

Towards an Antifragile Public Sector

Introducing Antifragility in the Dutch Public Sector
with Enterprise Architecture

René Bliekendaal

Promotor Prof. Dr. Ing. Hans Mulder
Co-Promotor Edzo A. Botjes, MSc.

A thesis submitted in fulfillment of the requirements
for the degree of Master of Enterprise IT Architecture (MSc)



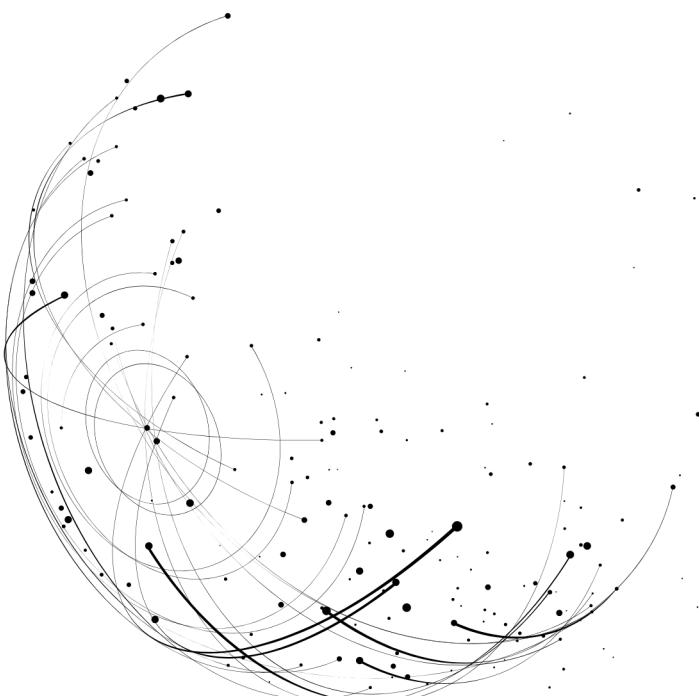
Antwerp Management School
Antwerp, Belgium
19 July 2022

”It is quite perplexing that those from whom we have benefited the most aren’t those who have tried to help us (say with ”advice”) but rather those who have actively tried - but eventually failed - to harm us.”
— *Nassim Nicholas Taleb*

”A consistency proof for [any] system can be carried out only by means of modes of inference that are not formalized in the system itself.”
— *Kurt Gödel*

”Reality is created by the mind.
We can change our reality by changing our mind.”
— *Plato*

”The only constant is change.”
— *Heraclitus*



Thesis Information

Title:	Towards an Antifragile Public Sector
Subtitle:	Introducing Antifragility in the Dutch Public Sector with Enterprise Architecture
Submission date:	13 May 2022
Publication date:	19 July 2022
Language:	British English
Reference Style:	APA 7th Edition
DOI:	10.5281/zenodo.6522851
Copyright	© 2022 J.R. Bliekendaal
License:	 This work is licensed under a CC-BY-SA 4.0 license.

Thesis Project

GitHub: <https://github.com/JRBliekendaal/master-thesis/>

Author

Name:	René Bliekendaal, MSc.
ORCID:	 0000-0002-5449-6449
Email:	jrbliekendaal@gmail.com
LinkedIn:	https://www.linkedin.com/in/bliekendaal/

Promotor

Name:	Prof. Dr. Ing. Hans Mulder
ORCID:	 0000-0002-3304-9711
Email:	Hans.Mulder@ams.ac.be
LinkedIn:	https://www.linkedin.com/in/jbfmulder/

Co-Promotor

Name:	Edzo A. Botjes, MSc.
ORCID:	 0000-0003-0097-7375
Email:	edzo.botjes@ou.nl
LinkedIn:	https://www.linkedin.com/in/edzob/

Sponsor

Name:	mr. Maarten Hillenaar
LinkedIn:	https://www.linkedin.com/in/maarten-hillenaar/
Company:	Centric Public Sector Solutions
Website:	https://www.centric.eu

Keywords

Agile, Agility, Resilient, Resiliency, Robust, Robustness, Antifragile, Antifragility, Enterprise architecture, Public sector, System-of-systems, System-in-environment, Co-evolution, Success factors

Towards an Antifragile Public Sector

Introducing Antifragility in the Dutch Public Sector with Enterprise Architecture

