make the goal areas 'technology research' and 'Innovation' more important as forecasted by Gampfler et al. (2018).

4. In the discussion about the consequences of the developments in artificial intelligence, an important topic is its ethical impact (Ashok et al., 2022). In our opinion, this should influence the role of EA to include ethical questions when introducing new technologies.

5. A major concern for many organizations is their IT security. Cybersecurity is not only an operational challenge but should start on a strategic level (Ghelani, 2022). This has

led to a sub-domain of EA: Enterprise Information Security Architecture. IT security is in the current set of goal areas included within the area of 'Information management' but with increasing interest, it may become an area in its own right.

6. A final development we foresee is the role of EA in digital transformation. This transformation will quite often disrupt the business processes in an organization including their supporting IT/IS. EA can take a leading role in the process (Korhonen & Halén, 2017; Zimmerman et al., 2018; Niemi & Pekkola, 2019). In the current set of goal areas, aspects of digital transformation are spread over various areas, for example, 'business processes', 'information management', 'innovation', and 'agility'.

The comparison presented in this paper has its limitations. First of all, there is the restriction to the Netherlands as the surveys are conducted there. On the other hand, the literature used is international and both the literature and the surveys support each other so we tentatively conclude that our conclusions are valid outside the Netherlands as well.

A much more fundamental limitation is how we have constructed table 7.5. In the first place, we have interpreted the questions in the various surveys when mapping these into the goal areas. For example: in the first two timeframes no questions are mapped into the area 'logistics', but this topic may be implicitly included in survey questions that are mapped into the area 'business processes'. The same goes for the area 'investments' which may have been implicitly included in survey questions about 'costs and benefits'. Second, in averaging the results of the various questions that were mapped into one area, we have given them equal weight, which may not have been the intention of the survey constructors. Finally, the literature consulted over the various timeframes is limited, but we have taken good care to include a representative range of papers from the three timeframes.

Despite these limitations, we hold the opinion that the results presented give a faithful image of how the perception of the contribution of EA in the Netherlands has evolved over time.

Chapter 8

Discussion and Conclusion

In this chapter, the outcomes of our research are critically reviewed and the research questions are answered. Limitations of our research and potential future work on the subject of EA value are discussed.

8. Discussion and Conclusion

8.1 Revisiting the Research Questions

In this section, we review our results by answering the research questions posed in the Introduction.

   RQ1: How can EA benefits and EA costs be defined and classified?

After extensive literature research, we did not find precise definitions of the key concepts of our research: EA benefit, EA cost, and EA value. To properly define these concepts, we consulted the literature on IT value which supports the notion that value is the (financial and non-financial) contribution to the organization. What contributes to an organization is captured in its goals.

   To differentiate between the contribution of EA and that of other disciplines, we decided to restrict the value of EA to the output of EA activities. These considerations led in chapter 2 of this thesis to the definitions repeated in table 8.1:

Table 8.1. Definitions of the key concepts

Concept	Definition
EA benefit	The positive contributions from (one or more) EA activities towards the desired state of affairs for an organization as stated by some goal of that organization.
EA cost	The negative contributions from (one or more) EA activities towards the desired state of affairs for an organization as stated by some goal of that organization.
EA value	The net contributions from (one or more) EA activities towards the desired state of affairs for an organization as stated by some goal of that organization.

These definitions were first presented in Plessius et al. (2018) and repeated in later publications. The restriction to EA activities limits the contribution of EA to the direct consequences of EA activities. We have chosen to leave indirect consequences 'out of scope' to prevent discussions about the extent to which an organizational benefit or cost can be contributed to the EA as discussed in section 1.3 of this thesis.

In literature, many different classifications of EA benefits, summarized in chapters 2 and 4 of this thesis, can be found. From this affluence, it becomes clear there are no intrinsic properties of EA value that can be used to classify these benefits. Therefore, we decided to base our classification of EA value items, which consist of EA benefits and EA costs, on the properties from our definitions: *organizational goal* and *EA activity.*

   To classify organizational goals, we chose the balanced scorecard (Kaplan & Norton, 1992), because organizational goals are often made explicit with the balanced scorecard (Peppard & Ward, 2016; Hasan & Chyi, 2017). Boucharas et al. (2010b) explored several frameworks for classifying organizational goals and considered the balanced scorecard as

the most suitable in the context of EA value. Moreover, the balanced scorecard discerns both exploitation and exploration goals in the Internal process perspective and in the Learning and growth perspective respectively, which is in line with practice in organizations pursuing ambidexterity (Raisch et al., 2009).

Concerning the other axis of our classification scheme, the EA activities, the classification chosen is the division into development-, implementation- and 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. This classification is not based on (traditional) phases in the work of EA, but it classifies the *activities* of the EA, regardless of the moment these take place.

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

Figure 8.1. The Enterprise Architecture Value Framework (EAVF)

The resulting classification scheme, the Enterprise Architecture Value Framework (EAVF) as displayed in figure 8.1, is *complete* within the framework of our definitions, due to the completeness of both its axes as discussed in chapter 2. As a consequence, every EA value item can be mapped into one or more categories of the EAVF.

RQ2: How can a framework to assess the value of EA, that is based on a classification of EA benefits and costs, be constructed?

In a Delphi study (chapter 3), we were able to discern in the organizational goals-axis of the EAVF 31 subcategories where EA may contribute, called the *EAVF categories* (in appendix 1 short descriptions of the EAVF categories can be found). These EAVF categories constitute the foundation of our assessment instrument. Although the EAVF categories do not necessarily cover the balanced scorecard completely, their importance lies in the fact that according to the experts consulted in the Delphi study, they cover the areas where a contribution of EA may be expected. By applying design science research principles (Hevner et al., 2004) in constructing the EAVF and the EAVF categories an artefact is created, the extended EAVF. In the next section, we will review our research against the

guidelines for design-science research and in section 8.4 we will discuss how the EAVF categories can be updated if new benefit areas arise in literature or practice.

Because most papers about EA value do not make clear what is understood by each EA benefit discerned, a mapping into the EAVF categories is not objective but subject to interpretation. The difficulties involved in classifying EA benefits as mentioned in the literature into the subcategories of the EAVF have been discussed in chapter 7 of this thesis.

RQ3: How can an EA assessment instrument be constructed and used in practice, taking into account differences between individual organizations?

Before the actual construction of an assessment instrument, we developed several objectives that the instrument should meet (Plessius et al., accepted for publication):

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

From an inventory of EA benefits as reported in the literature (objective 1), we derived a set of 112 EA value contributions. As we wanted to restrict the number of questions in the instrument (objective 3), we combined these into 58 value items. Further we classified the value items in the EAVF categories, therewith addressing construct validity. The development process is described in more detail in chapter 4 and is summarized in figure 8.2.
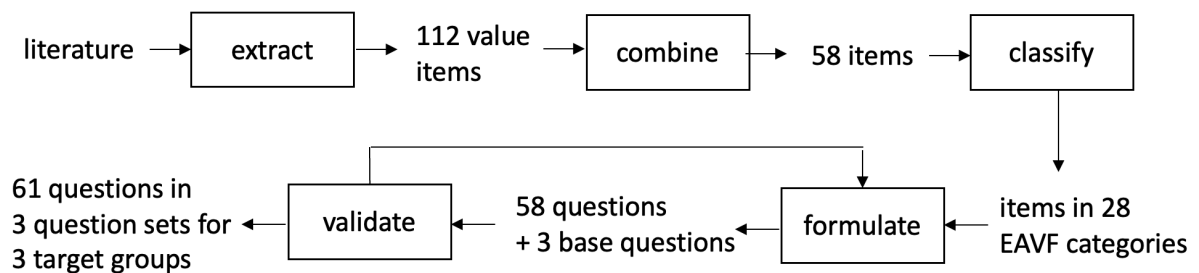
Figure 8.2. The development process of the instrument

