MASTER'S THESIS

Enterprise architecture challenges in the financial sector

An exploratory study after its effectiveness

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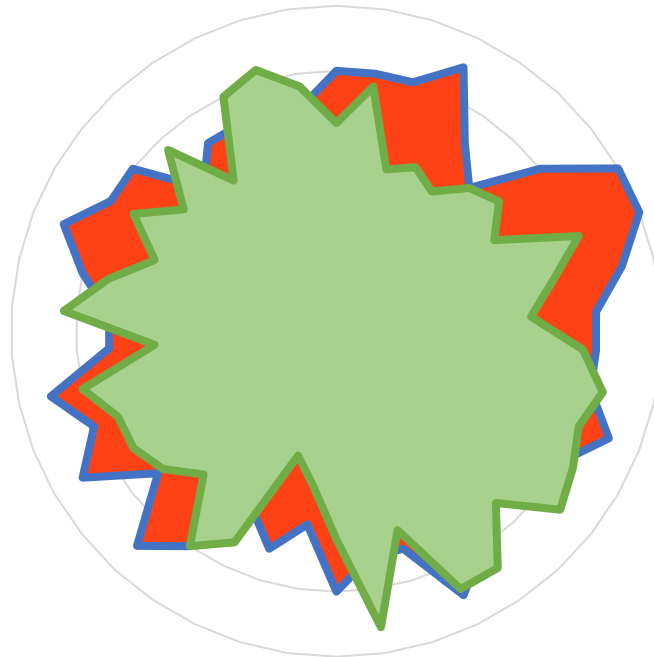
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Abstract

Market and technological developments have a strong influence on developments in the financial sector. Because of this, banks are facing uncertain and complex times. Many organizations believe that Enterprise Architecture (EA) is able to provide guidance. However, in a world where complexity is increasing, it is necessary to evaluate whether current EA practices (EAPs), which act as tools, are able to cope with arising EA challenges (EACs). This research focuses on the development of an assessment instrument on the basis of which EA effectiveness can be measured in the context of nine EACs. Based on the Design Science Research Methodology, the EACs have been operationalized and incorporated in the dimensions: internal monitoring, external monitoring, communication & understanding, and partnership. The development of the assessment instrument has been completed in a qualitative case study in which the instrument has been applied and evaluated throughout semi-structured interviews among two EA stakeholder groups within a large international bank. These steps provided insight into the extent to which current EAPs are able to cope with EACs whereby a competence gap has also been discovered between business and IT.

Key terms
Enterprise Architecture, effectiveness, challenges, practices.

The figure on the cover page shows a visualization of the competence gap between IT (architects in red/blue) and business (development teams in green), which is identified using the assessment tool developed in this research.

Summary

The world has changed a lot since the founding of the first bank in 1472. As the degree of complexity and uncertainty is increasing rapidly, banks are looking for guidance. Many organizations are convinced that EA can provide this guidance and lead them through these difficult and complex times. However, just like the financial landscape, EA has evolved over the years. The EA discipline has grown from a method for managing information systems (IS) and associated business elements to a variety of EAPs which help organizations in their business and IT alignment activities. Although many see EA as a means to deal with complexity and uncertainty, not much is known about the extent to which EA Practices (EAPs) will address arising EA challenges (EACs). Increasing attention is being paid to how EA should redefine itself to remain relevant in a rapidly changing world. However, limited research has been conducted into whether a long-term commitment to EAPs actually contributes to EA effectiveness (EAE) in the context of new arising EACs. In order to determine this, an assessment instrument is developed in this study which gives substance to the following main question:

To what extent do current enterprise architecture practices contribute to enterprise architecture effectiveness in the context of enterprise architecture challenges?

The EACs are characterized by their complex nature and challenge the current EAPs in different ways. EAPs will have to face new realities, an increasing degree of complexity, uncertainty and will also have to evolve in order to stay relevant. An overview of the 10 EACs that are central in this study can be found in *Table 1*.

Table 1: Enterprise Architecture Challenges

Enterprise Architecture Challenges (EACs)
EAC.1   Utilizing data outside and within their boundaries
EAC.2   Effective Knowledge Management
EAC.3   Organizational adaptability and innovation
EAC.4   Designing responsible processes and organizations
EAC.5   Dealing with greater cultural and generational diversity among workers
EAC.6   Dealing with challenges related to ownership, responsibility, roles, and power
EAC.7   24/7 accessibility through virtual channels
EAC.8   Navigating the terrain of turbulent markets, complexity and uncertainty
EAC.9   Making effective use of new resources
EAC.10 Organizational agility

Since there is no existing instrument for measuring EAE in the context of EACs, an assessment instrument has been developed on the basis of the Design Science Research Methodology (DSRM). The Enterprise Architecture Effectiveness Measurement Model (EAEMM) is used as a basis in the development process because of its clear and predefined structure. Through a structured process, the requirements, properties and indicators were defined. This process led to the selection of five EAEMM dimensions and 42 statements in which nine EACs have been incorporated. The EAEMM dimensions: internal monitoring, external monitoring, communication & understanding, partnership and readiness for change have been adjusted in such a way that they are able to measure the nine EACs and provide insight into the extent in which current organizational EAPs lead to EAE.

The development of the assessment instrument was not exclusively based on theoretical insights. There has also been empirical research in which improvements were made by means of a document analysis and expert interviews. During this evaluation process various improvements were identified using the multidisciplinary insights of a solution architect.

Finally, the assessment instrument was demonstrated. By means of a case study, seven semi-structured interviews were held with EA stakeholders from both business and IT. The results have been processed quantitatively and qualitatively as a result of which a considerable depth has been achieved which resulted in the identification of a competence gap. The results of the assessment instrument provided the following interesting findings:

- The EAPs largely enable the organization to deal with the EACs. The current EAPs facilitate the most in EAC.4: *"designing responsible processes and organizations"* and EAC.7: *"24/7 accessibility through virtual channels"*. A clear strategy, the presence of flexible processes and systems, and a customer-oriented focus are mainly determining factors in this.
- In contrast, current EAPs are mostly challenged by EAC.2: *"effective Knowledge Management"* and EAC.1: *"utilizing data outside and within their boundaries"*. This is mainly because there is no clear KM strategy present resulting in the absence of a KM culture.
- A competence gap has been found between business and IT which shows that communication between departments is of great importance to be able to cope with EACs.

As a recommendation, the organization should critically evaluate their process of how they utilize their data and work towards a method whereby data sets are not only viewed and understood individually *(isolated)*, but also integrated and combined across other data sets in order to produce useful information that can be used to gain a competitive advantage. Adopting a Knowledge Management (KM) strategy will help the organization in knowledge retention and the dissemination of knowledge across departments. Finally, the organization should take a good look at the way in which different EA stakeholders communicate with each other. Communication is the determining factor when it comes to the realization of EAE through EAPs.

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AEM	Architecture Effectiveness Model
DSRM	Design Science Research Methodology
EA	Enterprise Architecture
EACs	Enterprise Architecture Challenges
EAE	Enterprise Architecture Effectiveness
EAEMM	Enterprise Architecture Effectiveness Measurement Model
EAFs	Enterprise Architecture Frameworks
EAGCs	Enterprise Architecture Grand Challenges
EAIM	Enterprise Architecture Implementation Methodologies
EAM	Enterprise Architecture Management
EAPs	Enterprise Architecture Practices
IS	Information Systems
KM	Knowledge Management

1. Introduction

1.1. Background

The world has changed a lot since the founding of the first bank in 1472. Market and technological developments have had a strong influence on the design of the financial sector. In the coming years this will only increase further, especially technological innovation will have a strong impact (De Nederlandsche Bank, 2016). This development will lead to new opportunities and risks for existing and emerging market players. The competition arising from technological innovation makes it more difficult for established market parties to continue to offer financial services profitably. Banks and insurers are aware of the potential impact of these developments. Because of this, these parties are reviewing their business models and strategies in order to stay relevant in dynamic and complex market (De Nederlandsche Bank, 2016).

Since organizations are facing uncertain times and ever-increasing levels of complexity there is a need for guidance. Many believe that Enterprise Architecture (EA) can guide organizations through these difficult and complex times (Gong and Janssen, 2019; Lapalme et al., 2016). Like the financial landscape, EA has evolved over the years. The EA discipline has grown from a method for managing information systems (IS) and associated business elements to a variety of Enterprise Architecture Practices (EAPs) which help organizations in their business and IT alignment activities (Gampfer, Jürgens, Müller, and Buchkremer, 2018).

This research focuses on providing insight into EA effectiveness (EAE) in the context of a rapidly changing world where new challenges arise and in which organizations constantly need to adapt. Based on existing theoretical insights, it will be determined what the EA discipline entails, which EA challenges (EACs) are emerging and what EAE means and how it can be measured. Based on this knowledge, an assessment tool is developed which can be applied empirically to determine whether current EAPs lead to EAE in the context of arising EACs. The results of the assessment tool can be used for two purposes. In an empirical setting it is possible to evaluate whether the current organizational strategy regarding EAPs gives substance to the development and maintenance of an effective EA. In addition, the scientific aspect of the EA discipline is given substance because there is insufficient knowledge about the extent to which current EAPs lead to EA effectiveness in the context of EACs. This chapter focuses on a brief exploration of EA and EACs, the motivation and relevance, the problem statement followed by the terms of reference and finally the main lines of approach.

1.2. Exploration of the topic

EA provides organizations with the tools needed to implement changes in a structured manner with the aim of business and IT alignment. EA is described by Jonkers et al. (2006) as: *"a coherent whole of principles, methods and models that are used in the design and realisation of the enterprise's organisational structure, business processes, information systems, and infrastructure"*. EA is thus seen by organizations as a means to change and adapt in an effective and controlled manner. The need for change is driven by both internal and external factors whereby alignment is sought between the organizational strategy and these factors. Since the world is changing rapidly, the degree of uncertainty and complexity is increasing significantly. The nature of EACs can therefore also be linked to these developments. Lapalme et al. (2016) is convinced that EACs, which arise from an increasing degree of uncertainty and complexity, should be addressed by EA. Although more and more attention is being paid to EACs in scientific studies, the impact of EACs on EAE has not been researched sufficiently (Hinkelmann et al., 2016; Lapalme et al., 2016).

1.3. Motivation & relevance

This research focuses on providing insight into EAE in the context of a rapidly changing world where new challenges arise and in which organizations constantly need to adapt. That is why it was decided to develop an assessment instrument that provides insight into the impact of EACs on EAE. This approach contributes to existing knowledge in various ways:

- Limited attention has been paid to EACs that will occur now and in the future. The research of Lapalme et al. (2016) focuses on the future of EA and the associated EACs. However, there has been no empirical research on how these EACs affect EAE. Additionally, Lapalme et al. (2016) indicate that there is little evidence about the effectiveness of traditional EAPs. Lapalme et al. (2016) states the following about this matter: *"Many technologies (methods, tools and techniques) have been developed over the years to guide the practice of EA. However, there is little evidence that these technologies have proven to be effective"*. For this reason, it is interesting to investigate to what extent current EAPs are leading to EAE in the context of EACs.
- Hinkelmann et al. (2016) acknowledges the EACs and indicates that EAPs will have to evolve to stay relevant. The research by Hinkelmann et al. (2016) therefore proposes a complex modelling paradigm that should give direction to this evolution. Due to the complexity of this paradigm, commercial tools are not immediately available that can be applied by EA practitioners. In addition to providing insight into EAE in the context of EACs, the proposed assessment tool will also provide insight into the direction in which EAPs must evolve to remain relevant within the financial sector.

In summary, the assessment instrument can determine to what extent EAPs result in EAE and what measures can be taken to ensure EAE in the context of EACs. In addition, insight can also be obtained on which aspects EAPs need to evolve in order to be able to cope with the EACs.

1.4. Problem statement

The financial sector is changing drastically because of technological innovations (De Nederlandsche Bank, 2016). Although this trend leads to new opportunities, there is also an increasing degree of complexity and uncertainty. Due to these developments, the average company lifespan has fallen from 60 years in 1960 to 25 years in 2015 (Anthony, Viguerie, & Waldeck, 2016; Satell, 2014). Organizations will have to adapt to be able to cope with a rapidly changing world. EA can offer the outcome in this transition where EAPs guide organizations in their business and IT alignment activities, with the aim of an effective EA that can give substance to predefined business goals. However, in a world where the degree of complexity and uncertainty is increasing, it is necessary to evaluate whether the EAPs, which act as tools, are able to cope with current and new arising EACs. For this reason, it is important to look at EAE in the context of EACs. After all, to what extent does a long-term commitment to EAPs contribute to EAE?

1.5. Terms of reference

Organizations, especially the financial sector, are forced to change due to an increasing degree of digitization (De Nederlandsche Bank, 2016). For this reason, it is important to work on an effective EA that can withstand internal and external challenges. Organizations are dependent on EAPs that have been developed over the years and aim to support organizations in achieving their business goals (Van Der Raadt, Bonnet, Schouten, & Van Vliet, 2010). The extent to which EAPs support organizations in achieving their business goals determines the degree of EAE (Steenbergen, 2011). This research focuses on providing insight into EAE in the context of EACs. The purpose of this is to determine to what extent current EAPs contribute to EAE in the context of EACs. The following main research question has been formulated for the design of the research:

To what extent do current enterprise architecture practices contribute to enterprise architecture effectiveness in the context of enterprise architecture challenges?

Based on the main research question the following sub-questions have been formulated:

Theoretical research questions
A. What are the different visions on EA?
B. What are EA challenges?
C. What is effectiveness in the context of EA and how can it be made transparent?
D. How can an assessment instrument measure EA effectiveness in the context of EA challenges?

E. How can the assessment instrument be improved based on empirical research?
F. To what extent is the assessment instrument considered as useful when applied in practice?
G. What added value does the assessment instrument offer the organization when applied?

These questions will not only guide the development process of the assessment instrument, but also the demonstration phase in which the assessment instrument is applied among EA stakeholders. Based on the results, it can be determined whether the current EAPs are contributing to EAE in the context of EACs.
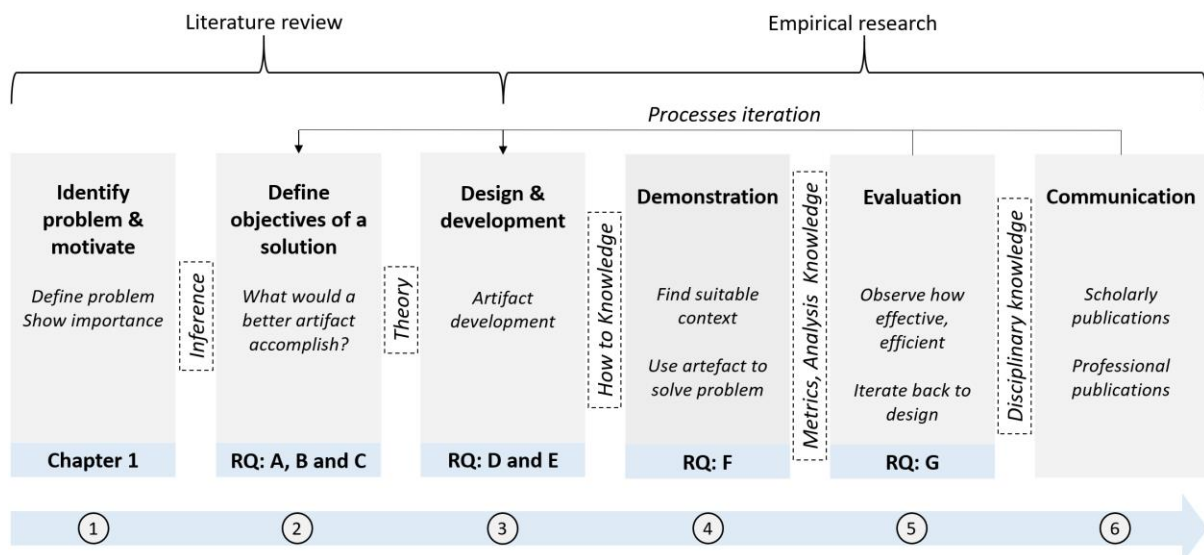
1.6. Main lines of approach

The main lines of approach have been drawn up on the basis of the Design Science Research Methodology (DSRM) as described by Wieringa (2014) and Ken Peffers, Tuure Tuunanen, Marcus A. Rothenberger, and Samir Chatterjee (2007). The choice for the DSRM was made because this method provides guidelines that are specifically drawn up for studies that take place in the information system focus area. The sub-questions within this research have been formulated in such a way that they tie in with the DSRM, see *Table 1*.

Table 1: Overview of DSRM process steps according to Ken Peffers et al. (2007) and associated sub-questions

Process step DSRM	Explanation of the process step	Associated sub-question/Chapter
1. Identify problem & motivate	Formulate and motivate the problem	*Chapter 1*
2. Define objectives of a solution	Determine the requirements and potential solution	*A*, *B*, and *C*
3. Design & development	Design and develop the artifact	*D* and *E*
4. Demonstration	Demonstrate the artifact in a real-life case	*F*
5. Evaluation	Determine the added value of the artifact	*G*
6. Communication	Publish the results	-*

* The publication of the results cannot be linked to a specific sub-question or chapter, this process step can be seen as a standard step in scientific research.

The advantage of DSRM is that it focuses on artefacts, such as methods and techniques within a certain context with the aim of investigating performance. This approach fits in almost seamlessly with this research in which the relationship between EAPs and EAE in the context of EACs is studied. The main lines of approach are shown schematically in *Figure 1*. The overview also includes the corresponding chapter or research questions (RQ) per process step.

Figure 1: Main lines of approach according to Ken Peffers et al. (2007)

Steps one and two will be carried out on the basis of literature research and will form the theoretical foundation for the design and development phase. Based on this knowledge, an assessment instrument will be developed in step three. The development of the assessment instrument does not only take place on the basis of theoretical insights, expert interviews will also be held to further improve the assessment instrument. For this reason, step three consists of both theoretical and empirical research as shown in *Figure 1*. The remaining steps will be carried out on the basis of empirical research, whereby in step four the assessment instrument will be demonstrated to two EA stakeholder groups. The results are presented in this step and the usefulness of the assessment tool is determined. In step five, an evaluation will take place to determine the added value of the instrument, and finally in step six the research will be published. The structure of the research is thus as follows:

- *Chapter 2* focuses on obtaining relevant scientific literature, answering the theoretical sub-questions, creating the theoretical foundation and the development of the assessment instrument based on theoretical insights.
- *Chapter 3* describes how the empirical research will be conducted in which the DSRM plays a central role.
- *Chapter 4* describes which improvements have been adopted based on expert interviews.
- In *chapter 5* the assessment instrument is demonstrated to two EA stakeholder groups and the results obtained are presented so that the usability can be determined.
- *Chapter 6* describes the added value of the assessment instrument when applied.
- Finally, *chapter 7* contains the discussion, reflection, conclusion and recommendation.

2. Theoretical framework

This chapter describes the theoretical framework. First, the research approach and the associated literature search strategy are described in *section 2.1*. Subsequently, the results of literature search strategy are presented in *Appendix A* followed by the answers to the four theoretical sub-questions in *section 2.1.1*, *2.1.2*, *2.1.3*, and *2.1.4*. Finally, the objective of the follow-up research is described in *section 2.2*.

2.1. Research approach

To establish a qualitative theoretical framework, it is necessary to conduct a critical literature review (Saunders, Lewis, & Thornhill, 2016, p. 70) . A critical literature review should provide clear arguments, conclusions and evaluated claims about what the published literature indicates about the research questions (Wallace & Wray, 2013). In order to be able to carry out the literature review process in a structured manner, it has been decided to carry out the literature review process according to the guidelines of Saunders et al. (2016, p. 73). *Figure 2* shows the literature review process that has been used within this research.
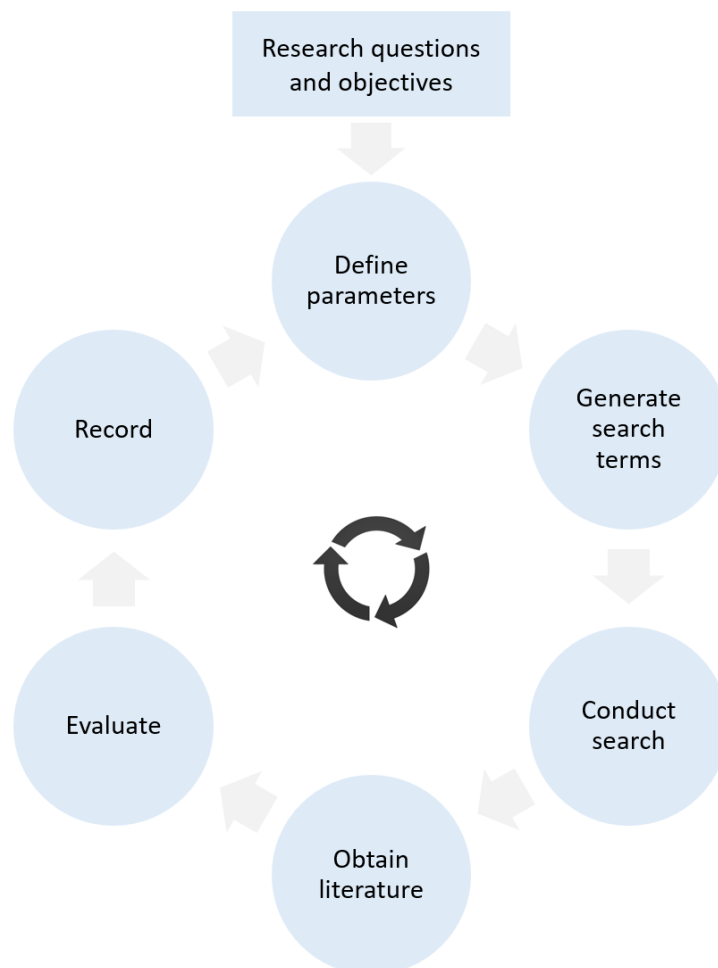
Figure 2: The literature review process based on Saunders et al. (2016, p. 73)

A brief explanation will follow of the literature review process, in which reference will be made to the six steps shown in *Figure 2*. The principles of Bell & Waters (2014, pp. 85-86) were used to define the parameters *(1)* of the research. These parameters focus on eliminating irrelevant literature and consist

out of the following points: language, publication period, discipline, literature type, review, availability of publication, search term title, search term text and the number of citations. The work of key authors has been studied to define appropriate search terms *(2)*. This approach has led to the identification of relevant search terms that can be used in the search for relevant literature (Saunders et al., 2016, p. 91). The search for literature can be conducted *(3)* through different approaches such as, online databases, books, and journal articles. Based on the search terms that have been generated and the search itself, it becomes possible to obtain the literature *(4)*. After the literature has been obtained, an evaluation *(5)* has taken place based on relevancy, value and sufficiency (Saunders et al., 2016). Finally, it is possible to record *(6)* the literature for the purpose of answering the theoretical sub-questions. It is important to note that changes can be made during the literature review process that can contribute to obtaining better literature and thus better answers to the theoretical sub-questions. This may include adjusting the parameters or the search terms because previously obtained articles have led to better insights that can be used in the literature review process. Based on the principles of Saunders et al. (2016, p. 90), the literature review proces has been translated into a literature search strategy which is presented in *Figure 3*.
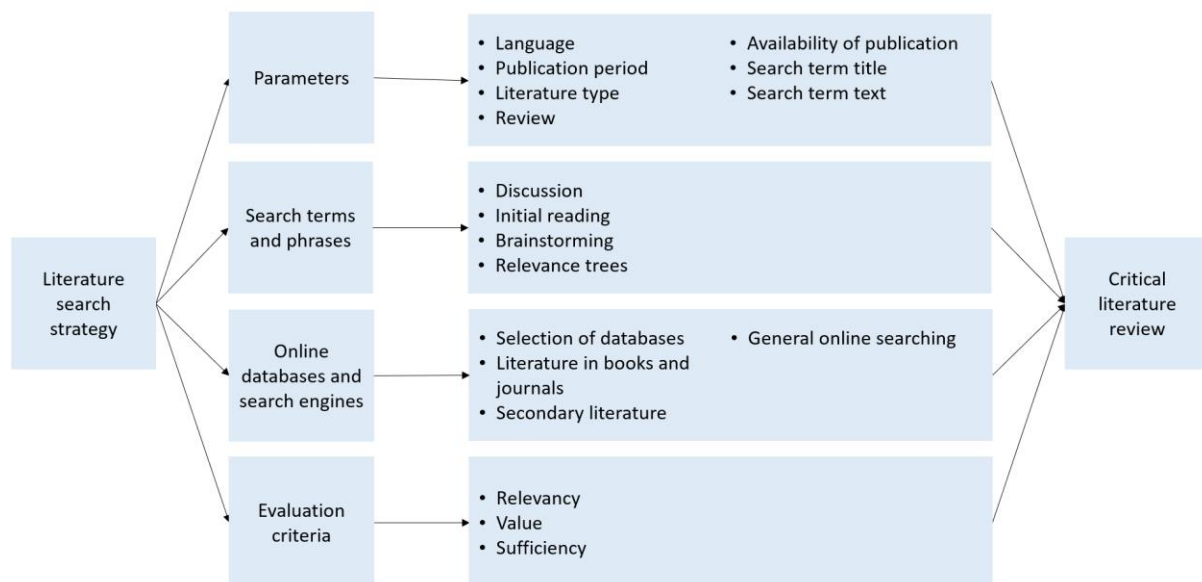
Figure 3: Literature search strategy based on Saunders et al. (2016, p. 90)

The following choices have been made concerning the literature search strategy:
1. Online databases and search engines: The Online University Library of the Open University has been selected as the primary search engine. The advantages of the Online University Library compared to general search engines is that there are more options available for search terms, phrases and parameters compared to general search engines. General search engines are on the other hand great for finding general information, but in some cases the academic rescources are not accessible due to paywalls. The Online University Library of the Open University providess easy access to a selection of academic rescources, all of which that are verified and accessible to use. It is important to note that during the execution of the literature search strategy it was decided to also include Google Scholar as a secondary search engine. This approach has been chosen because it has been determined that the reach of The Online University Library or the Open University is limited and that valuable articles were therefore not featured.
2. Parameters: the parameters of Bell & Waters (2014, pp. 85-86) in combination with the available parameter options in the search engines have formed the basis for determining which parameters

have beenn used during the implementation phase. Based on this, the following parameters have been determinded:

-	**Language:**	*English**
-	**Publication period:**	*>2015*
-	**Discipline:**	*If applicable (for example "architecture")**
-	**Literature type:**	*Journal article**
-	**Review:**	*Peer reviewed**
-	**Availability of publication:**	*Open Access**
-	**Search term title:**	*<See point 3, search terms and phrases>*
-	**Search term text:**	*<See point 3, search terms and phrases>*
-	**Number of citations:**	*10 or more***

* This parameter can only be applied within the Open University library due to limited search options in Google Scholar.
** This parameter only applies to Google Scholar.

Google Scholar articles may only be included if they have been cited 10 times or more. Unfortunately, Google Scholar does not offer an automatic option to include this parameter, for this reason the search results have been returned to a manageable level where the number of citations per article have been reviewed.

3. **Search terms and phrases:** the process of Saunders et al. (2016, p. 92) has been used to generate search terms and phrases. *Table 2* shows an overview of the selected search terms. Please not that sub-question D is not included in this overview since since this question is answered based on the results of sub-questions A to C.

Table 2: Overview of search terms per theretical sub-question

Theoretical sub-question	Description
A	Definition enterprise architecture
B	Challenges enterprise architecture
C	Effectiveness enterprise architecture

4. Evaluation criteria: the process of Saunders et al. (2016, pp. 104-106) has been used to evaluate the scientific articles. This process focuses on three evaluation criteria, namely:
- Relevance: the relevance of the literature found is determined by the formulated research questions. Relevance is hereby expressed to what extent the article contributes to answering the research questions.
- Value: the quality of the article is central here, with the focus being placed on robustness and the quality of the arguments and arguments contained in the article.
- Sufficiency: here it is decisive whether you have read enough literature from key researches that have been acknowledged by other researchers within the field. The key here is whether you have taken sufficient action to be sufficiently informed about the subject.
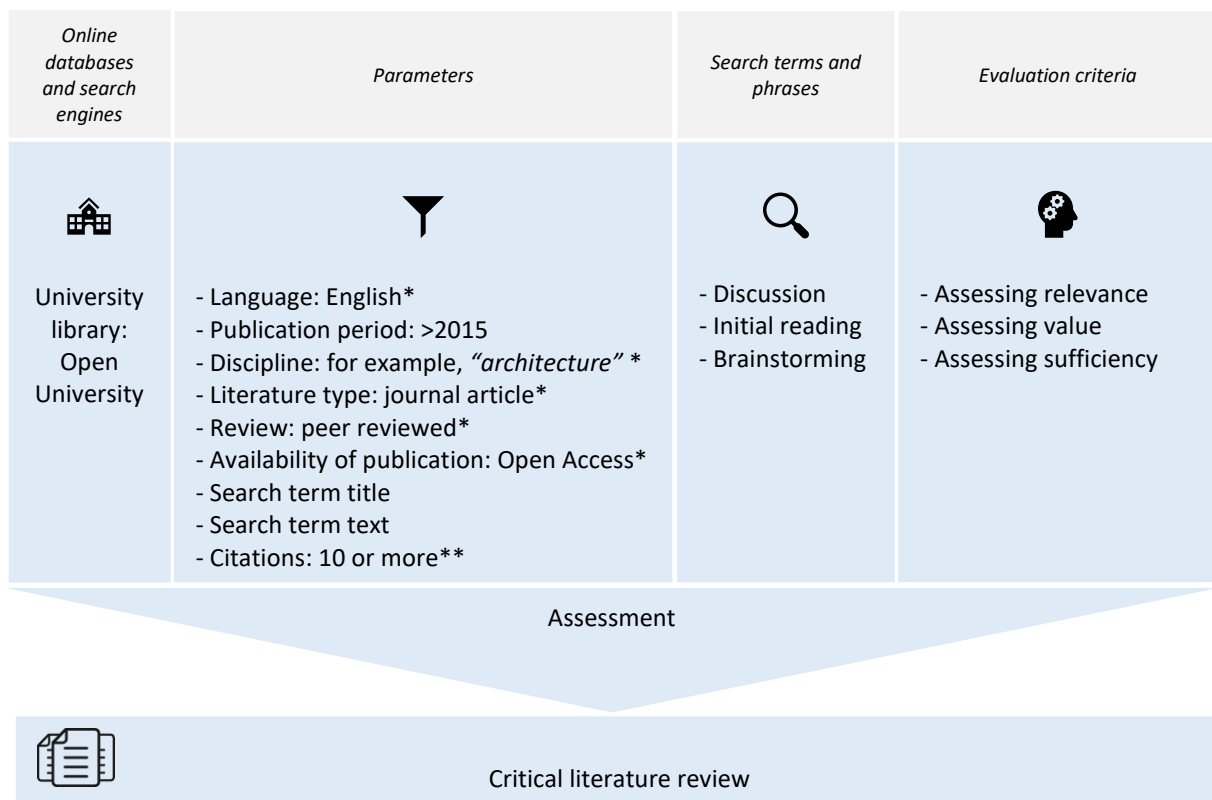
In order to be able to assess the articles found in a structured way, it was decided to use the checklist of Saunders et al. (2016, p. 105). The checklist is shown in *Table 3*.

Table 3: Assessment checklist according to Saunders et al., (2016)

Relevance	Value
Has the article been recently published (> 5 years)?	Is the article peer reviewed?
Is it likely that the article has been superseded?	Are there any biases in the article?
Does the research tie in with the set research goals?	Does the article sufficiently show that there is precision?
Is the item likely to be excluded by our relevance criteria?	Is there a clear description of the methodological choices?
Are the references in the article useful for our research?	Does the article provide guidance for future research?
Does the article take a clear position in confirming or invalidating arguments?	

Note. Reprinted from "*Research Methods for Business Students*", by Saunders, M., Lewis, P., & Thornhill, A., (2016), p. 105, Harlow, UK: Pearson.

During the review of the articles, attention also has been paid to the used literature. By applying the snowball method, valuable literature has been obtained. After the first four steps were completed, the articles were assessed, resulting in a critical literature overview which formed the basis for answering the theoretical sub-questions A, B and C. *Figure 5* shows which choices have been made for the literature search strategy.

Online databases and search engines	Parameters	Search terms and phrases	Evaluation criteria
University library: Open University	- Language: English* - Publication period: >2015 - Discipline: for example, *"architecture"* * - Literature type: journal article* - Review: peer reviewed* - Availability of publication: Open Access* - Search term title - Search term text - Citations: 10 or more**	- Discussion - Initial reading - Brainstorming	- Assessing relevance - Assessing value - Assessing sufficiency

Assessment

Critical literature review

* This parameter can only be applied within the Open University library due to limited search options in Google Scholar
** This parameter only applies to Google Scholar

Figure 5: *Literature search strategy*

The results are shown in *Appendix A* that have emerged from the selected literature search strategy.

2.1.1. What are the different visions on enterprise architecture?

The literature shows that there are several views on EA (Gong & Janssen, 2019; Jallow, Demian, Anumba, & Baldwin, 2017). EA is described by Jonkers et al. (2006) as: *"A coherent whole of principles, methods and models that are used in the design and realisation of the enterprise's organisational structure, business processes, information systems, and infrastructure"*. Foorthuis, van Steenbergen, Brinkkemper, and Bruls (2016) describe EA more from a process-based angle and define EA as: *"A set of high-level views and norms that guide the coherent design and implementation of processes, organizational structures, information provision and technology within an organization"*. Many of these definitions complement each other and often focus on similar topics such as business and IT alignment. It is interesting to see how these different visions came about. Previous research has shown that organizational and applicational aspects play a key role in the development of these different kind of perspectives on EA (Ross, Weill, & Robertson, 2006). Because the development of EA took place across several domains such as the military, company, government, and manufacturing domain, this has led to various visions regarding EA. After all, every domain has specific needs which are formed by organizational and applicational aspects. Several EA Frameworks (EAFs) are based on EAFs that have found their nature in other domains. These developments have been visualised by Gong and Janssen (2019) as shown in *Figure 6.*
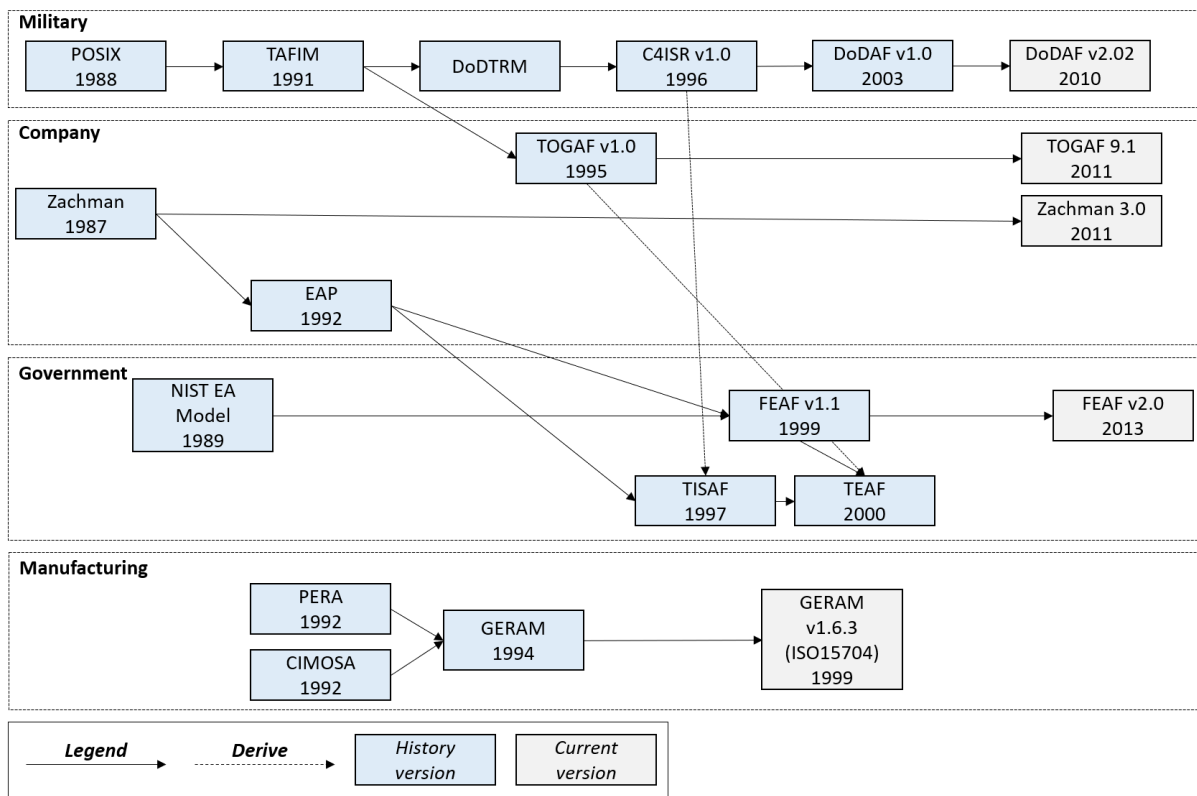
Note. Reprinted from *"The value of and myths about enterprise architecture"*, by Gong, Y., & Janssen, M., 2019, Journal of Information Management, 46, p. 3.

Figure 6: EA framework developments from 1987 to 2017 according to Gong & Janssen (2019)

In practice, EA knowledge is often applied through EAFs which offer systematic guidance for the desired strategic and operational goals of an organization (Schekkerman, 2003). The EAFs are used to achieve organizational short and long-term goals. EAFs facilitate a set of practices, concepts, assumptions and values which help the organization to structure, design and maintain the desired EA (Budiman, Prahasto, & Kusumawardhani, 2018). Because the development of the various EAFs took place largely independently of each other, it is no coincidence that different views on EA have been

established. This is plausible as there are distinctive types of needs per domain. The term architecture in the context of TOGAF is based on the ISO/IEC/IEEE 42010: 2011 standard which describes 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"* (The Open Group, 2018). In addition to the ISO/IEC/IEEE 42010: 2011 standard, TOGAF defines a second meaning to the term "architecture": *"the structure of components, their inter-relationships, and the principles and guidelines governing their design and evolution over time"* (The Open Group, 2018). The two definitions are similar, but there is a difference. Namely, TOGAF considers an enterprise as a system where a balance is sought between the promotion of concepts, standards and commonly accepted terminologies that are known to the TOGAF community. The goal of TOGAF is to establish an effective EA through their architecture development method which focusses on business-, data-, application- and technology architecture layers (The Open Group, 2018).

Answer to sub-question A:
Because the development of different EA frameworks took place largely independently of each other, it is no coincidence that different views on EA have been established. The reason for this is the wide variety of sectors where EA is applied, such as the military, companies, governments and manufacturing environments. These views complement each other and often discuss the same EA topics such as methods, models, standards which result in EAPs for their respective domain. EAPs aim for business and IT alignment to arrive at an effective EA that contributes to the realization of strategic business goals.

2.1.2. Wat are enterprise architecture challenges?

Implementing EA correctly to achieve alignment between business and IT is a challenge (Giachetti, 2016; Olsen, 2017). For this reason, topics such as; Enterprise Architecture Management (EAM), EA adoption and EA Frameworks (EAFs) have been examined frequently in recent years (Haki, Legner, & Ahlemann, 2012). Rouhani, Mahrin, Nikpay, and Nikfard (2013) have looked at the implementation of EA, in which five well-known EAFs (EAP, TOGAF, DODAF, Gartner & FEA) have been compared to see how they facilitate Enterprise Architecture Implementation Methodologies (EAIM). Nikpay, Ahmad, Rouhani, Mahrin, and Shamshirband (2017) describe EAIM as: *"A set of methods and practices for developing, managing, and maintaining an EA implementation project"*. The evaluation framework used in their research represents the results based on three important aspects of each EAIM, which have been acknowledged by Lagerström, Franke, Johnson, and Ullberg (2009), namely; concepts, modelling and process. The results of their research are shown in *Table 4*.

	EAP	TOGAF	DODAF	Gartner	FEA
Concepts					
Alignment	L	M	M	M	L
Artifacts	M	H	M	M	M
Governance	M	H	M	M	L
Repository	M	M	M	M	M
Strategy	H	H	H	M	H
Modelling					
Easy to use	M	L	M	M	M
Easy to learn	M	L	M	M	M
Traceability	M	H	L	L	M
Consistency	M	H	L	L	M
Different Views	M	M	M	L	M
Complexity	L	L	L	L	L
Dynamic	L	L	L	L	L
Process					
Requirement	L	H	L	L	L
Step by Step	M	M	M	M	M
Detailed Design	M	M	M	M	M
Implementation	M	M	M	M	M
Guidelines	M	H	M	L	H
Maintenance	L	M	L	L	M
Continual	M	H	L	L	L

H: High consideration or detailed and clear description - M: Medium consideration or little description -
L: Low consideration or high-level description

The components *"complexity"* and *"dynamics"* score low across the board, none of the EAFs facilitate in these challenges. Recent studies have shown that there is a need for addressing and exploring EA challenges (Hinkelmann et al., 2016; Lapalme et al., 2016). Hinkelmann et al. (2016) has investigated how alignment between business and IT can be achieved in a rapidly changing environment. A new paradigm has been proposed that focuses on developing an approach where continuous adaption of the agile enterprise plays a central role. Lapalme et al. (2016) on the other hand, looked at EA challenges (EACs) that organizations are experiencing in the field of EA. *Figure 7* shows the ten identified EACs and the three overarching EA Grand Challenges (EAGCs).

When taking a closer look at the ten EACs, it is particularly noticeable that the EACs have a strong focus on external trends in the field of data, Knowledge Management (KM), adaptability, innovation, sustainability, responsibility, and complexity. These external challenges are then translated into internal challenges that organizations face. The challenge here lies mainly in organizational adaptability. To what extent does the organization recognize these developments and is the organization able to respond adequately? The ten EACs are summarized into three EAGCs so that it is clear what current EAPs must address in order to deal with EACs. Here again, the external and internal nature of the EACs is emphasized, indicating that organizations should not only use their current EAPs to deal with these EACs, but that the EAPs must also evolve in order to remain relevant.

10 Enterprise Architecture Challenges (EACs)

EAC.1	Utilizing data outside and within their boundaries
EAC.2	Effective Knowledge Management
EAC.3	Organizational adaptability and innovation
EAC.4	Designing responsible processes and organizations
EAC.5	Dealing with greater cultural and generational diversity among workers
EAC.6	Dealing with challenges related to ownership, responsibility, roles, and power
EAC.7	24/7 accessibility through virtual channels
EAC.8	Navigating the terrain of turbulent markets, complexity and uncertainty
EAC.9	Making effective use of new resources
EAC.10	Organizational agility

3 Enterprise Architecture Grand Challenges (EAGC)

EAGC.1	Designing organizations that are resistant to the increasing degree of "uncertainty" and "complexity"
EAGC.2	Designing organizations that are aware of "the new reality"
EAGC.3	Evolving EA Practices (EAPs)

Figure 7: EA Grand Challenges according to Lapalme et al. (2016)

To get a better understanding of the three EAGCs, an in-depth analysis of the ten EACs has been carried out and can be consulted in *Appendix B*. This overview focuses not only on what the EACs entail, but also on how organizations should deal with these challenges.

As indicated, the ten EACs form the basis for three overarching EAGCs which Lapalme et al. (2016) believe will impact organizations and need to be addressed by EA:

EAGC.1	Designing organizations that are resistant to the increasing degree of *"uncertainty"* and *"complexity"*

Within the EA discipline, no consensus has been reached on the exact definition of the term *"complexity"* (Schneider, Zec, & Matthes, 2014). For this reason it is important to consider how the term complexity is interpreted in the context of EA. Lapalme et al. (2016) describes the term complexity as: *"coping with situations that are either very difficult or utterly impossible to comprehend in their entirety"*. When this term is translated into an organizational setting, this results in scenarios in which the organization cannot fully oversee complex situations, resulting in uncertainty. Lapalme et al. (2016) argue that employee empowerment leads to adaptation capacity within the organization. Through employee empowerment, an organization coordinates its decision-making capabilities effectively. The effectiveness arises because employees, who have the highest level of awareness, are given the opportunity to act and to use their knowledge and expertise. Staber & Sydow (2002) confirm these claims and indicate that adaptation capacity is the way to face the challenges of complexity and uncertainty.