René Bliekendaal

Abstract

The Greek philosopher Heraclitus once said that one constant since the beginning of time is change. Nothing in life is permanent, nor can it be, because the very nature of existence is change. The Dutch public sector deals with many changes in its environment. Changes follow one another at lightning speed. The Dutch public sector uses Enterprise Architecture to accompany change. In recent years, the environment placed new and increasingly compelling demands on the functioning of public organisations. A responsive and adaptive government is needed to deal with this. We must create public organisations that can cope with or even seize opportunities in a dynamic, complex, unpredictable environment. The Dutch public sector proposed to use antifragile to deal with disruptive change. However, how can the Dutch public sector achieve antifragility with the support of Enterprise Architecture? Hence, the research question of this thesis is: 'What are the success factors of Enterprise Architecture and antifragile that positively influence the contribution of Enterprise Architecture in achieving antifragility in the Dutch public sector?' We can conclude that there are fourteen potential success factors. We used triangulation to determine these success factors. We performed literature research and used semi-structured interviews with four CxOs of the Dutch public sector for validation and data collection. An expert group of ten Dutch public sector enterprise architects validated the final results.

Executive Summary

The Greek philosopher Heraclitus once said that one constant since the beginning of time is change. His central claim is summed up in the phrase Panta Rhei ("life is flux"), recognising life's essential, underlying essence as change. Nothing in life is permanent, nor can it be, because the very nature of existence is change. The Dutch public sector deals with many changes in its environment. Changes follow one another at lightning speed. These are changes such as new technologies, social developments and political priorities. In recent years, the external environment placed new and increasingly compelling demands on the functioning of public organisations. The public sector finds it challenging to adapt to the expected speed of change. "There is a need to invest for an even better government that can respond adequately and flexibly to unforeseen circumstances." was plead to 'informateur'¹ Schippers (Huijts, 2017). To cope with or even seize opportunities in a dynamic, complex, unpredictable environment, we need to create public organisations that are responsive and adaptive. In his essay, van der Steen (2018, p. 79) tossed the concept antifragile from Taleb (2012) as a possible direction to create an adaptive government.

This speed of change confronts policy-makers with high demands on their steering skills. The public sector started an improvement program for information provisioning to deal with the increasingly compelling demands on the functioning of public organisations. The improvement program positions Enterprise Architecture as supportive of the proposed improvements, specifically the Nederlandse Overheids Referentie Architectuur (NORA) and the Enterprise Architecture Rijksdienst (EAR). Enterprise Architecture is defined as a tool by the Dutch public sector to support with the implementation of changes.

The Dutch public sector wants to change toward being more adaptive and responsive. It was proposed by van der Steen (2018) to use antifragile from Taleb (2012) to deal with disruptive change. However, how can the Dutch public sector achieve antifragility with support of Enterprise Architecture? What are antifragile success factors relevant to the Dutch public sector, and what are Enterprise Architecture success factors in achieving it? Hence, our research question: '*What are success factors of Enterprise Architecture and antifragile that positively influence the contribution of Enterprise Architecture in achieving antifragility in the Dutch public sector?*'

We can conclude — based on our used data sets — that there are fourteen attributes that are potential success factors. We identified the first seven potential success factors in all three research tools. We identified the last seven in two of three research tools. Alternatively, through literature and confirmed by interviews or through interviews and validated by the expert group. We identified two potential attributes that were not found in literature and can be unique for the Dutch public sector. In our opinion, these could make the difference for the Dutch public sector as possible 'key' differentiators. We recommended starting with the first seven, possibly with the two possible 'key' success factors for the Dutch public sector.

¹ An 'informateur' is responsible to explore possible governing alliances after elections.

#	Attribute	Category
1	Optionality	Antifragile
2	Fail-fast	Antifragile
3	Resources to invest	Antifragile
4	Systems-in-Environment thinking	Enterprise Architecture
5	Environmental learning	Enterprise Architecture
6	Intra-organisational coherency	Enterprise Architecture
7	System-in-environment coevolution learning	Enterprise Architecture
8	Non-monotonicity	Antifragile
9	Self-organisation	Antifragile
10	Seneca's barbell	Antifragile
11	Safe working environment*	Antifragile
12	Holistic (systemic) stance	Enterprise Architecture
13	Organisational learning	Enterprise Architecture
14	Adapt to business language*	Enterprise Architecture

* Not found in literature

Potential success factors

The concept of antifragile is relatively young, and as far as we have been able to find, it has not been used in practice in the context of the Dutch public sector. Little information was therefore available to perform a quantitative analysis. We did choose to use the qualitative research method. The challenge of this method was the validation of results. How could we reduce possible subjectivity? We reduced subjectivity by applying triangulation with multiple research tools.