The EAVF categories together constitute a classification of organizational goals and as such are independent of the organization of the EA and the methods and tools used (objective 2). We recognized that in practice, apart from the developers of the EA, other stakeholder groups are involved: implementers and users of the EA. We decided to develop three different versions of the questionnaire targeted at the three stakeholder groups. In this way, the developers can be confronted with the opinion of the other groups who are

confronted with the EA as developed (objective 4). By following the steps taken in the development of the instrument as discussed in chapter 4, the resulting instrument can easily be adapted when new contributions are found in the literature (objective 5) or if an organization wants more detail in some areas. We will discuss the consequences of such adaptations in section 8.4 of this thesis.

The comprehensibility, relevance, and completeness of the questions in the instrument were tested and fine-tuned in a series of three case studies, sequentially conducted in three organizations. In the process, some questions were split, bringing the overall number of questions to 61 and several formulations were adapted for better understandability as discussed in chapter 4. All questions included in the instrument can be found in appendix 2 of this thesis.

The outcomes gathered with the instrument were recognized by the stakeholders and supported the reliability of the instrument. The usefulness, ease of use, and efficacy of the instrument were confirmed in the fourth case study which was carried out by the organization itself, without outside support. We conclude that the instrument gives a valid and recognizable picture of the contribution of EA to the goals of the organizations assessed and by construct validity, the validity of the framework.

Differences between organizations are visible in their goals and are addressed by comparing the outcomes of an assessment with the goals of the organization assessed.

From the experiences in the case studies, a guide on how to use the instrument has been constructed giving directions about how the instrument can be used in practice. This guide can be found in appendix 3 of this thesis.

To evaluate the instrument and the framework in more depth, we conducted a survey in the Netherlands. In the survey, questions about the completeness of the questions in the instrument and the recognizability of the outcomes were explicitly asked. Some possible value items were mentioned and can be found in chapter 5, but these are not mentioned in the current literature and were put aside for a new version of the instrument. About 80% of the respondents found the outcomes of the instrument recognizable (chapter 5). The other 20% either had misgivings about EA itself or disagreed with the priorities of their EA.

In line with the definitions given to the value concepts (table 8.1), the contribution of EA in a given EAVF category is the difference between the benefits and the costs of EA in that category which implies that the contribution of EA can be negative. However, in the current version of the instrument, it is not possible to indicate that the contribution of EA in an EAVF category is perceived negatively as the answer options only vary from 'not important at all' to 'very important'.

In the first three case studies, no indications were given by the interviewees that they perceived a negative contribution of EA, but in the fourth case study the possibility of indicating a negative contribution might have made a difference in the scores. In the survey, 8,6% of the scores given were 'not important at all'. These may include items where the respondents found the contribution of EA negative. We conclude that in the next version of the instrument, it seems worthwhile to expand the answer options with the possibility: 'the item has a negative influence' as in this way the costs of EA are more explicitly addressed.

RQ4: In which areas can a change in the perception of EA in the Netherlands be observed?

This research question arose when we realized after the survey of 2021 (chapter 5) that at least three surveys have been conducted in the Netherlands: in 2010 (Foorthuis et al., 2010), in 2014 (Plessius et al., 2015) and in 2021 (Plessius et al., 2023). We were curious if these surveys could show development in the areas where EA contributes. In chapter 7 we have shown that over time, the focus of EA has moved from the internal aspects of an organization to include its surroundings and we have extrapolated our findings to changes that may be expected in the near future.

8.2 Main Research Question

The main research question of our research is:

MRQ: How can the contribution of enterprise architecture to organizations be assessed?

This thesis explains how an instrument has been constructed to assess the contribution of EA to organizations. The instrument is an operationalization of a framework developed: the extended Enterprise Architecture Value Framework (eEAVF). Construct validity is addressed in the construction process where all value items mentioned in the literature could be mapped into the EAVF categories. Moreover, the mapping process as discussed in chapter 7 showed that older survey questions could also be mapped into the EAVF categories, confirming the construct validity.

Both the instrument and the framework have been evaluated in four case studies and a survey, conducted in the Netherlands.

In a methodological sense, the construction of an artefact is the essence of this research and consequently, we have leveraged the design science approach from Hevner et al. (2004). In their paper, they have formulated seven guidelines for design science research (table 1.1). In this section, we discuss the results of our work against these guidelines.

Guideline: Problem relevance.

The research on EA benefits is abundant as shown in chapters 2 and 4. But to our knowledge there currently exists no instrument that can give feedback to the architects about the relevance of their practice to the organization they work for. Especially in this era of digital transformation, the third school of thought of Lapalme (2012), enterprise ecological adaptation, is becoming more and more important to EA. An instrument to assess the value EA contributes to the organization may foster the organizational learning that is the purpose of EA in this school of thought.

In their overview of the critical problems of EA, Kaisler and Armour (2017, pp. 4813-4814) explicitly mention EA assessment challenges: the diversity of the artefacts produced by EA, missing KPI's (key process indicators), and how to measure EA value.

Guideline: Design as an artefact.

The artefact delivered in this research is the extended EAVF. The EAVF is a framework to classify EA benefits and EA costs, and is derived from definitions of the key value concepts. The EAVF classifies EA value items in terms of organizational goals and EA activities. Organizational goals are classified using the balanced scorecard (Kaplan and Norton, 1992), and the EA activities are divided into development -, implementation – and exploitation activities (Ahleman & El Arbi, 2012). It has been shown (chapter 2) that the EAVF is complete in the sense that all EA benefits can be mapped into the EAVF. In a further categorization of organizational goals, 31 so-called EAVF categories are discerned. These are operationalized in an instrument to assess the contribution of EA in organizations.

Guideline: Research rigor.

In the literature about EA value, definitions of the key concepts are hardly given (chapter 2). To overcome this, we started this research with strict definitions of these key concepts, based on definitions of value concepts that can be found in business literature. The axes of the EAVF are derived from business literature as well: the balanced scorecard (Kaplan and Norton, 1992) and the work of Ahleman and El Arbi (2012). The categorization into the EAVF categories is based on a refinement of the balanced scorecard, the strategy map (Kaplan & Norton, 2001) and authenticated in a Delphi study with 13 Dutch experts.

To construct the instrument, we started with benefits that can be found in literature about EA value and we classified these in the EAVF categories. The instrument constructed is grounded in the existing literature and in the construction process, construct validity has been monitored carefully.

Guideline: Design as a search process.

The value definitions, the (extended) EAVF, and the assessment instrument have been adapted several times. To illustrate, chapter 6 has been added to this thesis in which an older version of the EAVF is used as well as another approach to building an instrument.

In the first three case studies, the formulation of the questions in the instrument has been adapted between case studies. While this makes the case studies more difficult to compare, it shows how feedback was used.

Guideline: Design evaluation.