EAGC.2	Designing organizations that are aware of *"the new reality"*

The need for organizations to become aware of *"the new reality"* is clearly reflected in the changing lifespan of organizations. The Standard & Poor's 500 shows that the average company lifespan has fallen from 60 years in 1960 to 25 years in 2015 (Anthony et al., 2016; Satell, 2014). Technical innovations play a major role in the realization of this trend (Lapalme et al., 2016). This last statement is based on statistics from Moore's law which predict that the processing power of

computers will increase significantly and that organizations will have to adapt to this in order to lead an existence (Moore, 1965, 1975). Other studies acknowledge this trend (Theis & Wong 2017; Waldrop, 2016). Additionally, when designing organizations, the three bottom lines must be considered; people, profit and profit with the aim of sustainability regarding social and ecological matters that occur in the organization and the supply chain of which it forms a part (Lapalme et al., 2016).

EAGC.3   Evolving EA Practices (EAPs)

Traditionally, EAPs were primarily focussing on aligning business & IT activities in order to achieve and support organizational strategies. This tradition has strongly been influenced by developments that took place in the field of computer science and engineering in which practices such as closed system thinking, reductionism, determinism and positivism have been promoted and therefore also adopted by organizations (Lapalme et al., 2016). Here the question can be asked, to what extent are these practices still effective in a rapidly changing world? Lapalme et al. (2016) therefore proposes to look at the adequacy of traditional practices, while also looking at alternatives assumptions such as indeterminism, constructivism, open system thinking and holism.

Answer to sub-question B:
Increasing attention is being paid to how EA must redefine itself to remain relevant in a fast-changing world. The degree of complexity and uncertainty is increasing and organizations are looking for ways to deal with these challenges. Many believe that EA can guide organizations through complex and uncertain times. However, the EA discipline also needs to evolve in order to be able to cope with these challenges. Ten EACs which are summarized in three EAGCs have been identified that will challenge organizations now and in the future. It is therefore important that the current EAPs give substance to the following EAGCs:

EAGC.1   Designing organizations that are resistant to the increasing degree of *"uncertainty"* and *"complexity"*;

EAGC.2   Designing organizations that are aware of *"the new reality"*;

EAGC.3   Evolving EA Practices.

2.1.3. What is effectiveness in the context of enterprise architecture and how can it be made transparent?

Several publications (Foorthuis et al., 2016; Ross et al., 2006; Tamm, Seddon, Shanks, & Reynolds, 2011) have shown that EA Practices (EAPs) can provide various benefits such as reduction of costs, complexity and risks, while working on business and IT alignment. The execution of EAPs determines hereby the extent to which EA effectiveness (EAE) is achieved (Foorthuis et al., 2016). Realizing an effective EA is challenging because EAPs, which are often based on architectural thinking, cannot be directly linked to business goals (Lankhorst, 2013; Steenbergen, 2011). This therefore results in a situation where EAPs are implemented but the desired or potentially undesired effects occur at a later stage. For this reason, it is important to look at EAE and what is meant by this term. Research shows that there are different definitions of the term effectiveness in the context of EA. Steenbergen (2011) describes the term effectiveness in the context of EA as: "*the degree to which the EA practice produces the desired results*". Van Der Raadt, Bonnet, Schouten, and Van Vliet (2010) define the same term as: *"effectiveness is determined by degree in which the outputs of architects help the organization attain its collective goals"*. Effectiveness in the context of EA is therefore about the extent to which the organizational EAPs, and the results that follow, contribute to organizational business goals. To be able to track developments regarding EAE, methods have been developed that make it possible to

measure EAE. Given the context of this study, two methods will be discussed that could potentially be used to determine the impact of the previously described EACs on EAE.

Architecture Effectiveness Model (AEM)
Steenbergen (2011) proposes the Architecture Effectiveness Model (AEM) as an instrument to measure EAE. Through cause-effect relationships, it is made clear to what extent architectural results are contributing to organizational business goals. *Figure 8* shows the AEM in which the results of Enterprise Architecture Practices (EAPs) are demonstrated by means of rectangles, the cause-effect relationship is hereby demonstrated by arrows. The architectural results, organizational performance, and business goals have been left empty in *Figure 8*, as these differ per organization. Architectural results include different EA standards, frameworks and projects that apply within the organization. When looking at organizational performance, the model focuses on internal processes and how these perform under the architectural results. Finally, the model focuses on the business goals that the organization has. This includes matters, which are expressed by means of key performance indicators (KPIs), such as customer service, employee satisfaction and the exchange of information within the organization. By studying and evaluating the relationship between the intended architectural results and the business goals, it can be determined to what extent the architecture contributes to these business goals.
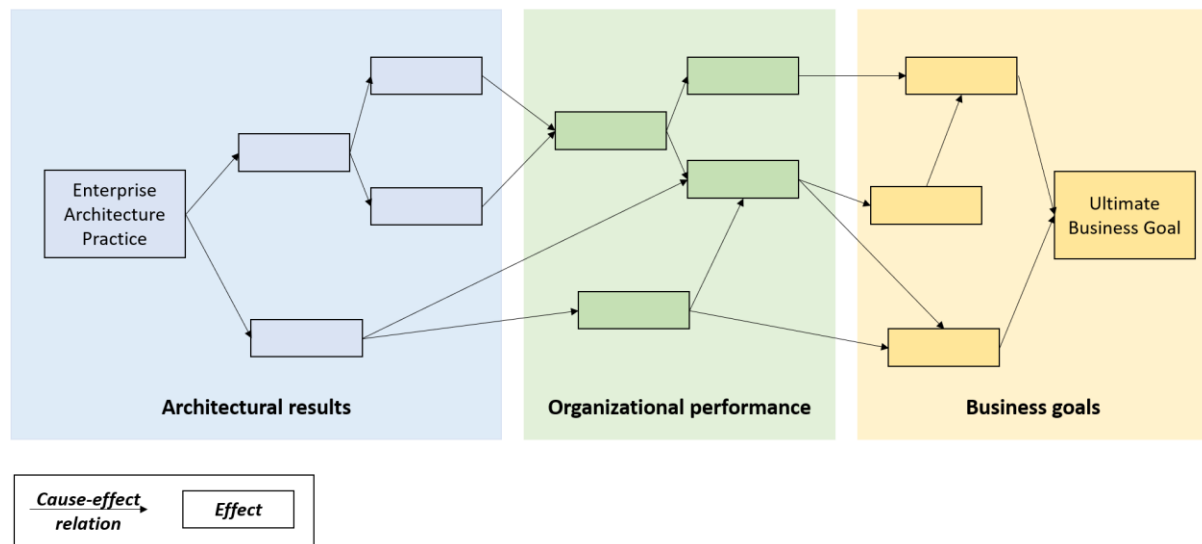
Note. Reprinted from *"Maturity and Effectiveness of Enterprise Architecture"*, by Steenbergen, M., 2013, Utrecht University, P.28.
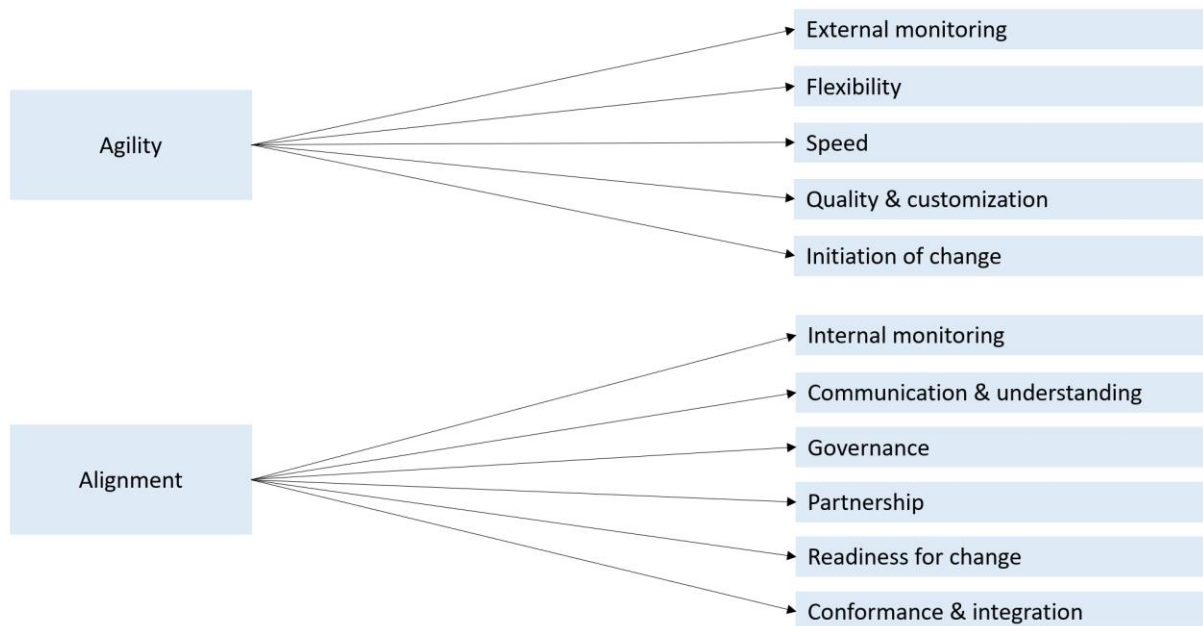
Figure 8: Architecture Effectiveness Model according to Steenbergen, (2011)

Within the research of Steenbergen (2011), the AEM was applied within three organizations, including a financial institution. Effectiveness in the context of EA is determined by the extent to which EAPs contribute to business goals. This visual representation of the AEM clearly shows the cause-effect relationships in which an assessment can take place based on actual results. Based on this assessment it is possible to determine to what extent EAPs contribute to business goals and thus EAE.

Enterprise Architecture Effectiveness Measurement Model (EAEMM)
The EAEMM of Van Der Raadt et al. (2010) also focuses on providing insight into EAE. The EAEMM has a simple structure compared to the AEM where it has been decided, based on literature research, that agility and alignment are generally the two main business goals. In contrast to the AEM, the EAEMM therefore works with predefined business goals. The business goals therefore do not have to be

mapped in the model. *Figure 9* shows that these business goals and the corresponding 11 EA objectives which act as measurable units for determining the degree of agility and alignment.

Note. Reprinted from *"The relation between EA effectiveness and stakeholder satisfaction"*, by Van Der Raadt, B., Bonnet, M., Schouten, S., & Van Vliet, H., 2010, Journal of Systems and Software, 83(10), P.1962.

Figure 9: Enterprise Architecture Effectiveness Measurement Model according to Van Der Raadt et al., (2010)

Although the EAEMM differs visually from the AEM, there are still similarities. For example, the EAEMM starts with predefined business goals at which EAE is determined based on measurable units. Since these measurable units are established based on EAPs, an opportunity has been created to investigate the relationship between the two. The AEM, on the other hand, can be seen as a blank canvas in which the model has to be built from left to right and the starting point are EAPs which result in organizational performance, whereupon it must be examined to what extent these measurable units contribute to the organizational objectives. Both models investigate the same, but with different starting points, for example, the AEM starts with EAPs and the EAEMM with predefined business goals with the aim of investigating the relationship between the two. The research by Van Der Raadt et al. (2010), as shown in *Table 5*, also focuses on providing insight to EA stakeholders. The advantage of this is that there is a clear overview showing which roles are responsible for which area of attention. This allows effective and efficient information retrieval.

	Business	Information	Information systems (IS)	Technical infrastructure (TI)
Enterprise	- CEO, CFO, COO - Board of Directors	- CIO	- CIO	- CTO
Domain	- Head of BD/BU - Business change manager	- DIO - IT change manager	- DIO - IT change manager	- Platform manager - Platform subject matter expert
Project	- Business project manager - Business analyst	- Information analyst	- Software project manager - Software designer/architect	- Infrastructure project manager - Infrastructure engineer
Operational	- Operational business manager - Business process administrator - End-user	- Database admin - End-user	- Application management - Application administrator - End-user	- Data center management - Infrastructure administrator

In addition, the description of the two dimensions agility and alignment is also considered. This overview can be consulted in *Table 6* and *Table 7*.

Dimension	Description	Contributing output of EA function
Internal monitoring	Routine reviews, assessments and benchmarks of operational performance of and changes implemented to business and IT organizational components.	EA products describe the quality indicators of all organizational components, and thus provide input for the specification of performance indicators and service level agreements. Architects perform reviews of solutions and changes implemented.
Communication & understanding	Common understanding of business and IT through knowledge sharing, and insight in consequences of decision making.	EA products contain explicit knowledge (descriptions) of business and IT components, which allows knowledge sharing. Architects provide management with insight in, and advice about, the consequences of decision making on existing organizational components.
Governance	Formal decision making, monitoring, and control of priorities and budget for both business and IT.	Architects translate strategic objectives to an architectural blueprint and transformation roadmap. Architects ensure that solutions and operational changes conform to these EA products.
Partnership	Business and IT are trusted partners where the business sponsors IT, sharing risks and rewards.	EA products link strategic plans and organizational components of the business (optimized for value creation) and IT (optimized for business support). By embracing and ratifying these EA products, business and IT management create a sense of partnership.
Readiness for change	Ability and willingness of the enterprise workforce to change attitudes, opinions, and behavior.	EA products provide insight in the consequences of, and the rationale for, organizational changes. By explaining the consequences and rationale, architects help changing the attitude, opinions, and behavior of the employees impacted.
Conformance & integration	Consolidation, standardization and integration of organizational components to a coherent, transparent and flexible business and IT landscape.	EA products provide transparent and enterprise-wide coherent architecture and standards. They describe and prescribe the consolidation and integration of organizational components. Architects ensure that all changes and new solutions conform to these EA products.

Table 7: Description of agility dimensions according to Van Der Raadt et al. (2010)

Dimension	Description	Contributing output of EA function
External monitoring	Identification of changes and opportunities, and the ability to translate these to new business and IT ideas.	Architects keep up with the social, market, technological and regulatory developments, and help management in identifying opportunities and required changes.
Flexibility	Ability to change organizational components without major changes and investments.	Standardized organizational components (through EA products and EA governance) enable easy re-orchestration of components to implement changes.
Speed	Shortest time-to-market, time to act upon change, educate employees, and run end-to-end operations.	Architects use their domain knowledge to help projects shorten their lead time by identifying reuse of existing organizational components, and helping to integrate the new solutions with the existing organizational components.
Quality & customization	High quality and customizable products and services of the business and IT	Architects use their domain knowledge to guide projects in making high quality designs, ensuring the quality requirements of the products and services are realized.
Initiation of change	Ability and willingness of management (and the workforce) to initiate changes to implement new business ideas or introduce new technologies.	Architects helps management in decision making about new business and IT ideas, by creating solution alternatives and analyzing their profitability and feasibility.

Note. Reprinted from *"The relation between EA effectiveness and stakeholder satisfaction"*, by Van Der Raadt, B., Bonnet, M., Schouten, S., & Van Vliet, H., 2010, Journal of Systems and Software, 83(10), P.1963.

Finally, *Appendix C* and *D* contain an overview in which measurable indicators, which give substance to the EAEMM dimensions described in *Table 4* and *Table 5*, can be found that offer indicators for determining organizational performance and thus the effectiveness of EAPs.

> **Answer to sub-question C:**
> Effectiveness in the context of EA can be defined as the extent to which EAPs, and the results involved, contribute to organizational business goals. There are various methods for measuring EAE such as the AEM and EAEMM. The EAEMM has been selected as a method for measuring EAE because it offers a clear predefined and modular structure that can be used within this research. Although both models (AEM and EAEMM) look at the relationship between EA and the contribution to business goals, the EAEMM is preferred because of its clear scope and predefined business goals that are in line with the EACs described in *section 2.1.2*. The similarity between the predefined business goals (agility and alignment), which act as two main dimensions, and the EACs is that external changes must be addressed and handled internally through EA, in which agility and alignment play an important role. The EAEMM is a suitable instrument in this context because it focuses precisely on these two main dimensions.

2.1.4. How can an assessment instrument measure EA effectiveness in the context of EA challenges?

As described in *section 2.1.3*, the degree of EAE is measured based on the extent to which EAPs, and the results involved, contribute to organizational business goals. Various instruments are available to measure EAE. However, these models have been drawn up to give substance to several predefined indicators that do not fit seamlessly with the EACs in this research. For this reason, it has been decided to adjust the EAEMM in such a way that it gives substance to measuring EAE in the context of the EACs.

Incorporating the EACs into the EAEMM is a challenging task. For this reason, it was decided to structure this process based on the Design Science Research Methodology (DSRM) approach as described by Wieringa (2014). The full development of the assessment instrument is described in *Appendix E*.

The development of the assessment instrument consists out of three steps. First, the requirements have been determined for measuring the EACs, where the translation into properties, indicators and unit of measurements took place as shown in *Figure 10*. It is important to mention that the 10 EACs described in [Appendix B](#) have been used during this process.
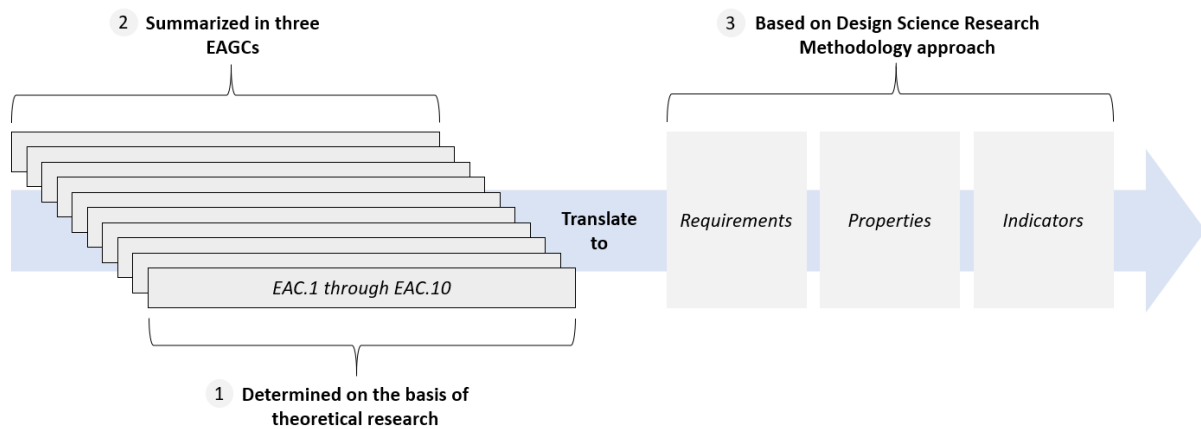
Figure 10: The development process of the assessment instrument

Threats that have a negative influence on construct validity have been considered during the translation of the EACs into requirements, properties, and indicators. For this, the requirements described by Wieringa (2014) have been adhered to, an overview of these requirements and associated threats is shown in *Table 8*.

Table 8: Construct validity requirements and threats according to Wieringa (2014)

Requirements	Threats
Are the constructs defined explicitly so that researchers can classify and count all and only the instances of the concept?	**Inadequate definition:** there is no definition that allows researchers to clearly classify and count all and only the instances of the concept
Can instances be classified unambiguously?	**Construct confounding:** an instance that satisfies the concept and satisfies other concepts too
Do indicators of constructs capture the intended meaning of the constructs?	**Mono-operation bias:** the indicators defined for a concept do not fully capture the concept
Does the method of measurement of an indicator avoid bias?	**Mono-method bias:** the indicators defined for a concept are all measured or applied in the same way

Note. Reprinted from *"Design science methodology: For information systems and software engineering"*, by Wieringa, R. J., (2014), p. 88, Heidelberg, DE: Springer.

These threats are handled in the following way:
Inadequate definition: indicators are formulated in such a way that they provide clear criteria for counting and classification purposes. This approach also facilitates step two where the indicators are matched to the dimensions of the Enterprise Architecture Effectiveness Measurement Model (EAEM). This makes it clear whether a certain dimension measures what it is supposed to measure in the context of this research. The presence of an indicator is determined based on three measurement indicators shown in *Table 8*.

Table 8: Measurement indicators

Measurement indicator	Description
Effort to learn	How does the EA stakeholder assess the learning ability of the organization?
Effort to use	How does the EA stakeholder assess the use of the relevant indicator within the organization
Presence of resources	Presence of policies, standards, strategy, documentation, systems, technologies, organizational structures, and procedures.

Construct confounding: requirements are formulated in such a way that they give substance to a specific EA dimension and not to several. The advantage of this is that the requirement, and thus the associated indicator, addresses a specific EA dimension, enabling generalizability within that specific dimension.

Mono-operation bias: the risk of mono-operation bias is mitigated by operationalizing non-directly measurable constructs by means of multiple indicators.

Mono-method bias: the assessment instrument has three possible measurement indicators that can be divided into two flows, namely the assessment of a stakeholder, the effort and the presence of policies, standards, strategies, documentation, systems, technologies, organizational structures and procedures. This approach mitigates the risk of mono-method bias because indicators are measured in different ways.

The requirements are matched to the dimensions of the EAEMM. The advantage of this is that, through an iterative process, the indicators drawn up in step 1 (determining requirements, properties and indicators) could be improved based on the indicators already present in the EAEMM. This matching process was performed in two steps. First, it was determined what a certain dimension within EAEMM entails. During this process *Table 4* and *Table 5* from [section 2.1.3](#) were used. By looking at the description of the dimension and the contributing output of the EA function, it was possible to link the requirements to their respective dimension. Subsequently, it was possible to make improvements to the EAC-indicators by comparing these indicators with the EAEMM indicators related to the matched dimension. During the elaboration of this step, it emerged that measuring EAC 10: *"organizational agility"* will be difficult. This is because *"organizational agility"* within the EAEMM is measured based on four additional dimensions. This would make it necessary to include 15 additional EAEMM indicators in the final assessment instrument, which should then be translated into approximately 45 statements. This would greatly increase the number of statements within the assessment instrument, which would make the assessment instrument far too broad. For this reason, it was decided not to include EAC 10: *"organizational agility"* in the assessment instrument so that a clear and feasible scope could be maintained. Finally, in the elaboration of step two, an overview has been included that clearly describes why a certain requirement is matched to a certain dimension. This process has led to the selection of five dimensions to be included in the assessment instrument, namely: *"internal monitoring"*, *"external monitoring"*, *"communication & understanding"*, *"partnership"* and *"readiness for change"*.

In the last step, the statements have been determined that will be included in the assessment instrument. Unfortunately, the EAEMM statements used in the research of Van Der Raadt et al. (2010) were not available. Because of this, the established indicators were translated into statements considering the unit of measurements. This process has led to 42 statements which are accommodated in five dimensions.

Answer to sub-question D:
Through a structured process, five EAEMM dimensions and 42 statements have been selected in which nine EACs have been incorporated, see *Figure 11*. The EAEMM dimensions: *"internal monitoring"*, *"external monitoring"*, *"communication & understanding"*, *"partnership",* and *"readiness for change"* have been adjusted in such a way that they give substance for measuring the nine EACs and provide insight into the extent in which current organizational EA practices lead to EAE. Due to the complexity in measuring EAC 10: *"organizational agility"*, it was decided not to include this EAC in the assessment instrument. This makes it possible to apply a scope to the other nine dimensions, whereby the feasibility of this research remains intact. The complete design process including a substantiation can be consulted in *Appendix E*. The assessment instrument can be consulted in *Appendix F*.
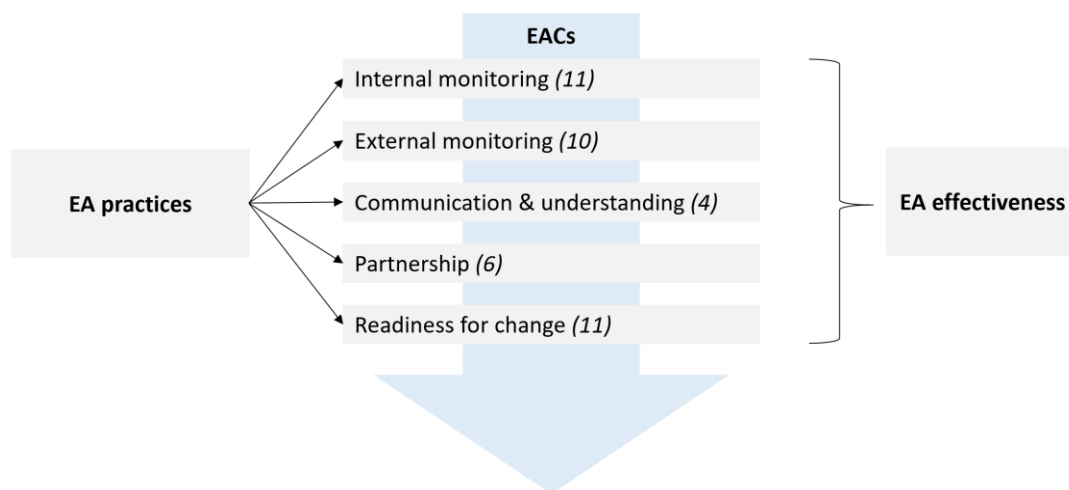
Figure 11: Framework for measuring EA effectiveness in the context of EA Challenges

2.2. Objective of the follow-up research

The literature study has shown that the EA discipline has a complex history with different visions. These visions have led to various EAPs that have been applied within organizations over the years with the aim of business and IT alignment. At the same time, the world has become considerably more complex and uncertain, the EACs illustrate this matter. Partly due to these developments, the average company lifespan has fallen from 60 years in 1960 to 25 years in 2015 (Anthony et al., 2016; Satell, 2014). For this reason, it is important to look at EACs. The literature study has shown that increasing attention is being paid to EACs. It has been established that there is a need to provide insight into the relationship between EACs and EAE. To what extent has a long-standing commitment to EAPs contributed to a resilient EA that can withstand the EACs?

Based on the literature study, ten EACs are formulated which will have an impact on the EA discipline and thus EA effectiveness. It has been established that there are various instruments available for measuring EA effectiveness. However, these models have been drawn up to give substance to several predefined indicators that do not fit seamlessly with the EACs in this research. For this reason, it has been decided to adjust the EAEMM in such a way that it gives substance to measuring EAE in the context of the EACs. Through a structured process, five EAEMM dimensions and 42 statements have been selected in which nine EACs have been incorporated. The EAEMM dimensions: *"internal monitoring"*, *"external monitoring"*, *"communication & understanding"*, *"partnership"* and *"readiness for change"* have been adjusted in such a way that they give substance for measuring the nine EACs and provide insight into the extent in which current organizational EAPs lead to EAE. By means of expert interviews, the developed assessment instrument will be further improved in order to arrive at a final assessment instrument. This final assessment instrument will be demonstrated to EA

stakeholders so that the usability and added value of the assessment instrument can be determined. Based on the results, it will be possible to evaluate whether current EAPs will ensure EAE in the context of EACs.

3. Methodology

This chapter describes how the empirical research will be carried out, giving substance to the Design Science Research Methodology (DSRM) and the corresponding process steps.

3.1. Conceptual design

The first objective is to obtain empirical information that will be used to improve and finalise the assessment instrument developed in _section 2.1.4_. An appropriate context will also have to be found in which the assessment instrument can be demonstrated and evaluated. Interviews with EA stakeholders will be a decisive factor during this process.

The choice for the DSRM, as described by Wieringa (2014) and Peffers, Tuunanen, Rothenberger, and Chatterjee (2007), was made because this method provides guidelines that are specifically drawn up for studies that take place in the information system focus area. The advantage of this method, in contrast to methods used for studies within management sciences (Saunders et al., 2016), is that it focuses on artefacts instead of predicting or explaining behaviour. Because artefacts are used, such as methods and techniques, within a certain context, it is possible to examine the performance of these artefacts. To arrive at an assessment instrument, it is necessary that the following empirical questions are answered:

> E. How can the assessment instrument be improved based on empirical research?
> F. To what extent is the assessment instrument considered as useful when applied in practice?
> G. What added value does the assessment instrument offer the organization when applied?

The DSRM, which serves as a guide within this study, is shown in _Figure 12_, the first two steps have already been implemented in _chapter 1_ and _chapter 2_. The development of the assessment instrument is continued in _step 3_. Based on a document analysis and an expert interview, improvements will be made to the assessment instrument. In _step 4_, the assessment instrument is applied, demonstrating the usability of the final assessment instrument. _Step 5_ focuses on an evaluation of the results that have emerged based on the assessment instrument to which, finally, _in step 6_ the research is published.
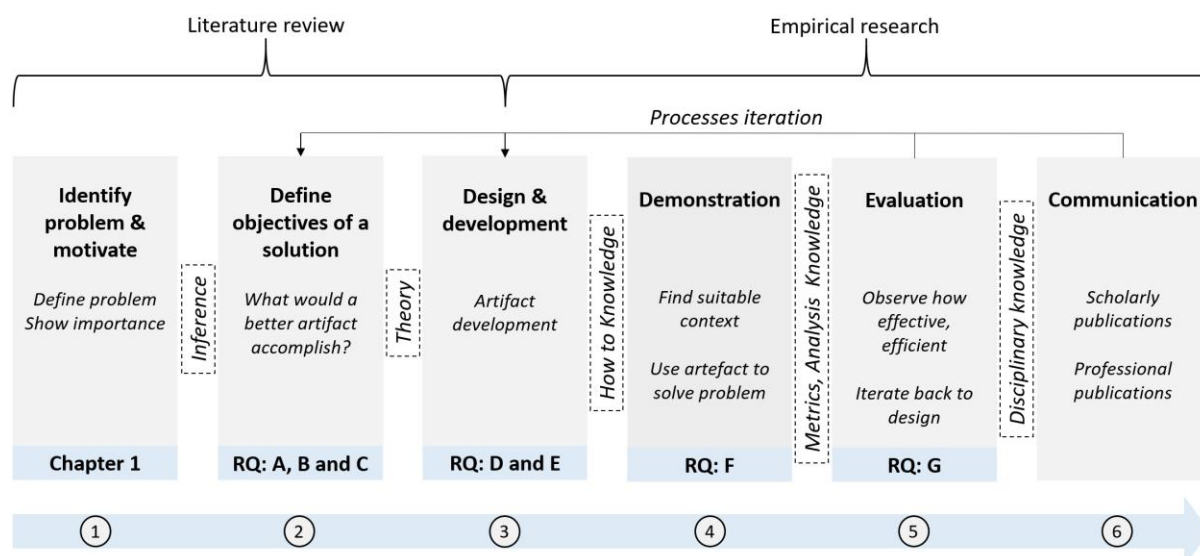
Figure 12: Main lines of approach according to Ken Peffers et al., (2007)

Hevner, March, Park, and Ram (2004) state that: "_The design-science paradigm seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts_". This means that this is an exploratory study. Since the aim is to make organizations aware of EACs and their potential impact on EAE, an interpretative research philosophy is used within this research. Saunders

et al. (2016) describes the purpose of interpretivism as a way to: *"create new, richer understandings and interpretations of social worlds and contexts"*. This therefore involves gaining insight into social worlds and context, within this research this concerns the topics; EAPs, EAE and the EACs that occur in a certain dynamic. The assessment instrument therefore focuses on providing clarity in this dynamic, based on how the reality is perceived by EA stakeholders (Wieringa, 2014).

It was decided to collect information based on qualitative research. The reason for this is because it concerns an exploratory study that focuses on interpretivism, which is in line with what Saunders et al. (2016) advise in this setting.

Based on a case study, the phenomenon *"EA effectiveness"* will be investigated in the context of *"EACs"*. According to Saunders et al. (2016), a case study fits in best within an exploratory study that focusses on interpretivism since it concerns an *"in-depth inquiry into a topic or phenomenon within its real-life setting"*. However, according to Saunders et al. (2016) there are also disadvantages to a case study, the results can be generalized to a limited extent, resulting in a negative impact on external validity. The reason why a case study is still chosen is because this method can provide information at a detailed level, the disadvantage of this is that it is a labour-intensive process (Saunders et al., 2016). In order to get a grip on this labour-intensive process, it was decided to have the data collection take place on the basis of a cross-sectional case study, which makes it possible to investigate a part of the organization instead of the entire organization (Saunders et al., 2016).

3.2. Technical design

As described in [section 3.1](#), a qualitative cross-sectional case study based on DSRM has been chosen. It has been decided to conduct the research within the Loan Servicing department of a large international bank. This department experiences the impact of EACs like no other as loan servicing is one of the bank's core activities. This department was found to be particularly suitable due to the presence of pre-existing challenges, legacy related issues, complexity and the need for change due to financial drivers. By applying a clear scope and not considering the entire organization or different departments, the limited time that can be spent on this research is also considered.

3.2.1. Data analysis

Although the DSRM provides a clear structure *(design, demonstrate and evaluate)*, it does not exactly describe how the data for these steps should be obtained. That is why this process is structured on the basis of three steps:

1. The first step focuses on answering [sub-question E](#), where the assessment instrument is improved based on empirical insights. In terms of content, this means that a document analysis is carried out and expert interviews are conducted.
2. The second step focuses on answering [sub-question F](#), in which the assessment instrument is applied through semi-structured interviews among EA stakeholders and the usability is examined by means of qualitative and quantitative methods.
3. The last step focuses on answering [sub-question G](#) in which the final assessment instrument is evaluated and the added value is determined.

In summary, this means that within this case study information will be obtained based on a document analysis, the assessment instrument, and the interviews which are going to be conducted throughout this research.

3.2.2. Stakeholder analysis

The stakeholder analysis is an crucial step in this research as important information can be collected from the so-called EA stakeholders. Wieringa (2014) indicates the following about stakeholders within the context of DSRM: *"Stakeholders are the source of goals and constraints of the project, which are in turn the source for requirements in the treatment, and so it is important to identify relevant stakeholders"*. EA stakeholders are defined by Van Der Raadt et al. (2010) as follows: "*EA stakeholders are individual or grouped representatives of the organization who are affected by EA products, either*

by providing input to EA decision making or having to conform to the EA products". In the research by Van Der Raadt et al. (2010), a stakeholder analysis has been carried out regarding the subject of measuring EAE indicating also which EA stakeholders can be approached during this process. A visualisation of the different kind of stakeholders, indicated by their respective domains, can be found in *Figure 13*.
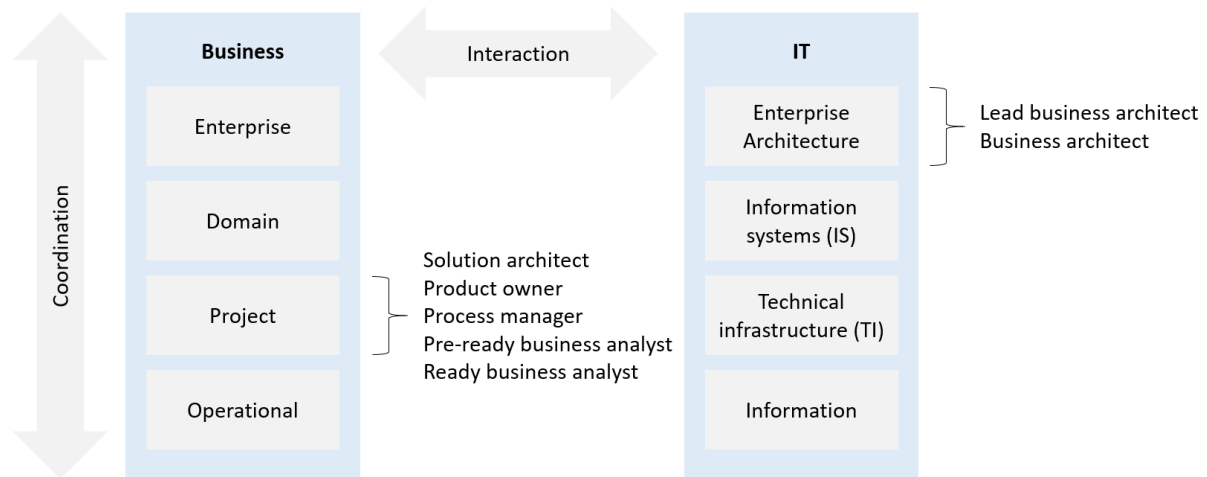
Figure 13: EA Engagement model according to Van Der Raadt et al., (2010)

When the engagement model is applied within the case study department, it is possible to find out where exactly the department is positioned from a business perspective. The Services department consists of scrum development teams composed of product owners, process managers, business analysts, and (lead) developers. In addition, there are also solution architects for the Services department. Despite the title, this position focuses more on the business side and bringing business and architecture together. On the IT side, there are business architects responsible for the EA under which development teams work. These have also a business scope but focus more on EA related topics. Using the engagement model, it can be determined which EA stakeholders are involved in this research, the results are presented in *Table 10*.

Table 10: Selected EA stakeholders

Stakeholders development team (business)	Stakeholders architecture (IT)
Solution architect	Lead business architect
Product owner	Business architect
Process manager	
Pre-ready business analyst	
Ready business analyst	

Since developers are less involved in project preparation activities, it was decided not to include these EA stakeholders in this case study. The reason for this is that especially leading roles are taken into account in this case study, since it is precisely this group that has more to do with EA complexity, legacy issues and uncertainty. From an architectural perspective, the lead business architect and a business architect will be involved. These roles also focus on creating business value, but from an

architecture perspective. The relationship between these two groups can be seen as follows. Business architects are mainly responsible for the EA and the effectivity it represents. Development teams on the other hand have to deal with this predefined EA whereby substance must also be given to strategic business goals and creating business value. It is precisely for this reason that it is interesting to compare these two groups and to see whether the current EAPs, which are under the responsibility of business architects, result in an effective EA that meets the needs of development teams so that business value can be established. When the ratio between the two groups (business versus IT) is compared, the impression can be given that there is an imbalance (five versus two). However, a limited number of business architect is assigned to each department. The ratio between architects and development teams, in absolute numbers, is realistically reflected in this research as only one business architect and one lead business architect are set up for this department.

3.2.3. Document analysis

Documents made available by the organization will be used to improve the assessment instrument. The obtained documents have a dual purpose, namely the gathering of information to be able to improve the assessment instrument and to be able to apply triangulation in interviews. However, the document analysis method also has disadvantages, such that not all documents are accessible due to, for example, sensitive information, the quality of the documents varies widely and may contain incorrect information (Saunders et al., 2016). Within this research, therefore, these restrictions have to be taken into account.

3.2.4. Interviews

Semi-structured interviews will be used to answer sub-question E, F, and G. One of the benefits of semi-structured interviews is that EA stakeholders are more likely to participate in an interview, as opposed to filling in a questionnaire (Saunders et al., 2016). In addition, discussions can also be held with the participant on the basis of which more in-depth information can be obtained. Disadvantages of a semi-structured interview include that there is a chance that the opinion of the interviewer, consciously or unconsciously, may influence the answers to the questions (Saunders et al., 2016). Summarized, the interviews within this study have two goals, namely:

1. Identifying improvements that can be implemented in the assessment instrument.
2. Applying the assessment instrument in the demonstration step so that the usability and added value can be determined.

3.3. Data analysis

After the assessment instrument has been used in semi-structured interviews, the results will be analysed. This analysis will be based on the Thematic Analysis method as described by Saunders et al. (2016). This method focuses on becoming familiar with the obtained data by; coding the data, searching for themes and relationships, refining themes and finally an evaluation (Saunders et al., 2016). These five steps are implemented as follows:

1. Transcripts will be drawn up based on the interviews so that the obtained data is recorded. Because the interview will be transcribed, this will result in a labour-intensive process. However, this process helps in becoming familiar with the obtained data.
2. The prepared transcripts will be coded.
3. The codes will be linked to themes that have emerged through the results.
4. An analysis is then made of the overarching themes that have been identified.
5. Finally, conclusions are drawn based on the analysis.

In addition to the qualitative method, there will also be a quantitative analysis based on the coded themes. The following additional steps will be carried out:

1. Based on the coding process, overarching themes have been identified, these results will be visually mapped.
2. The reliability of the statements will be tested based on Cronbach's Alpha.

3.4. Validity, reliability, and ethical aspects

This section focuses on the topics of validity, reliability, and ethical aspects.

Validity: validity refers to the generalizability of the results, validity is described by Saunders et al. (2016) as: *"The appropriateness of the measures used, accuracy, accuracy of the analysis of the results and generalizability of the findings"*. In order to meet the validity requirements, which are defined by Saunders et al. (2016, p. 202), the following measures are taken:

1. In order to actually measure EAE in the context of EACs, it is important that the assessment instrument is based on already proven methods for measuring EA to ensure validity. For example, the EAEMM of Van Der Raadt et al. (2010) is mentioned in various studies as an effective means of measuring EAE (Alaeddini, Asgari, Gharibi, & Rashidi Rad, 2017; Nikpay et al., 2017). Also the EACs described by Lapalme et al. (2016) come from a peer-reviewed article. In addition, to prevent tunnel vision, the article by Lapalme et al. (2016) is not leading in the determination of the EACs, as other articles are also considered in order to obtain more depth and to view the EACs from different perspectives.

2. By making use of the Design Science Research Methodology (DSRM) approach as described by Wieringa (2014), it is not only possible to build the assessment instrument in a structured way, it is also possible to take into account construct validity requirements and threats such as an inadequate definition, construct confounding, mono-operation bias, and mono-method. bias. This leads to clear and transparent measurement indicators and statements that give substance to construct validity aspects.

3. By using clear measurement indicators (effort to use, effort to learn, and presence of resources) it is possible to formulate clear statements that give substance to face validity aspects. In the context of transparency, the full development and matching process is described in *Appendix E*. In addition, through an iterative process, the EAEMM is used to further strengthen the assessment instrument resulting in statements that are based on an already existing and proven instrument.

4. For the analysis of the results, methods will be used that are widely accepted in scientific studies. Results will be triangulated to ensure that the interpreted information actually also represents what it should represent in the context of this research (Saunders et al., 2016). Therefore, it is also decided that, after each interview, a moment is taken to evaluate the results of the assessment instrument together and to check whether matters have been properly intercepted by both participants.

5. Given the fact that this is a case study, the results can be generalized to a limited extent. This has to do with the fact that the research focuses on answering research questions within a specific complex environment. However, the research does give substance to unexplored EA issues such as, to what extent do EAPs lead to EA effectiveness in the context or emerging EACs (Lapalme et al., 2016). Finally, it is important to point out that, given the time aspect, no statements are made about the generalizability of the results. This research is about supplementing science and not forming new paradigms.

Reliability: reliability has to do with the extent to which the research can be replicated, whereby the same results are achieved, it is therefore about the degree of consistency within the research (Saunders et al., 2016). The challenge with qualitative research is the multi-interpretability of the information obtained (Doorewaard, Kil, & Ven, 2019). For this reason, 4 measures are being taken to limit the negative effects of multi-interpretability:

1. **Four eyes principle:** this principle is applied within the research during interviews. For example, the four-eye principle will be particularly relevant in the further development of the assessment instrument where important decisions will be made together with EA stakeholders and not individually. This ensures that the instrument can be used effectively within the case organization.

2. **Feedback to respondents:** findings from interviews will be briefly summarized per topic so that it can be verified whether the answers have been properly interrogated.

3. **Expert advice:** important conclusions and decisions are made with key EA stakeholders who are aware of developments in the organization and the EA field.
4. **Restrictive reporting:** within this research, reports will be reserved in a conservative manner, since only based on qualitative research no statements can be made within the scientific domain as there is insufficient evidence for this.

All findings within this study are recorded in such a way that, if the study were to be repeated under the same circumstances, the same results would be achieved. This is expressed in, among other things, the recording of; interviews, documents and articles that have been used for the purpose of this research. These steps are taken to work on the reliability aspect as transparently as possible.

Ethical aspects: according to Saunders et al. (2016, p. 249), ethical issues can occur in different stages of the research. Ethical aspects can occur within this research when EA stakeholders are consciously or unknowingly forced to participate in the research. For this reason, the checklist of Saunders et al. (2016, p. 251) is maintained so that ethical issues are avoided within the study. The following decisions were made on this basis:

1. Based on verbal and non-verbal communication, an assessment is made as to whether the EA stakeholder is entirely voluntary and benevolent in the participation of the research.
2. EA stakeholders will not receive compensation in any form.
3. Because there is a chance that the study will produce negative results regarding EA effectiveness, participants will be included in the purpose of the study, how the study will be carried out and how the results will be processed so that participants can form a picture of the potential risks that the study entails. Before the interview takes place, the participant will be asked whether he or she accepts the conditions so that it can be determined that the participation took place entirely voluntarily and consciously.
4. Finally, it is indicated in advance that participants can withdraw their participation in the study at any time, without any consequences.