We performed a literature study. We distilled a list of possible success factors on antifragile and Enterprise Architecture. We used semi-structured interviews to have the possibility to capture more information than a structured interview. We selected interviewees from the public sector with a role as CxO to get the business perspective of the Dutch public sector. We validated our findings while at the same time we collected new data. The result after analysis was a selection of fourteen possible success factors. Our last validation step was the use of an expert group. We used a different perspective for the expert group members than for the interviewees. We decided to use the Enterprise Architecture perspective of the Dutch public sector. We used a group support system for the expert group session for brainstorming and rating possible success factors. After the expert group analysis, the results were a set of fifteen validated possible success factors.

We combined the literature study results, interviews, and expert group. We analysed the possible success factors on the occurrences over the three tools and ranked the possible success factors. We selected the success factors with three and two occurrences as potential success factors. We ranked them based on occurrences.

Acknowledgements

I do believe you should never stop learning. When you stop learning, you will stop developing yourself while your life and profession are in flux. That is why I am always following an education, professional training or reading books on various subjects. A couple of years ago, I decided to pursue a bachelor's degree in Business & IT. At that time, I had classes on Enterprise Engineering. A study of eighteen weeks on Design & Engineering Methodology for Organisations. At the end of the first day, we had a flash visit from Hans Mulder, who drove by after a lecture at the Nyenrode Business University. Hans told us that this particular bachelor was the perfect preparation for the Executive Master of Enterprise IT Architecture (MEITA) at the Antwerp Management School (AMS). At that moment, I had never heard of the AMS, and I even was surprised that there was an educational track for architecture. I visited an introduction evening at AMS for more information. After my visit, I knew it for sure. I am privileged that my directors Dieneke Schouten and Maarten Hillenaar supported me to pursue the MEITA at the AMS. Not only for making it possible but also for supporting me during my research with all means necessary.

I still remember what Steven de Haes (the dean of the AMS) told us during the opening seminar at Corsendonk (BE). Studying at the AMS will be a life-changing experience. It did not feel that way in the first year. COVID-19 happened, and classes on-site were impossible. Everything was online after Corsendonk. There was a noticeable distance between the students and the Antwerp Management School. Gladly this changed the second and last year of the MEITA.

At least once a month to AMS for two days of masterclasses and some fun with my fellow students. We have grown from a group of casual students to a group with strong ties in social and business. We endured a lot together in that last year. I will never forget our Thursday nights with 'Bollekes'. Always with the same group of the MEITA with Ingrid, Stefan, Didier, Marc, Cole, Maarten, and Gijs.

I started thinking of a subject for my research and thesis right after we started the master's. I started half a year later with researching antifragility combined with Enterprise Architecture in the Dutch public sector. I did this with Hans's support as my promotor and Edzo Botjes as my co-promotor. Edzo already researched antifragility during his master's at the AMS. Thank you both for this life-changing experience. Edzo I will never forget our collaboration and the philosophical discussions we had. But all good things come to an end. I finished my research and thesis, and so ended my journey at the AMS. If you ask me what the most important lesson is that I have learned during the past two years, I can only give the following answer:

"I discovered that I have found out how little I actually know."

I want to stand still with the two most important people in my life. My wife Krista and my son Declan. Thank you both for supporting me and enduring me in the time of following classes, conducting research, and writing this thesis. I could not have done this without you. Finally you have your husband and father back. Love you both.