The research leading to the framework and the instrument has been evaluated in various ways. In the first place, by using EA benefits as reported in the literature, the framework and the instrument are embedded in existing theory giving both a sound scientific base. The developed instrument is tested in practice in two ways: using case studies and a survey. The case studies showed the, reliability, ease of use, usefulness, and efficacy of the instrument and the survey reinforced its completeness and the recognizability of the results as discussed in the previous section. As the instrument is an operationalization of the extended EAVF, from the construct validity we infer from these evaluations the validity of both the framework and the instrument.

Guideline: Research contributions.

The research contributes to the practice of EA by delivering an instrument to evaluate their results. As the instrument is independent of the organization of the EA function and the methods and tools used by the architects, it can be used without adaptations in all organizations where a distinction between developers and implementers of EA can be made (the appendix describes how the instrument can be adapted when this distinction cannot be made).

In a more theoretical sense, the main contributions of this research are the definitions given of the EA value concepts and the classification mechanism of EA value items in terms of organizational goals and EA activities. The instrument itself may over time set a baseline of what to expect from EA and bring a more empirical base to EA value (Shanks et al., 2018; Ahleman et al., 2021). The construction process of the instrument is of theoretical and practical interest as this makes it possible to maintain the instrument over time (see section 8.4).

Guideline: Communication of research.

During various stages of our research, papers have been presented at congresses where a double-blind review process is customary. This thesis brings the most important of these publications together.

8.3 Limitations

Our work has its limitations, both in the process leading to the instrument and in the instrument itself. In this section, we discuss the limitations in both aspects.

Limitations of the research

The instrument has only been tested in larger companies where a clear distinction can be made between the three kinds of stakeholders: EA developers, EA implementers, and users of EA. While we think that for smaller organizations it is possible to integrate the questionnaire aimed at EA developers with that of EA implementers (see appendix 3), currently this has not been tested.

Second, it cannot be guaranteed that questions are interpreted in the same way by all interviewees. However, from the case studies and the survey conducted, there is no indication that questions are multi-interpretable. To remedy discrepancies in this regard, we advise discussing the outcomes afterward with the stakeholders interviewed.

The validation of the instrument has also its limitations. In the first three case studies, only a few stakeholders were interviewed (chapter 4). The outcomes of these case studies were nevertheless recognized in the case organizations. Moreover, the fourth case study (chapter 4) and the survey conducted (chapter 5) confirm the validity of the instrument.

Another kind of limitation stems from the method used to create the questionnaires. In the questionnaires only value items are found that have their origin in previously published scientific papers. New developments in EA may therefore be missed, but this is easy to overcome by adding questions about other possible EA benefits such as those discussed in section 7.5. But in publications, we suggest keeping these questions apart from the results gathered with the questionnaires to make comparisons possible.

In the same vein, an organization may want to drill down in some areas and add more detailed questions. An example is an industrial company that may be interested in the contribution of EA to its technological (non-IT) architecture. In this EAVF category, no questions were found in the literature.

Limitations of the instrument

An important feature of the instrument is the use of three stakeholder groups: EA developers, EA implementers, and users of EA. This makes a triangulation of the outcomes possible and helps to prevent any bias. While we have suggested above that in smaller organizations it may be possible to integrate the questionnaires for EA developers and EA implementers, we think that it is important that at least two different stakeholder groups can be distinguished to get reliable results that are supported in the organization.

Another limitation is that the Likert scale used in the instrument does not provide for negative contributions as discussed in section 8.1. While we have no indication that this

seriously effects the outcomes, in a next version we advise to add the answer option 'the item has a negative influence' to the Likert scale.

Furthermore, in larger organizations, it may not be possible to interview all stakeholders. It is important to look for a representative selection of interviewees, based on general knowledge of the stakeholders or making a random selection. However, averaging results may smooth out relevant differences. It is worthwhile not only to look to the averages but to the extremes as well. A good place to discuss these is a meeting afterward in which the outcomes are evaluated and choices for the future are made.

8.4 Outlook

In the previous chapter, we discussed that EA as a discipline is not static and therefore, the areas where contributions of EA may be expected, have changed over time. Changes in the discipline of EA will continue and as a consequence, the instrument developed needs regular updating to reflect these changes. Updates may concern the EAVF categories, the questions in the questionnaires, and how the answers to the questions are aggregated.

Updates to the EAVF categories

In the original Delphi study (chapter 3) we distinguished 31 disjunct categories in the four perspectives in the EAVF where a contribution of EA may be expected. These EAVF categories were found to cover all areas where a contribution of EA may be found by the experts consulted.

In the construction of the instrument, we combined the subcategories 'costs' and 'revenues' and, as in the literature no benefits were found in the subcategories 'procurement' and 'technical systems (non-IT)' we left these out, effectively using 28 EAVF categories.

The EAVF categories are not necessarily complete, so an extension of these categories is not impossible. When adding new EAVF categories, they must be disjunct from the existing ones. This may mean that existing EAVF categories should be redefined. An example is the possible addition of an EAVF category 'IT security management': this would change not only 'information management' but IT security risks should also have to be excluded from 'risk management'.

The example shows that adding new EAVF categories should be treated with care because as a consequence, new outcomes may no longer be comparable with previous outcomes. It would also be necessary to validate the set of EAVF categories anew: are they disjunct from each other, clearly defined, recognizable in practice and do they cover all areas where contributions of EA may be found?

A different – and often better - solution can be found in defining a *view*: a virtual category in which a set of questions is collected. An example might be a view 'digital

transformation' in which questions from various EAVF categories can be included and that can be extended – if wanted - with extra questions. Views may be considered lightweight EAVF categories that can be introduced without side effects. To establish if there are universally useful views requires further research.

Updates to the questions

All in all, the instrument consists of 61 questions. To keep the outcomes comparable, we advise using all these questions. When more details are needed, extra questions can always be added by an organization, but care should be taken about how the answers to these questions are used. As they are not part of the instrument, extra questions should not be used in the outcomes by EAVF category or BSC perspective. They should be treated separately or in views defined by the organization.

Adding new questions, deleting old ones, or changing existing ones implies that outcomes are not easy comparable with previous outcomes. To keep the instrument valid, we think based on the research described in chapter 7, that a period of 4 to 5 years between updates suffices. If necessary, extra questions can always be added, without these questions being part of the instrument. In changing the instrument, construct validity and other criteria used in its development should be respected to keep the instrument scientifically grounded, 'based on existing literature' and, to keep the instrument universally applicable, 'independent of the organization of the EA function and methods used'. In chapter 4, all criteria can be found. Also, after each update, a validation of the instrument is called for along the lines set out in chapter 4.

Aggregating the answers

In the instrument, all questions are weighed equally. In the case studies we experimented with different forms of weighing the questions, but we found that the overall picture stayed the same so we decided not to use weighting factors.

However, we still have some doubt whether using some form of weighing might not give outcomes that reflect the actual situation better. Interesting was the experiment discussed in chapter 4 to ask for documents that could support the given answer; unfortunately, it was often unknown if such a document existed.

Final remarks

Apart from its use in practice, the instrument can be used in research. An example is the comparison of the perceived value of EA in relation to the perceived maturity of the EA function. One of our students has done some (unpublished) research into this question and found a weak correlation between the two in his organization. Based on this result, we think that it is worthwhile to invest in the EA capability as this may be paid back in the value delivered by the EA. However, much more research is needed to determine if this is valid.