4. How can the assessment instrument be improved based on empirical research?

This chapter is a continuation of the design and development phase and describes what additions have been made to the assessment instrument developed in *section 2.1.4*. Based on a document analysis and two expert interviews, several improvements have been incorporated in the final assessment instrument which can be consulted in *Appendix K*. The empirical development process is structured on the basis of the steps described in *Figure 14*. To give substance to the *"chain of evidence"*, the interview has been transcribed and a log has been kept describing why and how the changes have been incorporated in the final assessment instrument. The transcription and the corresponding logbook can be consulted in *Appendix I* and *Appendix J*.
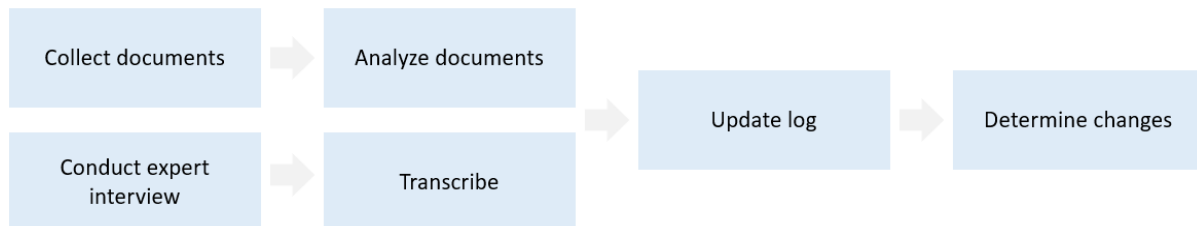
Figure 14: Empirical development process

4.1. Document analysis

Before the interview with the expert took place, a document analysis has been carried out focusing on providing insight into the organizational EA. By mapping out the EA, it is possible to determine whether there is a connection between the designed assessment instrument and the organization in which it will be applied. In addition, the document analysis also provides the necessary basis for a profound conversation with the expert. Because the organization has a dedicated environment for EA related topics, it was possible to search for relevant documents in a targeted manner. It is important to mention that certain sensitive architectural information was inaccessible due to its confidential nature. However, despite this fact, sufficient information has been obtained to provide an appropriate picture of the organizational EA, principals, practices, implementation processes including the Project Start Architecture (PSA) and the strategy of the company. A complete overview of consulted documents can be found in *Appendix G*. Based on this documentation; an organizational Business Function Model is shown in *Figure 15*. This Business Function Model broadly describes the EA of the organization, in which the rectangles on both sides (governance and organization support) are particularly interesting, since a clear link can be found between the organizational units that are responsible for the EAPs and the EACs that are central to the assessment instrument. The business unit *"Lending"* is included under *"product and arrangement management"* to clarify how the specific case study department falls within the EA of the organization. Based on the document analysis, it can be established that there is a sufficient link between the organizational EAPs and in the way the assessment instrument determines EAE.

Figure 15: Organizational Business Function Model (Bank, 2018)

4.2. Expert interviews

Based on two expert interviews, the assessment instrument was reviewed with a solution architect within the Services domain. To structure the interview, an interview schedule has been maintained, which can be consulted in *Appendix H*. The choice for a solution architect was made because this EA stakeholder is the link between both business and IT. Given this role, the solution architect has insight into both the organizational EAPs and the business needs that development teams have to give substance to. During this evaluation process various improvements were identified using the multidisciplinary insights of the solution architect. By scheduling two interviews with the solution architect, it was possible to collect feedback in the first interview, process this feedback and go through the implemented changes in the second interview. This ensures that the changes have been correctly interpreted and processed in the final assessment instrument. The EACs and the assessment instrument are considered as interesting by the solution architect. The first interview was completed in 55 minutes and the second interview in 50 minutes. The research goal was assessed by the solution architect as interesting and relevant to the organization. Although a purely quantitative research design was preferred due to the relatively shorter completion time and applicability within the two target groups, the assessment instrument is assessed as a valid way to give substance to the research goal. The statements were evaluated based on comprehensibility, content and purpose, and there have also been in-depth discussions about the EACs that currently exist within the organization. In particular, it emerged that the topics data, accessibility and strategy are relevant, current topics that concern the organization. The transcript of this interview can be found in *Appendix I*.

4.3. Changes in the assessment instrument

Based on the expert interviews, changes have been made to the assessment instrument. Statements have been adapted and improved, with attention also being paid to the order of the dimensions, statements and certain visual aspects which further strengthen the structure of the instrument. A logbook has been kept which provides insight into which changes have been made and on the basis of which feedback this is done. The logbook can be consulted in *Appendix J* and the final definitive assessment tool can be found in *Appendix K*. Based on the following five themes, changes have been made to the assessment instrument:

- **Intake questions:** the instrument did not obtain sufficient information about the participant, for example, the instrument did not clarify which area of interest the participant has and whether the participant is familiar with EA. By incorporating this into the instrument, it is also possible to see from which context the statements were answered.
- **Structure:** because the EACs are arranged in five different dimensions, it was sometimes unclear in which context the statements had to be answered. In addition, the order of the questions was experienced as unpleasant. This has to do with the order of the questions, where first *"effort to learn"* is considered, then *"effort to use"* and finally *"availability of resources"*. The expert interview showed that questions related to *"effort to use"* are best included first as they are considered introductory.
- **Clarity:** some statements were too long and insufficiently operationalized, making the statements unclear. It is important to look back at what information should be obtained and what purpose it serves in the context of the assessment instrument.
- **Making full use of data:** the assessment instrument retrieves a lot of information which is processed in only one radar chart. Given the structure of the instrument, it is also possible to gain insight into the *"effort to use"*, *"effort to learn"* and *"presence of resources"*. In addition, it is also possible to further specify the scores per dimensions by showing a score per EACs. This specification can lead to more focused discussions.
- **Evaluation:** the participant does not have the opportunity to provide feedback through the assessment tool. Since this is also an important part of the evaluation step, it is important that evaluation questions are included.

Based on this feedback, the following changes have been made to the assessment instrument:

- Three intake questions have been included that provide more information about the participant, the added questions can be consulted in *Table 11*.

Table 11: Added intake questions assessment instrument

Intake question	Options based on a 5-point Likert scale
My work focusses on	IT - Business
My work focusses on	Systems - Processes
I am familiar with enterprise architecture	Completely disagree – Totally agree

- The order of the dimensions has been adjusted to *"internal monitoring"*, *"external monitoring"*, *"communication and understanding"*, *"partnership"* and finally *"readiness for change"*. In addition, the order of the questions has been adjusted to *"effort to use"*, *"effort to learn"* and *"presence of resources"* as this order is experienced as more pleasant.
- Within each dimension, the corresponding EACs are included in the header. This immediately shows a clear relationship between the dimension and the EACs that take place within that context.

- Based on an in-depth evaluation, statements have been improved to further increase comprehensibility. A complete overview of this process can be found in *Appendix J*.
- To ensure that the tool encourages targeted discussions a radar chart has been added that shows the average score per EAC and a visualization of the average *"effort to use"*, *"effort to learn"* and *"presence of resources"* score across all EACs.
- The assessment instrument has switched from a 6-point Likert scale to a 5-point Likert scale as this is one of the most validated and accepted Likert scales in science. Although the 5-point Likert scale is less challenging to give a positive or negative assessment, the validity of the instrument takes precedence.
- The results page now uses dynamic icons that simplify discussing the results. By looking at the scores given per statement, a cross, exclamation mark or check mark can be displayed per statement. This makes it easier to consider substantively why a statement is experienced positively or negatively. *Figure 16* shows when which icon is shown.
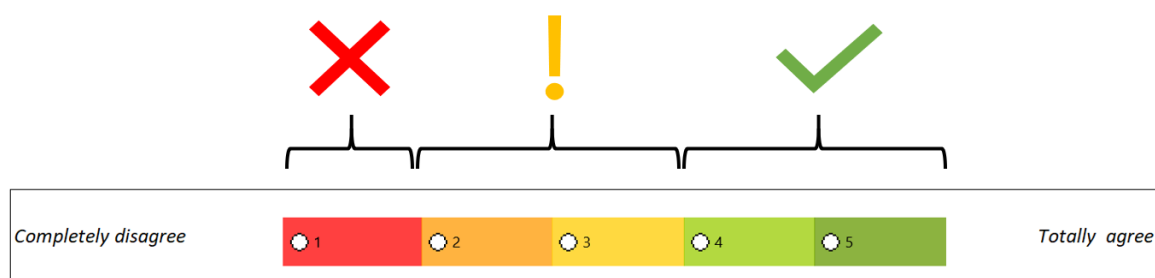
Figure 16: Dynamic icons assessment instrument

- Finally, three evaluation questions have been included which are shown in *Table 12*, and a field has been included in the assessment instrument in which the participant may leave additional comments.

Table 12: Added evaluation questions assessment instrument

Evaluation question	Options based on a 5-point Likert scale
The assessment instrument has a clear structure	*1 - 5*
The questions are clearly formulated	*1 - 5*
The results of the assessment instrument are useful	*1 - 5*

Answer to sub-question E:
Based on two expert interviews, five themes have been identified that have led to a number of improvements within the assessment instrument:
- **Intake:** three intake questions have been added to obtain more background information about the participant. As a result, the data obtained represents a greater value since more information is provided about the participants and their background.
- **Structure:** both the order of the dimensions and the questions has been adjusted. The order of the questions has been changed to *"effort to use"*, *"effort to learn"* and *"presence of resources"* as this order is experienced as pleasant and logical.
- **Clarity:** statements have been adapted and improved based on the given feedback. In addition, within each dimension, the corresponding EACs are included in the header to enhance clarity.

- **Data utilization:** an additional radar chart has been included that also provides insight into the score per EAC and the average *"effort to use*, *"effort to learn"* and *"presence of resources"* scores can now also be looked at.
- **Evaluation:** three evaluation questions have been included that also give substance to the evaluation process in this research (evaluation step). In addition, the participant has the opportunity to leave a comment.

In addition, a number of visual adjustments have been made, a switch has been made from a 6-point Likert scale to a 5-point Likert scale and dynamic icons have been included in the results screen so that the results are even easier to discuss. *Appendix J* can be consulted for a full overview of adopted changes.

5. To what extent is the assessment instrument considered as useful when applied in practice?

In this chapter attention is paid to the process step *"demonstration"*. By looking at the results of the assessment instrument, it will be determined to what extent the instrument is considered useful. The data obtained will be viewed from the perspective of the business architects, development team members and a total average. Based on these different perspectives, it can be examined how EAPs are experienced in the context of EACs. On the basis of this, the communication between the two groups can also be assessed. Potential differences can lead to learning and discussion since the two groups can reinforce each other. The data will be processed both quantitatively and qualitatively. The complete *"demonstration"* process is shown in *Figure 17*.
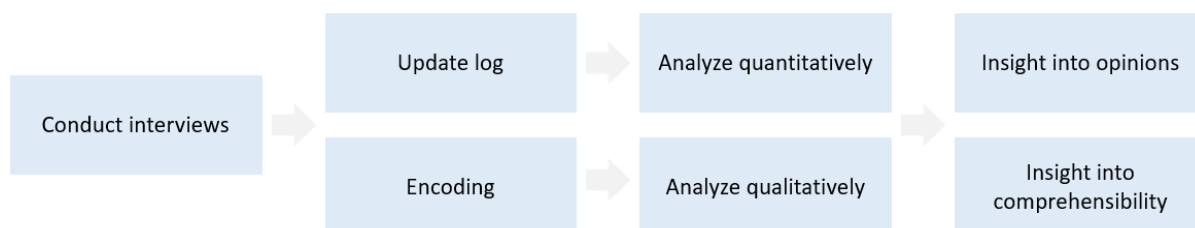
Figure 17: Demonstration process assessment instrument

5.1. Interviews

The assessment instrument was completed together with seven participants throughout semi-structured interviews. Unfortunately, due to the worldwide COVID-19 pandemic, it was not possible to conduct the interviews at the head office, because employees were obliged to work from home. Improvisation was therefore necessary and a good alternative channel needed to be found which gives substance to the validity and reliability aspects of this research. By making use of Microsoft Teams[2], it was possible to conduct the interviews remotely, whereby the instrument could be completed through screen sharing. Making use of this channel was important due to ethical aspects. After the interview, the recording is stored in a secured environment that complies with all organizational security policies. For completeness, the organization-specific privacy policy, which applies to recordings throughout Teams, is included in *Appendix M* and shared with the participants to provide clarity on how the recordings are handled by the organization. The interview is secured and can only be viewed by the participants, interference by third parties is not possible. For this reason, the participants experience this communication channel as pleasant. Throughout all seven interviews no negative incidents occurred. The average time of the interviews was 50 minutes, the longest interview was with the business architect *(interview 7, time: 78 minutes)* and the shortest interview with the solution architect *(interview 3, time: 37 minutes)*. The interviews were conducted in Dutch and there was also one interview in English. The assessment instrument, which is in English, was not experienced as disturbing, this because all internal communication within the organization is mostly in English. All interviewees were open and accessible during the interviews. An interview schedule was used which can be consulted in *Appendix L*. The interviews have proven that the instrument stimulates discussions about the EACs. Some questions required some further explanation or were experienced as unclear. This was evident from the verbal and non-verbal communication that was possible via the Teams platform.

The participants consist out of two groups, namely the members of the development team and the business architects. The intake questions were used to distinguish these two groups, the results of which are shown in *Figure 18*. Based on this overview, it can be concluded that the business architects see themselves as the bridge between business and IT *(average response: 3)*. The development team

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[2]*For more information about Microsoft Teams, please consult: https://www.microsoft.com/nl-nl/microsoft-365/microsoft-teams/group-chat-software*

mainly focuses on the creation of business value and therefore leans more towards the business side *(average response: 4)*. Business architects are also more often involved with processes than systems *(average response: 4)* where the developers are exactly in the middle, seeking a balance between processes and systems. Finally, as expected, the business architects are familiar with EA with an average response of *5* where the knowledge about this subject is slightly lower among development members of the development team *(3)*.
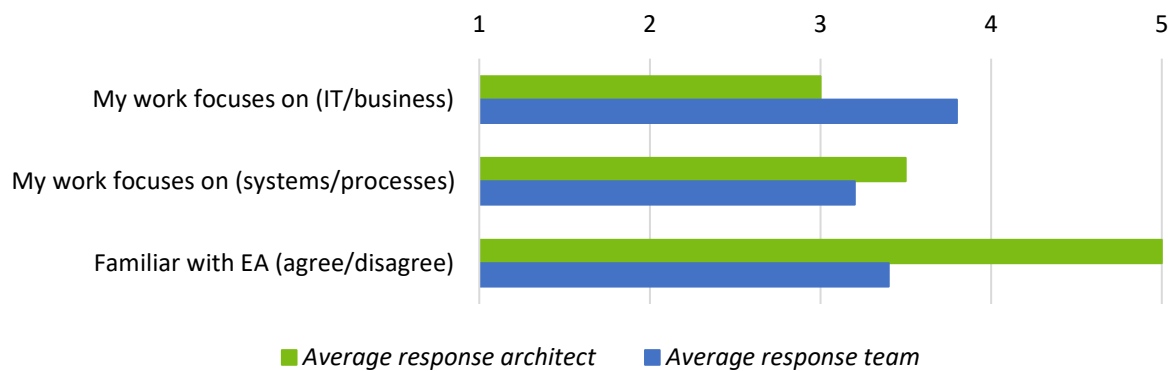
Figure 18: Average response intake questions, team versus architects

5.2. Quantitative results

The purpose of the assessment instrument is to show to what extent the current EAPs are contributing to EAE in the context of EACs. This is done by examining the presence or absence of EAPs and competencies. The assessment instrument facilitates this purpose by visualizing an average score that has been established on the basis of the answers given throughout a 5-point Likert scale *(1 = completely disagree – 5 = totally agree)*. It is also possible to examine the distribution of the answers and to look at the reliability of the assessment instrument using Cronbach's Alpha. The qualitative results are discussed in this section, the data used for this process can be consulted in *Appendix N*.

To get a general impression and to set a baseline, a radar chart has been drawn up in which the average total scores are included for each dimension, this radar chart can be consulted in *Figure 19*. The calculation of the score was made by looking at the maximum number of points that can be achieved within a dimension and comparing this against the average number of points achieved over all interviews. What emerges here is that the dimension *"communication & understanding"* has the lowest average score *(59.29%)*, followed by *"internal monitoring" (68.31%)*. On the other hand, the dimension *"external monitoring" (80.29%)* and *"partnership" (75.24%)* score relatively higher. The dimension *"readiness for change"* falls in between with an average score of *71.43%*.
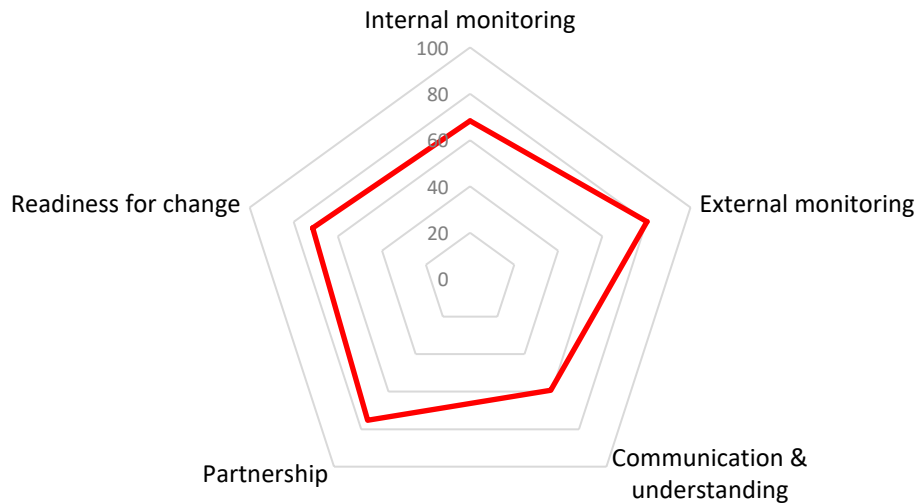
Figure 19: Average overall score per dimension

It is also possible to view the radar chart from two additional perspectives, see *Figure 20*. When the two groups *(architects versus development teams)* are compared against each other, it is possible to see that the average scores are very similar in a number of areas *("readiness for change" and "external monitoring")*. This is most likely due to the clear overall business strategy that focuses on these two areas and is therefore given considerably higher scores across both groups. Remarkable is that the two groups disagree most about the lowest scoring dimensions *("communication & understanding" (architects: 67.50% versus development teams 56%)* and *"internal monitoring" (architects: 82.73% versus development teams 62.55%))*. This gives the impression that architects have a relatively more positive view of the EA within these dimensions compared to the development teams.
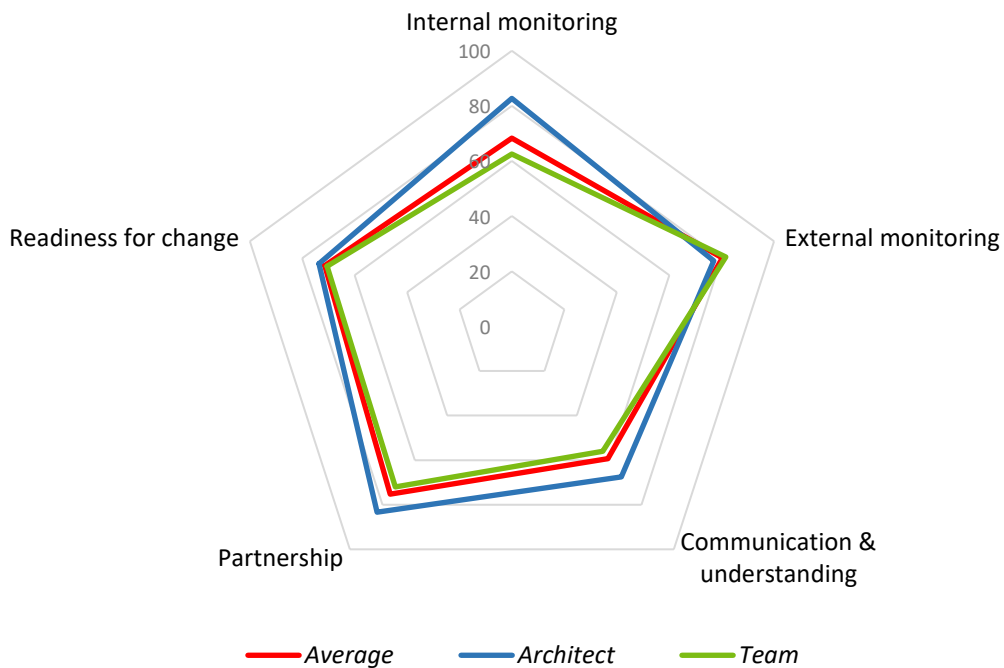
Figure 20: Average scores from three perspectives per dimension

The dimension-based radar chart illustrates a good overall impression of the average scores but provides limited depth. For this reason, the data can also be viewed from an EAC perspective, *see Figure 21*. The main differences between the two groups can be found in the *EACs "making effective use of new resources" (90% versus 65.60%, "utilizing data outside and within their boundaries" (76.67% versus 60%)* and *"effective Knowledge Management" (67.50% versus 56%)*. This is no surprise as these EACs are part of the dimensions *"internal monitoring"* and *"communication & understanding"* in which the biggest differences were found in the dimension-based radar chart *(Figure 20)*. The two groups agree most about the EACs *"dealing with greater cultural and generational diversity among workers" (70% versus 74%)*, *"24/7 accessibility through virtual channels" (76% versus 80.80%)* and *"designing responsible processes and organizations" (78% versus 82.40%)*.
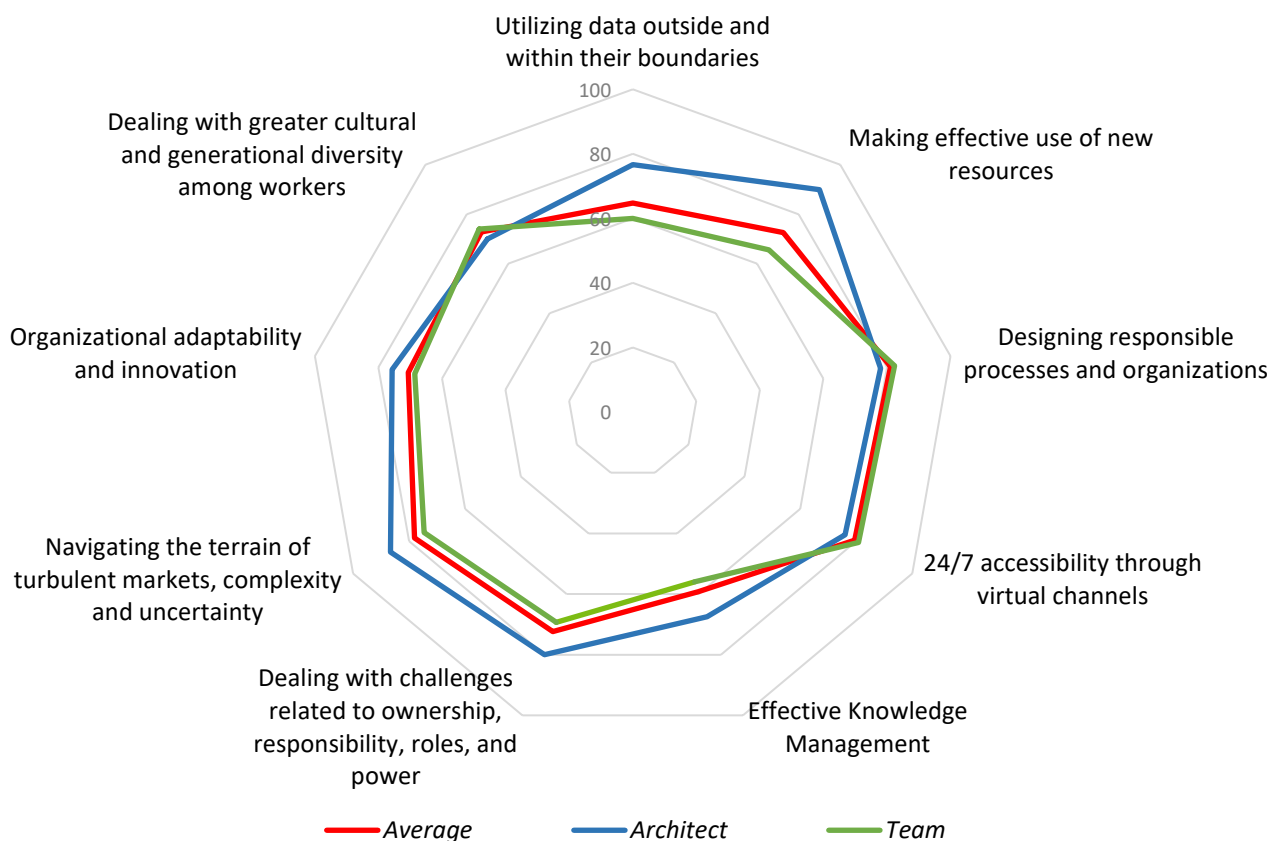
Figure 21: Average scores from three perspectives per EAC

In order to get a better picture of what exactly the average highest and lowest scoring EACs are, an overview is included in *Table 13.* The scores in this overview are shown in descending order.

Table 13: Overview of scores per EAC in descending order

Average score	EAC
81.14%	**EAC.4:** designing responsible processes and organizations
79.43%	**EAC.7:** 24/7 accessibility through virtual channels
78.10%	**EAC.8:** navigating the terrain of turbulent markets, complexity and uncertainty
72.86%	**EAC.5:** dealing with greater cultural and generational diversity among workers
72.57%	**EAC.9:** making effective use of new resources
72.38%	**EAC.6:** dealing with challenges related to ownership, responsibility, roles, and power
70.61%	**EAC.3:** organizational adaptability and innovation
64.76%	**EAC.1:** utilizing data outside and within their boundaries
59.29%	**EAC.2:** effective Knowledge Management

It is also possible to look at the answers at a statement level. A legend has been drawn up, see *Table 14*, which ensures the usability of *Figure 22*. In contrast to a score, which was included in the previous radar charts, an average answer based on the 5-point Likert scale is now shown. The radar chart shows a consistent representation whereby again the aforementioned dimensions and their corresponding statements show the biggest difference in average answers between the two groups. *Appendix K* can be consulted for a full overview of included statements (the statement code S.X.X corresponds to the EAC (first number) and the specific statement (second number) within the EAC). Based on this, the exact question can be traced.

Table 14: Overview of EACs and related statements

Enterprise architecture challenge (EAC)	EAC	Statements
Utilizing data outside and within their boundaries	EAC.1	S.1.1 to S.1.6
Making effective use of new resources	EAC.9	S.9.1 to S.9.5
Designing responsible processes and organizations	EAC.4	S.4.1 to S.4.5
24/7 accessibility through virtual channels	EAC.7	S.7.1 to S.7.5
Effective Knowledge Management	EAC.2	S.2.1 to S.2.4
Dealing with challenges related to ownership, responsibility, roles, and power	EAC.6	S.6.1 to S.6.3
Navigating the terrain of turbulent markets, complexity and uncertainty	EAC.8	S.8.1 to S.8.3
Organizational adaptability and innovation	EAC.3	S.3.1 to S.3.7
Dealing with greater cultural and generational diversity among workers	EAC.5	S.5.1 to S.5.4
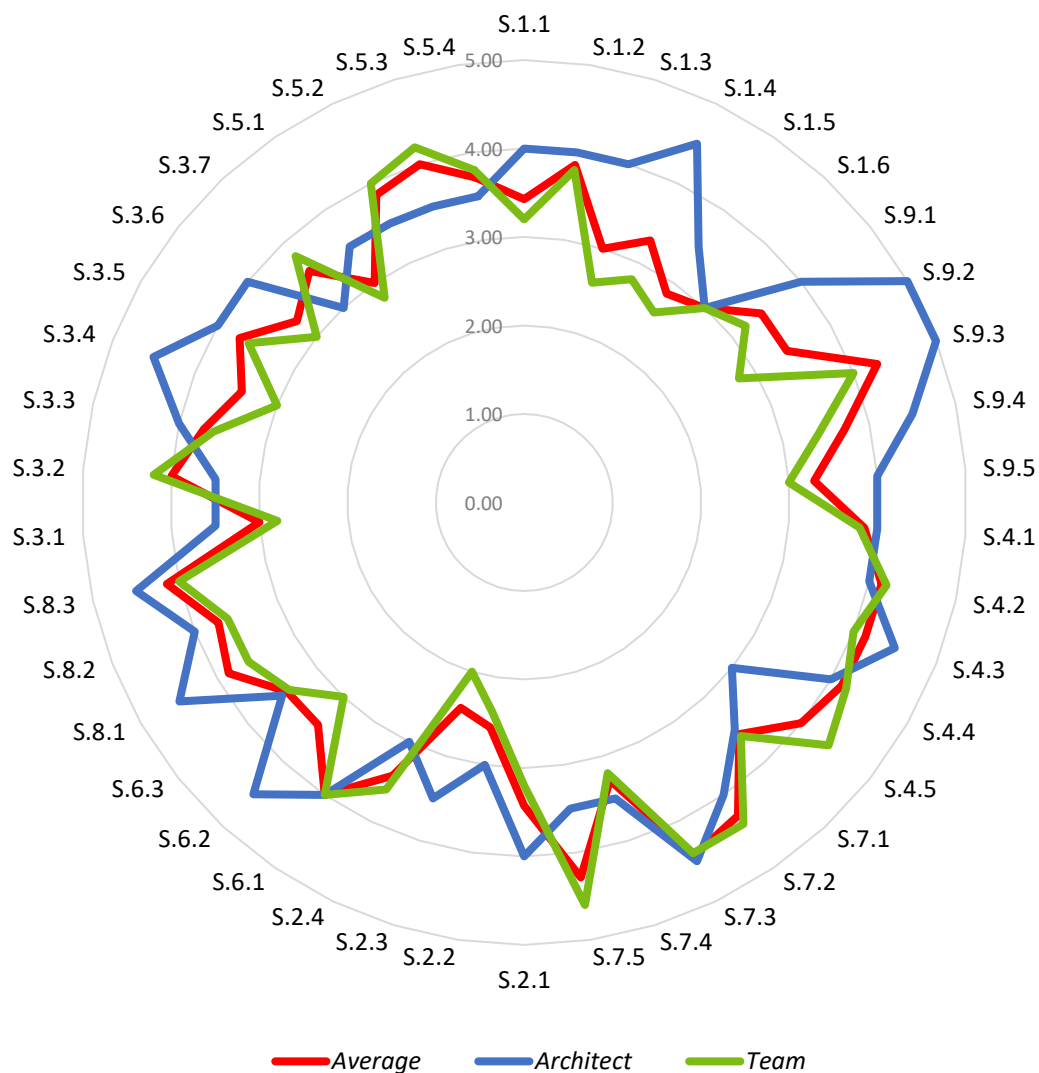
Figure 22: Overview of average answers from three perspectives per statement

The architects and development teams most agree on the following statements (deviation <0.5): *S.1.2, S.1.6, S.4.1, S.4.2, S.4.3, S.4.4, S.7.1, S.7.2, S.7.3, S.7.4, S.7.5, S.6.1, S.6.3, S.8.2, S.8.3, S.3.3, S.3.5, S.5.2,* and *S.5.4.* In particular, the architects agree on the EACs *"designing responsible processes and organizations"*, *"navigating the terrain of turbulent markets, complexity and uncertainty"* and *"24/7 accessibility through virtual channels"*.

The biggest differences can be found in the following statements (deviation >1.0): *S.1.3, S.1.4, S.9.2, S.9.3, S.9.4, S.9.5, S.4.5, S.7.5, S.2.3, S.6.2, S.3.4,* and *S.3.6*. What is particularly striking is that the architects are considerably more positive about the EAC *"making effective use of new resources"* compared to the development teams and that the greatest deviation can be found within this EAC. In particular statement *S.1.4*: *"external developments related to how data can be utilized are followed in a consistent and structured manner"* and *S.9.2: "new data resources such as contextual data are actively used to gain a competitive advantage"* are notable given their high deviation (> 1.7) between the two groups.

It is also possible to look at the distribution of the answers based on the obtained data. *Figure 23* contains an overview of answers per participant, with the answers sorted in the following order:

"totally agree", "agree", "partially disagree", "disagree" and "totally disagree". In order to be able to distinguish the different answers well, colors have been assigned to the different options. The red answers are particularly noticeable at EAC.2: *"effective Knowledge Management"* and EAC.1: *"utilizing data outside and within their boundaries"*. An overview has also been made of the average lowest and highest assessed statements, which can be consulted in .
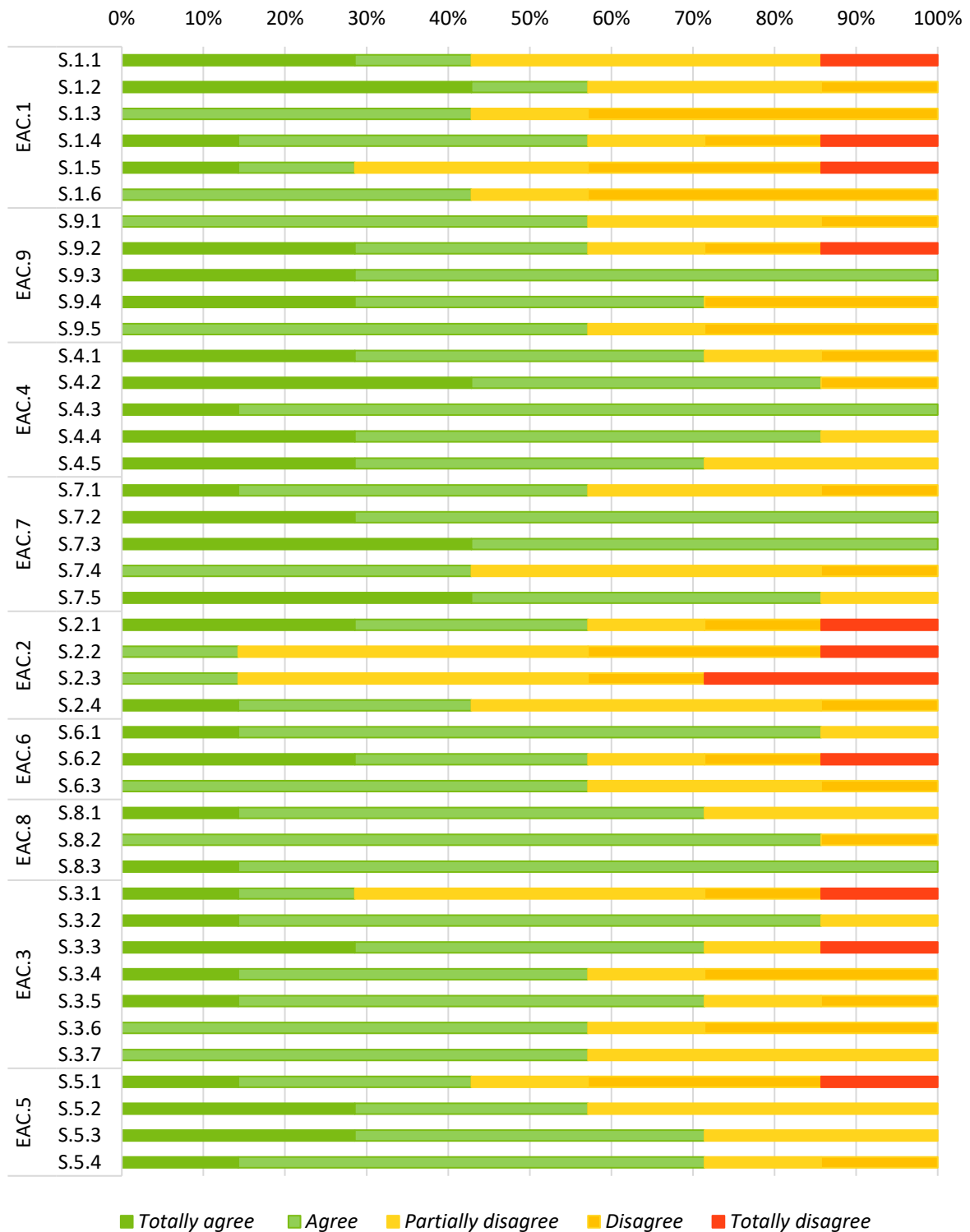
Figure 23: Distribution of answers per statement

The distribution of answers can also be translated to an EAC level, see *Figure 24*. Here again, EAC.1 and EAC.2 are particularly noticeable. Respondents are generally positive about EAC.4 and EAC.8.
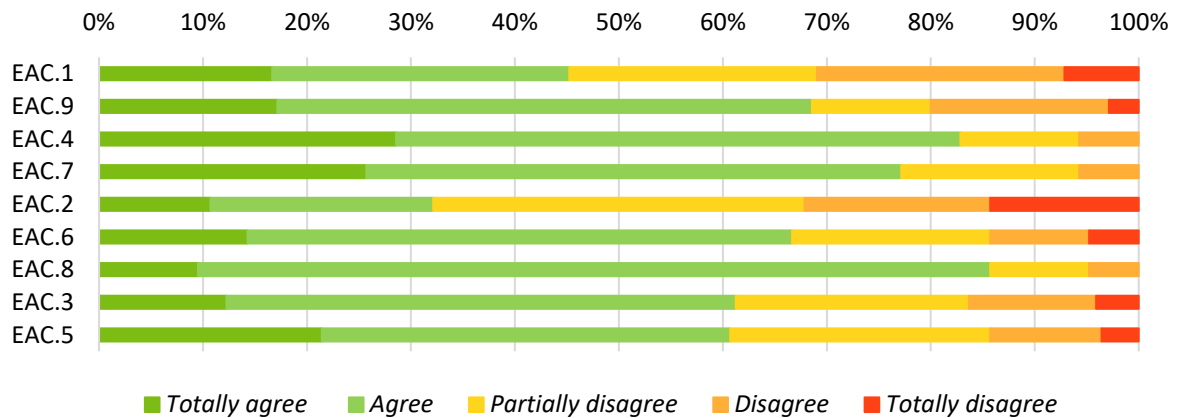
Figure 24: Distribution of answers per EAC

Because the statements are divided into three measurement indicators (effort to use, effort to learn and presence of resources), it is possible to visualise the presence of these indicators per EAC. The results of all the EAC can be consulted in *Appendix N*. This section focuses on the two highest and lowest scoring EACs. *Figure 25* shows that within EAC.1: *"utilizing data outside and within their boundaries"*, the participants are particularly unsatisfied about the effort to learn and the resources related to this topic. Technical developments are insufficiently monitored and current data utilization practices are evaluated to a limited extent. The resources that are in place and have to support data utilization practices are also considered as insufficient. Finally, when looking at the effort to use, it is noticeable that the organization can grow in the way data is managed and how data is used in the decision-making process.
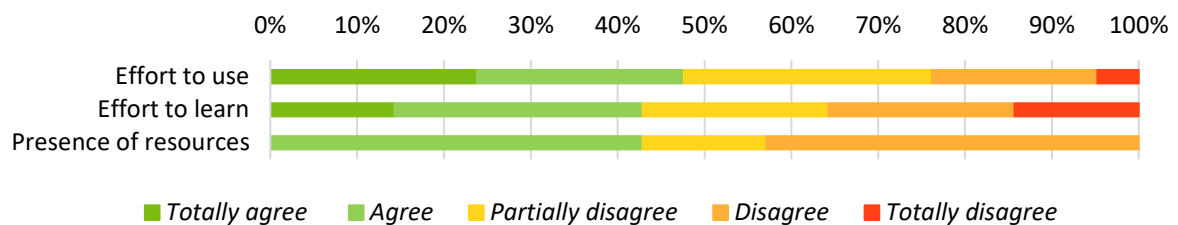
Figure 25: Effort to use, effort to learn and presence of resources (EAC.1)

Within the EAC *"effective Knowledge Management"*, the participants are particularly dissatisfied about the organizational effort to learn and the effort to make use of practices that enhance knowledge sharing practices, see *Figure 26.* Attention should be paid to the promotion of a clear KM culture, strategy and following both internal and external KM developments.
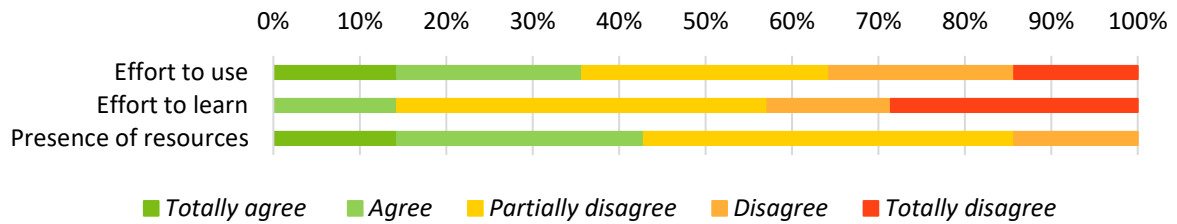
Figure 26: Effort to use, effort to learn and presence of resources (EAC.2)

EAC.4: *"designing responsible processes and organizations"* and EAC.7: *"24/7 accessibility through virtual channels"*, on the other hand, score considerably better when we look at *Figure 27* and *Figure 28*. It can be concluded that the organization is able to respond to external changes when it comes to people, environment, and society. The high score is mainly achieved because the organization follows these external developments closely and also considers these aspects during the development of their processes and systems.
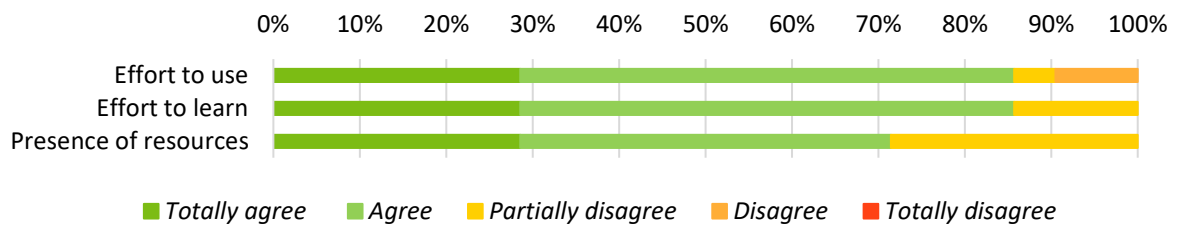
Figure 27: Effort to use, effort to learn and presence of resources (EAC.4)

The organization also scores high in terms of accessibility. The organization follows developments in the field of accessibility and invests in new technologies to further improve their accessibility. By periodically monitoring how accessible the organization is experienced, it is possible to identify improvements. However, these improvements are not always implemented. Because of this the effort to learn within this EAC is slightly lower.
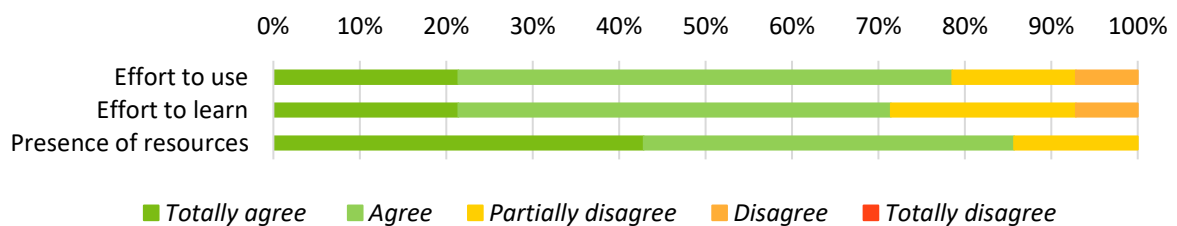
Figure 28: Effort to use, effort to learn and presence of resources (EAC.7)

Finally, the Cronbach's Alpha is calculated per EAC, the results can be consulted in *Appendix N*. Although the results show an adequate Cronbach's Alpha (> 0.7) across all EACs, they cannot be considered as reliable because of the small sample group size. For this, the Cronbach's Alpha test simply lacks power, a larger sample size would mitigate this problem. The Cronbach's Alpha results should therefore only be considered as an indication.