— René

Table of Contents

Acknowledgements	i
Table of Contents	ii
1. Introduction	1
1.1. Introduction to antifragile	1
1.2. Introduction to Enterprise Architecture	2
1.3. Research relevance	3
1.4. Research model	4
1.5. Research question	4
1.6. Thesis design	5
2. Background	6
2.1. System	6
2.1.1. System-of-Systems and System-in-Environment	7
2.1.2. Ecosystem	7
2.2. Antifragile	7
2.2.1. Antifragile as a system property	8
2.2.2. Resilience	10
2.2.3. Learning organisation	10
2.2.4. Attenuate variety and amplified variety	11
2.2.5. Is agility antifragility?	11
2.2.6. Antifragile system attributes	12
2.3. Public sector	13
2.3.1. The public sector as a system	14
2.4. Enterprise Architecture	15
2.4.1. Approaches of Enterprise Architecture	16
2.4.2. Defining a lens on Enterprise Architecture	18
2.4.3. Enterprise Architecture system attributes	20
3. Methodology	21
3.1. Research design	21
3.1.1. Research quality	21
3.1.2. Research method	21
3.1.3. Triangulation	22
3.1.4. Research model	22
3.2. Research approach	23
3.2.1. Literature study	23
3.2.2. Interviews	24
3.2.3. Expert Group	25
3.2.4. Conclusion and discussions	25
3.3. Implementation of research quality	25

3.4. Research infrastructure and tooling	26
3.4.1. Research execution	26
3.4.2. Research administration	27
3.4.3. Thesis creation	27
4. Interviews	28
4.1. Interview results	29
4.1.1. Interview results on attenuate variety	30
4.1.2. Interview results on amplify variety	30
4.1.3. Interview results on learning organisation	32
4.1.4. Interview results on Enterprise Architecture schools of thought	32
4.1.5. Interview results on possible new attributes	33
4.2. Qualitative data analysis	34
4.3. Attributes most probable to be success factors	36
5. Expert group	38
5.1. Validation of attributes	39
5.1.1. Validation of antifragile attributes	39
5.1.2. Validation of Enterprise Architecture schools of thought	40
5.1.3. Validation of Enterprise Architecture attributes	40
5.2. Relevance of the research	41
5.3. Potential success factors	42
5.3.1. Selected antifragile attributes	42
5.3.2. Selected Enterprise Architecture attributes	43
5.3.3. Selected attributes as probable success factors	43
6. Conclusion and discussions	45
6.1. Conclusion	45
6.2. Research limitations	46
6.3. Discussions	47
6.3.1. The relevance of this research	47
6.3.2. Is antifragile and Enterprise Architecture in the Dutch public sector a timely topic?	47
6.3.3. Is the Dutch public sector different than that from other countries?	48
6.3.4. Differences between the central and local Dutch governments	48
6.3.5. Blaming culture in the Public Sector	48
6.3.6. Adapt to business language	49
6.3.7. Enterprise Architecture in general	49
6.3.8. Was reinstating the attribute optionality a good approach?	49
6.4. Recommendations	50
6.4.1. How to start with antifragile in the Dutch public sector	50
6.5. Retrospective	50
References	52
List of Figures	60
List of Tables	62
Glossary of Terms	63

Abbreviations	71
Appendix A. Properties of the Enterprise Architecture schools of thought	73
A.1. The properties of Enterprise IT Architecting	73
A.2. The properties of Enterprise Integrating	74
A.3. The properties of Enterprise Ecological Adaptation	75
Appendix B. Authors of the Enterprise Architecture schools of thought	76
Appendix C. Antifragile literature June 2019–April 2022	77
Appendix D. Interview summaries	80
D.1. Interview central government	80
D.2. Interview local government	81
D.3. Interview Independent Software Vendor	83
D.4. Interview consultancy firm/service provider	87
Appendix E. Interview findings	90
E.1. Interview findings Engineering Resilience attributes	90
E.2. Interview findings Systems Resilience attributes	90
E.3. Interview findings Complex Adaptive Systems Resilience attributes	91
E.4. Interview findings Antifragile attributes	91
E.5. Interview findings learning organisation attributes	92
E.6. Interview findings Enterprise Architecture schools of thought	92
E.7. Interview findings new attributes	93
Appendix F. Expert group findings	94
F.1. Validation of antifragile attributes	94
F.1.1. Validation of optionality	94
F.1.2. Validation of non-monotonicity	95
F.1.3. Self-Organisation	96
F.1.4. Fail-Fast	97
F.1.5. Resources to invest	98
F.1.6. Seneca's Barbell	99
F.1.7. Safe working environment	100
F.1.8. Outside-In and Collaboration	101
F.1.9. Data Governance Planes	102
F.2. Validation of Enterprise Architecture schools of thought	103
F.2.1. Enterprise IT Architecting	103
F.2.2. Enterprise Integrating	104
F.2.3. Enterprise Ecological Adaptation	105
F.3. Validation of Enterprise Architecture attributes	106
F.3.1. Systems-in-Environment thinking	107
F.3.2. Holistic (systemic) stance	108
F.3.3. Organisational learning	109
F.3.4. Environmental learning	110
F.3.5. Intra-organisational coherency	111
F.3.6. System-in-Environment Co-Evolution learning	112
F.3.7. Adapt to business language	113
F.3.8. Agile Enterprise	114