We think it is important in every organization and for every employee to reflect on his/her work on a regular base. In many organizations, this is institutionalized for individuals in performance interviews. This should be the same for function groups in the organization: to create and maintain a learning organization they should regularly reflect on their contribution towards the organization. EA has shown it can be a strategic tool in business transformations. To keep that position, it is important to reflect on the contribution EA provides to organizations. The instrument developed can be used to that end.

We close this thesis with a word of warning: using the instrument means looking at the past. But as a well-known saying goes: *Past performance is no guarantee for future results*.

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Abstracts

(English) Summary

(English) Summary

Valuing the contribution of Enterprise Architecture (EA) to an organization is a long-standing issue and an answer seems elusive. To illustrate: in a recent survey by Bizzdesign, "*Improving the communication of EA's value to the business*" is seen by 55% of the respondents as the "*top priority to improve EA's organizational impact*". But what makes this question so elusive in light of the many publications about the subject? In this thesis, we identify several reasons, the most important being the intangible character of many EA benefits and secondly, the attribution problem: if a project produces benefits, to what extent can these be attributed to the EA?

To overcome these challenges, we have developed an EA Value Assessment Instrument with which (enterprise) architects and stakeholders of EA can express their views on the contribution of EA in many different areas. Although such an assessment does not yield results about the value of EA in economic terms, it can be used to highlight areas where improvements are possible and, related to the goals of the organization, desirable.

Addressing the above scientifically, we have defined the following main research question:

How can the value of enterprise architecture to organizations be assessed?

Our answer to this research question is based on six studies included in this thesis. In the second and third chapters of this thesis, we lay the foundation for our research. As hardly any definition of EA value can be found in the literature, we defined 'value' in line with its use in business as: "*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*". This definition is used to create a two-dimensional classification scheme, the Enterprise Architecture Value Framework (EAVF). In the EAVF the four perspectives of the balanced scorecard (BSC) are used to classify organizational goals and three types of EA activities are discerned: EA development -, EA implementation -, and EA exploitation activities (see figure).

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

The Enterprise Architecture Value Framework (EAVF)

(English) Summary

The classification of EA value items, both EA benefits and EA costs, in the EAVF is based solely on the definition of EA value as given above. As such the EAVF is independent of how the architectural function is organized and the methods and tools used by the architects. However, in practice - as the benefits and costs of EA find their origin in the activities of the architects - the EA activity axis can be refined to align the EAVF with the way of working of the architects as illustrated in Appendix 1.

In the next step, as described in chapter four, we set out to develop an instrument to assess the contribution of EA to an organization. An assessment of the contribution of EA to an organization should be based only on the results achieved by the architects, not on how these are arrived at. Therefore, to develop an assessment instrument, only the EAVF's classification in organizational goals is used. However, the four perspectives of the balanced scorecard are too coarse-grained for a useful assessment instrument. In a Delphi study, these four perspectives were refined into 31 subcategories where a contribution of EA can be expected: the *EAVF categories.*

From the literature, we gathered all kinds of contributions of EA which we subsequently summarized in 61 value items and classified in the EAVF categories. Based on these value items, three questionnaires were constructed, one for EA developers, one for EA implementers, and one for EA users: stakeholders who after implementation are confronted with the results of the EA. In this way, a triangulation of the outcomes of an assessment can be made.

Each of the three questionnaires consists of a base question in which an estimate of the contribution of EA on selected value items is asked for. All answers are scored on a 5-point Likert scale.

The questionnaires were validated in a series of three case studies in which the comprehensibility of the questions, their completeness, their relevance, and the recognisability of the outcomes were tested. After each assessment, a report was drafted for the case organization with the outcomes of the assessment as well as conclusions and recommendations which in all case organizations were recognized. To test the usefulness, efficacy, and ease of use of the instrument, in a follow-up fourth case study the assessment was carried out by the organization itself which proved easy to do and resulted in concrete actions. We conclude that the EA Value Assessment Instrument gives valid and useful results.

The last three studies in the thesis discuss results from surveys about the contributions of EA in the Netherlands. In chapter five, the EA Value Assessment Instrument is used as a foundation for a survey, conducted in 2021. The outcomes of the survey again validate the

comprehensibility and completeness of the EA Value Assessment Instrument. Chapter six discusses the outcomes of a survey held in 2014 based on an older version of the EAVF. Of special interest in this chapter is the analysis of the value items that contribute the most to the outcomes in the categories. These results may be used in a future version of the instrument to weigh the outcomes on particular value items.

In chapter seven the outcomes of these two surveys and an older survey from Foorthuis et al. (2010) are compared. The study shows that in the periods between the three surveys, the scope of EA has broadened: from the internal workings of the organization to include the environment of the organization as well. We expect comparable changes in the future, for example in the areas of cybersecurity, societal responsibility, and new technologies (such as artificial intelligence). In the last chapter, the Conclusion, we discuss how the EA Value Assessment Instrument can be kept up to date in light of the changing scope of the EA.

The research described in this thesis shows how the EA Value Assessment Instrument has been developed, validated, and used in practice. The instrument is independent of the organization of the EA function and the methods and tools used by the architects. It can be adjusted to changes in the scope of the EA by adding new questions and or new EAVF categories. The current version of the EA Value Assessment Instrument can be found in Appendix 2 of this thesis.

The research in this thesis contributes to the scientific body of knowledge by giving detailed definitions of the main EA value concepts and the development of a classification scheme based on these definitions, the EAVF. The EAVF can also be used to interpret or code the many research papers on the value of EA. The EA Value Assessment Instrument developed can be used as a common denominator to compare the contribution of EA within and between organizations.

In practice, the instrument can be used by architects to align their activities with the goals of the organization. Moreover, it can be used to "*improve the communication about EA's value to the business*" by making clear where strengths and weaknesses are found in the EA and deciding on a course of action.

(Nederlandstalige) Samenvatting

De waarde van Enterprise Architectuur – een ongrijpbare grootheid?

Hoe de bijdrage van Enterprise Architecture (EA) aan een organisatie gewaardeerd kan worden, is een al lang bestaand probleem en een antwoord erop lijkt ongrijpbaar. Ter illustratie: in een recent onderzoek van Bizzdesign wordt "*Het verbeteren van de communicatie over de waarde van EA voor het bedrijf*" door 55% van de respondenten gezien als "*topprioriteit om de organisatorische impact van EA te verbeteren*". Maar wat maakt deze vraag zo ongrijpbaar in het licht van de vele publicaties over dit onderwerp? In dit proefschrift identificeren we verschillende redenen, waarvan de belangrijkste zijn het immateriële karakter van veel EA-bijdragen en het attributieprobleem: als een project positief uitpakt, in welke mate kan dit dan aan de EA worden toegeschreven?

Om deze uitdagingen het hoofd te bieden, hebben we een EA Value Assessment Instrument ontwikkeld waarmee (enterprise) architecten en belanghebbenden van EA hun perceptie kunnen vastleggen over de bijdrage van EA op veel verschillende gebieden. Hoewel een dergelijke beoordeling geen eenduidig antwoord geeft over de waarde van EA in economische termen, kan deze wel worden gebruikt om die gebieden onder de aandacht te brengen waar verbeteringen mogelijk en, gerelateerd aan de doelstellingen van de organisatie, wenselijk zijn.

Om het bovenstaande wetenschappelijk te kunnen benaderen, hebben we de volgende onderzoeksvraag opgesteld:

Hoe kan de waarde van enterprise architectuur voor organisaties worden beoordeeld?