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5.3. Qualitative results

In order to determine the usability of the assessment instrument, the transcribed interviews, which are included in *Appendix M*, have been processed qualitatively using MAXQDA 2020[3]. A full description of the coding process can be found in *Appendix N*. The codebook, including overarching themes, can be consulted in *Figure 29*.
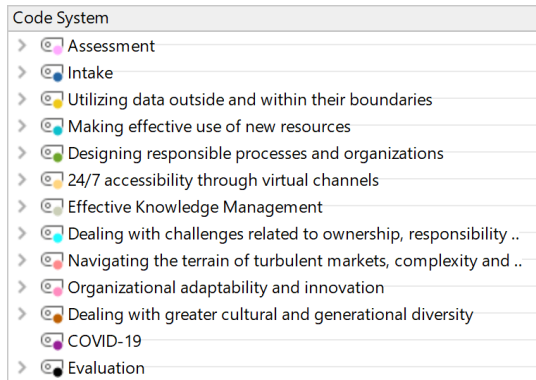
Figure 29: Code system used in MAXQDA 2020

Based on the coding system, it is possible to make a visualization indicating how often coding has been applied within a specific EAC, *see Figure 28*. The larger the sphere, the more depth there has been in the interview. In *Figure 30* the spheres are set off against each other on the horizontal axis, so per EAC across all interviews. As an example, within the EAC *"Utilizing data outside and within their boundaries"* the EAC was discussed most in *interviews 3*, *6*, and *7* as shown by the large sphere. The smaller sphere in *interviews 1*, *2*, *4*, and *5* shows that the EAC was less discussed in that specific interview compared to the other interviews. This does not necessarily mean that the discussion regarding the EAC was bad in terms of content, it only gives an indication of how much discussion there has been. From the overview it can be concluded that every participant, and therefore every interview, provides different insights. The interviews with the architects are relatively more in-depth with regard to the development team members. However, team members have different insights on various EACs, having a positive contribution on obtaining a clear picture of the situation.
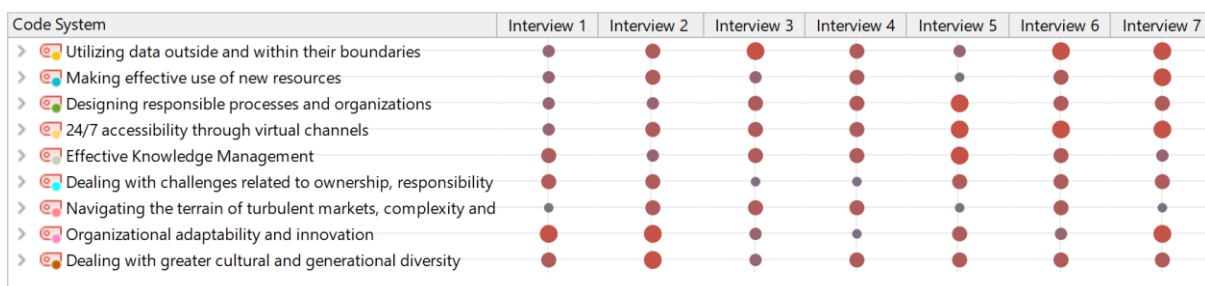
Figure 30: Coding results per EAC, comparison between interviews

The coding results can also be viewed per EAC and per interview only, see *Figure 31*. In contrast to *Figure 30*, where the size of the sphere is determined by a comparison across all interviews (horizontally), in *Figure 28* the size of the sphere is determined by only looking at the interview itself (vertically). This makes it possible to see per interview which EAC was discussed the most. It is striking that in particular the EAC.3: *"organizational adaptability and innovation"* is coded the most. This is also plausible since this EAC consists of seven statements and has therefore been discussed in more

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[3] *For more information about MAXQDA 2020, please consult*: *https://www.maxqda.com/new-maxqda-2020*

detail compared to other EACs such as *"effective knowledge management"* which only consists of four statements. The lowest-scoring EAC: *"utilizing data outside and within their boundaries"* was discussed most in *interview 3 (solution architect), 4 (business analyst)* and with the two business architects *(interview 6 and 7)*. The other low-coded EACs have on average the least number of statements, which means that they are also relatively less discussed compared to the larger EACs.
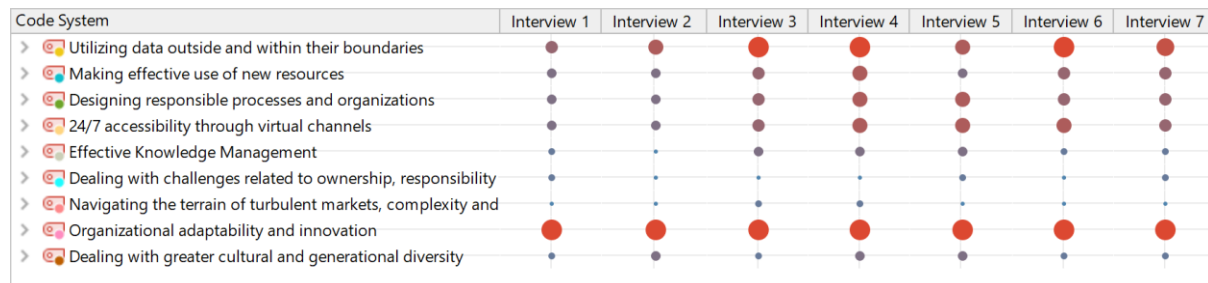
Figure 31: Coding results per interview, comparison between EACs

It can also be investigated how often positive or negative expressions were made with regard to an EAC, see *Figure 32*. The size of the sphere says something about how often something is experienced as positive or negative within that specific EAC. The spheres are then placed against each other at EAC level to determine their size. For example, when looking at the EAC *"24/7 accessibility through virtual channels"*, it is noticeable that the interviewees are predominantly positive about this EAC and that the number of negative expressions is limited.
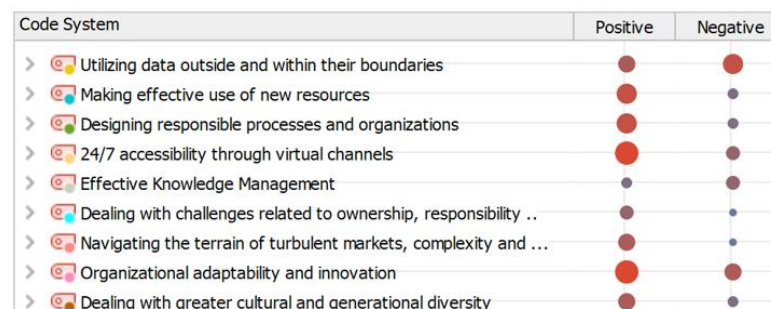
Figure 32: Positive and negative expressions per EAC

The EACs *"utilizing data outside and within their boundaries"* and *"effective Knowledge Management"* deserve the most attention, since they are most often experienced as negative. Because not only the perception of reactions was examined in the coding process, but also why something is experienced as positive or negative, a statement can be made as to why these two EACs score low:
- It is indicated that the utilization of data is limited because there is no data lineage across departments, there are data quality issues and there is no presence of a PDCA-cycle on the basis of which teams can evaluate their data utilization practices. For this reason, teams are not encouraged to use data outside and within their boundaries.
- With regard to *"effective Knowledge Management"* it is indicated that no attention is paid to knowledge retention and that there is no clear vision when it comes to Knowledge Management. As a result, everyone has their own interpretation of knowledge sharing and is dealt with in different, sometimes ineffective ways.

A complete overview of how EAC are experienced can be found in *Appendix N.*

During the encoding process it emerged that in almost every interview the COVID-19 situation, and how the organization has dealt with this, was discussed, see *Figure 33*.

Code System	Interview 1	Interview 2	Interview 3	Interview 4	Interview 5	Interview 6	Interview 7
⊙ COVID-19	●	●	●	●	●	●	●

Figure 33: Presence of COVID-19 code per interview

Figure 33 does not show how often the topic COVID-19 occurs, but only that it occurs in a specific interview. Particularly, the question *"the presence of flexible processes and systems enable the organization to respond to external changes related to people, environment, and society" (EAC.4)* is interesting since almost all respondents have indicated that the organization has proven this by developing new loan types and deploying them in a relatively short timeframe. However, when the statement is discussed in more detail, it appears that almost all respondents would had given considerably lower score before the crisis, since the organization is experienced as slow in general. This finding emphasizes once again that the data obtained should be seen as a snapshot and not as absolute truth.

5.4. Comprehensibility of the statements

Finally, the comprehensibility of the statements was evaluated per EAC. By examining how often a statement was perceived as unclear, it is possible to determine the comprehensibility of the EAC. The transcripts were also used in this process and the unclear statements were coded using MAXQDA 2020. The result can be consulted in *Figure 34*. The coding process clearly highlighted how often a statement within an EAC is perceived as unclear. The percentage shown in *Figure 32* is determined by comparing the total number of unclear perceived statements against the total number of statements across all interviews.
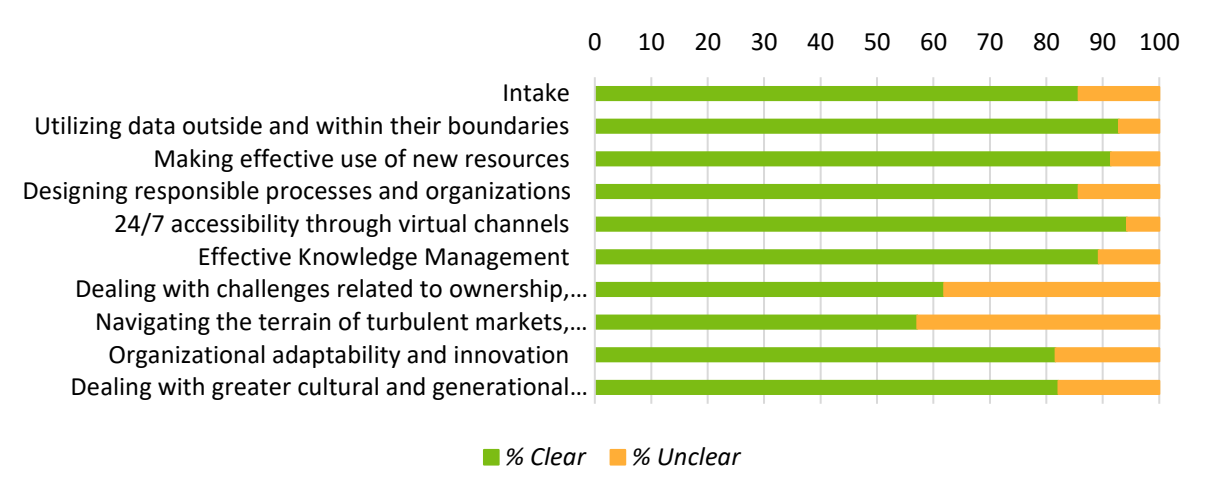
Figure 34: Comprehensibility of statements per EAC

The statements within the EAC: *"navigating the terrain of turbulent markets, complexity and uncertainty"* and *"dealing with challenges related to ownership, responsibility, roles, and power"* are mostly perceived as unclear. The statements within the EAC *"24/7 accessibility through virtual channels"* are the clearest. In general, it can be concluded that the statements are perceived as clear overall with an average score of >80%, while there is still room for improvement within certain EACs.

Answer to sub-question F:
In order to determine the usability of the instrument, the results have been processed both quantitatively and qualitatively with the following results:

- The quantitative analysis shows that there is a difference in the way the two groups assess certain EACs. The architects are predominantly more positive about EAC.1 and EAC.9, in contrast to the team members who judge these EACs considerably lower. However, there are also similarities between the two groups and the way in which EACs are assessed *(EAC.5, EAC.4 and EAC.7)*.
- The differences point to a competence gap and show that in terms of data, the two groups deviate the most from each other. Architects are more positive about the way data is utilized and new data resources are obtained than the development teams. Development teams experience that there is no data lineage across systems and that the use of data is not made accessible by complex processes and systems resulting in a lower score.
- The qualitative analysis shows that the assessment instrument is highlighting different aspects within each interview. This results in multidisciplinary insights that contribute to capturing how the organization is handling EACs.
- Throughout the qualitative analysis it is also possible to determine why a certain EAC is assessed positively or negatively because of the extensive coding process. In *Figure 35* the two lowest and highest scoring EACs are specified.
- Finally, the statements were assessed for comprehensibility, with two EACs scoring relatively low *(EAC.6 (62%) and EAC.8 (57%)*, all other EACs having a score of >80% and are therefore considered clear.

Based on these results, it can be concluded that the instrument can be regarded as useful when applied in practice. The tool leads to in-depth discussions with a central focus on the EACs.
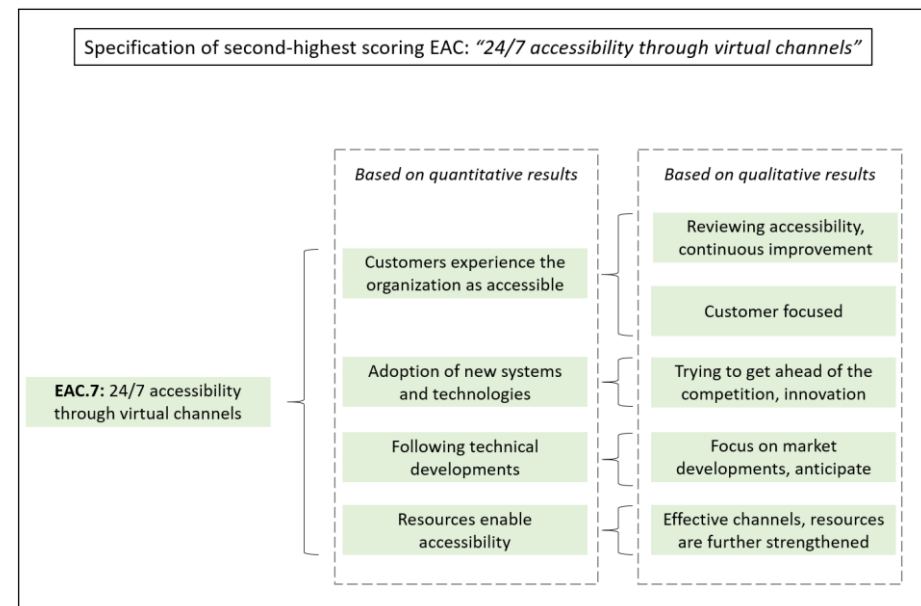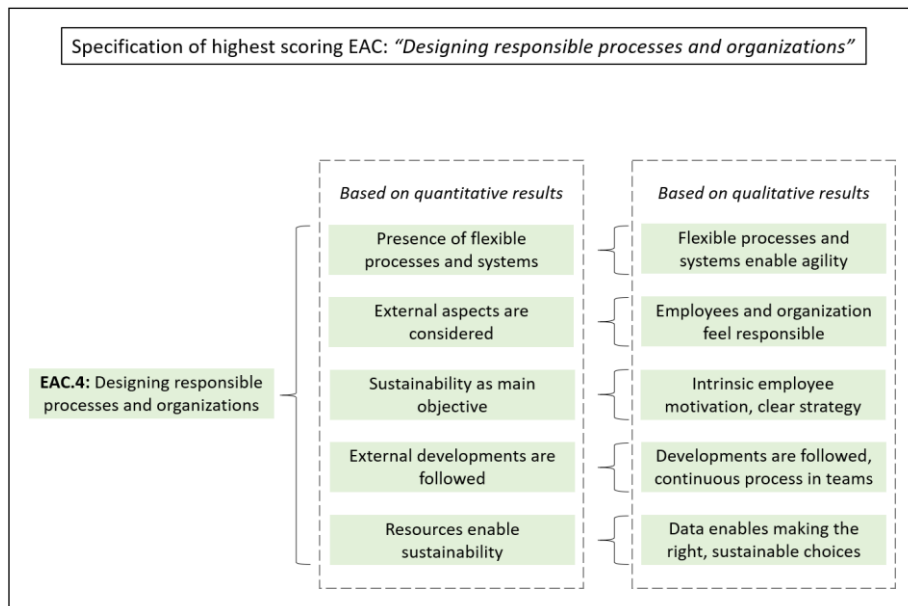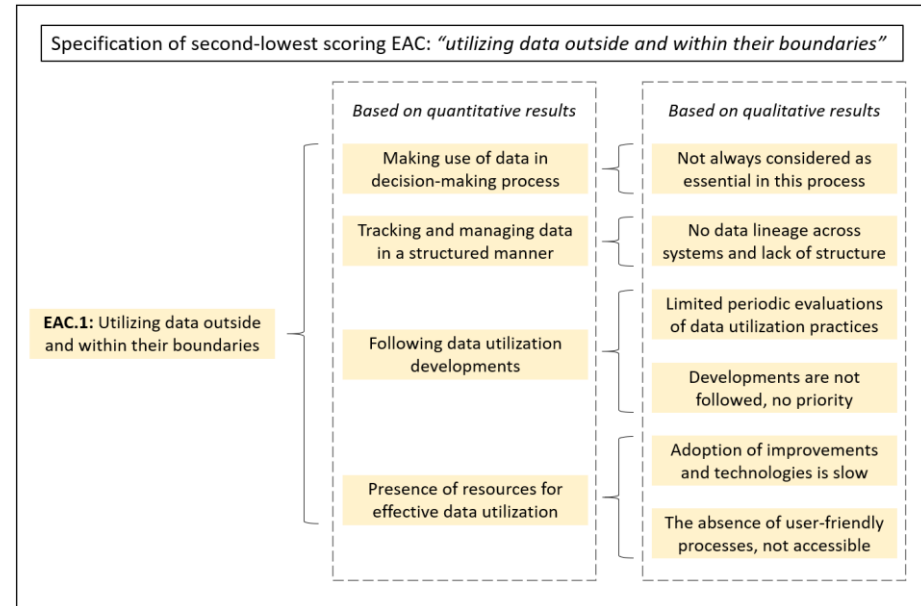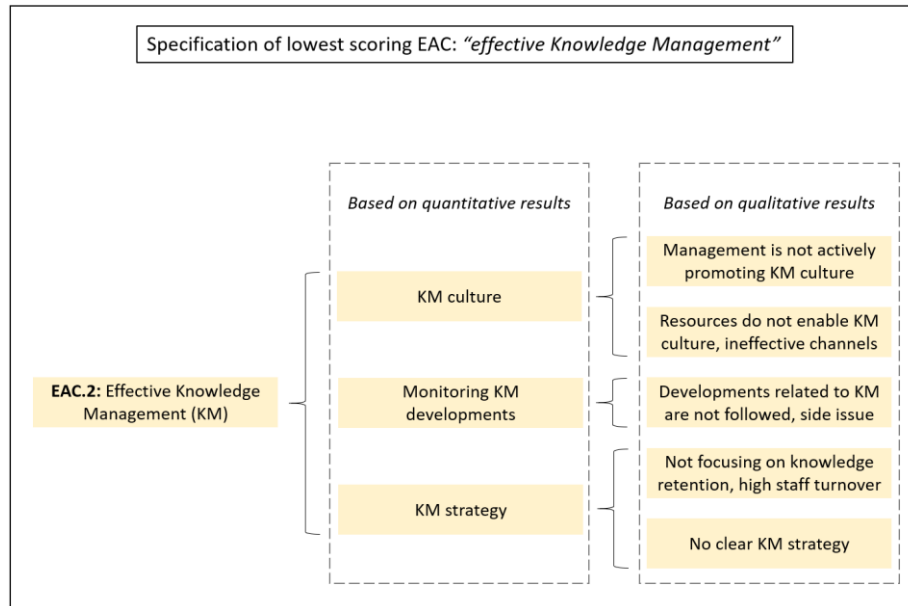
Figure 35: Overview of lowest and highest scoring EACs

6. What added value does the assessment instrument offer the organization when applied?

In this chapter the evaluation of the assessment instrument takes place. To be able to make a statement about the added value of the instrument, the degree of deepening that takes place per dimension is examined. The data used for this process can be consulted in *Appendix O*. By examining the logbook and the obtained feedback, it is possible to evaluate to what extent the instrument actually provides added value to the organization. The steps that comprise this process are shown in *Figure 36*.
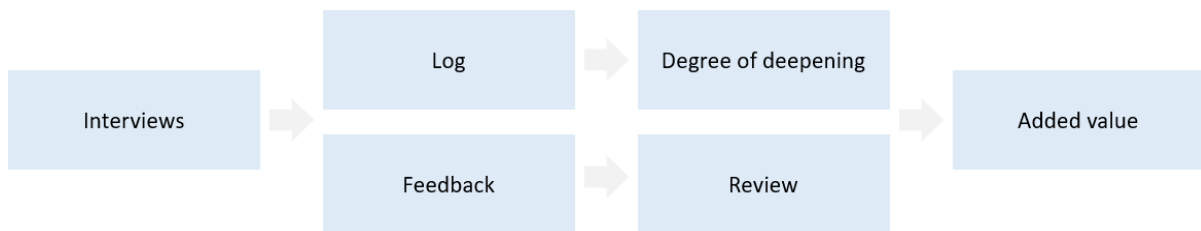
Figure 36: *Process for determining the added value of the organization*

6.1. Feedback from the participants

To give substance to the evaluation process, three evaluation questions have been included in the assessment instrument. At the end of each interview, the participant was asked to assess the instrument on three points, namely: structure, clarity and outcome. Based on these results it is possible to look at what additions can be made to further improve the assessment instrument and to determine whether the assessment instrument and associated results are considered as useful. The outcome of these evaluation questions is shown in *Figure 37*.
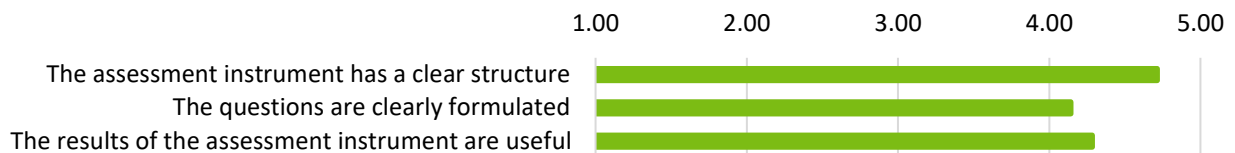
Figure 37: Assessment instrument evaluation scores

The interviewees were particularly pleased with the structure and the way in which the instrument was developed, including the layout, ease of use and simplicity. This part is therefore also rated as highest with an average rating of 4.71 out of 5. The clarity of the questions is rated slightly lower with an average of 4.14 out of 5. In particular, the length of some questions is perceived as unpleasant, especially the questions related to the presence of resources since these are the longest questions. Finally, the results of the instrument are assessed as useful with an average rating of 4.29 out of 5. The interviews revealed that the results and statements encourage thinking, evaluating, discussing and taking action. Although the organization has the necessary EAPs, it is still good to check whether the chosen strategy actually leads to a future-proof EA. Because the instrument can be used by various EA stakeholders, it is also considered accessible. This makes it relatively easy to examine the EACs that are central to the instrument from various angles. The disadvantage of an assessment instrument is that it is a snapshot. For example, it was often stated that the organization *"is working on it"*. On the other hand, the effort to fill the instrument is relatively minimal with an average completion time of 51 minutes including discussing the results. An overview of the average time it took to complete the instrument and discuss the results is shown in *Figure 38*.
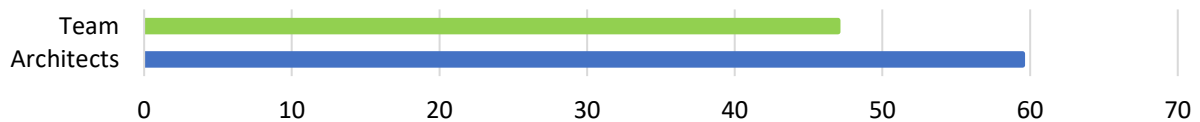
Figure 38: Average interview time in minutes, team versus architect

6.2. Added value

To determine the added value of the instrument, the average response per EAC was examined. Although the number of words does not represent a degree of added value, this unit of measure can indicate whether the EAC has been discussed substantively or not. This method should only be considered indicative because there is no scientific basis for this measurement method. *Figure 39* shows the average number of words per EAC.
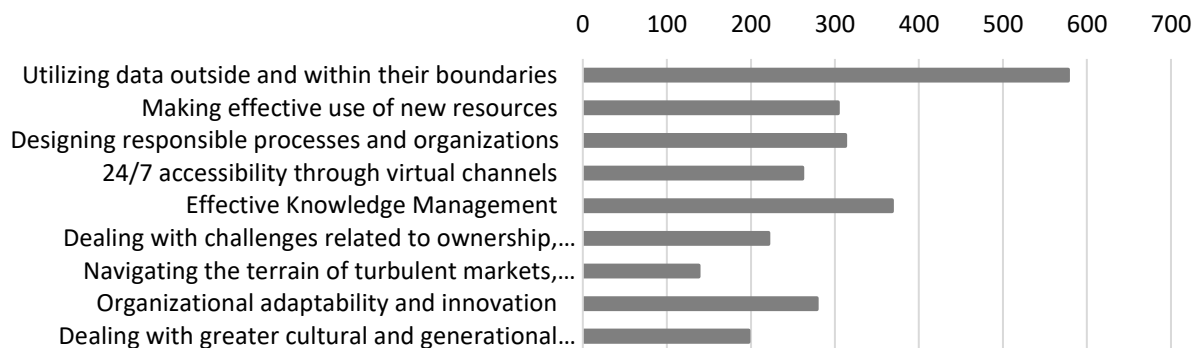
Figure 39: Average number of words per EAC

What is particularly striking is that the EAC: *"utilizing data outside and within their boundaries"* has relatively more words *(578)* compared to the other EACs. This is plausible as this is also one of the lowest rated EACs after *"effective Knowledge Management"* which comes second when it comes to the average number of words *(368)*. The EACs: *"navigating the terrain of turbulent markets, complexity and uncertainty"* and *"dealing with greater cultural and generational diversity"* have the lowest number of words on average *(138 and 197)*. This is due to the limited number of questions within these EACs *(3 and 4)*, but also due to the fact that the organization scores relatively well on these EACs, which results in less discussion and with this depth. This shows that EACs that do not score well are discussed relatively more, in contrast to EACs that do score well.

The average number of words can also be viewed from the perspective of the architect and the development team member as shown in *Figure 40*. By comparing these two groups, it is possible to assess whether there are differences in the way in which these two groups deal with the EAC and the corresponding discussion.

What stands out is that architects structurally engage in more in-depth discussions in contrast to the team members. This is plausible because of their role and their knowledge of EA in general. Only in two cases did team members have a larger average response. These are also EACs that are more *"general"* and where it is plausible that team members are more involved. This finding is interesting because it may be necessary to review the statements and adjust them in such a manner so that team members are also encouraged to provide a more comprehensive response. This improvement can be shaped by looking more closely at the focus area of the team members and taking this into account when developing the statements.
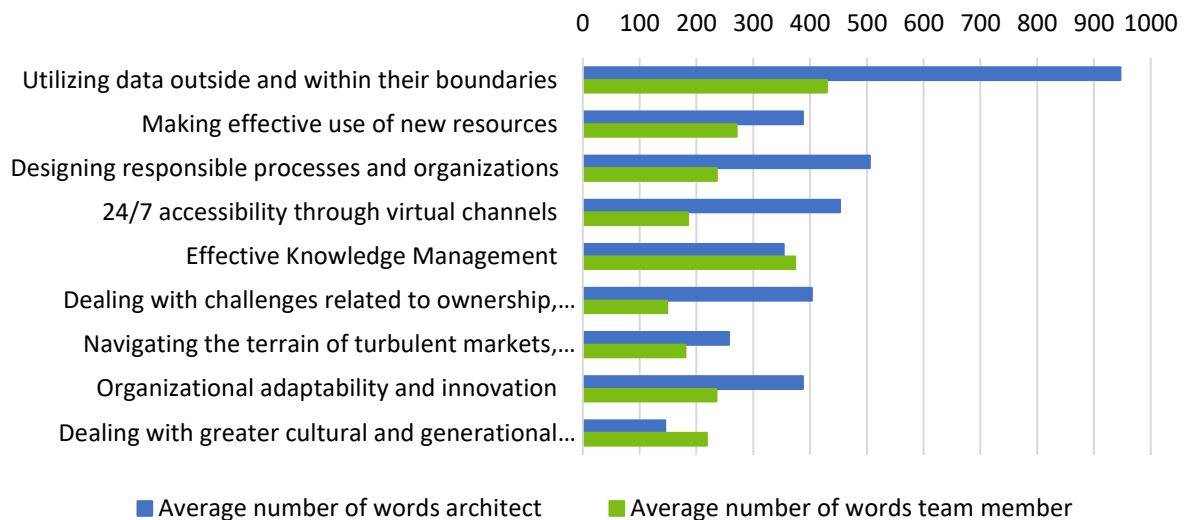
Figure 40: Average number of words, team versus architect

Finally, the degree of deepening was examined. This was done by evaluating the transcriptions, which are listed in *Appendix M* and assessing the coded MAXQDA data in *Appendix N*. Within this context there is a deepening when the participant engages into a discussion, elaborates on the content of the EAC, and in-depth questions are answered. The results are shown in *Figure 41*. The green bar shows how often there has been deepening within an EAC, the yellow bar illustrates how often this was not the case.
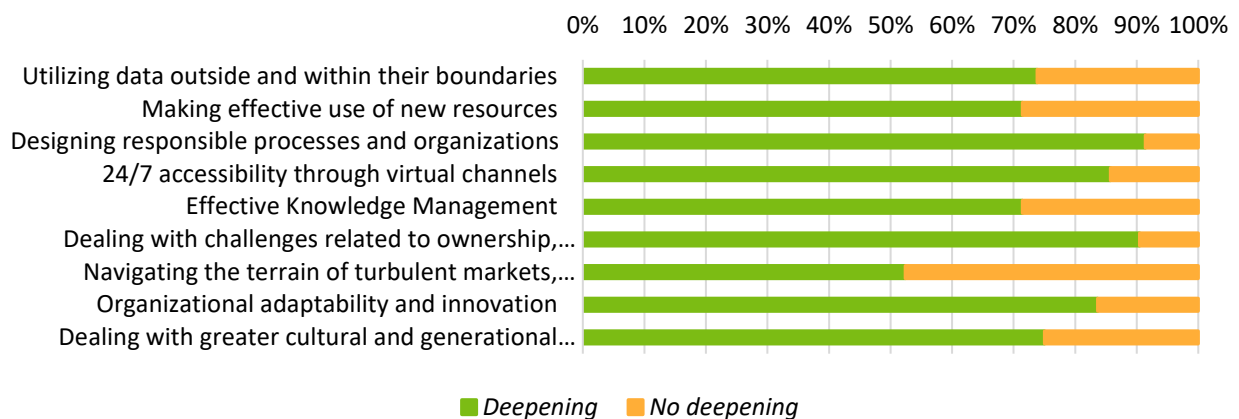
Figure 41: Degree of deepening per EAC

All EACs show signs of deepening, whereby the highest degree of deepening *(91%)* taken place at the EAC: *"designing responsible processes and organizations"*. The EAC *"navigating the terrain of turbulent markets, complexity and uncertainty"* scores as expected, based on the limited amount of words, low *(52%)* and challenges the participant the least. All other EACs show a deepening of between *71%* and *90%* where it can generally be concluded that the instrument encourages substantive discussions.

Answer to sub-question G:
The participants rated the assessment instrument with a 4.4 out of 5. The structure, results and ease of use are particularly appreciated. However, there is also room for improvement. In particular, the statements in the EAC *"navigating the terrain of turbulent markets and complexity"* and *"dealing with*

challenges related to ownership, responsibility, roles, and power" are most often experienced as unclear. The added value that the instrument provides can be found in the way that the instrument encourages thinking, evaluating and engaging discussions, since almost all EAC and the associated statements provide more depth *(highest rate of deepening: 91% and lowest 52%)*.

7. Discussion, conclusions and recommendations

7.1. Reflection - discussion

The study by Lapalme et al. (2016) describes 10 EACs that are expected to have an impact on the EAE of organizations. Additionally, Lapalme et al. (2016) also indicate that there is little evidence about the effectiveness of traditional EAPs in the context of these EACs. Hinkelmann et al. (2016) acknowledges this and indicates that EAPs will have to evolve in order to stay relevant. This theoretical knowledge has created the impression that the current EAPs are limited in the way they deal with EACs and that there is a need to evolve these EAPs.

This research shows that that the case study organization is experiencing EACs. However, the results also shown that current EAPs are able to cope with the majority of the EACs. When it comes to the evolution of EAPs, it can be concluded that this is not a conscious process that can be initiated at any moment. The evolution of EAPs is a long-term process that is based on the organizations EAPs, external developments and the ability to adapt.

The financial sector is described as a complex and uncertain environment. The COVID-19 crisis has only increased the degree of uncertainty and complexity for financial institutions. The research has shown that the organization has been able to respond adequately and effectively to the global COVID-19 crisis by adapting existing products and facilitating new products so that customers also able to take up this challenge. The participants did indicate that they were impressed by the way in which the organization responded to the COVID-19 crisis. However, before the crisis, the participants were significantly more negative about the presence of flexible processes and systems which enable the organization to respond to external changes. When this finding is compared with the EACs, it can be concluded that the organization is able to meet EACs as long as there is a focus and resources are allocated. As a result of the COVID-19 crisis, the evolution of EAPs may gain momentum, which means that organizations are forced to adapt and evolve their EAPs in order to survive.

The research has also shown that EAC.2: *"effective Knowledge Management"* is scoring low. Organizations are increasingly faced with knowledge retention challenges due to the way in which employees are recruited. By making use of external work forces who operate within the company for shorter periods, a lot of knowledge is lost. This acquisition-as-needed approach has adverse consequences on the management of organizational skill sets, organizational knowledge and intellectual property (Lapalme et al., 2016). A possible solution is a clear Knowledge Management strategy that focuses on the dissemination of knowledge in order to improve organizational performance. The results have shown that the absence of a clear strategy therefore results in a low scoring EAC.

EAC.1: *"utilizing data outside and within their boundaries"* also scores low. Data is not always considered as essential in the decision-making process. This is mainly due to the lack of usable data, data quality issues, and the way in which this data is obtained. Decisions usually have to be made quickly, but the processes for requesting data are complex and slow, so that data is often not used. A shift is currently taking place whereby organizations should not only use the data, which is under their own control, but also look at technological developments that make new data available such as the Internet of Things (IoT), the cloud and big data. However, due to legislation, GDPR and a complex legacy, the adoption of new systems is often slow. The organization agrees with Fang (2015) which describes Data Lakes as a potential solution for the EAC. However, an adoption period must be taken into account.

EAC.4: *"designing responsible processes and organizations"*, on the other hand, scores high. Through a clear strategy, the presence of flexible processes and systems and employee commitment, the organization is able to take people, environment and society into account. This is in line with what (Lapalme et al., 2016) describes in his research.

EAC.7: *"24/7 accessibility trough virtual channels"* also scores high. Through periodic reviews the organization is able to continuously improve their accessibility. Not always all feedback is processed immediately, but there is a backlog where the changes are managed tracked. New systems and

technologies are also continuously adopted to further improve this aspect. The organization focusses on 24/7 accessibility as proposed by Lapalme et al., (2016).

The quantitative analysis shows that there is a difference in the way the two groups assess certain EACs. The architects are predominantly more positive about EAC.1: *"utilizing data outside and within their boundaries"* and EAC.9: *"making effective use of new resources"*, in contrast to the development team members who judge these EACs considerably lower. Based on this, it can be concluded that there is a competence gap between the two groups in the field of communication. It is important here that the architects maintain good contact with the development teams in order to be aware of their needs. The study of Lapalme et al. (2016) describes the EACs, their characteristics, and how organizations should deal with them. However, limited attention is paid to the internal communication that is important in order to recognize the EACs so that they can be addressed internally.

7.2. Validity and reliability

The aim of this study is to measure EAE in the context of EACs. Based on scientific literature, 10 EACs have been identified that organizational EAPs must give substance to in order to achieve EAE. Since limited research has been done on EACs, it has been decided not to view the research by Lapalme et al. (2016) as an isolated means for determining EACs, but to look more broadly. Since the EACs are composed of various disciplines, including Knowledge Management, data utilization practices and accessibility, relevant studies have been consulted that provide more depth resulting in a stronger theoretical base on the basis of which clear measurement indicators have been drawn up. By using this approach, it is not only possible to give substance to validity aspects, but it is also possible to get a better understanding of the EAC and to learn more about how organizations can cope with these EACs. In the interviews, the EACs were considered recognizable by the participants, which also indicated that these are certainly issues that play a role within the organization.

In order to be able to measure EAE, it is important to determine what EAE means and how this phenomenon can be measured. Various scientific sources have been consulted to establish the definition of EAE. The definition of EAE has been set at the extent to which EAPs, and the results involved, contribute to organizational business goals.

By comparing different models for measuring EAE, it has been possible to make an appropriate choice. This was a very important decision as it can positively contribute to the construct validity. During this process, it has been determined that the EAEMM provides the best basis for measuring EAE within the context of EACs because of its clear structure. Although the EAEMM offers a good basis for measuring EACs and with this EAE, the instrument had to be adapted. After all, the instrument looks at the total EAE without applying a scope to EACs. By not including all dimensions, the risk arises that certain aspects are not observed that may also have a relationship with the EACs. However, the inclusion of all dimensions was not feasible as this would make the research too broad.

Defining the correct requirements, properties and indicators for the assessment instrument is a very important process since this is one of the key factors for measuring EAE. To structure this process, it was decided to use the DSRM as described by Wieringa (2014) and Ken Peffers et al., (2007). The advantage of this is that this method provides guidelines that are specifically drawn up for studies that take place in the information system focus area. In contrast to methods used for studies within management sciences (Saunders et al., 2016), the DSRM focusses on artefacts instead of predicting or explaining behaviour. Because artefacts are used, such as methods and techniques, within a certain context, it is possible to examine the performance of these artefacts. Threats that have a negative influence on construct validity have been considered during the translation of the EACs into requirements, properties, and indicators. For this, the requirements described by Wieringa (2014) have been adhered to mitigate risks such as inadequate definitions, construct confounding, mono-operation bias and mono-method bias. In the field of mono-method bias, an improvement could have been made, for example, the statements could have been drawn up from different perspectives so that participants would be given even more thought.

To ensure alignment between the assessment instrument and the case study organization, the assessment instrument is not only developed on the basis of theoretical insights but also on empirical findings. Based on a document analysis and two expert interviews with a lead solution architect, various improvements have been identified and processed resulting in a useful instrument that fits the case study organization. When applying the assessment tool, it emerged that it is sufficiently in line with the case study organization and the participating EA stakeholders.

Due to the DSRM, usability and added value were also considered. These were established by looking at the results, both quantitatively and qualitatively. These results show that the actual EAE is measured in the context of EACs. This has resulted in a considerable degree of depth. However, the intake questions of the assessment instrument should have been better formulated so that the differences between the two groups are even more emphasized.

For the analysis of the results, methods are used that are widely accepted in scientific studies. And by triangulating the results, it is ensured that the interpreted information actually also represents what it should represent in the context of this research (Saunders et al., 2016).

In the context of reliability, the following steps have been taken:
- In interviews, the findings were summarized per topic to verify whether the answers were correctly interpreted.
- During the evaluation process of the assessment instrument various improvements were identified using the multidisciplinary insights of the lead solution architect. The choice to only involve one expert in the interviews was a well-considered choice. Conducting the interview among various participants may have led to valuable improvement points from different perspectives. However, the choice to involve only one expert in the interviews has led to more depth. For example, points for improvement were identified in the first interview, discussed and incorporated into the assessment instrument afterwards. In the second interview, a verification took place in which the final assessment instrument was shown and discussed. Based on this process, a number of changes have been made that have led to a several improvements in structure and clarity, whereby the collected data is also fully utilized and visualized.
- Restrictive reporting is applied in this research. Due to the exploratory nature of this research, a single case study is used. The disadvantages of this is that the results can be generalized to a limited extent, resulting in a negative impact on external validity.
- In six of the seven interviews, the respondents indicated that the COVID-19 situation made them look at the organization differently. For example, almost all respondents indicated that the organization is able to respond quickly to external changes where participants were less positive about this point before the crisis. This again emphasizes that the assessment tool and the results can only be seen as a snapshot.

7.3. Conclusions

By applying the assessment instrument under two EA stakeholder groups *(business architects and development teams)*, it is possible to examined whether the current EAPs of the organization are contributing in the creation of business value and lead to EAE in the context of nine EACs. The following main research question has been formulated for the design of the research:

To what extent do current enterprise architecture practices contribute to enterprise architecture effectiveness in the context of enterprise architecture challenges?

Based on the results of this research, the following can be concluded:

- The theoretical research has shown that through five dimensions, including; internal monitoring, external monitoring, communication & understanding, partnership and readiness for change it is possible to determine the extent to which the organization has the appropriate competencies to cope with the nine incorporated EACs.

- The assessment instrument shows the presence or absence of EA competencies. Based on this, it can be determined whether the organization is able to cope with EACs.

- By comparing the EA competencies between both business and IT, it is possible to identify a competence gap. This promotes further discussion, evaluation and learning.

- A qualitative analysis shows that different dimensions are discussed and highlighted per participant. Based on this, valuable results are obtained and in-depth discussions are held.

- An analysis of comprehensibility shows that the statements are perceived as clear with an average score of 82.2%. The assessment instrument is also positively assessed by the participants with an average score of 4.4 out of 5.

- The added value that the assessment instrument provides can be found in the way that the instrument encourages thinking, evaluating and engaging discussions, since almost all EAC and the associated statements provide more depth *(highest rate of deepening: 91% and lowest 52%)*.

- When it comes to the evolution of EAPs, it can be concluded that this is not a conscious process that can be initiated at any moment. The evolution of EAPs is a long-term process that is based on the organizations EAPs, external developments and the ability to adapt.

- The EAPs largely enable the organization to deal with the EACs. The current EAPs facilitate the most in EAC.4: *"designing responsible processes and organizations"* and EAC.7: *"24/7 accessibility through virtual channels"*. A clear strategy, the presence of flexible processes and systems, and a customer-oriented focus are mainly determining factors in this.

- In contrast, current EAPs are mostly challenged by EAC.2: *"effective Knowledge Management"* and EAC.1: *"utilizing data outside and within their boundaries"*. This is mainly because there is no clear KM strategy present resulting in the absence of a KM culture.

- A competence gap has been found between the architects and development teams which shows that communication between departments is of great importance to be able to cope with EACs.

7.4. Practice recommendations

Data is essential when it comes to decision making and the transformation process, for this reason it is important that the organization manages and tracks their data. The organization should not only use the data, which is under their own control, but also look at technological developments that make new data available such as the Internet of Things (IoT), the cloud and big data. The organization will therefore have to critically evaluate their process of how they utilize their data and work towards a method whereby data sets are not only viewed and understood individually *(isolated)*, but also integrated and combined across other data sets in order to produce useful information that can be used to gain competitive advantage. Although the organization has data quality issues, it is important that Data Lakes are adopted. A Data Lake consists of multi-structured and unstructured data that represents an (still) unrecognizable value for the organization. A Data Lake methodology is a potential solution for the EAC: *"utilizing data outside and within their boundaries"*. This methodology can, among other things, provide for the transformation process of data, the structuring of data, the storage of data and the implementation of new types of data processing which can potentially lead to competitive advantage.

The EAC: *"effective Knowledge Management"* relates to employees which are considered as an inventory set that traditionally fell completely under the control of the organization. The challenge here lies in the way in which employees are recruited, with a strong focus on acquisition-as-needed. However, the acquisition-as-needed approach will also have adverse consequences on the management of organizational skill sets, organizational knowledge and intellectual property. The organization should therefore adopt a clear Knowledge Management (KM) strategy which also takes into account knowledge retention. This strategy will help the organisation with the dissemination of knowledge across departments.

Finally, the organization should take a good look at the way in which different EA stakeholders communicate with each other. Communication is the determining factor when it comes to the realization of EAE through EAPs. When the business architects are not aware of what is going on within the organization, they are also unable to provide an EA which suits the needs of development teams. Although there are periodic meetings in which there is communication with the various EA stakeholders, it is important that the right items are on the agenda. For this, the organization must periodically review its EAPs critically so that the correct improvements can be implemented. In this way, the organization continues to work on an EA that can continue to withstand the EACs.

7.5. Recommendations for further research

The results show that communication between different EA stakeholders is insufficient. The risk of this is that EACs are not discussed in time, resulting in an ineffective EAPs. For this reason, ways to improve this communication should be looked at. Based on the obtained data it is possible to further improve the assessment instrument so that even more depth can be obtained. In addition, it is also possible to adjust the instrument in such a way that a survey is developed. By means of this survey, a periodic assessment can be performed on EAE, which makes it possible to manage and track EAC developments. Finally, the assessment instrument can be applied to other organizations and departments to further increase the external validity of the instrument.

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        179–201. https://doi.org/10.2307/259118

Appendix A: Implementation of the literature search strategy

The literature search strategy is implemented in this section. For each sub-question it is indicated which parameters have been applied, which results this has yielded, and finally which articles have been selected. For completeness, it is also indicated which snowball articles have been selected.

Search results sub-question A

Table 1 and *Table 2* show the search results that relate to sub-question A.