F.3.9. Real Time Trust	115
F.3.10. Foster Dialogue	116
F.3.11. Architecture validation	117
F.3.12. Always fitting Enterprise Architecture	118
F.4. Relevance of the research	119
F.4.1. To what extent do you find the research relevant?	119
F.4.2. To what extent did this session fulfil your expectations?	120
F.4.3. To what extent do you think that the research can be used by yourself? .	121
F.4.4. To what extent do you think that the research can be used in the public sector?	122
F.4.5. To what extent do you think that the research can be used by your orga- nisation?	123
F.5. Follow-Up Survey	123

Appendix G. Combined findings	124
--------------------------------------	------------

1. Introduction

The Greek philosopher Heraclitus once said that one constant since the beginning of time is change (Seibt, 2022). However, the fear of change is also a constant. His central claim is summed up in the phrase Panta Rhei ("life is flux"), recognising life's essential, underlying essence as change. Nothing in life is permanent, nor can it be, because the very nature of existence is change. Since times immemorial, humans have liked routine, making us feel in control of our lives. When the feeling of loosing control becomes irrational, the ability to control it can become a phobia (PsychTimes, n.d.). Someone with a phobia for change feels like they have no control over their lives due to constant change. These people tend to live in the past and are unwilling to progress, often leading to depression, seriously impacting their professional and personal lives. If a society or country rejects change, there could be no growth and progress (Mark, 2010). The inability to change, progress, or grow can result in stagnation.

The Dutch public sector deals with many changes in its environment (Nijssen et al., 2018, p. 1). Changes follow one another at lightning speed. These are changes such as new technologies, social developments and political priorities. In the past, these were internal changes such as improving the financial and human resource processes, implementing a new way to organise and control, and the professionalisation of management processes (van Eck et al., 2009, p. 13). In recent years, the external environment placed new and increasingly compelling demands on the functioning of public organisations. The public sector finds it challenging to adapt to the expected speed of change (Linders, 2013; Wiebes, 2014, p. 2; Koolmees & van Ark, 2019, pp. 5–6; Meijer et al., 2019, p. 8; Tangi et al., 2020, pp. 1–2). E.g. "The processes, while solid, cannot withstand the current pace of change; the dependence on emergency solutions and manual work is increasing" (Wiebes, 2014, p. 2). Trying to follow the expected speed of change often gets stuck on embedded norms, bureaucracy, processes, and structures (Tangi et al., 2020, p. 1).

"There is a need to invest for an even a better government that can respond adequately and flexibly to unforeseen circumstances." was plead to Schippers^{1,2} (Huijts, 2017). A responsive and adaptive government is needed to deal with this (van der Steen, 2018, pp. 79–81). We need to create public organisations that can cope with or even seize opportunities in a dynamic difficult, unpredictable environment (Nijssen et al., 2018, pp. 1–2). In his essay, van der Steen (2018, p. 79) tossed the concept antifragile from Taleb (2012) as a possible direction to create an adaptive government.

1.1. Introduction to antifragile

There are different manifestations to deal with uncertainty and disruptive changes (van der Steen, 2018, pp. 79–81). Van der Steen (2018) uses Taleb (2012) to discuss several manifestations for dealing with disruptive change. The five manifestations of Taleb (2012) provide a framework for the conversation about adaptive organisations (van der Steen, 2018, pp. 79–81). We have fragility, robustness, resiliency, agility, and antifragility. Organisations that find it difficult or impossible

1 https://en.wikipedia.org/wiki/Edith_Schippers

2 Schippers was at that time the appointed '*informateur*' (Dutch). An '*informateur*' is responsible to explore possible governing alliances after elections.

to deal with changes are fragile. That does not mean that these organisations are not successful. They are often very sturdy, solid and successful. However, a fragile organisation will run into problems if the environment requires something from those organisations beyond the limits of the organisations capabilities. A robust organisation absorbs and resists stress, while resilient organisations move along with stress but bounce back to the status quo. Agile organisations avoid stress just in time but do not gain, and with antifragility an organisation gets better from stress. Agile is not acknowledged by Taleb (2012) and is in this context only used by van der Steen (2018). Resiliency is mentioned but Taleb (2012) only uses fragile, robust, and antifragile for his triad (figure 1.1).