Het antwoord op deze onderzoeksvraag is gebaseerd op zes onderzoeken die in dit proefschrift zijn opgenomen. In het tweede en derde hoofdstuk van dit proefschrift leggen we de basis voor dit onderzoek. Omdat er in de literatuur nauwelijks definities over de waarde van EA te vinden zijn, hebben we 'waarde', in lijn met het gebruik ervan in het bedrijfsleven, gedefinieerd als: "*de netto bijdrage van (een of meer) EA-activiteiten aan een door een organisatie gewenste stand van zaken uitgedrukt in een doel van die organisatie*". Deze definitie is gebruikt om een tweedimensionaal classificatieschema op te stellen, het Enterprise Architecture Value Framework (EAVF). In het EAVF worden de vier perspectieven van de balanced scorecard (BSC) gebruikt om organisatiedoelen te classificeren en er worden drie soorten EA-activiteiten onderscheiden: EA-ontwikkelings-, EA-implementatie- en EA-exploitatieactiviteiten (zie figuur).

Organisatiedoel EA Activiteiten	Financiën en verantwoording	Klanten en partners	Interne processen	Lerend vermogen
EA ontwikkeling				
EA Implementatie				
EA Exploitatie				

Het Enterprise Architecture Value Framework (EAVF)

De classificatie van EA waarde-items, dat zijn zowel opbrengsten als kosten van EA, in de EAVF is uitsluitend gebaseerd op de definitie van de waarde van EA zoals hierboven gegeven. Als zodanig is de EAVF onafhankelijk van de manier waarop de architectuurfunctie is georganiseerd en van de methoden en hulpmiddelen die door de architecten worden gebruikt. In de praktijk kan, omdat de opbrengsten en kosten van EA hun oorsprong vinden in de activiteiten van de architecten, de as van EA-activiteiten worden verfijnd om de EAVF af te stemmen op hun manier van werken. Dit is verder uitgewerkt in appendix 1.

Als volgende stap, zoals beschreven in hoofdstuk vier, zijn we begonnen met de ontwikkeling van een instrument om de bijdrage van EA aan een organisatie te kunnen beoordelen. Een beoordeling van de bijdrage van EA aan een organisatie zou alleen gebaseerd moeten zijn op de resultaten die de architecten behalen, en niet op de manier waarop deze tot stand komen. Om een beoordelingsinstrument te ontwikkelen is daarom alleen de classificatie in organisatiedoelen van de EAVF gebruikt. De vier perspectieven van de balanced scorecard zijn echter te grofkorrelig voor een bruikbaar beoordelingsinstrument. In een Delphi-studie zijn deze vier perspectieven dan ook verfijnd in 31 subcategorieën waar een bijdrage van EA te verwachten is: de *EAVF-categorieën*.

Uit de literatuur zijn vervolgens alle mogelijke bijdragen van EA verzameld, samengevat in 61 waarde-items en tenslotte geclassificeerd in de EAVF-categorieën. Op basis van deze waarde-items zijn drie vragenlijsten opgesteld, één voor ontwikkelaars van EA, één voor diegenen die EA implementeren en één voor de gebruikers van EA: belanghebbenden die na implementatie worden geconfronteerd met de resultaten van de EA. Op deze manier kan een triangulatie van de uitkomsten van een beoordeling plaatsvinden.

Elk van de drie vragenlijsten bestaat uit een basisvraag waarin wordt gevraagd de bijdrage van EA op de verschillende waarde-items te beoordelen. Alle antwoorden worden gescoord op een 5-punts Likertschaal.

De vragenlijsten zijn gevalideerd in een serie van drie casestudies waarin de begrijpelijkheid, de volledigheid en de relevantie van de vragen alsmede de

herkenbaarheid van de uitkomsten zijn getest. Na ieder onderzoek is voor de casusorganisatie een rapport opgesteld met de uitkomsten van het onderzoek en de conclusies en aanbevelingen. Deze zijn bij alle casusorganisaties herkend. Om het nut, de werkzaamheid en het gebruiksgemak van het instrument te testen, werd in een vierde casestudie de beoordeling door de organisatie zelf uitgevoerd. Dit bleek goed te doen en resulteerde in concrete acties. We concluderen dat het EA Value Assessment Instrument valide en bruikbare resultaten oplevert.

De laatste drie hoofdstukken in het proefschrift bespreken de resultaten van enquêtes naar de bijdragen van EA in Nederland. In hoofdstuk vijf wordt het EA Value Assessment Instrument gebruikt als basis voor een enquête, uitgevoerd in 2021. De uitkomsten van deze enquête valideren opnieuw de begrijpelijkheid en volledigheid van het EA Value Assessment Instrument. Hoofdstuk zes bespreekt de uitkomsten van een enquête uit 2014, opgesteld op basis van een oudere versie van de EAVF. In dit hoofdstuk verdient de analyse van de waarde-items die het meest bijdragen aan de uitkomsten in een categorie, speciale aandacht. Deze resultaten kunnen in een toekomstige versie van het instrument worden gebruikt om de uitkomsten op de waarde-items onderling te wegen.

In hoofdstuk zeven worden de uitkomsten van deze twee enquêtes en een oudere enquête van Foorthuis et al. (2010) vergeleken. Uit dit onderzoek blijkt dat in de perioden tussen de drie enquêtes het terrein waarop EA actief is, uitgebreid is: van alleen de interne werking van de organisatie omvat het nu ook de omgeving van de organisatie. We verwachten vergelijkbare veranderingen in de toekomst, bijvoorbeeld op het gebied van cybersecurity, maatschappelijke verantwoordelijkheid en nieuwe technologieën (zoals kunstmatige intelligentie). In het laatste hoofdstuk, de Discussie en Conclusie, bespreken we hoe het beoordelingsinstrument actueel kan worden gehouden in het licht van de veranderende reikwijdte van de EA.

Het in dit proefschrift beschreven onderzoek laat zien hoe het EA Value Assessment Instrument in de praktijk is ontwikkeld, gevalideerd en gebruikt. Het instrument is onafhankelijk van de organisatie van de EA-functie en de methoden en instrumenten die door de architecten worden gebruikt. Het kan worden aangepast aan veranderingen op het terrein waar EA actief is door nieuwe vragen en/of nieuwe EAVF-categorieën toe te voegen. De huidige versie van het EA Value Assessment Instrument is te vinden in bijlage 2 van dit proefschrift.

Het onderzoek in dit proefschrift draagt bij aan de wetenschappelijke kennis door het geven van gedetailleerde definities van de belangrijkste concepten op het gebied van de waarde van EA en de ontwikkeling van een classificatieschema gebaseerd op deze definities, de EAVF. De EAVF kan ook worden gebruikt voor het interpreteren of coderen

van de vele onderzoeken naar de waarde van EA. Het ontwikkelde EA Value Assessment Instrument kan als gemene deler worden gebruikt om de bijdrage van EA binnen en tussen organisaties te vergelijken.

In de praktijk kan het instrument door architecten worden gebruikt om hun activiteiten af te stemmen op de doelstellingen van de organisatie. Bovendien kan het worden gebruikt om "*de communicatie over de waarde van EA voor het bedrijf te verbeteren*" door duidelijk te maken waar de sterke en zwakke punten binnen de EA liggen en daarnaar te handelen.

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About the author

Summary

After his study at the University of Twente, Henk Plessius (1949) developed himself in the field of ICT education. He has worked as a lecturer, curriculum developer, and manager in higher professional education, university education, and within the business community. His attention is drawn mainly to issues at the intersection of organization and information and to modelling.