Table 1: Open University search results sub-question A

Research question	Online database	Discipline	Language	Literature type	Review	Availability	Search term(s) text	AND / OR	Contains	Search term(s) title	AND / OR	Search term(s) title	Contains	Publication date	Search date	Number of articles	Link to search URL
A	OU Library	All	English	Journal	Peer	Open Access	Definition enterprise architecture	-	-	-	-	-	-	>2015	18/11/2019	5.031	Link
A	OU Library	All	English	Journal article	Peer reviewed	Open Access	Definition enterprise architecture	AND	Any of these words	Definition enterprise architecture	-	-	-	>2015	18/11/2019	326	Link
A	OU Library	Architecture	English	Journal article	Peer reviewed	Open Access	Definition enterprise architecture	AND	Any of these words	Definition enterprise architecture	-	-	-	>2015	18/11/2019	85	Link
A	OU Library	Architecture	English	Journal article	Peer reviewed	Open Access	Definition enterprise architecture	AND	Any of these words	Definition enterprise architecture	AND	Enterprise architecture	Exact match	>2015	22/11/2019	12	Link

Table 2: Google Scholar search results sub-question A

Research question	Online database	Search term(s)	Search in text or title	Exact phrase	Publication date	Search date	Number found	Of which quoted ten times or more	Link to search URL
A	Google Scholar	Definition enterprise architecture	Text	-	>2015	27/12/2019	18.900	-	Link
A	Google Scholar	Definition enterprise architecture	Title	-	>2015	27/12/2019	6	0	Link
A	Google Scholar	-	Text	Definition enterprise architecture	>2015	27/12/2019	20	1	Link

Table 3 shows a total overview of articles that have been selected for further evaluation based on the search results. After the assessment it was decided to select 5 articles for answering sub-question A. Because the snowball method has been applied within the selected articles, this has led to additional valuable articles. An overview of selected snowball articles can be found in *Table 4*.

Table 3: Selected Google Scholar & Open University articles regarding sub-question A

Article number	APA reference	Selected?
OU/A.1	Bojinov, B. V. (2016). *Enterprise architecture in the company management framework*. Problemy Ekonomiky, 4(4), 98-106.	No
OU/A.2	Lapalme, J., Gerber, A., Van der Merwe, A., Zachman, J., Vries, M. D., & Hinkelmann, K. (2016). *Exploring the future of enterprise architecture: A zachman perspective. Computers in Industry*, 79, 103-113. doi:10.1016/j.compind.2015.06.010	**Yes**
OU/A.3	Hinkelmann, K., Gerber, A., Karagiannis, D., Thoenssen, B., van der Merwe, A., & Woitsch, R. (2016). *A new paradigm for the continuous alignment of business and IT: Combining enterprise architecture modelling and enterprise ontology.* Computers in Industry, *79,* 77-86. doi:10.1016/j.compind.2015.07.009	No
OU/A.4	Budiman, K., Prahasto, T., & Kusumawardhani, A. (2018). *Enterprise architecture planning in developing A planning information system: A case study of Semarang State University.* E3S Web of Conferences, 31, 11002. doi:10.1051/e3sconf/20183111002	**Yes**
OU/A.5	Gong, Y., & Janssen, M. (2019). *The value of and myths about enterprise architecture.* International Journal of Information Management, 46, 1-9. doi:10.1016/j.ijinfomgt.2018.11.006	**Yes**
OU/A.6	Azevedo, C. L. B., Iacob, M., Almeida, J. P. A., van Sinderen, M., Pires, L. F., & Guizzardi, G. (2015). *Modeling resources and capabilities in enterprise architecture: A well-founded ontology-based proposal for ArchiMate.* Information Systems, 54, 235-262. doi:10.1016/j.is.2015.04.008	No
OU/A.7	Foorthuis, R., van Steenbergen, M., Brinkkemper, S., & Bruls, W. (2016). *A theory building study of enterprise architecture practices and benefits*. Information Systems Frontiers, 18(3), 541-564. doi:10.1007/s10796-014-9542-1	**Yes**
OU/A.8	Vargas, A., Vargas, A., Cuenca, L., Cuenca, L., Boza, A., Boza, A., . . . Moisescu, M. (2016). *Towards the development of the framework for inter sensing enterprise architecture.* Journal of Intelligent *Manufacturing*, 27(1), 55-72. doi:10.1007/s10845-014-0901-z	No

OU/A.9	Bernaert, M., Bernaert, M., Poels, G., Poels, G., Snoeck, M., Snoeck, M., . . . De Backer, M. (2016). *CHOOSE: Towards a metamodel for enterprise architecture in small and medium-sized enterprises.* Information Systems Frontiers, 18(4), 781-818. doi:10.1007/s10796-015-9559-0	No
OU/A.10	Hussein, R. (2017). *The promise of enterprise architecture for global health informatics*. Journal of Medical Systems, 41(7), 1-3. doi:10.1007/s10916-017-0756-x	No
OU/A.11	Ilin', I., Levina, A., & Iliashenko, O. (2017). *Enterprise architecture approach to mining companies engineering.* MATEC Web of Conferences, 106, 8066. doi:10.1051/matecconf/201710608066	No
OU/A.12	Gomes, R. S. (2016). *Resilience and enterprise architecture in SMEs.* Journal of Information Systems and Technology Management, 12(3) doi:10.4301/S1807-17752015000300002	No
GS/A.1	Gampfer, F., Jürgens, A., Müller, M., & Buchkremer, R. (2018). *Past, current and future trends in enterprise architecture—A view beyond the horizon.* Computers in Industry, 100, 70-84.	**Yes**

Table 4: Selected snowball articles for sub-question A

Extracted from key article number	Snowball article number	APA Citation
OU/A.2	*OU/SA.A2.1*	Jallow, A. K., Demian, P., Anumba, C. J., & Baldwin, A. N. (2017). An enterprise architecture framework for electronic requirements information management. *Elsevier*, (37), 455–472.
OU/A.5	*OU/SA.A5.1*	Schekkerman, J. (2003). *How to survive in the jungle of enterprise architecture frameworks: Creating or choosing an enterprise architecture framework* (2nd ed.). Bloomington, Indiana: Trafford Publishing.
	OU/SA.A5.2	DoD (2010). *The DoDAF architecture framework version 2.02.* DoD Deputy Chief Information Officer.
OU/A.7	*OU/SA.A7.1*	Jonkers, H., Lankhorst, M. M., Ter Doest, H. W. L., Arbab, F., Bosma, H., & Wieringa, R. J. (2006). Enterprise architecture: Management tool and blueprint for the organisation. *Information Systems Frontiers*, 8(2), 63–66. https://doi.org/10.1007/s10796-006-7970-2
	OU/SA.A7.2	Ross, J.W.,Weill, P., & Robertson, D. (2006). *Enterprise architecture as strategy: Creating a foundation for business execution.* Boston: Harvard Business School Press.
GS/A.2	*GS/SA.A2.1*	Jallow, A. K., Demian, P., Anumba, C. J., & Baldwin, A. N. (2017). *An enterprise architecture framework for electronic requirements information management. Elsevier*, (37), 455–472.
GS/A.5	*GS/SA.A5.1*	Schekkerman, J. (2003). *How to survive in the jungle of enterprise architecture frameworks: Creating or choosing an enterprise architecture framework* (2nd ed.). Bloomington, Indiana: Trafford Publishing.
	GS/SA.A5.2	DoD (2010). *The DoDAF architecture framework version 2.02.* DoD Deputy Chief Information Officer.
GS/A.7	*GS/SA.A7.1*	Jonkers, H., Lankhorst, M. M., Ter Doest, H. W. L., Arbab, F., Bosma, H., & Wieringa, R. J. (2006). *Enterprise architecture: Management tool and blueprint for the organisation. Information Systems Frontiers*, 8(2), 63–66. https://doi.org/10.1007/s10796-006-7970-2
	GS/SA.A7.2	Ross, J.W.,Weill, P., & Robertson, D. (2006). *Enterprise architecture as strategy: Creating a foundation for business execution.* Boston: Harvard Business School Press.

Search results sub-question B

Table 5 and *Table 6* show the search results that relate to sub-question B.

Table 5: Open University search results sub-question B

Research question	Online database	Discipline	Language	Literature type	Review	Availability	Search term(s) text	AND / OR	Contains	Search term(s) title	AND / OR	Search term(s) title	Contains	Publication date	Search date	Number of articles	Link to search URL
B	OU Library	All	English	Journal	Peer	Open Access	Challenges enterprise architecture	-	-	-	-		-	>2015	22/11/2019	7.258	Link
B	OU Library	All	English	Journal article	Peer reviewed	Open Access	Challenges enterprise architecture	AND	Any of these words	Challenges enterprise architecture	-	-	-	>2015	22/11/2019	801	Link
B	OU Library	Architecture	English	Journal article	Peer reviewed	Open Access	Challenges enterprise architecture	AND	Any of these words	Challenges enterprise architecture	-	-	-	>2015	22/11/2019	137	Link
B	OU Library	Architecture	English	Journal article	Peer reviewed	Open Access	Challenges enterprise architecture	AND	Any of these words	Challenges enterprise architecture	AND	Enterprise architecture	Exact match	>2015	22/11/2019	11	Link

Table 6: Google Scholar search results sub-question B

Research question	Online database	Search term(s)	Search in text or title	Exact phrase	Publication date	Search date	Number found	Of which quoted ten times or more	Link to search URL
B	Google Scholar	Challenges enterprise architecture	Text	-	>2015	27/12/2019	53.400	-	Link
B	Google Scholar	Challenges enterprise architecture	Title	-	>2015	27/12/2019	25	3	Link

Table 7 shows a total overview of articles that have been selected for further evaluation based on the search results. After the assessment it was decided to select 4 articles for answering sub-question B. Because the snowball method has been applied within the selected articles, this has led to additional valuable articles. An overview of selected snowball articles can be found in *Table 8*.

Table 7: Selected Google Scholar & Open University articles regarding sub-question B

Article number	APA reference	Selected?
OU/B.1	Lapalme, J., Gerber, A., Van der Merwe, A., Zachman, J., Vries, M. D., & Hinkelmann, K. (2016). *Exploring the future of enterprise architecture: A Zachman perspective.* Computers in Industry, 79, 103-113. doi:10.1016/j.compind.2015.06.010	Yes
OU/B.2	Hinkelmann, K., Gerber, A., Karagiannis, D., Thoenssen, B., van der Merwe, A., & Woitsch, R. (2016). *A new paradigm for the continuous alignment of business and IT: Combining enterprise architecture modelling and enterprise ontology.* Computers in Industry, 79, 77-86. doi:10.1016/j.compind.2015.07.009	Yes
OU/B.3	Gong, Y., & Janssen, M. (2019). *The value of and myths about enterprise architecture.* International Journal of Information Management, 46, 1-9. doi:10.1016/j.ijinfomgt.2018.11.006	No
OU/B.4	Vargas, A., Vargas, A., Cuenca, L., Cuenca, L., Boza, A., Boza, A., . . . Moisescu, M. (2016). *Towards the development of the framework for inter sensing enterprise architecture.* Journal of Intelligent Manufacturing, 27(1), 55-72. doi:10.1007/s10845-014-0901-z	No
OU/B.5	Azevedo, C. L. B., Iacob, M., Almeida, J. P. A., van Sinderen, M., Pires, L. F., & Guizzardi, G. (2015). *Modeling resources and capabilities in enterprise architecture: A well-founded ontology-based proposal for ArchiMate.* Information Systems, 54, 235-262. doi:10.1016/j.is.2015.04.008	No
OU/B.6	Ilin', I., Levina, A., & Iliashenko, O. (2017). *Enterprise architecture approach to mining companies engineering.* MATEC Web of Conferences, 106, 8066. doi:10.1051/matecconf/201710608066	No
OU/B.7	Hussein, R. (2017). *The promise of enterprise architecture for global health informatics.* Journal of Medical Systems, 41(7), 1-3. doi:10.1007/s10916-017-0756-x	No
OU/B.8	Gomes, R. S. (2016). *Resilience and enterprise architecture in SMEs.* Journal of Information Systems and Technology Management, 12(3) doi:10.4301/S1807-17752015000300002	No

Extracted from key article number		APA Citation	
OU/B.9		Searle, S. (2018). *The benefits of enterprise architecture for library technology management: An exploratory case study.* Information Technology and Libraries, 37(4), 27-46. doi:10.6017/ital.v37i4.10437	No
OU/B.10		Alaeddini, M., Asgari, H., Gharibi, A., & Rashidi Rad, M. (2017). *Leveraging business-IT alignment through enterprise architecture—an empirical study to estimate the extents.* Information Technology and Management, 18(1), 55-82. doi:10.1007/s10799-016-0256-6	No
OU/B.11		Sajid, M., Ahsan, K., & Federal Urdu University of Arts, Science and Technology, Karachi, Pakistan. (2016). *Role of enterprise architecture in healthcare organizations and knowledge-based medical diagnosis system.* Journal of Information Systems and Technology Management, 13(2), 181-192. doi:10.4301/S1807-17752016000200002	No
GS/B.1		Olsen, D. H., & Trelsgård, K. (2016). *Enterprise Architecture adoption challenges: An exploratory case study of the Norwegian higher education sector.* Procedia Computer Science, 100, 804-811.	**Yes**
GS/B.2		Szabó, Z., & Öri, D. (2017, December). *Information strategy challenges in the digital era how enterprise architecture management can support strategic IS planning.* In 2017 11th International Conference on Software, Knowledge, Information Management and Applications (SKIMA) (pp. 1-8). IEEE.	No
GS/B.3		Olsen, D. H. (2017). *Enterprise architecture management challenges in the Norwegian health sector.* Procedia computer science, 121, 637-645.	**Yes**

Table 8: Selected snowball articles for sub-question B

Extracted from key article number	Snowball article number	APA Citation
OU/B.2	*OU/SA.B2.1*	Giachetti, R. (2016). *Design of enterprise systems: Theory, architecture, and methods.* CRC Press.
OU/B.1	*OU/SA.B1.1*	Fang, H. (2015, June). *Managing data lakes in big data era: What's a data lake and why has it became popular in data management ecosystem.* In 2015 IEEE International Conference on Cyber Technology in Automation, Control, and Intelligent Systems (CYBER) (pp. 820-824). IEEE.
	OU/SA.B1.2	Girard, J., & Girard, J. (2015). *Defining knowledge management: Toward an applied compendium.* Online Journal of Applied Knowledge Management, 3(1), 1-20.
	OU/SA.B1.3	Dell, C. O., & Gray, C. J. (2014). *If Only We Knew What We Know : Identification and Transfer of Internal Best Practices.* California Management Review, 40(3), 154–174
	OU/SA.B1.4	Lepisto, D. A., & Pratt, M. G. (2017). *Meaningful work as realization and justification: Toward a dual conceptualization.* Organizational Psychology Review, 7(2), 99-121.
	OU/SA.B1.5	Kahn, W. A. (1990). *Psychological conditions of personal engagement and disengagement at work.* Academy of management journal, 33(4), 692-724.
	OU/SA.B1.6	Hackman, J. R., & Oldham, G. R. (1975). *Development of the job diagnostic survey.* Journal of Applied psychology, 60(2), 159.
	OU/SA.B1.7	Wrzesniewski, A., & Dutton, J. E. (2001). *Crafting a job: Revisioning employees as active crafters of their work.* Academy of management review, 26(2), 179-201.
	OU/SA.B1.8	Chau, T., Maurer, F., & Melnik, G. (2003, June). *Knowledge sharing: Agile methods vs. tayloristic methods.* In WET ICE 2003. Proceedings. Twelfth IEEE International Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises, 2003. (pp. 302-307). IEEE.
	OU/SA.B1.9	Backes-Gellner, U., & Pull, K. (2013). *Tournament compensation systems, employee heterogeneity, and firm performance.* Human Resource Management, 52(3), 375-398.

	OU/SA.B1.10	Voorberg, W. H., Bekkers, V. J., & Tummers, L. G. (2015). *A systematic review of co-creation and co-production: Embarking on the social innovation journey.* Public Management Review, 17(9), 1333-1357.
	OU/SA.B1.11	Kolk, A., Van Tulder, R., & Kostwinder, E. (2008). *Business and partnerships for development.* European Management Journal, 26(4), 262-273.
	OU/SA.B1.12	Informatics and Creative Multimedia, ICICM 2013, 1–6. https://doi.org/10.1109/ICICM.2013.9 Satell, G. (2014). Managing For Disruption. Retrieved January 5, 2020, from https://www.creativitypost.com/index.php?p=business/managing_for_disruption
	OU/SA.B1.13	Fowler, M. (2002). *Patterns of enterprise application architecture.* Addison-Wesley Longman Publishing Co., Inc..
	OU/SA.B1.14	Staber, U., & Sydow, J. (2002). *Organizational adaptive capacity: A structuration perspective.* Journal of management inquiry, 11(4), 408-424.
	OU/SA.B1.15	Anthony, S. D., Viguerie, S. P., & Waldeck, A. (2016). *Corporate longevity: Turbulence ahead for large organizations.* Strategy & Innovation, 14(1), 1-9.
	OU/SA.B1.16	Waldrop, M. M. (2016). *The chips are down for Moore's law.* Nature News, 530, 144.
	OU/SA.B1.17	Theis, T. N., & Wong, H. S. P. (2017). *The end of moore's law: A new beginning for information technology.* Computing in Science & Engineering, 19(2), 41.
	OU/SA.B1.18	Moore, G. E. (1965). *Cramming more components onto integrated circuits*.
	OU/SA.B1.19	Moore, G. E. (1975, December). *Progress in digital integrated electronics.* In Electron Devices Meeting (Vol. 21, pp. 11-13).
GS/B.1	*GS/SA.B1.1*	Rouhani, B. D., Mahrin, M. N., Nikpay, F., & Nikfard, P. (2013, September). *A comparison enterprise architecture implementation methodologies*. In 2013 International Conference on Informatics and Creative Multimedia (pp. 1-6). IEEE.
GS/B.1	*GS/SA.B1.2*	Haki, K., Legner, C., & Ahlemann, F. (2012). *Beyond EA frameworks: Towards an understanding of the adoption of enterprise architecture management.* Association for Information Systems.
GS/B.1	*GS/SA.B1.3*	Nikpay, F., Ahmad, R. B., Rouhani, B. D., Mahrin, M. N. R., & Shamshirband, S. (2017). *An effective enterprise architecture implementation methodology.* Information Systems and e-Business Management, 15(4), 927-962.

Search results sub-question C

Table 9 and *Table 10* show the search results that relate to sub-question C.

Table 9: Open University search results sub-question C

Research question	Online database	Discipline	Language	Literature type	Review	Availability	Search term(s) text	AND / OR	Contains	Search term(s) title	AND / OR	Search term(s) title	Contains	Publication date	Search date	Number of articles	Link to search URL
C	OU Library	All	English	Journal	Peer	Open	Effectiveness enterprise architecture	-	-	-	-	-	-	>2015	1/7/2020	3.890	Link
C	OU Library	All	English	Journal article	Peer reviewed	Open Access	Effectiveness enterprise architecture	AND	Any of these words	Effectiveness enterprise architecture	-	-	-	>2015	1/7/2020	239	Link
C	OU Library	Architecture	English	Journal article	Peer reviewed	Open Access	Effectiveness enterprise architecture	AND	Any of these words	Effectiveness enterprise architecture	-	-	-	>2015	1/7/2020	43	Link
C	OU Library	Architecture	English	Journal article	Peer reviewed	Open Access	Effectiveness enterprise architecture	AND	Any of these words	Effectiveness enterprise architecture	AND	Enterprise architecture	Exact match	>2015	1/7/2020	7	Link

Table 10: Google Scholar search results sub-question C

Research question	Online database	Search term(s)	Search in text or title	Exact phrase	Publication date	Search date	Number found	Of which quoted ten times or more	Link to search URL
C	Google Scholar	Effectiveness enterprise architecture	Text	-	>2015	12/28/2019	45	-	Link
C	Google Scholar	Effectiveness enterprise architecture	Title	-	>2015	12/28/2019	6	1	Link

Table 11 shows a total overview of articles that have been selected for further evaluation based on the search results. After the assessment it was decided to select 3 articles for answering sub-question C. Because the snowball method has been applied within the selected articles, this has led to additional valuable articles. An overview of selected snowball articles can be found in *Table 12*.

Table 11: Selected Google Scholar & Open University articles regarding sub-question C

Article number	APA reference	Selected?
OU/C.1	Budiman, K., Prahasto, T., & Kusumawardhani, A. (2018). Enterprise architecture planning in developing A planning information system: A case study of Semarang State University. E3S Web of Conferences, 31, 11002. doi:10.1051/e3sconf/20183111002	No
OU/C.2	Foorthuis, R., van Steenbergen, M., Brinkkemper, S., & Bruls, W. (2016). A theory building study of enterprise architecture practices and benefits. Information Systems Frontiers, 18(3), 541-564. doi:10.1007/s10796-014-9542-1	Yes
OU/C.3	Alaeddini, M., Asgari, H., Gharibi, A., & Rashidi Rad, M. (2017). Leveraging business-IT alignment through enterprise architecture—an empirical study to estimate the extents. Information Technology and Management, 18(1), 55-82. doi:10.1007/s10799-016-0256-6	Yes
OU/C.4	Bernaert, M., Bernaert, M., Poels, G., Poels, G., Snoeck, M., Snoeck, M., . . . De Backer, M. (2016). CHOOSE: Towards a metamodel for enterprise architecture in small and medium-sized enterprises. Information Systems Frontiers, 18(4), 781-818. doi:10.1007/s10796-015-9559-0	No
OU/C.5	Ilin', I., Levina, A., & Iliashenko, O. (2017). Enterprise architecture approach to mining companies engineering. MATEC Web of Conferences, 106, 8066. doi:10.1051/matecconf/201710608066	No
OU/C.6	Gomes, R. S. (2016). Resilience and enterprise architecture in SMEs. Journal of Information Systems and Technology Management, 12(3) doi:10.4301/S1807-17752015000300002	No
OU/C.7	Sajid, M., Ahsan, K., & Federal Urdu University of Arts, Science and Technology, Karachi, Pakistan. (2016). Role of enterprise architecture in healthcare organizations and knowledge-based medical diagnosis system. Journal of Information Systems and Technology Management, 13(2), 181-192. doi:10.4301/S1807-17752016000200002	No
GS/C.1	Nikpay, F., Ahmad, R. B., Rouhani, B. D., Mahrin, M. N. R., & Shamshirband, S. (2017). An effective enterprise architecture implementation methodology. Information Systems and e-Business Management, 15(4), 927-962.	Yes

Table 12: Selected snowball articles for sub-question C

Extracted from key article number	Snowball article number	APA Citation
OU/C.2	*OU/SA.C2.1*	Steenbergen, M. V. (2011). *Maturity and effectiveness of enterprise architecture* (Doctoral dissertation, Utrecht University).
	OU/SA.C2.2	Tamm, T., Seddon, P. B., Shanks, G., & Reynolds, P. (2011). *How does enterprise architecture add value to organisations?* Communications of the association for information systems, 28(1), 10.
	OU/SA.C2.3	Ross, J.W., Weill, P., & Robertson, D. (2006). *Enterprise architecture as strategy: Creating a foundation for business execution.* Boston: Harvard Business School Press.
	OU/SA.C2.4	Van der Raadt, B., Bonnet, M., Schouten, S., & Van Vliet, H. (2010). *The relation between EA effectiveness and stakeholder satisfaction.* Journal of Systems and Software, 83(10), 1954-1969.

In-depth explanation of EA challenges

EAC.1 - Data is essential when it comes to decision making and the transformation process, for this reason it is important that organizations manage and track their data. A shift is currently taking place whereby organizations should not only use the data, which is under their own control, but also look at technological developments that make new data available such as the Internet of Things (IoT), the cloud and big data. Organizations will therefore have to critically evaluate their process of how they utilize their data and work towards a method whereby data sets are not only viewed and understood individually (isolated), but also integrated and combined across other data sets in order to produce useful information that can be used to gain competitive advantage (Lapalme et al., 2016). Fang (2015) acknowledges that organizations need to review the way they utilize data, focusing specifically on Data Lakes. Fang (2015) describes a Data Lake as: *"a methodology enabled by a massive data repository based on low cost technologies that improves the capture, refinement, archival, and exploration of raw data within an enterprise"*. A Data Lake consists of multi-structured and unstructured data that represents an (still) unrecognizable value for the organization. A Data Lake methodology is a potential solution for the EAC: *"utilizing data outside and within their boundaries"*. This methodology can, among other things, provide for the transformation process of data, the structuring of data, the storage of data and the implementation of new types of data processing which can potentially lead to competitive advantage (Fang, 2015).

EAC.2 - The second EAC: *"effective Knowledge Management"* relates to employees which are also an inventory set that traditionally fell completely under the control of the organization. The challenge here lies in the way in which employees are recruited, with a strong focus on acquisition-as-needed. However, the acquisition-as-needed approach will also have adverse consequences on the management of organizational skill sets, organizational knowledge and intellectual property (Lapalme et al., 2016). Knowledge Management (KM) is a strategy that deals with the dissemination of knowledge within an organization with the aim of improving organizational performance (Dell & Gray, 2014). KM can fulfil this challenge by creating a culture in which knowledge sharing is promoted, this is achieved through policies, organizational structures, procedures, technologies, information assets and applications (Girard & Girard, 2015).

EAC.3 - The third EAC: *"organizational adaptability and innovation"* also relates to personnel as they make a primary contribution to the execution of the processes and thus the work. Because employees are the people who primarily deal with uncertainty and complexity, it is important to organize processes and work in such a way that they are interesting and meaningful for the personnel. It is important to reflect on process design decisions which focus on standardization and compliance, since these principles are suitable for machines but not for people (Lapalme et al., 2016). The literature shows different definitions with regard to the term "meaningful work" (Hackman & Oldham, 1975; Kahn, 1990; Wrzesniewski & Dutton, 2001). Given the context of the challenge, the definition, regardless of the age of the article, of Hackman & Oldham (1975) is the most appropriate, which defines the term *"meaningful work"* as: *"the degree to which the employee experiences the job as one which is generally meaningful, valuable, and worthwhile"*. When designing work and processes, this experience must therefore be given substance. Lepisto & Pratt (2017) acknowledge that meaningful work is once again becoming a central topic within organizations and that there are two potential sources that can fulfil this goal, namely; self-realization through work and accountability of the work.

EAC.4 - In addition to EAC.3, the fourth EAC: *"designing responsible processes and organizations"* focuses on designing processes and organizations that take people, environment and society into account, with sustainability as the main objective (Lapalme et al., 2016). Non-traditional paradigms, such as scientific management, Tayloristic methods and Agile methods can provide guidance in this challenge as these methods focus on topics such as knowledge management, knowledge sharing, documentation, continuous learning and team composition which are needed for designing and maintaining responsible processes and organizations (Chau, Maurer, & Melnik, 2003).

EAC.5 - The fifth EAC: *"dealing with greater cultural and generational diversity among workers"* focuses on employees in which heterogeneity among work forces is specifically mentioned (Lapalme et al., 2016). Mazhar & Zaheer (2010) confirms that heterogeneity among employees, with variables such as; gender, age, work experience and function area, is increasingly taking a prominent place within business scenarios and that it could potentially contribute to organizational performance. Unlike the study by Mazhar & Zaheer (2010), the research of Backes-Gellner & Pull (2013) has shown that heterogeneity can also have an negative impact on organizational performance. It is therefore important to find a balance in heterogeneity among work forces so that the composition of employees can contribute to organizational performance.

EAC.6 - The sixth EAC: *"dealing with challenges related to ownership, responsibility, roles, and power"* refers to stakeholders which can influence matters such as organizational ownership, responsibility, roles and power through initiatives such as co-creation and co-production which serve as a platform for exercising this influence. In addition, the group of stakeholders will only increase further due to globalization, whereby these stakeholders also expect that their demands will be considered (Lapalme et al., 2016). However, co-creation and co-production can also be considered as an opportunity for organizations as these methods can fulfil organizational goals such as the effective production of products which meet the expectations of the end-users. Involving end-users through co-creation and co-production can also lead to a more effective value creation process since this group is an interesting source of information for the organization which could potentially lead to innovative services and products (Voorberg, Bekkers, & Tummers, 2015).

EAC.7 - The seventh EAC: *"24/7 accessibility through virtual channels"* also stems from the increasing degree of globalization, since organizations can offer their products and services worldwide (Lapalme et al., 2016). The organization must be available 24/7 through virtual channels so that customers can interact with the organization if necessary.

EAC.8 - The eight EAC: *"navigating the terrain of turbulent markets, complexity and uncertainty"* refers to the executive who must lead the organization through turbulent markets, complexity and uncertainty where the management of boundaryless competitors, partners and customers is crucial (Lapalme et al., 2016). Entering into the right partnerships is of great importance here, because these partnerships can contribute to both economic and non-economic objectives that express themselves in strategic and economic benefits (Kolk, van Tulder, & Kostwinder, 2008; Lapalme et al., 2016).

EAC.9 - The ninth EAC: *"making effective use of new resources"* focuses on the competitive advantage that can be achieved through effective use of new resources such as contextual customer data (Lapalme et al., 2016). In order to arrive at new resources, the architecture must be critically examined, and a big data mindset is required. In addition, organizations should also look at a more Bayesian approach which emphasizes on the execution, evaluation and revision of their strategy instead of only focusing on organizational planning and execution cycles (Satell, 2014).

EAC.10 - The tenth EAC: *"organizational agility"* aims at organizational design which resolves around never reaching a final design (Lapalme et al., 2016). The aim should be an agile organization where the organization is in a continuous state of design in order to stay relevant.

Appendix C: Indicators for alignment dimensions

Internal monitoring

(1) IT metrics are available concerning technical performance, cost efficiency, ROI, cost effectiveness and external partners.
(2) Business metrics are available based on functional organization, traditional financial indicators, clients and cooperation with external partners.
(3) Business and IT performance is assessed by using mutually dependent indicators, with respect to external partners.
(4) Service Level Agreements are used throughout the enterprise, extended to external partners.
(5) Benchmarking is routinely performed, with feedback from external partners.
(6) Formal assessments and reviews are performed routinely.
(7) Continuous improvement takes place based on the assessments using routine practices.

Governance

(1) Business strategic planning is integrated across and outside the enterprise.
(2) IT strategic planning is integrated across and outside the enterprise.
(3) There is a federated reporting/organization structure where the CIO reports to the CEO.
(4) IT is seen as a cost and profit center.
(5) Decision making is steered by partnerships.
(6) Prioritization is based on added value, extended to the added value of external partners.
(7) IT program management is based on continuously improved standards.

Partnership

(1) Business perceives IT as a partner in creating value.
(2) Business and IT develop the strategic plan together.
(3) Risks and rewards, concerning objective achievement, are shared among business and IT.
(4) Business and IT are trusted partners.
(5) CEO is IT sponsor/champion.

Conformance & integration

(1) IT has an external scope and is a driver and enabler for the business strategy.
(2) Enterprise and inter-enterprise standards are specified and maintained.
(3) The EA is integrated vertically (from strategy to operations).
(4) The EA is integrated horizontally (between business units).
(5) The EA is transparent and flexible across the organization (change projects shape EA).
(6) Synthesis of diverse technologies (system integration).

Readiness for change

(1) Innovation and entrepreneurship by the employees is the norm.
(2) There is high and focused change readiness throughout the organization.
(3) Education and cross-training is possible across the organization.
(4) Employees can switch careers across the organization.
(5) Management style is relationship based.
(6) A trusted environment is created by valued partnerships.

Communication & understanding

(1) Improved understanding of business by IT.
(2) Improved understanding of IT by business.
(3) Less communication protocols and more informal communication.
(4) Knowledge is shared within and between business IT and extra-enterprise.
(5) Broader and more effective internal and extra-enterprise liaison(s).

Note. Reprinted from *"The relation between EA effectiveness and stakeholder satisfaction"*, by Van Der Raadt, B., Bonnet, M., Schouten, S., & Van Vliet, H., 2010, Journal of Systems and Software, 83(10), P.1967.

Appendix D: Indicators for agility dimensions

External monitoring
(1) Responsiveness to change in customer's preferences, demands.
(2) Responsiveness to market and technological changes and trends.
(3) Responsiveness to social, regulatory and environmental issues.
(4) Adjustability of business objectives to the changes.
Flexibility
(1) Flexible product model.
(2) Flexible IT systems.
Quality & customization
(1) High product quality.
(2) High IT quality.
(3) Customization of products/services.
(4) Customization of IT systems.
Speed
(1) Shortest Time-To-Market.
(2) Shortest time between identifying necessary changes and acting upon that identification.
(3) Shortest time of educating employees.
(4) Shortest time of operations (time needed for end-to-end chain).
Initiation of change
(1) Innovation and entrepreneurship by management is the norm.
(2) There is high and focused change readiness among management.
(3) Education and cross-training is possible between management roles.
(4) Managers can switch roles.
(5) Executives, including CIO and partners, have decision-power.

Note. Reprinted from *"The relation between EA effectiveness and stakeholder satisfaction"*, by Van Der Raadt, B., Bonnet, M., Schouten, S., & Van Vliet, H., 2010, Journal of Systems and Software, 83(10), P.1968.

Appendix E: Development of the assessment instrument

This Appendix describes the development of the assessment instrument. Based on the theoretical framework, three steps are elaborated that are necessary for the realization of the assessment instrument. This concerns the following steps: determining requirements, matching requirements, and finally determining the statements. These steps are illustrated in *Figure 1* will be elaborated based on an iterative process in which a continuous balance is sought between the theoretical framework and the research objective.
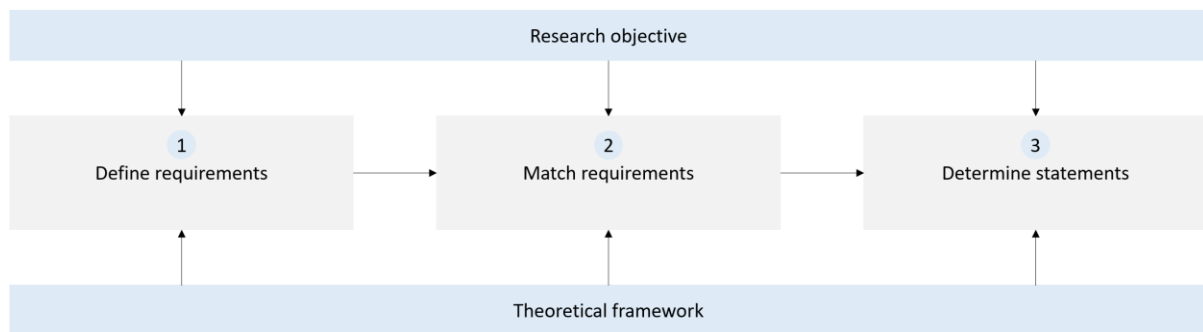
Figure 1: The development process of the assessment instrument

Step 1: define requirements

The theory has shown that there are two perspectives on the basis of which the assessment instrument can be designed, namely: the Enterprise Architecture Challenges (EACs) and the Enterprise Architecture Effectiveness Measurement Model (EAEMM). By bringing these two perspectives together in one assessment instrument, it can be examined to what extent current EAPs contribute to EA effectiveness. However, incorporating these two perspectives into one assessment instrument is a challenging task and requires a structured approach. That is why it was decided to structure this process on the basis of the Design Science Research Methodology (DSRM) approach as described by Wieringa (2014).

Chapter 2 also describes the different views on EA, however, section 2.1.1 is primarily intended as an introductory and descriptive section. This knowledge cannot be applied in the development of the assessment instrument in which explanatory knowledge is desired and not descriptive knowledge. The articles of Lapalme et al. (2016) and Van Der Raadt et al. (2010) deal with this matter in a similar way. It is important to start by determining the requirements, as they play a central role in the development of the assessment instrument. Wieringa (2014) describes requirements as: *"a property of the treatment desired by some stakeholder, who has committed resources (time and/or money) to realize the property"*. In this research, the *"treatment"* is to determine the extent current EA practices contribute to EA effectiveness in the context of EACs which can be interpreted as properties. It is therefore important to translate requirements into operationalized properties that contribute to the *"treatment"*, in other words the research objective.

The operationalization of properties takes place based on indicators that are used during the measuring process so that the presence of a property can be determined. This immediately highlights an important subject of the assessment instrument, namely the construct validity. Since the properties are operationalized by means of indicators, specific attention must be paid to validity aspects. For this reason, it was decided to illustrate the requirements, properties, and indicators by means of a table in which the relationship between the three elements can be traced. In addition, it is also described to which EACs the requirement relates and which literature has been consulted. This approach provides insight into the way in which indicators are created and how the requirements are measured. Because of this transparency it is clear which phenomena must be observed to be able to determine the actual presence of a requirement.

The operationalization of the EACs is made possible by the elaboration in section 2.1.2, which indicates what the three Enterprise Architecture Grand Challenges (EAGCs) are. The EAGCs were established on the basis of ten EACs, which are fully described in Appendix B. The process with regard to determining requirements, properties and indicators within this research is shown in *Figure 2*.
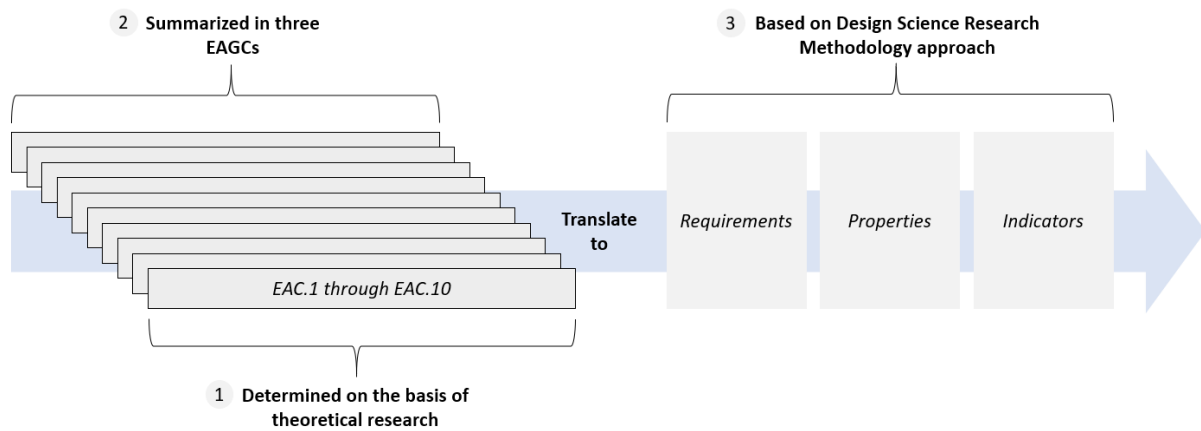
Figure 2: The development process of the assessment instrument

Threats that have a negative influence on construct validity have been considered during the translation of the EACs into requirements, properties, and indicators. For this, the requirements described by Wieringa (2014) have been adhered to, an overview of these requirements and associated threats is shown in *Table 1*.

Table 1: Construct validity requirements and threats according to Wieringa (2014)

Requirements	Threats
Are the constructs defined explicitly so that researchers can classify and count all and only the instances of the concept?	**Inadequate definition:** there is no definition that allows researchers to clearly classify and count all and only the instances of the concept
Can instances be classified unambiguously?	**Construct confounding:** an instance that satisfies the concept and satisfies other concepts too
Do indicators of constructs capture the intended meaning of the constructs?	**Mono-operation bias:** the indicators defined for a concept do not fully capture the concept
Does the method of measurement of an indicator avoid bias?	**Mono-method bias:** the indicators defined for a concept are all measured or applied in the same way

Note. Reprinted from *"Design science methodology: For information systems and software engineering"*, by Wieringa, R. J., (2014), p. 88, Heidelberg, DE: Springer.

These threats are handled in this research in the following way:

Inadequate definition: indicators are formulated in such a way that they provide clear criteria for counting and classification purposes. This approach also facilitates step two where the indicators are matched to the dimensions of the Enterprise Architecture Effectiveness Measurement Model (EAEM). This makes it clear whether a certain dimension measures what it is supposed to measure in the

context of this research. The presence of an indicator is determined based on three measurement indicators shown in *Table 2*.

Table 2: Measurement indicators

Measurement indicator	Description
Effort to learn	How does the EA stakeholder assess the learning ability of the organization?
Effort to use	How does the EA stakeholder assess the use of the relevant indicator within the organization
Presence of resources	Presence of policies, standards, strategy, documentation, systems, technologies, organizational structures, and procedures.

Construct confounding: requirements are formulated in such a way that they give substance to a specific EA dimension and not to several. The advantage of this is that the requirement, and thus the associated indicator, addresses a specific EA dimension, enabling generalizability within that specific dimension.

Mono-operation bias: the risk of mono-operation bias is mitigated by operationalizing non-directly measurable constructs by means of multiple indicators where an effort is made to find a fault and to test a resolution.

Mono-method bias: the assessment instrument has three possible measurement indicators that can be divided into two flows, namely the assessment of a stakeholder, the effort and the presence of policies, standards, strategies, documentation, systems, technologies, organizational structures and procedures. This approach mitigates the risk of mono-method bias because indicators are measured in different ways.

Table 3 shows the requirements, properties and indicators that will be used for the development of the assessment instrument. It is important to mention that for requirement 10: "*The assessment instrument shows how agile the organization is*" no properties, indicators and units of measurement have been established. It was decided not to include EAC.10 as measuring organizational agility would add an extra complex dimension to the instrument. Because the measurement of organizational agility within the EAEMM is done based on 5 dimensions in which an additional 19 indicators should be measured, this would lead to an overly extensive and complex instrument. The assessment instrument will therefore focus on EAC.1 to EAC.9

Table 3: Overview of requirements, properties, and indicators

Requirement (R)	Property (P)	Indicator (I)	Unit of measurement (M)	EAC	Reference
R.1: The assessment instrument shows how effectively the organization is utilizing data outside and within their boundaries	**P.1:** Utilizing data outside and within their boundaries	**I.1.1:** Technical developments regarding data are monitored **I.1.2:** A periodic evaluation takes place regarding how data is used **I.1.3:** Data is being managed and tracked **I.1.4:** Data is used for decision making **I.1.5:** New technologies and improvements regarding data utilization are adopted **I.1.6:** The presence of policies, organizational structures, procedures, technologies, information assets and applications that support data utilization practices	**M.1.1:** Effort to learn **M.1.2:** Effort to learn **M.1.3:** Effort to use **M.1.4:** Effort to use **M.1.5:** Effort to use **M.1.6:** Presence of resources	EAC.1	(Fang, 2015; Lapalme et al., 2016)
R.2: The assessment instrument shows how effectively the organization is managing their knowledge	**P.2:** Effective Knowledge Management	**I.2.1:** Developments on how to improve organizational Knowledge Management are followed **I.2.2:** A Knowledge Management strategy is in place **I.2.3:** A Knowledge Management culture is promoted by the management **I.2.4:** The presence of policies, organizational structures, procedures, technologies, information assets and applications that support Knowledge Management	**M.2.1:** Effort to learn **M.2.2:** Effort to use **M.2.3:** Effort to use **M.2.4:** Presence of resources	EAC.2	(Dell & Gray, 2014; Girard & Girard, 2015; Lapalme et al., 2016)

R.3: The assessment instrument shows how effectively the organization can adapt and innovate	**P.3:** Organizational adaptability and innovation	**I.3.1:** Developments in the field organizational adaptability and innovation are followed **I.3.2:** How work is experienced by employees is periodically evaluated **I.3.3:** Process design decisions which focus on standardization and compliance are reviewed **I.3.4:** Through employee empowerment, an organization coordinates its decision-making capabilities effectively **I.3.5:** The organization designs interesting and meaningful work **I.3.6:** When designing work, the organization pays attention to processes that focus on standardization and compliance since they are suitable for machines but not for people **I.3.7:** The presence of policies, organizational structures, procedures, technologies, information assets and applications that support organizational adaptability and innovation	**M.3.1:** Effort to learn **M.3.2:** Effort to learn **M.3.3:** Effort to learn **M.3.2:** Effort to use **M.3.4:** Effort to use **M.3.5:** Effort to use **M.3.6:** Effort to use **M.3.7:** Presence of resources	EAC.3	(Hackman & Oldham, 1975; Kahn, 1990; Lapalme et al., 2016; Lepisto & Pratt, 2017; Wrzesniewski & Dutton, 2001)
R.4: The assessment instrument shows how effectively the organization is designing responsible processes	**P.4:** Designing responsible processes and organizations	**I.4.1:** Developments related to people, environment and society are followed **I.4.2:** The organization takes people, environment and society into account when designing processes and organizations **I.4.3:** The organization has sustainability as main objective **I.4.4:** The organization is able to response to changes related to people, environment and society **I.4.5:** The presence of policies, organizational structures, procedures, technologies, information assets and applications that support designing responsible processes and organizations	**M.4.1:** Effort to learn **M.4.2:** Effort to use **M.4.3:** Effort to use **M.4.4:** Effort to use **M.4.5:** Presence of resources	EAC.4	(Chau, Maurer, & Melnik, 2003; Lapalme et al., 2016)
R.5: The assessment instrument shows how effectively the organization is dealing with greater cultural and generational diversity among workers	**P.5:** Dealing with greater cultural and generational diversity among workers	**I.5.1:** Developments regarding greater cultural and generational diversity among workers are followed **I.5.2:** The organization is aware that heterogeneity among employees is increasingly taking a prominent place within business scenarios **I.5.3:** The organization is looking for a balance in heterogeneity among work forces and takes appropriate measures **I.5.4:** The presence of policies, organizational structures, procedures, technologies, information assets and applications that support dealing with greater cultural and generational diversity among workers	**M.5.1:** Effort to learn **M.5.2:** Effort to learn **M.5.3:** Effort to use **M.5.4:** Presence of resources	EAC.5	(Mazhar & Zaheer, 2010; Backes-Gellner & Pull 2013; Lapalme et al., 2016)
R.6: The assessment instrument shows how effectively the organization is dealing with challenges related to ownership, responsibility, roles, and power	**P.6:** Dealing with challenges related to ownership, responsibility, roles, and power	**I.6.1:** Developments related to ownership, responsibility, roles, and power are followed **I.6.2:** The organization uses initiatives such as co-creation and co-production for exercising stakeholder influence **I.6.3:** The presence of policies, organizational structures, procedures, technologies, information assets and applications that support dealing with challenges related to ownership, responsibility, roles, and power	**M.6.1:** Effort to learn **M.6.2:** Effort to use **M.6.3:** Presence of resources	EAC.6	(Lapalme et al., 2016; Voorberg, Bekkers, & Tummers, 2015)

R.7: The assessment instrument shows accessible the organization is through virtual channels	**R.7:** 24/7 accessibility through virtual channels	**I.7.1:** Developments related to technological changes and trends, with a specific scope on online accessibility, are followed **I.7.2:** The organization reviews its online accessibility periodically **I.7.3:** The organization is 24/7 accessible through virtual channels **I.7.4:** The organization adopts new virtual accessibility technologies **I.7.5:** The presence of policies, organizational structures, procedures, technologies, information assets and applications that support virtual accessibility	**M.7.1:** Effort to learn **M.7.2:** Effort to learn **M.7.3:** Effort to use **M.7.4:** Effort to use **M.7.5:** Presence of resources	EAC.7	(Lapalme et al., 2016)
R.8: The assessment instrument shows how effectively the organization is navigating the terrain of turbulent markets, complexity, and uncertainty	**R.8:** Navigating the terrain of turbulent markets, complexity, and uncertainty	**I.8.1:** Developments related to the management of competitors, partners and customers are followed **I.8.2:** Existing partnerships are periodically evaluated **I.8.3:** The presence of policies, organizational structures, procedures, technologies, information assets and applications that support navigating the terrain of turbulent markets, complexity, and uncertainty	**M.8.1:** Effort to learn **M.8.2:** Effort to use **M.8.3:** Presence of resources	EAC.8	(Kolk, van Tulder, & Kostwinder, 2008; Lapalme et al., 2016)
R.9: The assessment instrument shows how effectively the organization is making effective use of new resources	**R.9:** Making effective use of new resources	**I.9.1:** Developments on how new data resources can be used to gain a competitive advantage are followed **I.9.2:** The architecture is critically examined and periodically reviewed **I.9.3:** The organization emphasizes on the execution, evaluation, and revision of their strategy **I.9.4:** New resources are used to gain a competitive advantage **I.9.5:** The presence of policies, organizational structures, procedures, technologies, information assets and applications that support making effective use of new resources	**M.9.1:** Effort to learn **M.9.2:** Effort to learn **M.9.3:** Effort to use **M.9.4:** Effort to use **M.9.5:** Presence of resources	EAC.9	(Satell, 2014; Lapalme et al., 2016)
R.10: The assessment instrument shows how agile the organization is	-	-	-	EAC.10	(Lapalme et al., 2016)

Step 2: match requirements

The Enterprise Architecture Effectiveness Measurement Model (EAEMM) forms the basis of the assessment tool. A substantiation of why this model has been selected as a means of measuring EA effectiveness in the context of EACs is described in section 2.1.3. *Figure 3* illustrates the framework of the assessment tool showing that EA Practices should lead to agility and alignment. To be able to measure these two organizational objectives, which determine EA effectiveness, 11 dimensions have been developed in the EAEMM. These high-level dimensions can be measured on the basis of indicators included in Appendix C and Appendix D. Since the EAEMM has not been specifically developed for demonstrating EA effectiveness in the context of EACs, it is important to evaluate to what extent these dimensions meet the requirements described in step 1.
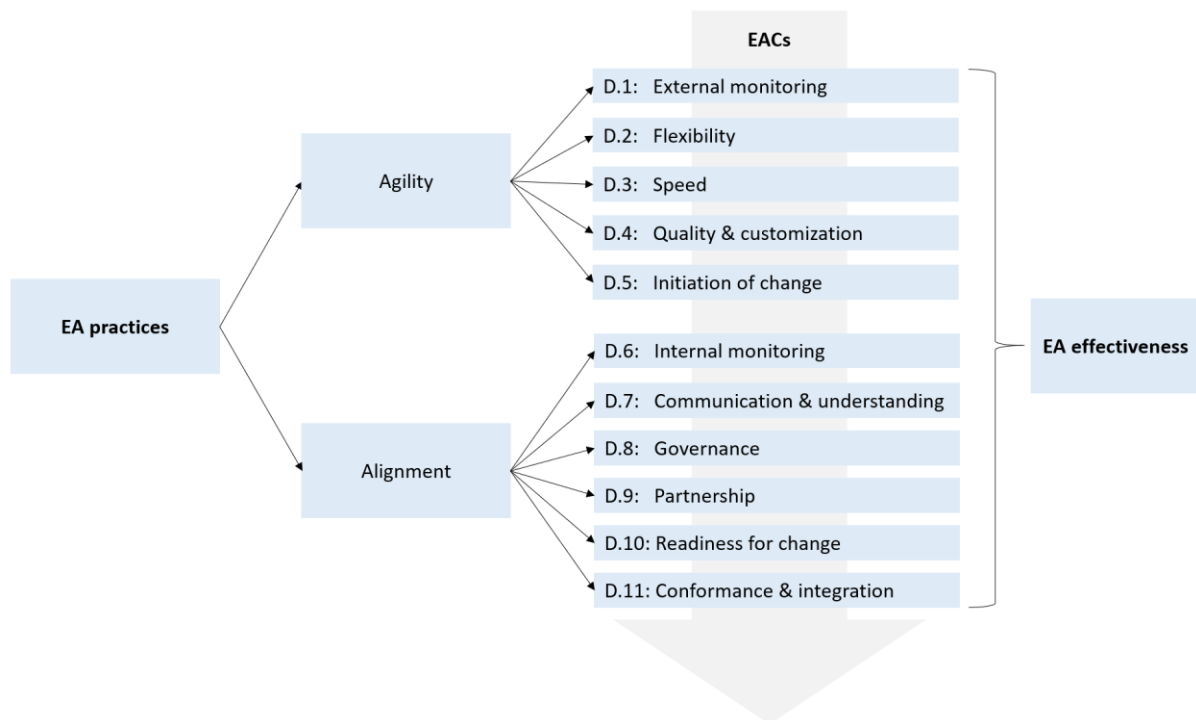
Figure 3: Framework for measuring EA effectiveness in the context of EA Grand Challenges

First, through an iterative process, the requirements are matched to the EAEMM dimensions. By evaluating the EAEMM dimensions and considering what being is measured, how it is measured and based on which indicators it is measured, it was possible to link the requirements to their respective EAEMM dimensions. The results can be consulted in *Table 4*. In the context of transparency, which also contributes to construct validity, it has been made clear why a certain requirement is linked to a specific dimension. For each requirement a short description is given, stating why the requirement is matched to that specific dimension. Attention is also paid to any shortcomings of the given dimension, which can then be considered during the development of step 3. The results of this process can be consulted in *Table 5*.

During the elaboration of this step, it emerged that measuring EAC 10: *"organizational agility"* will be difficult. This is because *"organizational agility"* within the EAEMM is measured based on four additional dimensions. This would make it necessary to include 15 additional EAEMM indicators in the final assessment instrument, which should then be translated into approximately 45 statements. This would greatly increase the number of statements within the assessment instrument, which would make the assessment instrument far too broad. For this reason, it was decided not to include EAC 10: *"organizational agility"* in the assessment instrument to maintain a clear and feasible scope.

Table 4: Overview of EAEMM dimensions according to Van Der Raadt et al., (2010) and matched requirements

Dimension (D)	Description	Contributing output of EA function	Requirement
D.1: External monitoring	Identification of changes and opportunities, and the ability to translate these to new business and IT ideas.	Architects keep up with the social, market, technological and regulatory developments, and help management in identifying opportunities and required changes.	**R.4, R.7, *R.10**
D.2: Flexibility	Ability to change organizational components without major changes and investments.	Standardized organizational components (through EA products and EA governance) enable easy re-orchestration of components to implement changes.	*R.10
D.3: Speed	Shortest time-to-market, time to act upon change, educate employees, and run end-to-end operations.	Architects use their domain knowledge to help projects shorten their lead time by identifying reuse of existing organizational components and helping to integrate the new solutions with the existing organizational components.	*R.10
D.4: Quality & customization	High quality and customizable products and services of the business and IT	Architects use their domain knowledge to guide projects in making high quality designs, ensuring the quality requirements of the products and services are realized.	*R.10
D.5: Initiation of change	Ability and willingness of management (and the workforce) to initiate changes to implement new business ideas or introduce new technologies.	Architects helps management in decision making about new business and IT ideas, by creating solution alternatives and analysing their profitability and feasibility.	*R.10
D.6: Internal monitoring	Routine reviews, assessments, and benchmarks of operational performance of and changes implemented to business and IT organizational components.	EA products describe the quality indicators of all organizational components, and thus provide input for the specification of performance indicators and service level agreements. Architects perform reviews of solutions and changes implemented.	**R.1., R.9**
D.7: Communication & understanding	Common understanding of business and IT through knowledge sharing, and insight in consequences of decision making.	EA products contain explicit knowledge (descriptions) of business and IT components, which allows knowledge sharing. Architects provide management with insight in, and advice about, the consequences of decision making on existing organizational components.	**R.2**
D.8: Governance	Formal decision making, monitoring, and control of priorities and budget for both business and IT.	Architects translate strategic objectives to an architectural blueprint and transformation roadmap. Architects ensure that solutions and operational changes conform to these EA products.	

D.9: Partnership	Business and IT are trusted partners where the business sponsors IT, sharing risks and rewards.	EA products link strategic plans and organizational components of the business (optimized for value creation) and IT (optimized for business support). By embracing and ratifying these EA products, business and IT management create a sense of partnership.	**R.6, R.8**
D.10: Readiness for change	Ability and willingness of the enterprise workforce to change attitudes, opinions, and behaviour.	EA products provide insight in the consequences of, and the rationale for, organizational changes. By explaining the consequences and rationale, architects help changing the attitude, opinions, and behaviour of the employees impacted.	**R.3, R.5**
D.11: Conformance & integration	Consolidation, standardization, and integration of organizational components to a coherent, transparent, and flexible business and IT landscape.	EA products provide transparent and enterprise-wide coherent architecture and standards. They describe and prescribe the consolidation and integration of organizational components. Architects ensure that all changes and new solutions conform to these EA products.	

Note. Reprinted from *"The relation between EA effectiveness and stakeholder satisfaction"*, by Van Der Raadt, B., Bonnet, M., Schouten, S., & Van Vliet, H., 2010, Journal of Systems and Software, 83(10), P.1963.

Table 5: Overview of EAEMM and matched requirements

Requirement	Matched dimension	Motivation
R.1	D.6	To gain insight into how effectively the organization is utilizing data outside and within their boundaries, it is necessary to assess how the organization handles internal data monitoring *(D.6)*. This dimension focuses on evaluating and implementing business and IT performance in which data plays an important role. However, because *D.6* mainly focuses on internal monitoring and not on external technical developments in the field of data utilization this will have to be considered when working out step 2.
R.2	D.7	Effective Knowledge Management (KM) plays a central role in *R.2*. For this reason, *D.7* has been selected as communication and understanding are determining factors when it comes to KM. In addition, *D.7* focuses on the presence of knowledge descriptions that enable knowledge sharing, which also give substance to the KM aspect that *R.2* focuses on.
R.3	D.10	*R.3* focuses on organizational adaptability and innovation, *D.10* fits in almost seamlessly since this dimension focuses on the relationship between employees and organizational changes. However, this dimension is limited to changing attitudes, opinions, and behaviour and not the interaction between these factors when new work and processes are developed. This will therefore have to be considered in step 3.
R.4	D.1	When developing responsible processes *(R.4)*, it is important that people, environment, and society are considered, which are external factors and therefore fall outside the organization. During the matching process of this requirement, attention has been paid to the fact that *"external monitoring" (D.1)* is mainly aimed at identifying external changes and that the design of responsible processes *(R.4)* probably must be transferred to another dimension. However, *D.1* focuses on external monitoring and the organizational responsiveness and thus the actual follow-up actions (designing responsible processes) that are sought within *R.4*.
R.5	D.10	*R.5* is matched to *D.10* as this dimension focuses specifically on workforces and organizational changes such as dealing with greater cultural and generational diversity among workers. Since *D.10* focuses on providing insight into the organizational willingness to change, this is a suitable dimension for *R.5*. It will be necessary to further specify this dimension in step 3 for the purpose of this requirement.
R.6	D.9	*R.6* focuses on how organizations deal with challenges related to ownership, responsibility, roles, and power in which external partners play a central role. Although *D.1* has an external scope when it comes to monitoring developments in the areas of social, market, technological and regulatory developments, no attention is paid to partnerships. *D.9* on the other hand focuses on partnerships but with an internal focus. That is why this dimension will have to be adjusted in step 3 so that external partnerships are also given substance.
R.7	D.1	*R.7* is matched to *D.1* because of the strong external scope that both elements have. For example, *R.7* focuses on 24/7 access via virtual channels where external monitoring is important. To meet customer requirements, it is important that social, market, technological and regulatory developments are followed and acted upon. This results in a virtual platform that is up-to-date and meets customer expectations.
R.8	D.9	To be able to navigate the terrain of turbulent markets, complexity and uncertainty requires the right partnerships *(R.8)*. For this reason, *R.8* is matched to *D.9* which focuses on partnerships. However, this dimension must be adjusted in step 3 because the *D.9* focuses exclusively on internal partnerships.
R.9	D.6	To determine how effectively the organization uses new resources *(R.9)*, it is important to consider the ability and willingness of management to deploy these new resources. *D.5* focuses on clarifying this requirement by looking at the extent to which architects help management in recognizing new business ideas or technologies.
*R.10	D.1, D.2, D.3, D.4, D.5	-

Step 3: determine statements

Now that the indicators have been matched to five EAEMM dimensions, the statements can be drawn up. Since EAEMM has its own indicators that are not specifically made for measuring EA effectiveness in the context of EACs, it was decided to make use of these indicators as a frame of reference. The advantage of this is that it is possible to check whether the indicators and thus the statements match relevant topics when it comes to measuring EA effectiveness. This approach has resulted in 43 statements which can be consulted in *Table 6*. The EA stakeholder can answer the statement based on a 6-point Likert scale.

Table 6: Statements assessment instrument

	Statement
D.1: External monitoring	**S.4.1:** External developments related to people, environment and society are followed in a consistent and structured manner.
	S.4.2: External aspects such as people, environment and society are considered when designing processes and systems.
	S.4.3: The organization has sustainability as main objective and behaves accordingly.
	S.4.4: The presence of flexible processes and systems enable the organization to respond to external changes related to people, environment, and society.
	S.4.5: The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to maintain and develop sustainable processes and systems.
	S.7.1: The organization follows technological developments in the field of online accessibility in a consistent and structured manner.
	S.7.2: Periodic reviews take place regarding online accessibility with the aim of improving the customer experience.
	S.7.3: Customers can view their products and services online, while it is also possible to make changes.
	S.7.4: When designing processes and systems, new technologies are being adopted and implemented to improve online accessibility.
	S.7.5: The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to maintain, develop and improve the virtual accessibility.

D.6: Internal monitoring	**Statement**
	S.1.1: Internal and external developments related to how data can be utilized are followed in a consistent and structured manner.
	S.1.2: A periodic evaluation takes place regarding how data is used with help from external partners.
	S.1.3: Data is being managed and tracked in a consistent and structured manner.
	S.1.4: Data is actively used throughout the organization when making decisions.
	S.1.5: New technologies and improvements regarding data utilization are adopted so that data can be utilized to its full potential**.**
	S.1.6: The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to maintain, develop and improve data utilization practices.
	S.9.1: Developments on how new data resources can be used to gain a competitive advantage are followed.
	S.9.2: The data architecture is critically examined and periodically reviewed with the help of external partners.
	S.9.3: The organization emphasizes on the execution, evaluation, and revision of their strategy**.**
	S.9.4: New data resources are actively used to gain a competitive advantage.
	S.9.5: The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to make effective use of new data resources.

D.7: Communication & understanding	**Statement**
	S.2.1: Developments in the field of Knowledge Management are followed in a consistent and structured manner.
	S.2.2: There is a clear Knowledge Management strategy in place which deals with the dissemination of knowledge.
	S.2.3: A Knowledge Management culture is actively promoted by the management.
	S.2.4: The presence of policies, organizational structures, procedures, technologies, information assets and applications enable an effective Knowledge Management culture.

D.9: Partnership	**Statement**
	S.6.1: Developments related to ownership, responsibility, roles, and power are followed in a consistent and structured manner.
	S.6.2: Initiatives such as co-creation and co-production are used for exercising stakeholder influence.
	S.6.3: The presence of policies, organizational structures, procedures, technologies, information assets and applications help the organization to deal with challenges related to ownership, responsibility, roles, and power.
	S.8.1: Developments related to competitors, partners and customers are followed in a consistent and structured manner.
	S.8.2: Existing partnerships are periodically evaluated, and action is taken if necessary.
	S.8.3: The presence of policies, organizational structures, procedures, technologies, information assets and applications help the organization in navigating the terrain of turbulent markets, complexity, and uncertainty.

	Statement
D.10: Readiness for change	**S.3.1:** Developments in organizational adaptability and innovation are followed in a consistent and structured manner.
	S.3.2: How work is experienced by employees is periodically evaluated and action is taken if necessary.
	S.3.3: Process design decisions which focus on standardization and compliance are reviewed.
	S.3.4: Through employee empowerment, the organization coordinates its decision-making capabilities effectively.
	S.3.5: The organization designs interesting and meaningful work.
	S.3.6: When designing work, the organization pays attention to processes that focus on standardization and compliance since they are suitable for machines but not for people.
	S.3.7: The presence of policies, organizational structures, procedures, technologies, information assets and applications enable organizational adaptability and innovation.
	S.5.1: Developments regarding greater cultural and generational diversity among workers are followed in a consistent and structured manner.
	S.5.2: The organization is aware that heterogeneity among employees is increasingly taking a prominent place within business scenarios.
	S.5.3: The organization is looking for a balance in heterogeneity among work forces and takes appropriate measures.
	S.5.4: The presence of policies, organizational structures, procedures, technologies, information assets and applications support the organization in dealing with greater cultural and generational diversity among workers.

Appendix F: Assessment instrument based on theoretical insights

Assessment instrument for measuring enterprise architecture effectiveness

Degree programme:	Open University of the Netherlands, Faculty of Management, Science & Technology
Course:	IM9806 Business Process Management and IT Graduation Assignment
Name:	Demir Kopic
Identification number:	852049091
Version:	0.9

Explanation: The purpose of this assessment instrument is to provide insight into the extent to which current enterprise architecture practices give substance to enterprise architecture challenges. On the basis of this, the impact on enterprise architecture effectiveness is assessed.
The assessment instrument and the accompanying enterprise architecture challenges, which play a central role in this research, were developed on the basis of theoretical insights from the field of enterprise architecture.
The assessment instrument consists of 5 parts containing 42 questions. *Indicate to what extent you believe that the statement describes the current situation within the organization.*

Details of the participant

Date:	DD/MM/YY
Name of the participant:	
Position of the participant:	

Figure 1: First screen assessment instrument: *"introduction"*

Partnership

Please indicate to what extent the statement describes the current situation within the organization

Statement	Scale
1. Developments related to organizational ownership, responsibility, roles, and power are followed in a consistent and structured manner.	Completely disagree — 0 1 2 3 4 5 — Totally agree
2. Initiatives such as co-creation and co-production are used for exercising stakeholder influence.	Completely disagree — 0 1 2 3 4 5 — Totally agree
3. The presence of policies, organizational structures, procedures, technologies, information assets and applications help the organization to deal with challenges related to ownership, responsibility, roles, and power.	Completely disagree — 0 1 2 3 4 5 — Totally agree
4. Developments related to competitors, partners and customers are followed in a consistent and structured manner.	Completely disagree — 0 1 2 3 4 5 — Totally agree
5. Existing partnerships are periodically evaluated and action is taken if necessary.	Completely disagree — 0 1 2 3 4 5 — Totally agree
6. The presence of policies, organizational structures, procedures, technologies, information assets and applications help the organization in navigating the terrain of turbulent markets, complexity and uncertainty.	Completely disagree — 0 1 2 3 4 5 — Totally agree

Figure 2: Second screen assessment instrument, dimension: *"partnership"*

External monitoring

Please indicate to what extent the statement describes the current situation within the organization

Statement	Scale
1. External developments related to people, environment and society are followed in a consistent and structured manner.	Completely disagree 0 1 2 3 4 5 Totally agree
2. External aspects such as people, environment and society are taken into account when designing processes and systems.	Completely disagree 0 1 2 3 4 5 Totally agree
3. The organization has sustainability as main objective and behaves accordingly.	Completely disagree 0 1 2 3 4 5 Totally agree
4. The presence of flexible processes and systems enable the organization to respond to external changes related to people, environment and society.	Completely disagree 0 1 2 3 4 5 Totally agree
5. The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to maintain and develop sustainable processes and systems which results in a sustainable organization.	Completely disagree 0 1 2 3 4 5 Totally agree
6. The organization follows technological developments in the field of online accessibility in a consistent and structured manner.	Completely disagree 0 1 2 3 4 5 Totally agree
7. Online accessibility is periodically reviewed and improved with the aim of meeting customer expectations.	Completely disagree 0 1 2 3 4 5 Totally agree
8. Customers and prospects can request, change and view all products and services online.	Completely disagree 0 1 2 3 4 5 Totally agree
9. When designing processes and systems, new technologies are being adopted and implemented to improve online accessibility.	Completely disagree 0 1 2 3 4 5 Totally agree
10. The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to maintain, develop and improve the virtual accessibility.	Completely disagree 0 1 2 3 4 5 Totally agree

Figure 3: Third screen assessment instrument, dimension: *"external monitoring"*

Communication & understanding

Please indicate to what extent the statement describes the current situation within the organization

Statement	Scale
1. Developments in the field of Knowledge Management are followed in a consistent and structured manner.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree
2. There is a clear Knowledge Management strategy in place which deals with the dissemination of knowledge.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree
3. A Knowledge Management culture is actively promoted by the management.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree
4. The presence of policies, organizational structures, procedures, technologies, information assets and applications enable an effective Knowledge Management culture.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree

Figure 4: Fourth screen assessment instrument, dimension: *"communication & understanding"*

Readiness for change

Please indicate to what extent the statement describes the current situation within the organization

Statement	Scale
1. Developments in organizational adaptability and innovation are followed in a consistent and structured manner.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree
2. How work is experienced by employees is periodically evaluated and action is taken if necessary.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree
3. Process design decisions which focus on standardization and compliance are reviewed periodically.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree
4. Through employee empowerment, the organization coordinates its decision-making capabilities effectively.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree
5. The organization designs interesting and meaningful work.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree
6. When designing work, the organization pays attention to processes that focus on standardization and compliance since they are suitable for machines but not for people.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree
7. The presence of policies, organizational structures, procedures, technologies, information assets and applications enable organizational adaptability and innovation.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree
8. Developments regarding greater cultural and generational diversity among workers are followed in a consistent and structured manner.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree
9. Heterogeneity among employees is increasingly taking a prominent place within business scenarios.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree
10. The organization is looking for a balance in heterogeneity among work forces and takes appropriate measures.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree
11. The presence of policies, organizational structures, procedures, technologies, information assets and applications support the organization in dealing with greater cultural and generational diversity among workers.	Completely disagree ○0 ○1 ○2 ○3 ○4 ○5 Totally agree

Figure 5: Fifth screen assessment instrument, dimension: *"readiness for change"*

Internal monitoring

Please indicate to what extent the statement describes the current situation within the organization

1. Developments related to how data can be utilized are followed in a consistent and structured manner.

Completely disagree | 0 | 1 | 2 | 3 | 4 | 5 | *Totally agree*

2. A periodic evaluation takes place regarding how data is used with help from external partners.

Completely disagree | 0 | 1 | 2 | 3 | 4 | 5 | *Totally agree*

3. Data is being managed and tracked in a consistent and structured manner.

Completely disagree | 0 | 1 | 2 | 3 | 4 | 5 | *Totally agree*

4. Data is essential when it comes to decision making.

Completely disagree | 0 | 1 | 2 | 3 | 4 | 5 | *Totally agree*

5. New technologies and improvements regarding data utilization are adopted so that data can be utilized to its full potential.

Completely disagree | 0 | 1 | 2 | 3 | 4 | 5 | *Totally agree*

6. The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to maintain, develop and improve data utilization practices.

Completely disagree | 0 | 1 | 2 | 3 | 4 | 5 | *Totally agree*

7. Developments on how new data resources can be used to gain a competitive advantage are followed.

Completely disagree | 0 | 1 | 2 | 3 | 4 | 5 | *Totally agree*

8. The data architecture is critically examined and periodically reviewed with the help of external partners.

Completely disagree | 0 | 1 | 2 | 3 | 4 | 5 | *Totally agree*

9. The organization emphasizes on the execution, evaluation and revision of their strategy instead of only focussing on organiszational planning and execution cycles.

Completely disagree | 0 | 1 | 2 | 3 | 4 | 5 | *Totally agree*

10. New data resources such as contextual data are actively used to gain a competitive advantage.

Completely disagree | 0 | 1 | 2 | 3 | 4 | 5 | *Totally agree*

11. The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to make effective use of new data resources.

Completely disagree | 0 | 1 | 2 | 3 | 4 | 5 | *Totally agree*

Figure 6: Sixth screen assessment instrument, dimension: *"internal monitoring"*

Overall results
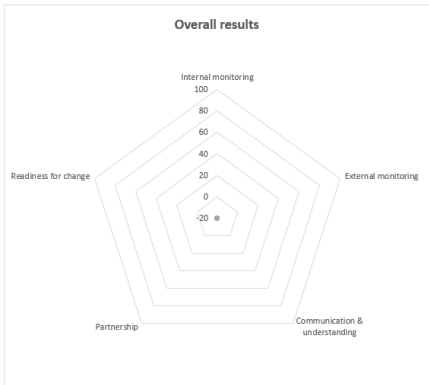
Internal monitoring

Question	Score		Comment
1. Internal and external developments related to how data can be utilized are followed in a consistent and structured manner.	✕	-1	
2. A periodic evaluation takes place regarding how data is used with help from external partners.	✕	-1	
3. Data is being managed and tracked in a consistent and structured manner.	✕	-1	
4. Data is actively used throughout the organization when making decisions.	✕	-1	
5. New technologies and improvements regarding data utilization are adopted so that data can be utilized to its full potential.	✕	-1	
6. The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to maintain, develop and improve data utilization practices.	✕	-1	
7. Developments on how new data resources can be used to gain a competitive advantage are followed.	✕	-1	
8. The data architecture is critically examined and periodically reviewed with the help of external partners.	✕	-1	
9. The organization emphasizes on the execution, evaluation and revision of their strategy.	✕	-1	
10. New data resources are actively used to gain a competitive advantage.	✕	-1	
11. The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to make effective use of new data resources.	✕	-1	

External monitoring

Question	Score		Comment
1. External developments related to people, environment and society are followed in a consistent and structured manner.	✕	-1	
2. External aspects such as people, environment and society are taken into account when designing processes and systems.	✕	-1	
3. The organization has sustainability as main objective and behaves accordingly.	✕	-1	
4. The presence of flexible processes and systems enable the organization to respond to external changes related to people, environment and society.	✕	-1	
5. The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to maintain and develop sustainable processes and systems.	✕	-1	
6. The organization follows technological developments in the field of online accessibility in a consistent and structured manner.	✕	-1	
7. Periodic reviews take place regarding online accessibility with the aim of improving the customer experience.	✕	-1	
8. Customers have the opportunity to view their products and services online, while it is also possible to make changes.	✕	-1	
9. When designing processes and systems, new technologies are being adopted and implemented to improve online accessibility.	✕	-1	
10. The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to maintain, develop and improve the virtual accessibility.	✕	-1	

Communication & understanding

Question	Score		Comment
1. Developments in the field of Knowledge Management are followed in a consistent and structured manner.	✕	-1	
2. There is a clear Knowledge Management strategy in place which deals with the dissemination of knowledge.	✕	-1	
3. A Knowledge Management culture is actively promoted by the management.	✕	-1	
4. The presence of policies, organizational structures, procedures, technologies, information assets and applications enable an effective Knowledge Management culture.	✕	-1	

Partnership

Question		Score
1. Developments related to ownership, responsibility, roles, and power are followed in a consistent and structured manner.	✕	-1
2. Initiatives such as co-creation and co-production are used for exercising stakeholder influence.	✕	-1
3. The presence of policies, organizational structures, procedures, technologies, information assets and applications help the organization to deal with challenges related to ownership, responsibility, roles, and power.	✕	-1
4. Developments related to competitors, partners and customers are followed in a consistent and structured manner.	✕	-1
5. Existing partnerships are periodically evaluated and action is taken if necessary.	✕	-1
6. The presence of policies, organizational structures, procedures, technologies, information assets and applications help the organization in navigating the terrain of turbulent markets, complexity and uncertainty.	✕	-1

Readiness for change

Question		Score
1. Developments in organizational adaptability and innovation are followed in a consistent and structured manner.	✕	-1
2. How work is experienced by employees is periodically evaluated and action is taken if necessary.	✕	-1
3. Process design decisions which focus on standardization and compliance are reviewed.	✕	-1
4. Through employee empowerment, the organization coordinates its decision-making capabilities effectively.	✕	-1
5. The organization designs interesting and meaningful work.	✕	-1
6. When designing work, the organization pays attention to processes that focus on standardization and compliance since they are suitable for machines but not for people.	✕	-1
7. The presence of policies, organizational structures, procedures, technologies, information assets and applications enable organizational adaptability and innovation.	✕	-1
8. Developments regarding greater cultural and generational diversity among workers are followed in a consistent and structured manner.	✕	-1
9. The organization is aware that heterogeneity among employees is increasingly taking a prominent place within business scenarios.	✕	-1
10. The organization is looking for a balance in heterogeneity among work forces and takes appropriate measures.	✕	-1
11. The presence of policies, organizational structures, procedures, technologies, information assets and applications support the organization in dealing with greater cultural and generational diversity among workers.	✕	-1

Figure 7: Seventh screen assessment instrument: *"results"*

Data for spider-chart

Dimension	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Max points	Achieved points	%
Internal monitoring	0	0	0	0	0	0	0	0	0	0	0	55	-11	-20
External monitoring	0	0	0	0	0	0	0	0	0	0	N/A	50	-10	-20
Communication & understanding	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20	-4	-20
Partnership	0	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	30	-6	-20
Readiness for change	0	0	0	0	0	0	0	0	0	0	0	55	-11	-20

Data for results per dimension

Dimension	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Max points	Achieved points	%
Internal monitoring	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	55	-11	-20
External monitoring	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	N/A	50	-10	-20
Communication & understanding	-1	-1	-1	-1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20	-4	-20
Partnership	-1	-1	-1	-1	-1	-1	N/A	N/A	N/A	N/A	N/A	30	-6	-20
Readiness for change	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	55	-11	-20

Figure 8: Eight screen assessment instrument: *"data tab"*

Appendix G: Document Analysis

This Appendix contains confidential information and has not been included for this reason.

Appendix H: Interview schedule for expert interview

The following schedule was used during the expert interview:

1. Introduction

- The participant is welcomed and thanked
- The researcher introduces himself briefly
- The research goal and the research method are explained
- The purpose of the interview is explained
- An explanation is given about the anonymity, confidentiality and the way in which the recording is processed and stored.
- The participant is given the opportunity to ask questions in advance.

2. Introductory questions

- Can you tell us more about your role in the organization and your involvement in the subject of enterprise architecture?
- Which enterprise architecture challenges do you see arising within the organization?
- What resources does the organization currently use to identify and highlight enterprise architecture challenges?

3. Review assessment tool

- Go through the introduction screen
- Go through the statements and pay attention to the layout
- Go through the results screen

4. In-depth questions

- To what extent do the statements relate to current developments within the organization?
- Are the statements sufficiently clear and is there a connection with the target group?
- To what extent are the results considered useful and how could this be improved?

5. Provide summary and complete interview

- A summary of points for improvement is given (interpretation check)
- The participant is thanked for taking part in the interview

Appendix I: Transcription of expert interview

This Appendix contains confidential information and has not been included for this reason.

Appendix J: Identified improvements based on empirical research

	Statement in assessment instrument	Adjustment based on expert interview	Statement in assessment instrument	Order
D.6: Internal monitoring	**S.1.1:** Internal and external developments related to how data can be utilized are followed in a consistent and structured manner.	**Feedback from expert:** See feedback statement Q.1.2. **Adjustment:** Including both internal and external developments within this statement creates confusion. For this reason, it has been decided to focus on external developments as this plays a central role in the EAC.	External developments related to how data can be utilized are followed in a consistent and structured manner.	*4*
	S.1.2: A periodic evaluation takes place regarding how data is used with help from external partners.	**Feedback from expert:** *"I find statement 2 difficult, which are actually two questions in one"* and *"then I think yes, we do it periodically but not with external partners so: "completely disagree".* **Adjustment:** The part *"with help from external partners"* has been removed from the statement because it is possible that the organization performs a good evaluation, but without the help of external partners. In addition, the EAC does not specifically target these external partners, this addition has been made based on the EAEMM.	A periodic evaluation takes place regarding how data is used.	*5*
	S.1.3: Data is being managed and tracked in a consistent and structured manner.	-	Data is being managed and tracked in a consistent and structured manner.	*3*
	S.1.4: Data is actively used throughout the organization when making decisions.	**Feedback from expert:** *"Shouldn't you simplify the statement?"* (feedback on statement Q.4.1). **Adjustment:** The question has been simplified to increase comprehensibility.	Data is essential when it comes to decision making.	*1*
	S.1.5: New technologies and improvements regarding data utilization are adopted so that data can be utilized to its full potential**.**	**Feedback from expert:** *"Shouldn't you simplify the statement?"* (feedback on statement Q.4.1). **Adjustment:** The statement has been simplified to increase comprehensibility.	Improvements and technologies are adopted so that data can be utilized to its full potential.	*2*

S.1.6: The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to maintain, develop and improve data utilization practices.	**Feedback from expert:** *"I find this statement very long"* and *"Because now you have a lot of things, you're going to try to relate them all to each other in your head".* **Adjustment:** The statement has been simplified by changing the part *"enable the organization to maintain, develop and improve data utilization practices"*. There were to many variables incorporated into one statement.	Resources such as policies, organizational structures, procedures, technologies, information assets and applications enable effective data utilization practices.	6
S.9.1: Developments on how new data resources can be used to gain a competitive advantage are followed.	**Feedback from expert:** *"I don't know what you're asking, what exactly your goal is".* **Adjustment:** The statement has been simplified by emphasizing on *"new data resources"* and *"competitive advantage"* as these two topics are explicitly mentioned in the EAC.	The organization is continuously looking at how new data resources can be used to gain a competitive advantage.	9
S.9.2: The data architecture is critically examined and periodically reviewed with the help of external partners.	**Feedback from expert:** See feedback statement Q.1.2. **Adjustment:** The part *"with help from external partners"* has been removed from the statement because it is possible that the organization performs a good data architecture review, but without the help of external partners. In addition, the EAC does not specifically target these external partners, this addition has been made based on the EAEMM.	The data architecture is critically examined and periodically reviewed.	10
S.9.3: The organization emphasizes on the execution, evaluation, and revision of their strategy**.**	**Feedback from expert:** *"I don't think everyone will understand this statement".* **Adjustment:** This statement has been made clearer by naming organizational planning and execution cycles (traditional approach) and then focusing on the execution, evaluation, and revision of their strategy.	The organization focuses not only on organizational planning and execution cycles, but also on the execution, evaluation, and revision of their strategy.	7
S.9.4: New data resources are actively used to gain a competitive advantage.	**Feedback from expert:** *The previous statement (Q.9.1) is about resources and this one is more about tooling.* **Adjustment:** *"contextual data"* has been added to the statement to emphasize that it is about *"tooling"* and the way in which data is used within the organization.	New data resources such as contextual data are actively used to gain a competitive advantage.	8

S.9.5: The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to make effective use of new data resources.	**Feedback from expert:** *"Statement 5 is too long, but we already knew that (because of statement Q.1.6), it really needs to be shortened.".* **Adjustment:** The statement has been simplified and the listing of resources now serves as an example.	Resources such as organizational structures, procedures, technologies, information assets and applications enable the organization to make effective use of new data resources.	*11*

	Statement in assessment instrument	Comment based on expert interview and document analysis	Statement in assessment instrument	Order
D.1: External monitoring	**S.4.1:** External developments related to people, environment and society are followed in a consistent and structured manner.	-	External developments related to people, environment and society are followed in a consistent and structured manner.	*4*
	S.4.2: External aspects such as people, environment and society are considered when designing processes and systems.	-	External aspects such as people, environment and society are considered when designing processes and systems.	*2*
	S.4.3: The organization has sustainability as main objective and behaves accordingly.	-	The organization has sustainability as main objective and behaves accordingly.	*3*
	S.4.4: The presence of flexible processes and systems enable the organization to respond to external changes related to people, environment, and society.	-	The presence of flexible processes and systems enable the organization to respond to external changes related to people, environment, and society.	*1*
	S.4.5: The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to maintain and develop sustainable processes and systems.	**Feedback from expert:** *"Shouldn't you simplify the statement?"* (feedback on statement Q.4.1). **Adjustment:** The statement has been simplified to increase comprehensibility.	Resources such as policies, organizational structures, procedures, technologies, information assets and applications enable the development of a sustainable organization.	*5*
	S.7.1: The organization follows technological developments in the field of online accessibility in a consistent and structured manner.	**Feedback from expert:** *"I think this is an old-fashioned statement"* and *"As if you do something that is not online"* **Adjustment:** *"online accessibility"* has been changed to *"accessibility"*. Accessibility can be experienced in different ways, not only through the online channel.	The organization follows technological developments in the field of accessibility in a consistent and structured manner.	*8*
	S.7.2: Periodic reviews take place regarding online accessibility with the aim of improving the customer experience.	**Feedback from expert:** See feedback statement Q.7.1. **Adjustment:** *"online accessibility"* has been changed to *"accessibility"*. Accessibility can be experienced in different ways, not only through the online channel.	Accessibility is periodically reviewed and improved with the aim of meeting customer expectations.	*9*

S.7.3: Customers can view all their products and services online, while it is also possible to make changes.	**Feedback from expert:** *"This is actually a yes or no statement"* and *"This is because of the word: "all""*. **Adjustment:** The statement has been simplified and *"can view all their products and services online"* has been removed.	Customers and prospects experience the organization as accessible.	6
S.7.4: When designing processes and systems, new technologies are being adopted and implemented to improve online accessibility.	**Feedback from expert:** See feedback statement Q.7.1. **Adjustment:** *"online accessibility"* has been changed to *"accessibility"*. Accessibility can be experienced in different ways, not only through the online channel.	When designing processes and systems, new technologies are being adopted and implemented to improve accessibility.	7
S.7.5: The presence of policies, organizational structures, procedures, technologies, information assets and applications enable the organization to maintain, develop and improve the virtual accessibility.	**Feedback from expert:** *"Statement 5 is too long, but we already knew that (because of statement Q.1.6), it really needs to be shortened".* **Adjustment:** The statement has been simplified and the listing of resources now serves as an example.	Resources such as organizational structures, technologies, information assets and applications enable the organization to improve their accessibility.	10

	Statement in assessment instrument	Comment based on expert interview and document analysis	Statement in assessment instrument	Order
D.7: Communication & understanding	**S.2.1:** Developments in the field of Knowledge Management are followed in a consistent and structured manner.	-	Developments in the field of Knowledge Management are followed in a consistent and structured manner.	*3*
	S.2.2: There is a clear Knowledge Management strategy in place which deals with the dissemination of knowledge.	**Feedback from expert:** *"I do not know what dissemination is".* **Adjustment:** *"Dissemination"* has been replaced by *"distribution"* this is much clearer.	There is a clear Knowledge Management strategy in place which deals with the distribution of knowledge.	*2*
	S.2.3: A Knowledge Management culture is actively promoted by the management.	-	A Knowledge Management culture is actively promoted by the management.	*1*
	S.2.4: The presence of policies, organizational structures, procedures, technologies, information assets and applications enable an effective Knowledge Management culture.	**Feedback from expert:** *"Statement 5 is too long, but we already knew that (because of statement Q.1.6), it really needs to be shortened".* **Adjustment:** The statement has been simplified and the listing of resources now serves as an example.	Resources such as organizational structures, procedures, technologies, and applications enable an effective Knowledge Management culture.	*4*

	Statement in assessment instrument	Comment based on expert interview and document analysis	Statement in assessment instrument	Order
D.9: Partnership	**S.6.1:** Developments related to ownership, responsibility, roles, and power are followed in a consistent and structured manner.	**Feedback from expert:** *"I just do not understand statement 1"* and *"This statement makes me think about internal responsibility, ownership, etc. and that is why I find that statement very difficult "* **Adjustment:** A clear emphasis was placed on the external character of this EAC and how the organization deals with this.	The organization monitors its image among customers, partners and other relevant stakeholders in a consistent and structured manner.	*2*
	S.6.2: Initiatives such as co-creation and co-production are used for exercising stakeholder influence.	-	Initiatives such as co-creation and co-production are used for exercising stakeholder influence.	*1*
	S.6.3: The presence of policies, organizational structures, procedures, technologies, information assets and applications help the organization to deal with challenges related to ownership, responsibility, roles, and power.	**Feedback from expert:** *"Statement 5 is too long, but we already knew that (because of statement Q.1.6), it really needs to be shortened".* **Adjustment:** The statement has been simplified and the listing of resources now serves as an example.	Resources such as organizational structures, technologies, information assets and applications help the organization to deal with challenges related to ownership, responsibility, roles, and power.	*3*
	S.8.1: Developments related to competitors, partners and customers are followed in a consistent and structured manner.	**Feedback from expert:** *"I think this is a difficult statement"* and *"This feels like it is the same as statement 1" (Q.6.1).* **Adjustment:** The statement has been adjusted to better interpret the EAC.	When evaluating partnerships, both at economic and non-economic objectives are taken into account that express themselves in strategic and economic benefits.	*4*
	S.8.2: Existing partnerships are periodically evaluated, and action is taken if necessary.	-	Existing partnerships are periodically evaluated, and action is taken if necessary.	*5*
	S.8.3: The presence of policies, organizational structures, procedures, technologies, information assets and applications help the organization in navigating the terrain of turbulent markets, complexity, and uncertainty.	**Feedback from expert:** *"Statement 5 is too long, but we already knew that (because of statement Q.1.6), it really needs to be shortened".* **Adjustment:** The statement has been simplified and the listing of resources now serves as an example.	Resources such as organizational structures, procedures, technologies, and applications enable the organization in navigating the terrain of turbulent markets, complexity and uncertainty.	*6*

	Statement in assessment instrument	Comment based on expert interview and document analysis	Statement in assessment instrument	Order
D.10: Readiness for change	**S.3.1:** Developments in organizational adaptability and innovation are followed in a consistent and structured manner.	-	Developments in organizational adaptability and innovation are followed in a consistent and structured manner.	*4*
	S.3.2: How work is experienced by employees is periodically evaluated and action is taken if necessary.	-	How work is experienced by employees is periodically evaluated and action is taken if necessary.	*5*
	S.3.3: Process design decisions which focus on standardization and compliance are reviewed.	-	Process design decisions which focus on standardization and compliance are reviewed.	*6*
	S.3.4: Through employee empowerment, the organization coordinates its decision-making capabilities effectively.	-	Through employee empowerment, the organization coordinates its decision-making capabilities effectively.	*1*
	S.3.5: The organization designs interesting and meaningful work**.**	-	The organization designs interesting and meaningful work**.**	*2*
	S.3.6: When designing work, the organization pays attention to processes that focus on standardization and compliance since they are suitable for machines but not for people.	-	When designing work, the organization pays attention to processes that focus on standardization and compliance since they are suitable for machines but not for people.	*3*
	S.3.7: The presence of policies, organizational structures, procedures, technologies, information assets and applications enable organizational adaptability and innovation**.**	**Feedback from expert:** *"Statement 5 is too long, but we already knew that (because of statement Q.1.6), it really needs to be shortened".* **Adjustment:** The statement has been simplified and the listing of resources now serves as an example.	Resources such as organizational structures, procedures, technologies, and applications enable organizational adaptability and innovation.	*7*
	S.5.1: Developments regarding greater cultural and generational diversity among workers are followed in a consistent and structured manner.	**Feedback from expert:** *I am actually missing a bit here; this is to say you are following it. But ultimately, it's about doing.* **Adjustment:** This statement focusses on the learning indicator, in order to learn it is necessary to track the developments. Because of this the statement has not been changed.	Developments regarding greater cultural and generational diversity among workers are followed in a consistent and structured manner.	*10*
	S.5.2: The organization is aware that heterogeneity among employees is increasingly taking a prominent place within business scenarios**.**	**Feedback from expert:** See feedback statement Q.2.2. **Adjustment:** Despite the fact that there has been no feedback on this statement, *"heterogeneity"* has been clarified through a number of variables.	Heterogeneity, with variables such as; gender, age, work experience and function area among employees is increasingly taking a prominent place within the organization.	*9*

S.5.3: The organization is looking for a balance in heterogeneity among work forces and takes appropriate measures**.**	**Feedback from expert:** *"By this I mean, male / female or Muslim relationship, Christian. Everything is possible"* and *"What exactly do you mean by this statement?".* **Adjustment:** *"heterogeneity"* has been clarified through a number of variables and a clear emphasis has been made on the desired output.	When designing teams, heterogeneity, with variables such as; gender, age, work experience and function is taken into account resulting in high performing teams.	*8*
S.5.4: The presence of policies, organizational structures, procedures, technologies, information assets and applications support the organization in dealing with greater cultural and generational diversity among workers.	**Feedback from expert:** *"Statement 5 is too long, but we already knew that (because of statement Q.1.6), it really needs to be shortened".* **Adjustment:** The statement has been simplified and the listing of resources now serves as an example.	Resources such as organizational structures, procedures, technologies, and applications help the organization in dealing with greater diversity among workers	*11*

Appendix K: Final assessment instrument

Assessment instrument for measuring enterprise architecture effectiveness

Degree programme:	Open University of the Netherlands, Faculty of Management, Science & Technology
Course:	IM9806 Business Process Management and IT Graduation Assignment
Name:	Demir Kopic
Identification number:	852049091
Version:	0.9

Explanation:

The purpose of this assessment instrument is to provide insight into the extent to which current enterprise architecture practices give substance to enterprise architecture challenges. On the basis of this, the impact on enterprise architecture effectiveness is assessed.
The assessment instrument and the accompanying enterprise architecture challenges, which play a central role in this research, were developed on the basis of theoretical insights from the field of enterprise architecture.
The assessment instrument consists of 5 parts containing 42 questions. *Indicate to what extent you believe that the statement describes the current situation within the organization.*

Details of the participant

Date:	DD/MM/YY
Name of the participant:	
Position of the participant:	

Intake questions

Please indicate what applies to you in the questions below

1. My work focuses on:	IT	●1 ○2 ○3 ○4 ●5	Business
2. My work focuses on:	Systems	●1 ○2 ○3 ○4 ●5	Processes
3. I am familiar with enterprise architecture.	Completely disagree	●1 ○2 ○3 ○4 ●5	Totally agree

End of page, please continue to the next page: "Internal monitoring".