From 2004 to 2010, he was as head of department responsible for the ICT courses at the Utrecht University of Applied Sciences. He resigned from that task at the beginning of 2011 to focus again on education and research. Research lines to which he has contributed since are IT education, sustainability, and the value of Enterprise Architecture, the subject of this thesis.

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	1992 - 1996 Lecturer ICT at Hogeschool van Utrecht (now Utrecht University of Applied Sciences)
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	1982 - 1987 Lecturer Mathematics and ICT at IHBO de Maere (now Saxion University of Applied Sciences)
	1976 - 1982 Mathematics teacher (secondary school) at 't Atrium, Amersfoort

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Appendices

The appendices cover the Enterprise Architecture Value Assessment instrument and consists of three parts:

1. *The Enterprise Architecture Value Framework.*
2. *The Enterprise Architecture Value Assessment Instrument.*
3. *How to use the Enterprise Architecture Value Assessment Instrument.*

Appendix 1. The Enterprise Architecture Value Framework

A1.1 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)

Dimension	Category name	Category description
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.

Appendix 1. *The Enterprise Architecture Value Framework*

A1.2 A Refinement of the Organizational Goals in the EAVF

In Plessius and van Steenbergen (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 & van Steenbergen, 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.

Main goal perspective	EAVF category	Brief description (Goals related to …)
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
	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

Main goal perspective	EAVF category	Brief description (Goals related to …)
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
Internal processes	Information management	… the processes and resources used to define, collect, organize, manipulate, store and distribute information by the organization
	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
	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

Appendix 1. *The Enterprise Architecture Value Framework*

Main goal perspective	EAVF category	Brief description (Goals related to …)
	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*.

A1.3 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

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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.
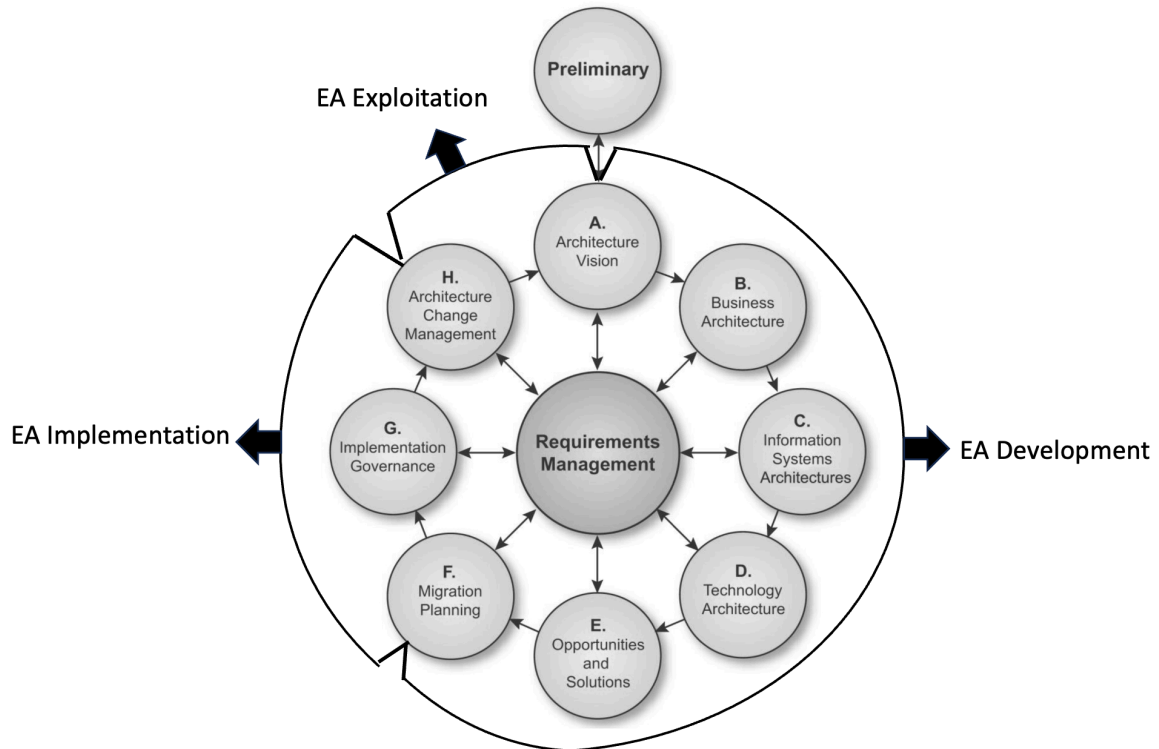

Figure A1.1. Mapping of the activity classes of the EAVF onto the Architecture Development Method from TOGAF (2022)

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 SAFe, a distinction is made between the roles of Enterprise Architect and System Architect as shown in figure A1.2. 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.

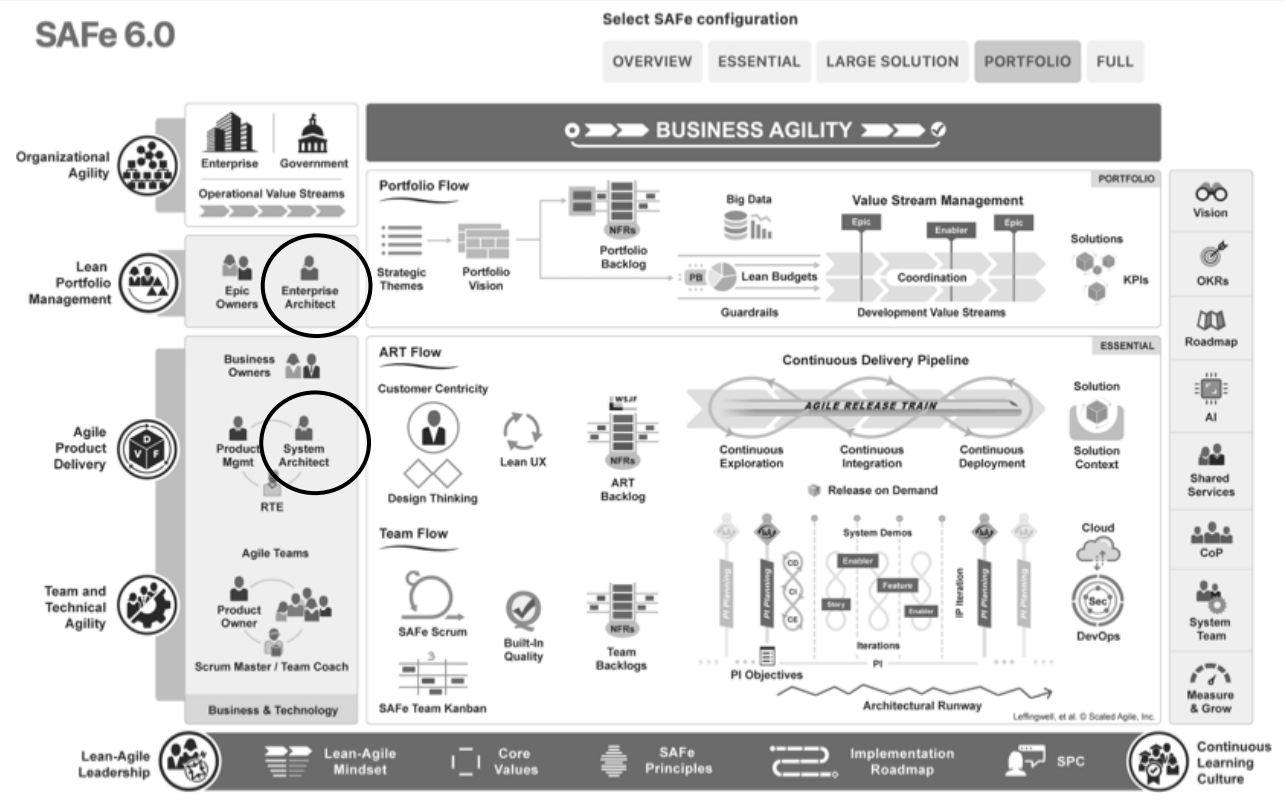Appendix 1. *The Enterprise Architecture Value Framework*

Figure A1.2. The Scaled Agile Framework SAFe (2023)

Note: in the full version of SAFe, targeting 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.