Figure 1: First screen assessment instrument: *"introduction"*

Figure 2: Second screen assessment instrument, dimension: *"internal monitoring"*

External monitoring:
"designing responsible processes and organizations" & "24/7 accessibility through virtual channels"

Please indicate to what extent the statement describes the current situation within the organization

Statement	Scale
1. The presence of flexible processes and systems enable the organization to respond to external changes related to people, environment, and society.	Completely disagree — 1 2 3 4 5 — Totally agree
2. External aspects such as people, environment and society are considered when designing processes and systems.	Completely disagree — 1 2 3 4 5 — Totally agree
3. The organization has sustainability as main objective and behaves accordingly.	Completely disagree — 1 2 3 4 5 — Totally agree
4. External developments related to people, environment and society are followed in a consistent and structured manner.	Completely disagree — 1 2 3 4 5 — Totally agree
5. Resources such as policies, organizational structures, procedures, technologies, information assets and applications enable the development of a sustainable organization.	Completely disagree — 1 2 3 4 5 — Totally agree
6. Customers and prospects experience the organization as accessible.	Completely disagree — 1 2 3 4 5 — Totally agree
7. When designing processes and systems, new technologies are being adopted and implemented to improve accessibility.	Completely disagree — 1 2 3 4 5 — Totally agree
8. The organization follows technological developments in the field of accessibility in a consistent and structured manner.	Completely disagree — 1 2 3 4 5 — Totally agree
9. Accessibility is periodically reviewed and improved with the aim of meeting customer expectations.	Completely disagree — 1 2 3 4 5 — Totally agree
10. Resources such as organizational structures, technologies, information assets and applications enable the organization to improve their accessibility.	Completely disagree — 1 2 3 4 5 — Totally agree

End of page, please continue to the next page: "Communication & understanding".

Figure 3: Third screen assessment instrument, dimension: *"external monitoring"*

Communication & understanding:
"effective Knowledge Management"

Please indicate to what extent the statement describes the current situation within the organization

1. A Knowledge Management culture is actively promoted by the management.	Completely disagree	○1 ○2 ○3 ○4 ○5	Totally agree

2. There is a clear Knowledge Management strategy in place which deals with the distribution of knowledge.	Completely disagree	○1 ○2 ○3 ○4 ○5	Totally agree

3. Developments in the field of Knowledge Management are followed in a consistent and structured manner.	Completely disagree	○1 ○2 ○3 ○4 ○5	Totally agree

4. Resources such as organizational structures, procedures, technologies, and applications enable an effective Knowledge Management culture.	Completely disagree	○1 ○2 ○3 ○4 ○5	Totally agree

End of page, please continue to the next page: "Partnership".

Figure 4: *Fourth screen assessment instrument, dimension: "communication & understanding"*

Partnership:
"dealing with challenges related to ownership, responsibility, roles, and power" & "navigating the terrain of turbulent markets, complexity and uncertainty"

Please indicate to what extent the statement describes the current situation within the organization

1. Initiatives such as co-creation and co-production are used for exercising stakeholder influence.	Completely disagree	○1 ○2 ○3 ○4 ○5	Totally agree

2. The organization monitors in a consistent and structured manner how stakeholders such as customers and partners view the organization.	Completely disagree	○1 ○2 ○3 ○4 ○5	Totally agree

3. Resources such as organizational structures, technologies, information assets and applications help the organization to deal with challenges related to ownership, responsibility, roles, and power.	Completely disagree	○1 ○2 ○3 ○4 ○5	Totally agree

4. When evaluating partnerships, both economic and non-economic objectives are taken into account that express themselves in strategic and economic benefits.	Completely disagree	○1 ○2 ○3 ○4 ○5	Totally agree

5. Existing partnerships are periodically evaluated and action is taken if necessary.	Completely disagree	○1 ○2 ○3 ○4 ○5	Totally agree

6. Resources such as organizational structures, procedures, technologies, and applications enable the organization in navigating the terrain of turbulent markets, complexity and uncertainty.	Completely disagree	○1 ○2 ○3 ○4 ○5	Totally agree

End of page, please continue to the next page: "Readiness for change".

Figure 5: Fifth screen assessment instrument, dimension: *"partnership"*

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Readiness for change:
"organizational adaptability and innovation" and "dealing with greater cultural and generational diversity among workers"

Please indicate to what extent the statement describes the current situation within the organization

Statement	Scale
1. Through employee empowerment, the organization coordinates its decision-making capabilities effectively.	Completely disagree ○1 ○2 ○3 ○4 ○5 Totally agree
2. The organization designs interesting and meaningful work.	Completely disagree ○1 ○2 ○3 ○4 ○5 Totally agree
3. When designing work, the organization pays attention to processes that focus on standardization and compliance since they are suitable for machines but not for people.	Completely disagree ○1 ○2 ○3 ○4 ○5 Totally agree
4. Developments related to organizational adaptability and innovation are followed in a consistent and structured manner.	Completely disagree ○1 ○2 ○3 ○4 ○5 Totally agree
5. How work is experienced by employees is periodically evaluated and action is taken if necessary.	Completely disagree ○1 ○2 ○3 ○4 ○5 Totally agree
6. Process design decisions which focus on standardization and compliance are reviewed periodically.	Completely disagree ○1 ○2 ○3 ○4 ○5 Totally agree
7. Resources such as organizational structures, procedures, technologies, and applications enable organizational adaptability and innovation.	Completely disagree ○1 ○2 ○3 ○4 ○5 Totally agree
8. When designing teams, heterogeneity, with variables such as; gender, age, work experience and function is taken into account resulting in high performing teams.	Completely disagree ○1 ○2 ○3 ○4 ○5 Totally agree
9. Heterogeneity, with variables such as; gender, age, work experience and function area among employees is increasingly taking a prominent place within the organization.	Completely disagree ○1 ○2 ○3 ○4 ○5 Totally agree
10. Developments regarding greater cultural and generational diversity among workers are followed.	Completely disagree ○1 ○2 ○3 ○4 ○5 Totally agree
11. Resources such as organizational structures, procedures, technologies, and applications help the organization in dealing with greater diversity among workers.	Completely disagree ○1 ○2 ○3 ○4 ○5 Totally agree

End of page, please continue to the next page: "Results".

Figure 6: Sixth screen assessment instrument, dimension: *"readiness for change"*

Results: average score per dimension

Overall results

Internal monitoring
External monitoring
Communication & understanding
Partnership
Readiness for change

Overall results: effort to use, effort to learn and presence of resources

☐ Effort to use   ☐ Effort to learn   ☐ Presence of resources

Results per Enterprise Architecture Challenge

Utilizing data outside and within their boundaries
Making effective use of new resources
Dealing with greater cultural and generational diversity among workers
Designing responsible processes and organizations
Organizational adaptability and innovation
24/7 accessibility through virtual channels
Navigating the terrain of turbulent markets, complexity and uncertainty
Dealing with challenges related to ownership, responsibility, roles, and power
Effective Knowledge Management

Internal monitoring

Question	Score	Comment
1. Data is essential when it comes to decision making.	⊗ 0	
2. Improvements and technologies are adopted so that data can be utilized to its full potential.	⊗ 0	
3. Data is being managed and tracked in a consistent and structured manner.	⊗ 0	
4. External developments related to how data can be utilized are followed in a consistent and structured manner.	⊗ 0	
5. A periodic evaluation takes place regarding how data is used.	⊗ 0	
6. Resources such as policies, organizational structures, procedures, technologies, information assets and applications enable effective data utilization practices.	⊗ 0	
7. The organization focuses not on organizational planning and execution cycles, but rather on the execution, evaluation, and revision of their strategy.	⊗ 0	
8. New data resources such as contextual data are actively used to gain a competitive advantage.	⊗ 0	
9. The organization is continuously looking at how new data resources can be used to gain a competitive advantage.	⊗ 0	
10. The data architecture is critically examined and periodically reviewed.	⊗ 0	
11. Resources such as organizational structures, procedures, technologies, information assets, and applications enable the organization to make effective use of new data resources.	⊗ 0	

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External monitoring

	Score	
1. The presence of flexible processes and systems enable the organization to respond to external changes related to people, environment, and society.	❌ 0	
2. External aspects such as people, environment and society are considered when designing processes and systems.	❌ 0	
3. The organization has sustainability as main objective and behaves accordingly.	❌ 0	
4. External developments related to people, environment and society are followed in a consistent and structured manner.	❌ 0	
5. Resources such as policies, organizational structures, procedures, technologies, information assets and applications enable the development of a sustainable organization.	❌ 0	
6. Customers and prospects experience the organization as accessible.	❌ 0	
7. When designing processes and systems, new technologies are being adopted and implemented to improve accessibility.	❌ 0	
8. The organization follows technological developments in the field of accessibility in a consistent and structured manner.	❌ 0	
9. Accessibility is periodically reviewed and improved with the aim of meeting customer expectations.	❌ 0	
10. Resources such as organizational structures, technologies, information assets and applications enable the organization to improve their accessibility.	❌ 0	

Communication & understanding

	Score	
1. A Knowledge Management culture is actively promoted by the management.	❌ 0	
2. There is a clear Knowledge Management strategy in place which deals with the distribution of knowledge.	❌ 0	
3. Developments in the field of Knowledge Management are followed in a consistent and structured manner.	❌ 0	
4. Resources such as organizational structures, procedures, technologies, and applications enable an effective Knowledge Management culture.	❌ 0	

Partnership

	Score	
1. Initiatives such as co-creation and co-production are used for exercising stakeholder influence.	❌ 0	
2. The organization monitors in a consistent and structured manner how stakeholders such as customers and partners view the organization.	❌ 0	
3. Resources such as organizational structures, technologies, information assets and applications help the organization to deal with challenges related to ownership, responsibility, roles, and power.	❌ 0	
4. When evaluating partnerships, both economic and non-economic objectives are taken into account that express themselves in strategic and economic benefits.	❌ 0	
5. Existing partnerships are periodically evaluated and action is taken if necessary.	❌ 0	
6. Resources such as organizational structures, procedures, technologies, and applications enable the organization in navigating the terrain of turbulent markets, complexity and uncertainty.	❌ 0	

Readiness for change

	Score	
1. Through employee empowerment, the organization coordinates its decision-making capabilities effectively.	❌ 0	
2. The organization designs interesting and meaningful work.	❌ 0	
3. When designing work, the organization pays attention to processes that focus on standardization and compliance since they are suitable for machines but not for people.	❌ 0	
4. Developments related to organizational adaptability and innovation are followed in a consistent and structured manner.	❌ 0	
5. How work is experienced by employees is periodically evaluated and action is taken if necessary.	❌ 0	
6. Process design decisions which focus on standardization and compliance are reviewed periodically.	❌ 0	
7. Resources such as organizational structures, procedures, technologies, and applications enable organizational adaptability and innovation.	❌ 0	
8. When designing teams, heterogeneity, with variables such as; gender, age, work experience and function is taken into account resulting in high performing teams.	❌ 0	
9. Heterogeneity, with variables such as; gender, age, work experience and function area among employees is increasingly taking a prominent place within the organization.	❌ 0	
10. Developments regarding greater cultural and generational diversity among workers are followed.	❌ 0	
11. Resources such as organizational structures, procedures, technologies, and applications help the organization in dealing with greater diversity among workers.	❌ 0	

Figure 8: Eight screen assessment instrument: *"evaluation"*

Data for spider-chart

Dimension	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Max points	Achieved points	%
Internal monitoring	0	0	0	0	0	0	0	0	0	0	0	55	0	0
External monitoring	0	0	0	0	0	0	0	0	0	0	N/A	50	0	0
Communication & understanding	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20	0	0
Partnership	0	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	30	0	0
Readiness for change	0	0	0	0	0	0	0	0	0	0	0	55	0	0

Data for results per dimension

Dimension	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Max points	Achieved points	%
Internal monitoring	0	0	0	0	0	0	0	0	0	0	0	55	0	0
External monitoring	0	0	0	0	0	0	0	0	0	0	N/A	50	0	0
Communication & understanding	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20	0	0
Partnership	0	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	30	0	0
Readiness for change	0	0	0	0	0	0	0	0	0	0	0	55	0	0

Intake

Question	Result
1. My work focusses on	0
2. My work focusses on	0
3. I am familiar with enterprise architecture.	0

Evaluatie assessment instrument

1. The assessment instrument has a clear structure.	0
2. The questions are clearly formul	0
3. The results of the assessment instrument are useful.	0

Data for effort to learn, effort to use and availibility of resources

Dimension	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Max points	Achieved points	%
Internal monitoring	0	0	0	0	0	0	0	0	0	0	0	55	0	0
External monitoring	0	0	0	0	0	0	0	0	0	0	N/A	50	0	0
Communication & understanding	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20	0	0
Partnership	0	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	30	0	0
Readiness for change	0	0	0	0	0	0	0	0	0	0	0	55	0	0

Legenda

Effort to use
Effort to learn
Presence of resources

Unit of measurement	Achieved points	Max points	%
Effort to use	0	90	0
Effort to learn	0	75	0
Presence of resources	0	45	0

Data for score per EACs

Dimension	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Max points	Achieved points	%
Internal monitoring	0	0	0	0	0	0	0	0	0	0	0	55	0	0
External monitoring	0	0	0	0	0	0	0	0	0	0	N/A	50	0	0
Communication & understanding	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20	0	0
Partnership	0	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	30	0	0
Readiness for change	0	0	0	0	0	0	0	0	0	0	0	55	0	0

EAC	Max. points	Achieved points	%
Utilizing data outside and within their boundaries	30	0	0
Making effective use of new resources	25	0	0
Designing responsible processes and organizations	25	0	0
24/7 accessibility through virtual channels	25	0	0
Effective Knowledge Management	20	0	0
Dealing with challenges related to ownership, responsibility, roles, and power	15	0	0
Navigating the terrain of turbulent markets, complexity and uncertainty	15	0	0
Organizational adaptability and innovation	35	0	0
Dealing with greater cultural and generational diversity among workers	20	0	0

Figure 9: Eight screen assessment instrument: *"data tab"*

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Appendix L: Interview schedule

The following schedule was used during the interviews with the architects and development team members:

1. Introduction

- The participant is welcomed and thanked
- The researcher introduces himself briefly
- The research goal and the research method are explained
- The purpose of the interview is explained
- An explanation is given about the anonymity, confidentiality and the way in which the recording is processed and stored.
- The participant is given the opportunity to ask questions in advance.

2. Intake questions

- Can you tell us more about your role in the organization and your involvement in the subject of enterprise architecture?
- Which enterprise architecture challenges do you see arising within the organization?
- The intake questions are completed

3. Assessment instrument

- The assessment instrument is completed
- The results are discussed

4. Evaluation of assessment instrument

- Evaluation questions are answered

5. Provide summary and complete interview

- A summary of points
- The participant is thanked for taking part in the interview

Appendix M: Transcribed interviews

This Appendix contains confidential information and has not been included for this reason.

Appendix N: Quantitative and qualitative data

Quantitative data

This Appendix contains the data used in the demonstration phase. First, the quantitative data is presented. *Table 1* shows an overview of all answers given during the interviews.

Table 1: Overview of answers from all participants

EAC	Statement	Interview						
		1	2	3	4	5	6	7
Utilizing data outside and within their boundaries	1	3	3	5	4	1	3	5
	2	5	5	3	4	2	3	5
	3	2	4	2	2	3	4	4
	4	4	2	3	4	1	4	5
	5	3	5	2	1	2	3	4
	6	4	2	3	4	2	2	4
Making effective use of new resources	1	4	3	4	3	2	4	4
	2	2	4	4	3	1	5	5
	3	4	4	4	4	4	5	5
	4	5	4	4	2	2	4	5
	5	3	2	4	2	4	4	4
Designing responsible processes and organizations	1	3	5	4	2	5	4	4
	2	5	5	4	2	5	4	4
	3	4	4	4	4	4	4	5

Category	#							
	4	5	4	4	3	5	4	4
	5	5	4	4	4	5	3	3
24/7 accessibility through virtual channels	1	4	4	3	2	5	3	4
	2	5	4	4	4	5	4	4
	3	5	4	4	4	5	4	5
	4	4	3	3	2	4	4	3
	5	4	5	4	5	5	3	4
Effective Knowledge Management	1	5	5	2	1	3	4	4
	2	4	2	3	2	1	3	3
	3	2	3	3	1	1	3	4
	4	4	5	4	3	2	3	3
Dealing with challenges related to ownership, responsibility, roles, and power	1	4	5	4	4	3	4	4
	2	5	3	4	2	1	4	5
	3	4	4	4	3	2	4	3
Navigating the terrain of turbulent markets, complexity and uncertainty	1	4	4	4	3	3	4	5
	2	4	4	4	4	2	4	4
	3	4	4	4	4	4	4	5

Category	#							
Organizational adaptability and innovation	1	3	5	3	2	1	3	4
	2	4	5	4	4	4	3	4
	3	3	5	5	1	4	4	4
	4	4	2	4	3	2	4	5
	5	4	5	4	2	3	4	4
	6	3	4	4	2	2	4	4
	7	3	4	4	4	4	3	3
Dealing with greater cultural and generational diversity among workers	1	1	4	5	2	2	3	4
	2	3	4	5	3	5	3	4
	3	3	4	5	4	5	3	4
	4	4	4	4	2	5	3	4

Effort to use, effort to learn and presence of resources

Because the statements are divided into three measurement indicators, the effort to use, effort to learn and presence of resources can be examined per EACs based on this data. The results can be consulted in *Figure 1* to *Figure 9*.
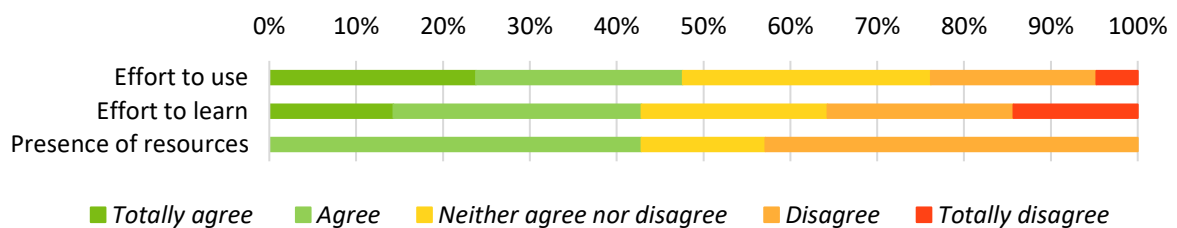
Figure 1: Effort to use, effort to learn and presence of resources (utilizing data outside and within their boundaries)
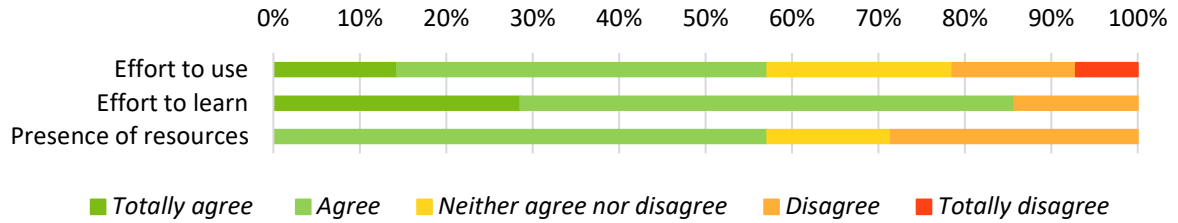
Figure 2: Effort to use, effort to learn and presence of resources (making effective use of new resources)
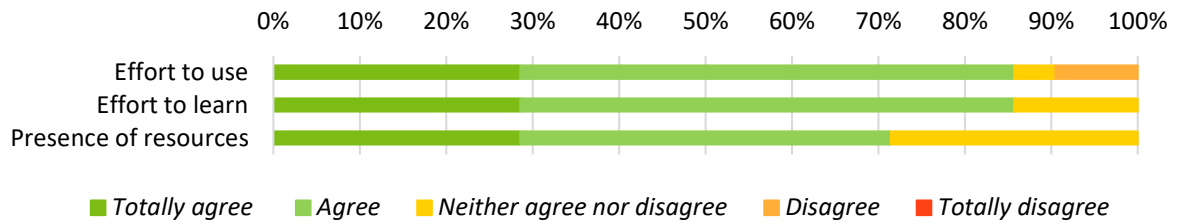
Figure 3: Effort to use, effort to learn and presence of resources (designing responsible processes and organizations)
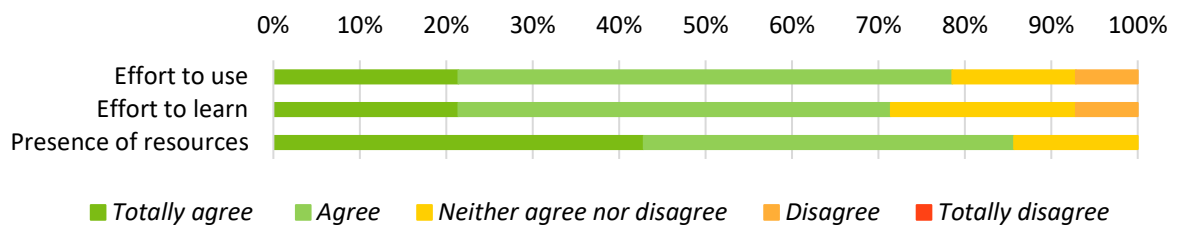
Figure 4: Effort to use, effort to learn and presence of resources (24/7 accessibility through virtual channels)
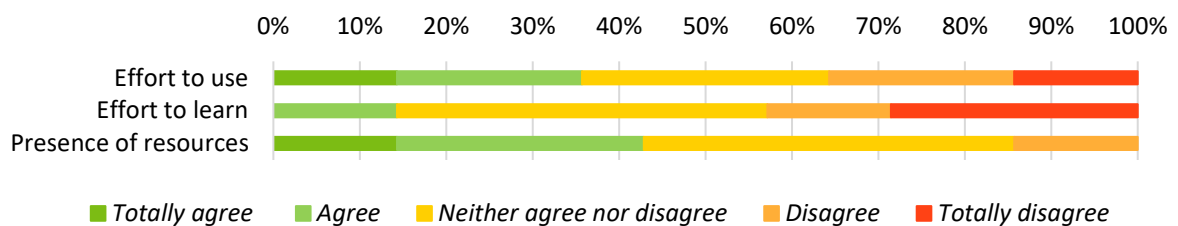
Figure 5: Effort to use, effort to learn and presence of resources (effective Knowledge Management)
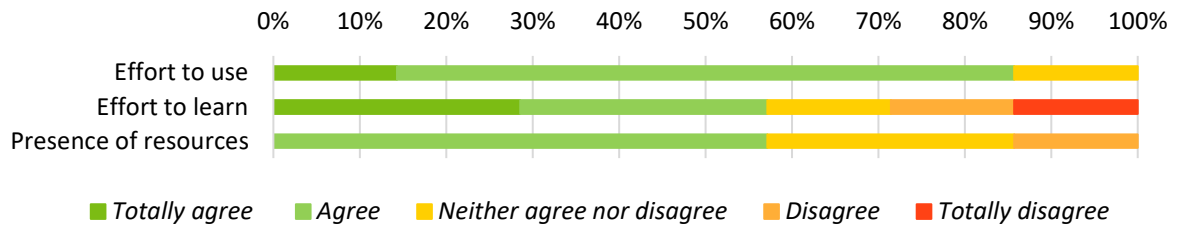
Figure 6: Effort to use, effort to learn and presence of resources (dealing with challenges related to ownership, responsibility, roles, and power)
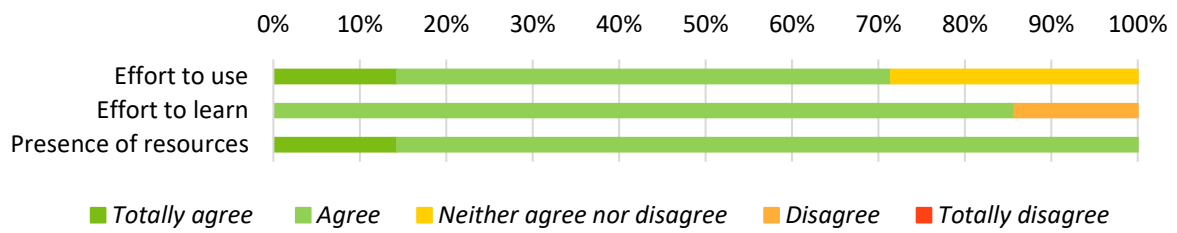
Figure 7: Effort to use, effort to learn and presence of resources (navigating the terrain of turbulent markets, complexity and uncertainty)
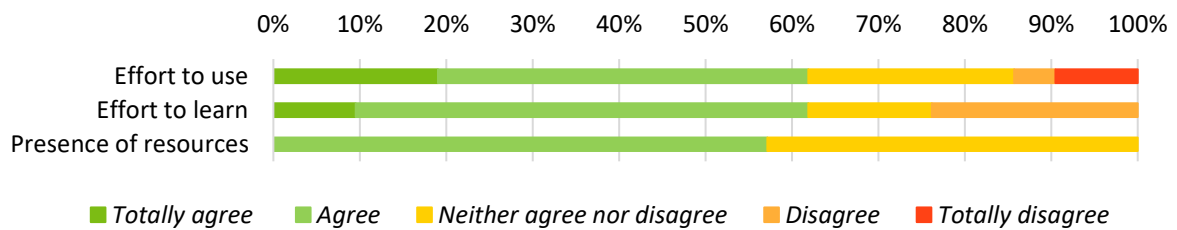
Figure 8: Effort to use, effort to learn and presence of resources (organizational adaptability and innovation)
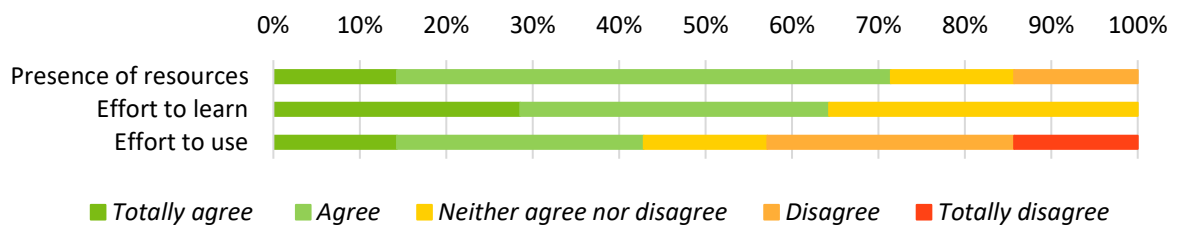
Figure 9: Effort to use, effort to learn and presence of resources (dealing with greater cultural and generational diversity among workers)

The average score per statement was also examined. It is possible to see what the highest and the lowest rated statements have been. The results can be consulted in *Figure 10*. *Table 2* can be consulted to determine which EAC the statement belongs to.
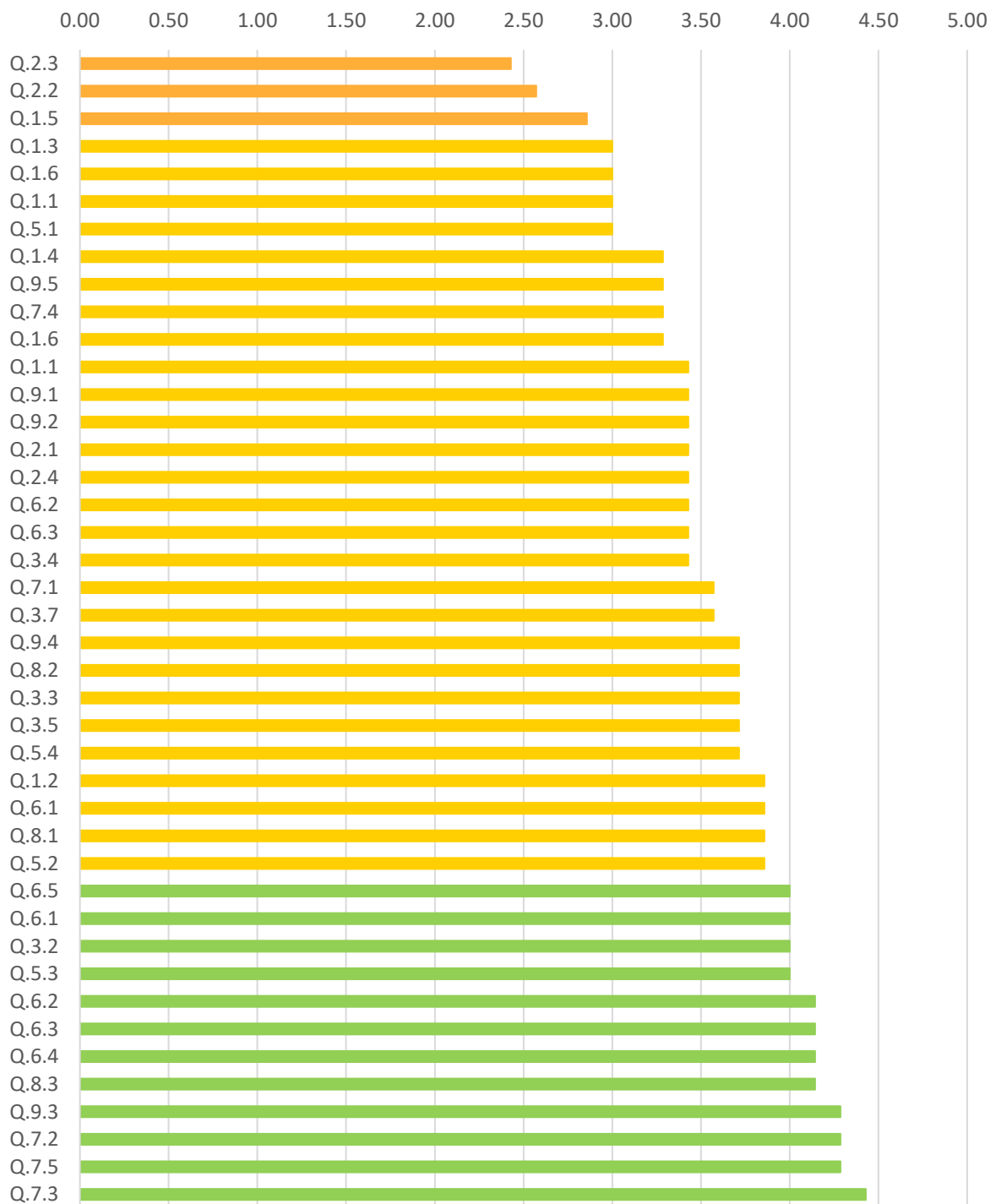
Figure 10: Average score per statement

Table 2: Overview of EACs and related statements

Enterprise architecture challenge (EAC)	EAC	Statements
Utilizing data outside and within their boundaries	*EAC.1*	*Q.1.1 to Q.1.6*
Making effective use of new resources	*EAC.9*	*Q.9.1 to Q.9.5*
Designing responsible processes and organizations	*EAC.4*	*Q.4.1 to Q.4.5*
24/7 accessibility through virtual channels	*EAC.7*	*Q.7.1 to Q.7.5*
Effective Knowledge Management	*EAC.2*	*Q.2.1 to Q.2.4*
Dealing with challenges related to ownership, responsibility, roles, and power	*EAC.6*	*Q.6.1 to Q.6.3*
Navigating the terrain of turbulent markets, complexity and uncertainty	*EAC.8*	*Q.8.1 to Q.8.3*
Organizational adaptability and innovation	*EAC.3*	*Q.3.1 to Q.3.7*
Dealing with greater cultural and generational diversity among workers	*EAC.5*	*Q.5.1 to Q.5.4*

Cronbach's Alpha formula

The following formula was used to determine the Cronbach's Alpha: $\quad \alpha = \frac{k}{k-1}\left(1 - \frac{\sum V_i}{V_t}\right)$

The calculation was performed in Excel using the VARP function, the results and calculations can be consulted in *Table 3* to *Table 12*.

Table 3: Cronbach's Alpha per EAC

Enterprise architecture challenge	Cronbach's Alpha
Utilizing data outside and within their boundaries	*0.715*
Making effective use of new resources	*0.765*
Designing responsible processes and organizations	*0.708*
24/7 accessibility through virtual channels	*0.727*
Effective knowledge management	*0.732*
Dealing with challenges related to ownership, responsibility, roles, and power	*0.709*
Navigating the terrain of turbulent markets, complexity and uncertainty	*0.702*
Organizational adaptability and innovation	*0.732*
Dealing with greater cultural and generational diversity among workers	*0.765*

Table 4: Calculation of Cronbach's Alpha: *"utilizing data outside and within their boundaries"*

Interview	Utilizing data outside and within their boundaries						Total variances
	Statement						
	1	2	3	4	5	6	
1	3	5	2	4	3	4	21
2	3	5	4	2	5	2	21
3	5	3	2	3	2	3	18
4	4	4	2	4	1	4	19
5	1	2	3	1	2	2	11
6	3	3	4	4	3	2	19
7	5	5	4	5	4	4	27
Variances	1.67	1.27	0.86	1.63	1.55	0.86	

Data for calculating Cronbach's alpha - Utilizing data outside and within their boundaries

Number of items	6
Sum of the Item variances	7.84
Variances of total scores	19.39
Cronbach's alpha	**0.715**

Table 5: Calculation of Cronbach's Alpha: *"making effective use of new resources"*

Interview	Making effective use of new resources					Total variances
	Statement					
	1	2	3	4	5	
1	4	2	4	5	3	18
2	3	4	4	4	2	17
3	4	4	4	4	4	20
4	3	3	4	2	2	14
5	2	1	4	2	4	13
6	4	5	5	4	4	22
7	4	5	5	5	4	23
Variances	0.53	1.96	0.20	1.35	0.78	

Data for calculating Cronbach's alpha - Making effective use of new resources

Number of items	5
Sum of the Item variances	4.82
Variances of total scores	12.41

Table 6: Calculation of Cronbach's Alpha: *"designing responsible processes and organizations"*

Cronbach's alpha						*0.765*
Interview	**Designing responsible processes and organizations**					**Total variances**
	Statement					
	1	**2**	**3**	**4**	**5**	
1	*3*	*5*	*4*	*5*	*5*	*22*
2	*5*	*5*	*4*	*4*	*4*	*22*
3	*4*	*4*	*4*	*4*	*4*	*20*
4	*2*	*2*	*4*	*3*	*4*	*15*
5	*5*	*5*	*4*	*5*	*5*	*24*
6	*4*	*4*	*4*	*4*	*3*	*19*
7	*4*	*4*	*5*	*4*	*3*	*20*
Variances	*0.98*	*0.98*	*0.12*	*0.41*	*0.57*	

Data for calculating Cronbach's alpha	
Number of items	*5*
Sum of the Item variances	*3.06*
Variances of total scores	*7.06*
Cronbach's alpha	*0.708*

Table 7: Calculation of Cronbach's Alpha: *"24/7 accessibility through virtual channels"*

Interview	24/7 accessibility through virtual channels					Total variances
	Statement					
	1	2	3	4	5	
1	4	5	5	4	4	22
2	4	4	4	4	4	20
3	3	4	4	3	4	18
4	2	4	4	2	5	17
5	5	5	5	4	5	24
6	3	4	4	4	3	18
7	4	4	5	3	4	20
Variances	0.82	0.20	0.24	0.53	0.41	

Data for calculating Cronbach's alpha

Number of items	5
Sum of the Item variances	2.20
Variances of total scores	5.27
Cronbach's alpha	**0.727**

Table 8: Calculation of Cronbach's Alpha: *"effective knowledge management"*

Interview	Effective knowledge management				Total variances
	Statement				
	1	2	3	4	
1	5	4	2	4	15
2	5	2	3	5	15
3	2	3	3	4	12
4	1	2	1	3	7
5	3	1	1	2	7
6	4	3	3	3	13
7	4	3	4	3	14
Variances	1.96	0.82	1.10	0.82	

Data for calculating Cronbach's alpha

Number of items	4
Sum of the Item variances	4.69
Variances of total scores	10.41
Cronbach's alpha	**0.732**

Table 9: Calculation of Cronbach's Alpha: *"dealing with challenges related to ownership, responsibility, roles, and power"*

Interview	Dealing with challenges related to ownership, responsibility, roles, and power			Total variances
	Statement			
	1	2	3	
1	4	5	4	13
2	5	3	4	12
3	4	4	4	12
4	4	2	3	9
5	3	1	2	6
6	4	4	4	12
7	4	5	3	12
Variances	0.29	1.96	0.53	

Data for calculating Cronbach's alpha	
Number of items	3
Sum of the Item variances	2.78
Variances of total scores	5.27
Cronbach's alpha	**0.709**

Table 10: Calculation of Cronbach's Alpha: *"navigating the terrain of turbulent markets, complexity and uncertainty"*

Interview	Navigating the terrain of turbulent markets, complexity and uncertainty			Total variances
	Statement			
	1	2	3	
1	4	4	4	12
2	4	4	4	12
3	4	4	4	12
4	3	4	4	11
5	3	2	4	9
6	4	4	4	12
7	5	4	5	14
Variances	0.41	0.49	0.12	

Data for calculating Cronbach's alpha	
Number of items	3
Sum of the Item variances	1.02
Variances of total scores	1.92
Cronbach's alpha	**0.702**

Table 11: Calculation of Cronbach's Alpha: *"utilizing data outside and within their boundaries"*

Interview	Organizational adaptability and innovation							Total variances
	Statement							
	1	2	3	4	5	6	7	
1	3	4	3	4	4	3	3	24
2	5	5	5	2	5	4	4	30
3	3	4	5	4	4	4	4	28
4	2	4	1	3	2	2	4	18
5	1	4	4	2	3	2	4	20
6	3	3	4	4	4	4	3	25
7	4	4	4	5	4	4	3	28
Variances	1.43	0.29	1.63	1.10	0.78	0.78	0.24	

Data for calculating Cronbach's alpha

Number of items	7
Sum of the Item variances	6.24
Variances of total scores	16.78
Cronbach's alpha	**0.732**

Table 12: Calculation of Cronbach's Alpha: *"utilizing data outside and within their boundaries"*

Interview	Dealing with greater cultural and generational diversity among workers				Total variances
	Statement				
	1	2	3	4	
1	1	3	3	4	11
2	4	4	4	4	16
3	5	5	5	4	19
4	2	3	4	2	11
5	2	5	5	5	17
6	3	3	3	3	12
7	4	4	4	4	16
Variances	1.71	0.69	0.57	0.78	

Data for calculating Cronbach's alpha	
Number of items	4
Sum of the Item variances	3.76
Variances of total scores	8.82
Cronbach's alpha	**0.765**

Finally, the evaluation questions and the corresponding scores are presented in *Table 13*.

Table 13: Results evaluation questions

Question	Evaluation question	Interview							Average score
		1	2	3	4	5	6	7	
1	The assessment instrument has a clear structure	5	5	5	4	5	4	5	4.7
2	The questions are clearly formulated	3	5	4	5	5	3	4	4.1
3	The results of the assessment instrument are useful	4	4	4	4	5	4	5	4.3

Qualitative data

The qualitative study was conducted using MAXQDA 2020[4], a software tool for qualitative research methods. In this section the qualitative part is described in which the coding process is discussed in more detail. Before the coding process has started, a structured codebook has been drawn up, the basic principles are described in *Table 14*.

Table 14: Maintained coding principles

Coding principle
There must be a structure per EAC
It must be possible to assess whether the respondent is replying positive or negative
The structure must provide the opportunity for deepening

Table 15 shows an overview of the codes used during the first step of the coding process. The codebook contains both the substantive components and the intake and evaluation components. Because of this, the whole assessment instrument is covered.

Table 14: *Maintained codes (first coding run)*

MAXQDA 2020 Overview of Codes

Colour	Parent code	Code
●	Utilizing data outside and within their boundaries	No periodic evaluation takes place
●	Utilizing data outside and within their boundaries	Resources do not enable effective data utilization practices
●	Utilizing data outside and within their boundaries	Resources enable effective data utilization practices
●	Utilizing data outside and within their boundaries	Periodic evaluation takes place
●	Utilizing data outside and within their boundaries	Data is not essential when it comes to decision making
●	Utilizing data outside and within their boundaries	Data is not managed and tracked
●	Utilizing data outside and within their boundaries	Improvements and technologies are not adopted
●	Utilizing data outside and within their boundaries	External developments are not followed
●	Utilizing data outside and within their boundaries	Data is managed and tracked
●	Utilizing data outside and within their boundaries	Improvements and technologies are adopted
●	Utilizing data outside and within their boundaries	External developments are followed
●	Utilizing data outside and within their boundaries	Data is essential when it comes to decision making
●	Organizational adaptability and innovation	Designing interesting and meaningful work
●	Organizational adaptability and innovation	Evaluating how work is experienced
●	Organizational adaptability and innovation	Employees are not empowered
●	Organizational adaptability and innovation	Focus on standardization and compliance
●	Organizational adaptability and innovation	Process design decisions are reviewed
●	Organizational adaptability and innovation	Resources do not enable adaptability and innovation
●	Organizational adaptability and innovation	Organizational adaptability developments are followed
●	Organizational adaptability and innovation	Process design decisions are not reviewed
●	Organizational adaptability and innovation	Resources enable adaptability and innovation
●	Organizational adaptability and innovation	Organizational adaptability developments are not followed
●	Organizational adaptability and innovation	Employees are empowered
●	Organizational adaptability and innovation	No focus on standardization and compliance
●	Organizational adaptability and innovation	Not designing interesting and meaningful work
●	Organizational adaptability and innovation	Not evaluating how work is experienced
●	Navigating the terrain of turbulent markets, complexity and …	Resources enable navigating turbulent markets
●	Navigating the terrain of turbulent markets, complexity and …	Existing partnerships are evaluated
●	Navigating the terrain of turbulent markets, complexity and …	Taking into account economic and non-economic objectives
●	Navigating the terrain of turbulent markets, complexity and …	Not taking into account economic and non-economic objectives
●	Navigating the terrain of turbulent markets, complexity and …	Existing partnerships are not evaluated
●	Navigating the terrain of turbulent markets, complexity and …	Resources do not enable navigating turbulent markets
●	Making effective use of new resources	Looking at how new data resources can be used
●	Making effective use of new resources	Data architecture is critically examined and reviewed
●	Making effective use of new resources	New data resources are used
●	Making effective use of new resources	Resources enable effective use of new data resources
●	Making effective use of new resources	New data resources are not used
●	Making effective use of new resources	Resources do not enable effective use of new data resources
●	Making effective use of new resources	Data architecture is not critically examined and reviewed
●	Making effective use of new resources	Not looking at how new data resources can be used
●	Making effective use of new resources	Not focussing on execution, evaluation and revision of strategy
●	Making effective use of new resources	Focussing on execution, evaluation and revision of strategy
●	Intake	Process oriented
●	Intake	System oriented
●	Intake	Both business and IT oriented
●	Intake	Familiar with EA
●	Intake	Both system and process oriented
●	Intake	Fairly familiar with EA
●	Intake	Business oriented
●	Evaluation	Results are useful
●	Evaluation	Instrument has a clear structure
●	Evaluation	Statements are clearly formulated
●	Evaluation	Statements are not clearly formulated
●	Effective Knowledge Management	No clear Knowledge Management strategy
●	Effective Knowledge Management	Developments are not followed
●	Effective Knowledge Management	Resources enable effective Knowledge Management
●	Effective Knowledge Management	Management is promoting a Knowledge Management culture
●	Effective Knowledge Management	Resources do not enable effective Knowledge Management
●	Effective Knowledge Management	Management is not promoting a Knowledge Management culture
●	Effective Knowledge Management	Clear Knowledge Management strategy
●	Effective Knowledge Management	Developments are followed
●	Designing responsible processes and organizations	Sustainability as main objective
●	Designing responsible processes and organizations	External developments are followed
●	Designing responsible processes and organizations	Resources enable a sustainable organization
●	Designing responsible processes and organizations	External aspects are considered
●	Designing responsible processes and organizations	Flexible processes and systems
●	Designing responsible processes and organizations	No presence of flexible processes and systems
●	Designing responsible processes and organizations	External aspects are not considered
●	Designing responsible processes and organizations	Sustainability not as main objective

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	Category	Value
●	Designing responsible processes and organizations	External developments are not followed
●	Designing responsible processes and organizations	Resources do not enable a sustainable organization
●	Dealing with greater cultural and generational diversity	Resources enable dealing with greater diversity
●	Dealing with greater cultural and generational diversity	Heterogeneity is taking a prominent place
●	Dealing with greater cultural and generational diversity	Cultural and generational developments are followed
●	Dealing with greater cultural and generational diversity	Heterogeneity is considered
●	Dealing with greater cultural and generational diversity	Heterogeneity is not considered
●	Dealing with greater cultural and generational diversity	Cultural and generational developments are not followed
●	Dealing with greater cultural and generational diversity	Heterogeneity is not taking a prominent place
●	Dealing with greater cultural and generational diversity	Resources do not enable dealing with greater diversity
●	Dealing with challenges related to ownership, responsibility ...	Initiatives for exercising stakeholder influence
●	Dealing with challenges related to ownership, responsibility ...	Stakeholders are monitored
●	Dealing with challenges related to ownership, responsibility ...	Resources enable dealing with challenges
●	Dealing with challenges related to ownership, responsibility ...	Stakeholders are not monitored
●	Dealing with challenges related to ownership, responsibility ...	Resources do not enable dealing with challenges
●	Dealing with challenges related to ownership, responsibility ...	No initiatives for exercising stakeholder influence
●	Assessment	Positive
●	Assessment	Negative
●	24/7 accessibility through virtual channels	Resources enable accessibility
●	24/7 accessibility through virtual channels	Accessibility is improved
●	24/7 accessibility through virtual channels	Technological developments are followed
●	24/7 accessibility through virtual channels	Organization is experienced as accessible
●	24/7 accessibility through virtual channels	Accessibility is reviewed
●	24/7 accessibility through virtual channels	Organization is not experienced as accessible
●	24/7 accessibility through virtual channels	Accessibility is not reviewed
●	24/7 accessibility through virtual channels	Resources do not enable accessibility
●	24/7 accessibility through virtual channels	Technological developments are not followed
●	24/7 accessibility through virtual channels	Accessibility is not improved
●		Assessment
●		Designing responsible processes and organizations
●		Dealing with challenges related to ownership, responsibility
●		Navigating the terrain of turbulent markets, complexity and
●		Organizational adaptability and innovation
●		Dealing with greater cultural and generational diversity
●		Utilizing data outside and within their boundaries
●		Making effective use of new resources
●		Intake
●		24/7 accessibility through virtual channels
●		Effective Knowledge Management

An overview of the encoding process and how it has progressed can be found in *Figure 11*. Due to confidentiality aspects, the transcript has been made illegible.
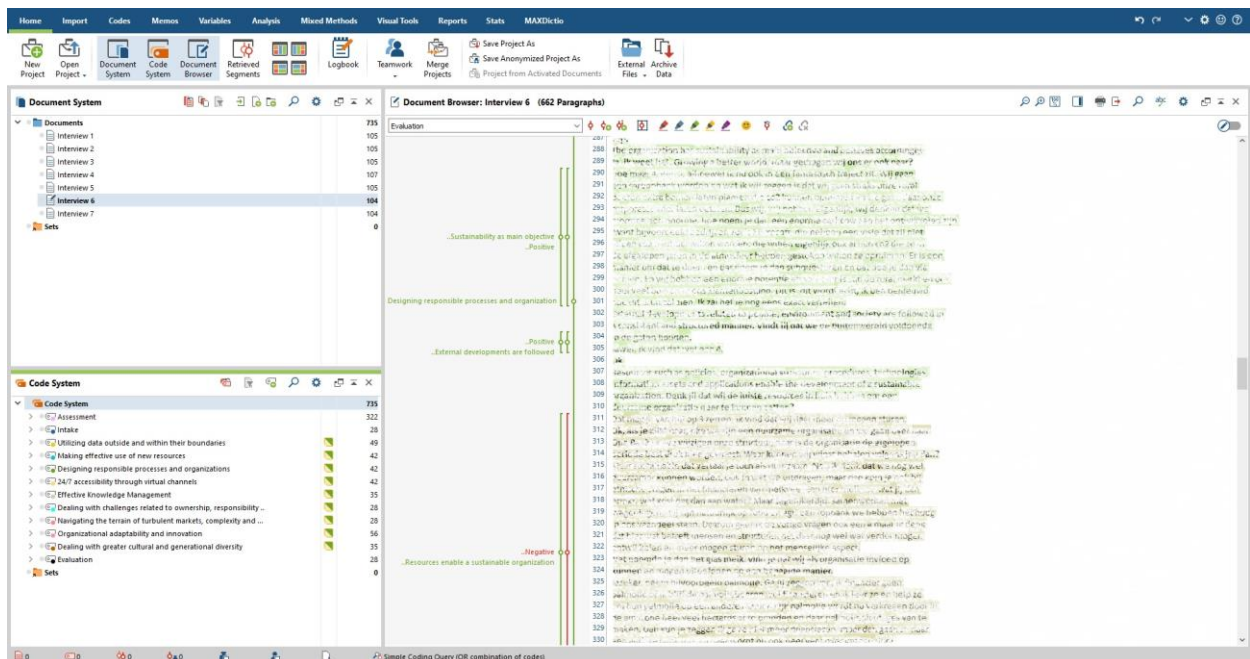
Figure 11: Coding process in MAXQDA 2020

The codebook has been applied to all 7 interviews and the results can be consulted in *Figure 12*. Because no deepening is made in this step, all circles have the same size when they are placed against each other. After all, the same number of statements were discussed in every interview.
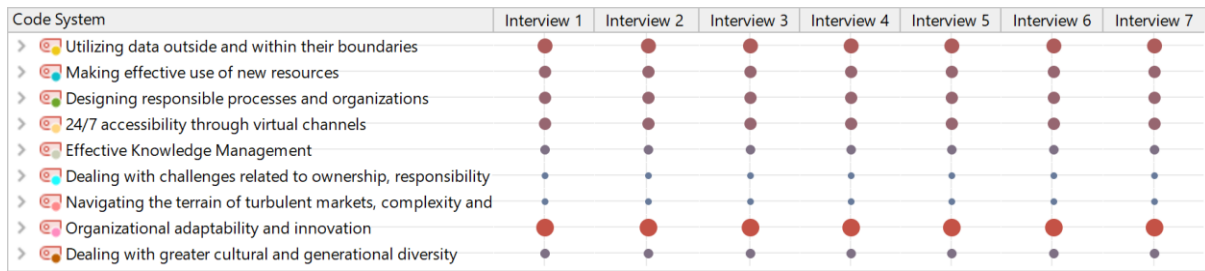
Figure 12: Qualitative results after the first coding step (column view)

The size of the circle describes how often encoding is done within a certain EAC. Since the EAC: *"organizational adaptability and innovation"* contains the most statements, the circles are the largest here. It is also possible to look at the presence of a code per row, the results of which are shown in Figure 13. It emerges that there are no deviations per interview. So, the same amount of coding is applied everywhere, and that is correct since all EACs have been treated in every interview.

Figure 13: Qualitative results after the first coding step (row view)

The deepening, or the discussion with the respondent, will only be clarified in the third step of the coding process.

The next step is to clarify whether the respondent is positive or negative about a certain statement. The following process was used for this. The EAC *"utilizing data outside and within their boundaries"* is taken as an example. For each subcode, it was examined whether the subcode contributes to a positive or negative assessment. The green subcodes have been added to the subcode *"positive"* and the red ones to the subcode *"negative"*. *Figure 14* illustrates this process.
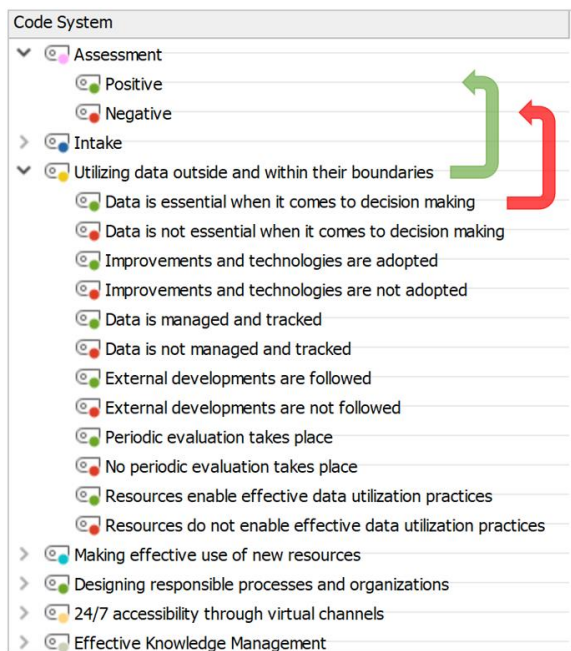
Figure 14: Process for determining positive or negative reactions

This process provides insight into the extent to which a participant is positive or negative about a certain dimension. The results of this can be consulted in *Figure 15*.
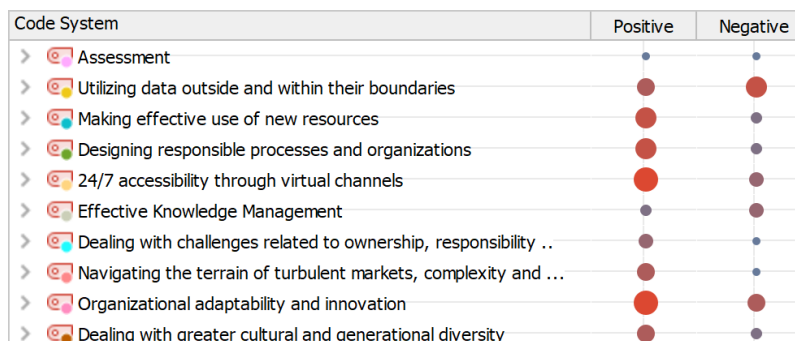
Figure 15: Overview of positive and negative reactions per EAC

It is striking that the EACs: *"utilizing data outside and within their boundaries"* and *"effective Knowledge Management"* are mostly perceived as negative. The EACs: *"24/7 accessibility through virtual channels"* and *"organizational adaptability and innovation"* show a more positive response.

To give more depth to the encoding process, a third encoding step has been used. By means of a second coding run, it was possible to find out not only that the participant is negative about a certain EAC, but also why. This deepening was achieved by looking at the reasons given by participants for a positive or negative assessment. *Table 15* shows the final coding book.

Table 15: *Final coding overview (after the second coding run)*

Colour	Parent code	Code	Cod. segments
●		Assessment	0
●		Intake	7
●	Intake	Business oriented	2
●	Intake	Both business and IT oriented	5
●	Intake	Both system and process oriented	3
●	Intake	Familiar with EA	4
●	Intake	Fairly familiar with EA	3
●	Intake	Process oriented	3
●	Intake	System oriented	1
●	Assessment	Positive	209
●	Assessment	Negative	110
●		Effective Knowledge Management	7
●		24/7 accessibility through virtual channels	7
●		Utilizing data outside and within their boundaries	7
●		Making effective use of new resources	7
●		Designing responsible processes and organizations	7
●		Dealing with challenges related to ownership, responsibility …	7
●		Navigating the terrain of turbulent markets, complexity and …	7
●		Organizational adaptability and innovation	7
●		Dealing with greater cultural and generational diversity	7
●	24/7 accessibility through virtual channels	Accessibility is not improved	0
●	24/7 accessibility through virtual channels	Organization is experienced as accessible	4
●	24/7 accessibility through virtual channels	Organization is not experienced as accessible	3
●	24/7 accessibility through virtual channels	Accessibility is improved	7
●	24/7 accessibility through virtual channels	Technological developments are followed	7
●	24/7 accessibility through virtual channels	Technological developments are not followed	0
●	24/7 accessibility through virtual channels	Accessibility is reviewed	4
●	24/7 accessibility through virtual channels	Accessibility is not reviewed	3
●	24/7 accessibility through virtual channels	Resources enable accessibility	7
●	24/7 accessibility through virtual channels	Resources do not enable accessibility	0
●	Accessibility is improved	Adoption of new technologies	7
●	Accessibility is not reviewed	No follow up, not thinking from customer perspective	2
●	Accessibility is reviewed	From a customer perspective	3
●	Accessibility is reviewed	Room for improvement	1
●	Clear Knowledge Management strategy	Availability of knowledge sharing platforms	1
●	Cultural and generational developments are followed	Diversity board	3
●	Cultural and generational developments are not followed	No participation from teams	1
●	Data architecture is critically examined and reviewed	Is done by departments	2
●	Data architecture is critically examined and reviewed	Slow establishment of business value	1
●	Data is essential when it comes to decision making	Fact based and data driven	1
●	Data is essential when it comes to decision making	Is actively used	2
●	Data is managed and tracked	Varies by domain	1
●	Data is managed and tracked	Structuring data actively	2
●	Data is managed and tracked	Slow establishment of business value	1
●	Data is not essential when it comes to decision making	Not accessible, shortage of effective data	2
●	Data is not essential when it comes to decision making	No focus, wrong focus	2
●	Data is not managed and tracked	Insufficient data lineage and structure	3
●	Dealing with challenges related to ownership, responsibility …	Initiatives for exercising stakeholder influence	6
●	Dealing with challenges related to ownership, responsibility …	No initiatives for exercising stakeholder influence	1
●	Dealing with challenges related to ownership, responsibility …	Stakeholders are monitored	4
●	Dealing with challenges related to ownership, responsibility …	Stakeholders are not monitored	3
●	Dealing with challenges related to ownership, responsibility …	Resources enable dealing with challenges	4
●	Dealing with challenges related to ownership, responsibility …	Resources do not enable dealing with challenges	3
●	Dealing with greater cultural and generational diversity	Heterogeneity is considered	3
●	Dealing with greater cultural and generational diversity	Heterogeneity is not considered	3
●	Dealing with greater cultural and generational diversity	Heterogeneity is taking a prominent place	5
●	Dealing with greater cultural and generational diversity	Heterogeneity is not taking a prominent place	3
●	Dealing with greater cultural and generational diversity	Cultural and generational developments are followed	5
●	Dealing with greater cultural and generational diversity	Cultural and generational developments are not followed	2
●	Dealing with greater cultural and generational diversity	Resources enable dealing with greater diversity	5
●	Dealing with greater cultural and generational diversity	Resources do not enable dealing with greater diversity	2
●	Designing interesting and meaningful work	Reduce administrative burden, more interesting and meaningful	6
●	Designing responsible processes and organizations	Flexible processes and systems	5
●	Designing responsible processes and organizations	No presence of flexible processes and systems	2
●	Designing responsible processes and organizations	External aspects are considered	6
●	Designing responsible processes and organizations	External aspects are not considered	1
●	Designing responsible processes and organizations	Sustainability as main objective	7
●	Designing responsible processes and organizations	Sustainability not as main objective	0

	Source	Target	Value
green	Designing responsible processes and organizations	External developments are followed	7
red	Designing responsible processes and organizations	External developments are not followed	0
green	Designing responsible processes and organizations	Resources enable a sustainable organization	7
red	Designing responsible processes and organizations	Resources do not enable a sustainable organization	0
red	Developments are not followed	Not focussing on knowledge retention, slow adoption	5
green	Effective Knowledge Management	Management is promoting a Knowledge Management culture	4
red	Effective Knowledge Management	Management is not promoting a Knowledge Management culture	4
green	Effective Knowledge Management	Clear Knowledge Management strategy	1
green	Effective Knowledge Management	No clear Knowledge Management strategy	5
green	Effective Knowledge Management	Developments are followed	1
red	Effective Knowledge Management	Developments are not followed	6
green	Effective Knowledge Management	Resources enable effective Knowledge Management	4
red	Effective Knowledge Management	Resources do not enable effective Knowledge Management	3
green	Employees are empowered	Teams are empowered, new Tribe structure	2
red	Employees are not empowered	Top-down management, fear, control culture	4
red	Employees are not empowered	Adoption phase, not yet	1
green	Evaluating how work is experienced	Engagement scan	5
black	Evaluation	Instrument has a clear structure	7
black	Evaluation	Statements are clearly formulated	5
black	Evaluation	Statements are not clearly formulated	2
black	Evaluation	Results are useful	7
green	Existing partnerships are evaluated	Contractually recorded, PDCA cycle available	5
red	Existing partnerships are not evaluated	No PDCA cycle	1
green	External aspects are considered	Customer focus	4
red	External aspects are not considered	Decisions without putting yourself in the customer	1
green	External developments are followed	Actively followed by architects	2
green	External developments are followed	Departments are doing their job, but slow sometimes	3
red	External developments are not followed	Implementation issues	1
red	External developments are not followed	Not at the right level	1
green	Flexible processes and systems	Able to act fast	4
green	Focus on standardization and compliance	Despite legacy problems, it is taken into account	1
green	Focus on standardization and compliance	Standardize, automate	4
green	Focussing on execution, evaluation and revision of strategy	Customer focus	1
green	Focussing on execution, evaluation and revision of strategy	PDCA in place	3
green	Heterogeneity is considered	As much as possible	3
red	Heterogeneity is not considered	No choice, no options, needs more attention	3
red	Heterogeneity is not taking a prominent place	Pragmatic	2
green	Heterogeneity is taking a prominent place	Awareness	4
green	Improvements and technologies are adopted	Adoption phase, data enterprise lake, analytics platform	3
red	Improvements and technologies are not adopted	Data quality issues, legacy	1
red	Improvements and technologies are not adopted	Long-term approval process, complexity due to GDPR	2
green	Initiatives for exercising stakeholder influence	Adopted by teams, both an internal and external focus	6
green	Looking at how new data resources can be used	Due to laws and regulations	1
green	Looking at how new data resources can be used	Data & analytics group	3
green	Making effective use of new resources	Focussing on execution, evaluation and revision of strategy	4
red	Making effective use of new resources	Not focussing on execution, evaluation and revision of strategy	3
green	Making effective use of new resources	New data resources are used	4
red	Making effective use of new resources	New data resources are not used	3
green	Making effective use of new resources	Looking at how new data resources can be used	7
red	Making effective use of new resources	Not looking at how new data resources can be used	0
green	Making effective use of new resources	Data architecture is critically examined and reviewed	6
red	Making effective use of new resources	Data architecture is not critically examined and reviewed	1
green	Making effective use of new resources	Resources enable effective use of new data resources	4
red	Making effective use of new resources	Resources do not enable effective use of new data resources	3
red	Management is not promoting a Knowledge Management culture	Not focussing on knowledge retention, not a clear vision	2
red	Management is not promoting a Knowledge Management culture	Implicit	2
red	Management is not promoting a Knowledge Management culture	Management is promoting, but results are not visible	2
green	Management is promoting a Knowledge Management culture	Management is accessible and facilitating	1
green	Management is promoting a Knowledge Management culture	Actively promoted by the management	0
green	Navigating the terrain of turbulent markets, complexity and ...	Taking into account economic and non-economic objectives	5
red	Navigating the terrain of turbulent markets, complexity and ...	Not taking into account economic and non-economic objectives	2
green	Navigating the terrain of turbulent markets, complexity and ...	Existing partnerships are evaluated	6
red	Navigating the terrain of turbulent markets, complexity and ...	Existing partnerships are not evaluated	1
green	Navigating the terrain of turbulent markets, complexity and ...	Resources enable navigating turbulent markets	7
red	Navigating the terrain of turbulent markets, complexity and ...	Resources do not enable navigating turbulent markets	0
red	New data resources are not used	Do not think beyond the chain	1
red	New data resources are not used	Not making active use of new data	2
green	New data resources are used	Enterprise data lake	1
green	New data resources are used	Unlocking and combining data, creating new business opportunities	2
red	No clear Knowledge Management strategy	Too complex, hard to find information, no clear vision	2
red	No focus on standardization and compliance	Not the right focus	2
red	No initiatives for exercising stakeholder influence	Not enough	1
red	No periodic evaluation takes place	No periodic review, no focus, no PDCA	3
red	No periodic evaluation takes place	Hard to find useful data	2
red	No presence of flexible processes and systems	Slow	1
red	No presence of flexible processes and systems	Only if major issues occur	1
red	Not designing interesting and meaningful work	Need for more creative employees	1

●	Not designing interesting and meaningful work	Focus only on downsizing	1
●	Not evaluating how work is experienced	Engagement scan is present, but no follow-up actions	2
●	Not focussing on execution, evaluation and revision of strategy	Due to complexity	1
●	Not focussing on execution, evaluation and revision of strategy	PDCA in place but still focussing on operational issues	2
●	Not taking into account economic and non-economic objectives	Too slow	1
●	Organization is experienced as accessible	Channel dependent	3
●	Organization is not experienced as accessible	Complexity due to CDD	1
●	Organization is not experienced as accessible	Because of the organizational structure	2
●	Organizational adaptability and innovation	Employees are empowered	2
●	Organizational adaptability and innovation	Employees are not empowered	5
●	Organizational adaptability and innovation	Designing interesting and meaningful work	6
●	Organizational adaptability and innovation	Not designing interesting and meaningful work	1
●	Organizational adaptability and innovation	Focus on standardization and compliance	5
●	Organizational adaptability and innovation	No focus on standardization and compliance	2
●	Organizational adaptability and innovation	Organizational adaptability developments are followed	4
●	Organizational adaptability and innovation	Organizational adaptability developments are not followed	3
●	Organizational adaptability and innovation	Evaluating how work is experienced	5
●	Organizational adaptability and innovation	Not evaluating how work is experienced	2
●	Organizational adaptability and innovation	Process design decisions are reviewed	4
●	Organizational adaptability and innovation	Process design decisions are not reviewed	3
●	Organizational adaptability and innovation	Resources enable adaptability and innovation	3
●	Organizational adaptability and innovation	Resources do not enable adaptability and innovation	4
●	Organizational adaptability developments are followed	Teams track developments	2
●	Organizational adaptability developments are not followed	Not on team level	1
●	Periodic evaluation takes place	Data Management	1
●	Process design decisions are not reviewed	No PDCA cycle	2
●	Process design decisions are reviewed	Operational reports, first line, second line monitoring	4
●	Resources do not enable a sustainable organization	Reorganization	1
●	Resources do not enable a sustainable organization	Ethical questions	1
●	Resources do not enable accessibility	Adoption new systems is slow	1
●	Resources do not enable adaptability and innovation	Need to become more agile	1
●	Resources do not enable adaptability and innovation	No time	1
●	Resources do not enable adaptability and innovation	Adoption phase	1
●	Resources do not enable dealing with challenges	Too modest	1
●	Resources do not enable dealing with challenges	Lack of flexibility	1
●	Resources do not enable dealing with greater diversity	Infrastructure related issues	2
●	Resources do not enable effective data utilization practices	Not accessible to use	3
●	Resources do not enable effective Knowledge Management	No clear focus	2
●	Resources do not enable effective Knowledge Management	Focus on downsizing staff, but not on knowledge retention	1
●	Resources do not enable effective use of new data resources	Not accessible due to complexity and GDPR and data quality	3
●	Resources enable a sustainable organization	Sustainability with pride	0
●	Resources enable a sustainable organization	Flexible resources	4
●	Resources enable accessibility	New technologies	3
●	Resources enable accessibility	Systems	3
●	Resources enable accessibility	Open market	1
●	Resources enable dealing with challenges	Enabling innovation	1
●	Resources enable dealing with challenges	Resources in place such as CES	1
●	Resources enable dealing with challenges	Better than competitors, strong customer focus	1
●	Resources enable dealing with greater diversity	Being able to act purposefully	3
●	Resources enable effective data utilization practices	Are not fully utilized	3
●	Resources enable effective Knowledge Management	Presence of resources and encouragement from management	2
●	Resources enable effective use of new data resources	Data can help us to measure, ethically responsible	2
●	Resources enable navigating turbulent markets	Teams are facilitated	2
●	Resources enable navigating turbulent markets	Resources are in place, speed stays important	2
●	Resources enable navigating turbulent markets	Acting quickly is possible if necessary	3
●	Stakeholders are monitored	Customer Effort Score (CES), marketing	4
●	Stakeholders are not monitored	Too little cooperation with stakeholders	1
●	Stakeholders are not monitored	Slow adoption of new resources	2
●	Sustainability as main objective	Clear vision but proactivity is sometimes lacking	4
●	Sustainability as main objective	Sustainable policy	3
●	Taking into account economic and non-economic objectives	Looking for right partnerships, long term relations	4
●	Technological developments are followed	Standard monitoring cycle	3
●	Utilizing data outside and within their boundaries	Data is essential when it comes to decision making	3
●	Utilizing data outside and within their boundaries	Improvements and technologies are adopted	4
●	Utilizing data outside and within their boundaries	Data is managed and tracked	4
●	Utilizing data outside and within their boundaries	External developments are followed	4
●	Utilizing data outside and within their boundaries	Data is not essential when it comes to decision making	4
●	Utilizing data outside and within their boundaries	Improvements and technologies are not adopted	3
●	Utilizing data outside and within their boundaries	Data is not managed and tracked	3
●	Utilizing data outside and within their boundaries	External developments are not followed	3
●	Utilizing data outside and within their boundaries	Periodic evaluation takes place	3
●	Utilizing data outside and within their boundaries	No periodic evaluation takes place	4
●	Utilizing data outside and within their boundaries	Resources enable effective data utilization practices	3
●	Utilizing data outside and within their boundaries	Resources do not enable effective data utilization practices	4
●		Evaluation	7
●		COVID-19	19

Based on these results, a visualization can be made of the coding frequency per row (*Figure 16*) and per column, (*Figure 17*).
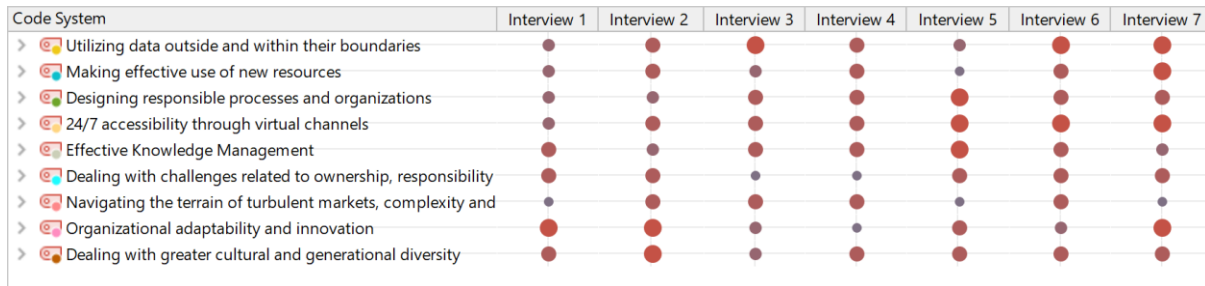
Figure 16: Overview of positive and negative reactions per EAC
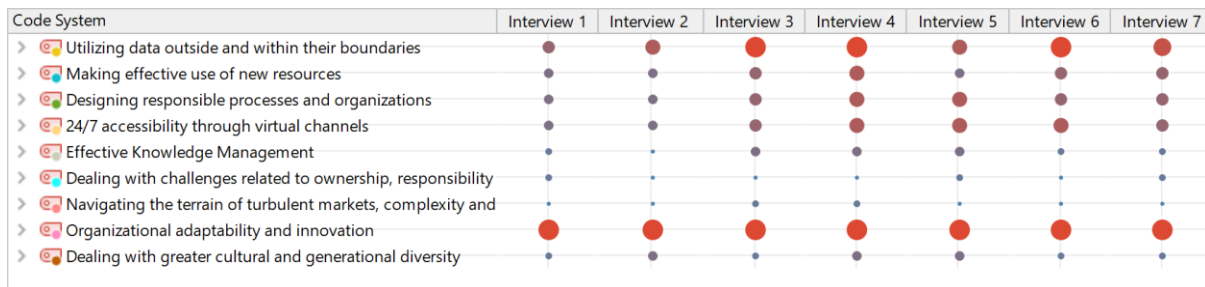
Figure 17: Overview of positive and negative reactions per EAC

Finally, a complete overview of codes per interview has been included, which can be consulted in *Figure 18 to Figure 23*.

Code System	Interview 1	Interview 2	Interview 3	Interview 4	Interview 5	Interview 6	Interview 7
Assessment							
⤷ Positive	●	●	●	●	●	●	●
⤷ Negative	●	●	●	●	●	●	●
Intake	●	●	●	●	●	●	●
⤷ Business oriented				●	●		
⤷ Both business and IT oriented	●	●	●			●	●
⤷ Process oriented				●	●		●
⤷ System oriented			●				
⤷ Both system and process oriented	●	●				●	
⤷ Familiar with EA		●		●		●	●
⤷ Fairly familiar with EA	●		●		●		
Utilizing data outside and within their boundaries	●	●	●	●	●	●	●
⤷ Data is essential when it comes to decision making			●	●			●
⤷⤷ Fact based and data driven							●
⤷⤷ Is actively used			●	●			
⤷ Data is not essential when it comes to decision making	●	●			●	●	
⤷⤷ Not accessible, shortage of effective data		●			●		
⤷⤷ No focus, wrong focus	●					●	
⤷ Improvements and technologies are adopted	●	●		●			●
⤷⤷ Adoption phase, data enterprise lake, analytics platform		●		●			●
⤷ Improvements and technologies are not adopted			●		●	●	
⤷⤷ Data quality issues, legacy					●		
⤷⤷ Long-term approval process, complexity due to GDPR			●			●	
⤷ Data is managed and tracked		●			●	●	●
⤷⤷ Varies by domain						●	
⤷⤷ Structuring data actively					●		●
⤷⤷ Slow establishment of business value		●					
⤷ Data is not managed and tracked	●		●	●			
⤷⤷ Insufficient data lineage and structure	●		●	●			
⤷ External developments are followed	●			●		●	●
⤷⤷ Actively followed by architects						●	●
⤷ External developments are not followed		●	●		●		
⤷⤷ Implementation issues			●				
⤷⤷ Not at the right level		●					
⤷ Periodic evaluation takes place		●				●	●
⤷⤷ Data Management							●
⤷ No periodic evaluation takes place	●		●	●	●		
⤷⤷ No periodic review, no focus, no PDCA			●		●		
⤷⤷ Hard to find useful data	●				●		
⤷ Resources enable effective data utilization practices	●			●			●
⤷⤷ Are not fully utilized	●			●			●
⤷ Resources do not enable effective data utilization practices		●	●		●	●	
⤷⤷ Not accessible to use		●	●			●	

Figure 18: *Coding overview: assessment, intake and utilizing data outside and within their boundaries*

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Code System	Interview 1	Interview 2	Interview 3	Interview 4	Interview 5	Interview 6	Interview 7
Making effective use of new resources	●	●	●	●	●	●	●
Focussing on execution, evaluation and revision of strategy	●		●			●	●
Customer focus			●				
PDCA in place	●					●	●
Not focussing on execution, evaluation and revision of strategy		●		●	●		
Due to complexity				●			
PDCA in place but still focussing on operational issues		●			●		
New data resources are used		●	●			●	●
Enterprise data lake			●				
Unlocking and combining data, creating business opertunities						●	●
New data resources are not used	●			●	●		
Do not think beyond the chain					●		
Not making active use of new data	●				●		
Looking at how new data resources can be used	●	●	●	●	●	●	●
Due to laws and regulations			●				
Data & analytics group		●			●		●
Not looking at how new data resources can be used							
Data architecture is critically examined and reviewed	●	●	●	●		●	●
Is done by departments						●	●
Slow establishment of business value		●					
Data architecture is not critically examined and reviewed					●		
Resources enable effective use of new data resources			●			●	●
Data can help us to measure, ethically responsible						●	●
Resources do not enable effective use of new data resources	●	●			●		
Not accessible due to complexity and GDPR and data quality	●	●			●		
Designing responsible processes and organizations	●	●	●	●	●	●	●
Flexible processes and systems		●	●		●	●	●
Able to act fast		●			●	●	●
No presence of flexible processes and systems	●				●		
Slow		●					
Only if major issues occur	●						
External aspects are considered	●	●	●		●	●	●
Customer focus			●		●	●	●
External aspects are not considered					●		
Decisions without putting yourself in the customer					●		
Sustainability as main objective	●	●	●		●	●	●
Clear vision but proactivity is sometimes lacking		●	●		●		
Sustainable policy	●					●	●
Sustainability not as main objective							
External developments are followed	●	●	●		●	●	●
Departments are doing their job, but slow sometimes		●	●		●		
External developments are not followed							
Resources enable a sustainable organization	●	●	●		●	●	●
Sustainability with pride							
Flexible resources	●		●	●	●		
Resources do not enable a sustainable organization							●
Reorganization							●
Ethical questions						●	

Figure 19: Coding overview: *"making effective use of new resources, designing responsible processes and organizations"*

Code System	Interview 1	Interview 2	Interview 3	Interview 4	Interview 5	Interview 6	Interview 7
24/7 accessibility through virtual channels	●	●	●	●	●	●	●
Organization is experienced as accessible	●	●			●		●
Channel dependent		●					●
Organization is not experienced as accessible			●	●		●	
Complexity due to CDD						●	
Because of the organizational structure			●	●			
Accessibility is improved	●	●	●	●	●	●	●
Adoption of new technologies	●	●	●	●	●	●	●
Accessibility is not improved							
Technological developments are followed	●	●	●	●	●	●	●
Standard monitoring cycle					●	●	●
Technological developments are not followed							
Accessibility is reviewed	●	●			●	●	
From a customer perspective		●			●	●	
Room for improvement	●						
Accessibility is not reviewed			●	●			●
No follow up, not thinking from customer perspective				●			●
Resources enable accessibility	●	●	●	●	●	●	●
New technologies			●		●		●
Systems	●	●		●			
Open market			●				
Resources do not enable accessibility							
Adoption new systems is slow						●	
Effective Knowledge Management	●	●	●	●	●	●	●
Management is promoting a Knowledge Management culture	●	●				●	●
Management is accessible and facilitating						●	
Actively promoted by the management							
Management is not promoting a Knowledge Management culture		●	●	●	●		
Not focussing on knowledge retention, not a clear vision					●	●	
Implicit				●			●
Management is promoting, but results are not visible			●		●		
Clear Knowledge Management strategy	●						
Availability of knowledge sharing platforms	●						
No clear Knowledge Management strategy			●	●	●	●	●
Too complex, hard to find information, no clear vision		●			●		
Developments are followed							●
Developments are not followed	●	●	●	●	●	●	
Not focussing on knowledge retention, slow adoption	●	●	●	●	●	●	
Resources enable effective Knowledge Management	●	●	●			●	
Presence of resources and encouragement from management	●	●	●				
Resources do not enable effective Knowledge Management					●	●	●
No clear focus						●	●
Focus on downsizing staff, but not on knowledge retention					●		

Figure 20: Coding overview: *"24/7 accessibility through virtual channels and effective Knowledge Management"*

Code System	Interview 1	Interview 2	Interview 3	Interview 4	Interview 5	Interview 6	Interview 7
⌄ Dealing with challenges related to ownership, responsibility ..	●	●	●	●	●	●	●
⌄ Initiatives for exercising stakeholder influence	●	●	●	●		●	●
Adopted by teams, both an internal and external focus	●	●	●	●		●	●
⌄ No initiatives for exercising stakeholder influence					●		
Not enough					●		
⌄ Stakeholders are monitored	●	●		●		●	●
Customer Effort Score (CES), marketing	●	●		●		●	●
⌄ Stakeholders are not monitored			●		●		
Too little cooperation with stakeholders			●		●		
Slow adoption of new resources			●				
⌄ Resources enable dealing with challenges	●	●	●			●	
Enabling innovation						●	
Resources in place such as CES			●				
Better than competitors, strong customer focus	●						
⌄ Resources do not enable dealing with challenges				●	●		●
Too modest							●
Lack of flexibility					●		
⌄ Navigating the terrain of turbulent markets, complexity and ...	●	●	●	●	●	●	●
⌄ Taking into account economic and non-economic objectives	●	●	●			●	●
Looking for right partnerships, long term relations		●	●			●	●
⌄ Not taking into account economic and non-economic objectives				●	●		
Too slow				●			
⌄ Existing partnerships are evaluated	●	●	●	●		●	●
Contractually recorded, PDCA cycle available	●	●	●	●		●	
⌄ Existing partnerships are not evaluated					●		
No PDCA cycle					●		
› Resources enable navigating turbulent markets	●	●	●	●	●	●	●
Resources do not enable navigating turbulent markets							

Figure 21: Coding overview: *"dealing with challenges related to ownership, responsibility and power and navigating the terrain of turbulent markets, complexity and uncertainty"*

Code System	Interview 1	Interview 2	Interview 3	Interview 4	Interview 5	Interview 6	Interview 7
⌄ Organizational adaptability and innovation	●	●		●	●	●	●
⌄ Employees are empowered		●					●
Teams are empowered, new Tribe structure		●					●
⌄ Employees are not empowered	●		●	●	●	●	
Top-down management, fear, control culture			●	●	●	●	
Adoption phase, not yet	●						
⌄ Designing interesting and meaningful work	●	●	●	●	●		●
Reduce administrative burden, more interesting and meaningfu	●	●	●	●	●		●
⌄ Not designing interesting and meaningful work						●	
Need for more creative employees						●	
Focus only on downsizing					●		
⌄ Focus on standardization and compliance		●	●		●	●	●
Despite legacy problems, it is taken into account						●	
Standardize, automate		●	●		●		
⌄ No focus on standardization and compliance	●			●			
Not the right focus	●				●		
⌄ Organizational adaptability developments are followed	●		●			●	●
Teams track developments	●						●
⌄ Organizational adaptability developments are not followed		●		●	●		
Not on team level		●					
⌄ Evaluating how work is experienced	●	●	●			●	●
Engagement scan	●	●	●			●	●
⌄ Not evaluating how work is experienced				●	●		
Engagement scan is present, but no follow-up actions				●	●		
⌄ Process design decisions are reviewed		●	●			●	●
Operational reports, first line, second line monitoring		●	●			●	●
⌄ Process design decisions are not reviewed	●			●	●		
No PDCA cycle	●				●		
Resources enable adaptability and innovation			●	●	●		
⌄ Resources do not enable adaptability and innovation	●	●				●	●
Need to become more agile							●
No time		●					
Adoption phase	●						

Figure 22: Coding overview: *"organizational adaptability and innovation"*

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Code System	Interview 1	Interview 2	Interview 3	Interview 4	Interview 5	Interview 6	Interview 7
Dealing with greater cultural and generational diversity	●	●	●	●	●	●	●
Heterogeneity is considered		●	●				●
As much as possible		●		●			●
Heterogeneity is not considered	●				●	●	
No choice, no options, needs more attention	●				●	●	
Heterogeneity is taking a prominent place		●	●	●	●		●
Awareness		●	●		●		●
Heterogeneity is not taking a prominent place	●			●		●	
Pragmatic	●			●			
Cultural and generational developments are followed		●	●		●		●
Diversityboard		●	●				●
Cultural and generational developments are not followed	●					●	
No participation from teams						●	
Resources enable dealing with greater diversity	●	●	●		●		●
Being able to act purposefully	●	●			●		
Resources do not enable dealing with greater diversity				●		●	
Infrastructure related issues				●		●	
Evaluation	●	●	●	●	●	●	●
Instrument has a clear structure	●	●	●	●	●	●	●
Questions are clearly formulated		●	●	●	●		●
Questions are not clearly formulated	●					●	
Results are useful	●	●	●	●	●	●	●
COVID-19	●	●	●	●	●	●	●

Figure 23: Coding overview: *"dealing with greater cultural and generational diversity, evaluation & COVID-19"*

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Appendix O: Evaluation log

This Appendix contains the logs required for the evaluation phase. *Table 1* provides an overview with details per interview. The response (expressed in words) was examined specifically for each participant. This makes it possible to calculate an average response over the two groups (architects versus development teams) and to see how much time an interview took on average. Finally, MAXQDA 2020 has been used to evaluate how often statements are labeled as unclear. These results can be consulted in *Table 2.*

Table 1: *Results evaluation*

	Interview 1	Interview 2	Interview 3	Interview 4	Interview 5	Interview 6	Interview 7	Total words/minutes	Total number of words/minutes architects	Average number of words/minutes architects	Total number of words/minutes team	Average number of words/minutes team	Average number of words/minutes team architects
Utilizing data outside and within their boundaries	237	832	352	240	489	1597	296	4043	1893	947	2150	430	578
Making effective use of new resources	60	374	117	191	611	547	228	2128	775	388	1353	271	304
Designing responsible processes and organizations	253	228	129	136	433	674	336	2189	1010	505	1179	236	313
24/7 accessibility through virtual channels	97	241	237	194	156	686	220	1831	906	453	925	185	262
Effective Knowledge Management	302	242	160	162	1005	463	244	2578	707	354	1871	375	368
Dealing with challenges related to ownership, responsibility, roles, and power	180	170	204	61	127	557	250	1549	807	404	742	149	221
Navigating the terrain of turbulent markets, complexity and uncertainty	24	129	147	36	115	453	62	966	515	258	904	181	138
Organizational adaptability and innovation	60	161	208	70	678	245	530	1952	775	388	1177	236	279
Dealing with greater cultural and generational diversity among workers	488	123	96	248	137	112	178	1382	290	145	1092	219	198
Total words	1701	2500	1650	1338	3751	5334	2344	18618	7678	3839	11393	2279	2660
Interview time in minutes	50	55	38	41	51	79	40	354	119	59.5	235	47	50.6

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Figure 2: Evaluation of clarity of statements

	Statement is clear	Statement is unclear	Number of statements	% Clear	% Unclear	Checksum
Intake	18	3	21	86	14	100
Utilizing data outside and within their boundaries	39	3	42	93	7	100
Making effective use of new resources	32	3	35	91	9	100
Designing responsible processes and organizations	30	5	35	86	14	100
24/7 accessibility through virtual channels	33	2	35	94	6	100
Effective Knowledge Management	25	3	28	89	11	100
Dealing with challenges related to ownership, responsibility, roles, and power	15	6	21	71	29	100
Navigating the terrain of turbulent markets, complexity and uncertainty	14	7	21	67	33	100
Organizational adaptability and innovation	40	9	49	82	18	100
Dealing with greater cultural and generational diversity among workers	23	5	28	82	18	100
Total/average	269	46	315	84	23	