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

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
      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.

If you still have questions, you may contact ……….

Appendix 2*. The Enterprise Architecture Value Assessment Instrument*

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 enterprise architecture in the next items 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

EAVF category	Item (as included in the questionnaires)	Details (can be used for clarification)	Included from literature (combined into one item)	D I U	Literature (references)
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;	-better substantiation of investments	D I U	[1][3][4][5][6][8][9]

Appendix 2. *The Enterprise Architecture Value Assessment Instrument*

EAVF category	Item (as included in the questionnaires)	Details (can be used for clarification)	Included from literature (combined into one item)	D I U	Literature (references)
		for example, computer equipment			
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]

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EAVF category	Item (as included in the questionnaires)	Details (can be used for clarification)	Included from literature (combined into one item)	D I U	Literature (references)
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]
	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	D I U	[3][6][8][10][11]

Appendix 2. *The Enterprise Architecture Value Assessment Instrument*

EAVF category (as included in the questionnaires)	Item (as included in the questionnaires)	Details (can be used for clarification)	Included from literature (combined into one item)	D I U	Literature (references)
(Customer) relationships	The interaction with customers	The effects on how the organization interacts with customers, for example the communication channels used	-strengthened impact of products/services on customers -improved interaction with customers -new customer channels	D I U	[1][5][6]
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	-strengthened partner management	D I U	[2][3][6][9]

EAVF category	Item (as included in the questionnaires)	Details (can be used for clarification)	Included from literature (combined into one item)	D I U	Literature (references)
		product or service) work together			
	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]
	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]

Appendix 2*. The Enterprise Architecture Value Assessment Instrument*

EAVF category	Item (as included in the questionnaires)	Details (can be used for clarification)	Included from literature (combined into one item)	D I U	Literature (references)
Business (production) processes	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]
	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]
	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]
Marketing and sales	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	A customer journey is the path of interactions a (potential)	-customer journeys clarifying the customer perspective	- I -	[10]

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EAVF category	Item (as included in the questionnaires)	Details (can be used for clarification)	Included from literature (combined into one item)	D I U	Literature (references)
Service delivery	customers make contact with the organization	customer has with the products and services of the organization			
	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]
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	Big data refers to the ability of the organization to combine structured, semi-structured and	-better integrated internal and external data sources	D I U	[7]

Appendix 2. *The Enterprise Architecture Value Assessment Instrument*

EAVF category	Item (as included in the questionnaires)	Details (can be used for clarification)	Included from literature (combined into one item)	D I U	Literature (references)
Information management	extensive – data files (big data)	unstructured data that can be mined for information			
	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 maangement	D I U	[1][3][4][6][9][10][11]
	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	-improved IT security	D I U	[3][6][8][9][11]

EAVF category	Item *(as included in the questionnaires)*	Details *(can be used for clarification)*	Included from literature *(combined into one item)*	D I U	Literature *(references)*
Technology (non-IT)	Outsourcing and cloud	such as computers, networks, and data 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]
	\<none\>	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]

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Appendix 2. *The Enterprise Architecture Value Assessment Instrument*

EAVF category	Item (as included in the questionnaires)	Details (can be used for clarification)	Included from literature (combined into one item)	D I U	Literature (references)
	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	- I U	[2][3][5][6][9]
			-reduced project realization time		
			-reduced project budget exceedance		
			-reduced project risks		
			-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]

EAVF category	Item (as included in the questionnaires)	Details (can be used for clarification)	Included from literature (combined into one item)	D I U	Literature (references)
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	-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]
	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]

Appendix 2. *The Enterprise Architecture Value Assessment Instrument*

EAVF category	*Item* *(as included in the questionnaires)*	*Details* *(can be used for clarification)*	*Included from literature* *(combined into one item)*	*D I U*	*Literature* *(references)*
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]
	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 management	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	D I U	[1][2][3][4][5][6][8][9][11]

EAVF category	Item (as included in the questionnaires)	Details (can be used for clarification)	Included from literature (combined into one item)	D I U	Literature (references)
Alignment	Alignment of business processes (business / business alignment)	How well the (internal) business processes work together and support each other	-improved communication on future direction -improved sharing of the baseline architecture -improved sharing of the target architecture -improved sharing of the roadmap -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]

Appendix 2. *The Enterprise Architecture Value Assessment Instrument*

EAVF category	Item (as included in the questionnaires)	Details (can be used for clarification)	Included from literature (combined into one item)	D I U	Literature (references)
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 -better insight in current and potential agility	D I U	[1][2][3][4][6][7][8][9][10][11]
	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	-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 -improved quality of project evaluations	- I U	[3][8][11]

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EAVF category	Item *(as included in the questionnaires)*	Details *(can be used for clarification)*	Included from literature *(combined into one item)*	D I U	Literature *(references)*
	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)	-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]

Appendix 3. How to use the Enterprise Architecture Value Assessment Instrument

A3.1 Prerequisite

The EA value assessment instrument has been developed with organizations in mind in which a distinct division in EA developers, EA implementers, and users of EA can be made.

Textbox A3.1. Three kinds 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.

This manual provides instructions on how to use the EA assessment instrument. These instructions are based on the experiences in the case studies described in chapter 4 of this thesis. As each organization is different, they should not be taken as absolutes but are intended to provide guidance when considering an assessment.

A3.2 Before the Actual Assessment

Before starting the actual assessment, several decisions have to be made:

Who is/are responsible for the correct implementation of the assessment?

The first step in the assessment is to appoint a person (or a group of persons) who is (are) responsible for conducting the assessment and the analysis of the results: the *organizer*. It is good practice that the organizer does not participate in the assessment.

Which EA developers, EA implementers, and users of EA to include in the assessment?

If possible, try to involve all stakeholders. If the overall number of stakeholders is very large, a selection can be made that is representative of all stakeholders. A *sample size calculator* (which can easily be found on the Internet) can be used to calculate for a given margin of error the minimum number of stakeholders. When the architectural function is divided into several domains, take care that all domains are present so – if wanted - a comparison between the domains can be made.

Appendix 3. *How to use the Enterprise Architecture Value Instrument*

In what form will the assessment be carried out?

The assessment can be carried out electronically, or on paper, or the questionnaires can be completed during interviews. The last form has the advantage that a supporting motivation can easily be asked with every question, but it is a lot more time-consuming than using an electronic or paper-based survey approach, especially because, in addition to the quantitative information from the questionnaires, a lot of qualitative information may become available in this way. Also, an assessment carried out electronically or on paper has the added benefit of anonymity.

Which period will be assessed?

As it takes some time for results from enterprise architecture to become visible, the period should not be too short. But if the period is too long, recent events may outweigh older ones. In general, a period of one year is advised.

To what extent will the questions be detailed?

Depending on the background of the stakeholders, the questions may be extended with clarifications derived from the additional details provided with each question (see table A2.1 in appendix 2). This can be done by extending the questions or, when the assessment is carried out electronically, in the form of pop-ups that can be activated when needed.

Should additional questions be added to the questionnaires?

The assessment instrument is universally applicable and not tailored to a specific type of organization. To get more detail, questions can be added to the instrument, both closed and open questions. An example of an open question we found useful is: *"In your opinion, what have been the most important results of the enterprise architecture in the period considered"*? With such a question additional information on issues that are insufficiently addressed in the eyes of the interviewees, can be gathered.

How will the conclusions be drawn and recommendations made?

After the analysis of the results (see section A3.4), it may be worthwhile to discuss the outcomes of the assessment and draw up recommendations with an expert group consisting of people who can align the recommendations with the strategy and goals of the organization.

How and with whom will the results be shared within the organization?

To all interviewees, at least a summary of the outcomes of the assessment should be given. This summary may be distributed more widely in the organization to optimize support for the EA.

As it is the intention to use the results of the assessment to make the EA function more value-aware, we advise sharing the outcomes and the analysis of the outcomes with at least the enterprise architects and involve them in the discussion to determine the actions to take (see section A3.4).

A3.3 During the Assessment

The assessment starts with the distribution of the questionnaires to the selected stakeholders and/or conducting the interviews planned.

Apart from giving help when needed, the main activity to be carried out by the organizer during the assessment is to collect and classify the goals of the organization. These will be used in the analysis to make a comparison between the outcomes of the assessment and the goals of the organization. To make a comparison possible, these goals should be classified into the various EAVF categories (see appendix 1). This is not always self-evident and often a choice has to be made on which EAVF categories a given organizational goal should be mapped. It may be helpful to interview business line managers about their goals and the scope of these goals over the period considered.

A3.4 After the Assessment

After the assessment, the organizer can start with the analysis. If a sample of all stakeholders has been asked for their opinion, the reliability of the outcomes can be calculated with a sample size calculator.

The first step in the analysis is, for each of the stakeholder categories, to calculate descriptive statistical data by question, EAVF category, and balanced scorecard perspective. In this guide, we will use the average to summarize the outcomes, but it may be worthwhile to calculate the standard deviation as well to get an impression of the extent to which the respondents agree. A (partial) template to summarize the outcomes is given in figure A3.1.

With these data, an overview of the averages by stakeholder group and balanced scorecard perspective can be compiled (figure A3.2). This can give an overall indication of the experienced contribution of EA. In surveys held in the past[1] and in our case studies we see that it is not unusual that EA users in this overview score somewhat lower (up to 0.5 points) than the other two stakeholder groups.

If the difference is more than 0.5 points, it may indicate that the contribution of EA is not recognized in the organization. This can be caused by a lack of results, but it can also mean that the EA is not communicating effectively with the rest of the organization. Conclusions like this cannot be derived from these data only and should be affirmed, for example in a discussion with stakeholders afterwards.

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[1]) See for example Foorthuis et al., 2010 and Plessius et al., 2015

Perspective			Data
	EAVF-category	Data	
		Question	Data	
Financial and Accountability			
	Costs and Benefits		
		Lower operational costs and/or higher revenues	
		The costs that must be made to implement the desired changes	
	Investments		
		The investments that must be made to implement the desired changes	
	Compliance		
		Compliance with laws and regulations as well as internal standards	
	Governance		
		Directions from the architecture supervising board (governance)	
		…	

Figure A3.1. Template (partial) to annotate averages of an assessment

	EA Developers	EA Implementers	EA Users
Financial and Accountability			
Customer and Partnerships			
Internal processes			
Learning and Growth			
Overall			

Figure A3.2. Averages by stakeholder group and balanced scorecard perspective

Next, an overview of the averages by stakeholder group and EAVF category can be made (figure A3.3). A Spearman correlation test may indicate if there exists consensus between the three stakeholder groups.

	EA Developers	EA Implementers	EA Users
Costs and Revenues			
Investments			
Compliance			
Governance			
…			

Figure A3.3. Averages by stakeholder group and EAVF-category

Mark in this overview (figure A3.3) the high scores (more than 0.5 points[2] above the average in the stakeholder group) and the low scores (more than 0.5 points[2] below the average in the stakeholder group). These are EAVF categories that deserve extra attention in further analysis.

It is now possible to compare the outcomes of the assessment with the organizational goals. Special attention should be given to those EAVF categories that score low (rule of thumb: 0.5 points lower than the average in the stakeholder group) but are present in the organizational goals. These indicate the EAVF categories where improvements in the 'value-driven nature' of the architecture are desirable.

Another interesting outcome is found in EAVF categories that score relatively high, but are not found in the goals of the organization. These may indicate that the focus of EA should be shifted.

Depending on the objective of the assessment, a more comprehensive statistical data analysis may be performed. An example is for each stakeholder group to calculate the standard deviations. A low standard deviation means that the respondents largely agree on the outcome, while a higher standard deviation means that the respondents have very different opinions about the question / EAVF category. Differences sometimes can be traced back to different domains, but these outcomes should be treated carefully.

If the questionnaires are extended with open questions or if interviews are held, a lot of qualitative information may be available. This information can be very helpful in the

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[2]) The value of 0.5 point is chosen as it brings the score in another Likert category

analysis of the outcomes: quantitative data give insight into the strengths and weaknesses of the EA, but not into the why of the opinions of the respondents.

After the analysis, the results should be summarized in a report. This report can be used as the starting point for a discussion with the enterprise architects about the conclusions and actions to take.

A3.5 Concluding Remarks

If the EA function in the organization is divided into several domains, it can be of interest to compare the outcomes of the domains so strengths can be shared.

In this guide, a prerequisite has been that a distinction can be made between three kinds of stakeholders: EA developers, EA implementers, and EA users. In smaller organizations or with some agile implementations, this distinction can not always be made. When a distinction between developers and implementers of EA is difficult to make, we advise combining the questionnaires for the EA developers and the EA implementers with the following main question: "*Please state with a score from 1 to 5 the importance of the next items in developing, updating, and implementing the enterprise/domain architecture*" and use all items from both stakeholder groups in the questions.

After a quarter of a century of Enterprise Architecture (EA) practice, enterprise architects still struggle with the question of how to communicate the value EA brings to their business. One reason behind this is the elusive character of what exactly is understood by EA value. Another is the attribution problem: after a successful project in which parts of the EA are implemented, what part of the business value created can be attributed to the EA?

In this thesis, a foundation is given to the key concepts of EA value, and based on this foundation, a model to categorize EA benefits and EA costs is proposed: the Enterprise Architecture Value Framework (EAVF). Based on the EAVF a multi-faceted instrument is introduced to assess the contribution of EA to the goals of the organization.

	Financial and Accountability	Customer and Partnerships	Internal Processes	Learning and Growth
EA Development				
EA Implementation	E	A	V	F
EA Exploitation				

Henk Plessius (1949) has worked as a lecturer, curriculum developer, and manager in higher professional education, university education, and within the business community. His attention is drawn mainly to issues at the intersection of organization and information and to modelling.

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