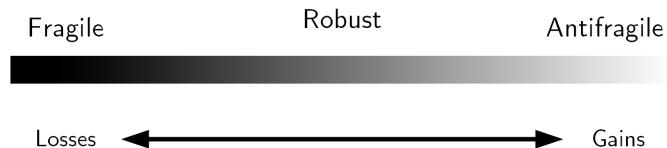


Figure 1.1.: The antifragile triad

Taleb (2012) coined antifragile as an answer to what he calls a Black Swan event. Black Swan events are large-scale unpredictable, and rare events of massive consequences (Taleb, 2012, p. 6). For extremely rare events the standard tools of probability and prediction, such as the normal distribution, do not apply since they depend on a large population and past sample sizes that are never available for rare events. Antifragile means that a system gains more than it loses.

1.2. Introduction to Enterprise Architecture

Due to the political and social environmental factors, the public sector deals continuously with changes and adjustments to objectives and missions (Nijssen et al., 2018). This speed of change confronts policy-makers with high demands on their steering skills. The public sector started an improvement program for information provisioning (Digitaleoverheid, 2021) to deal with the increasingly compelling demands on the functioning of public organisations (van Eck et al., 2009, p. 13). This program is a collaborative effort between governmental organisations, science, and suppliers (Digitaleoverheid, 2021, p. 128).

The improvement program positions, on multiple occasions, Enterprise Architecture as supportive of the proposed improvements, specifically the Nederlandse Overheids Referentie Architectuur (NORA) and the Enterprise Architecture Rijksdienst (EAR). Enterprise Architecture. E.g. "Organisations can learn from previous experiences with the cross-organisational collaboration of the Uitvoeringsinstituut Werknemersverzekeringen, and the Tax and Customs administration. The pillars and building blocks for chain management are part of the NORA." (Digitaleoverheid, 2021, p. 40). The governments defined Enterprise Architecture as "Architecture that describes the current and future organisational management and the transformation path between them. Enterprise Architecture is a tool to manage the coherence between the various developments in the organisation." (Nora, n.d.). NORA and EAR are so called reference architectures.

A reference architecture describes general structures (Greefhorst et al., 2008, p. 8). It is not specific to one organisation. Many organisations can use a reference architecture because it is abstract. Abstract architectures are the basis for more specific architectures (Greefhorst et al., 2008, p. 11). They are an essential tool for reuse at an architectural level. Therefore, organisations should draw as much as possible from these architectures.

We deduct that there are multiple levels of architecture. Some kind of architecture hierarchy. Traditionally, reference architectures and Enterprise Architecture in the public sector correspond to the NORA terms of content ('NORA Familie', n.d.). These are reference architectures like EAR but also Gemeentelijke Model Architectuur (GEMMA). The NORA itself is a daughter of the European Interoperability Reference Architecture (EIRA) (figure 1.2).

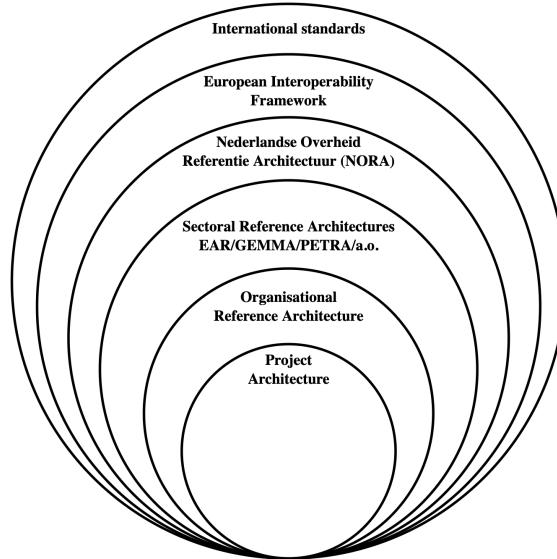


Figure 1.2.: Architecture subsidiaries, based on Greefhorst et al. (2008)

Changing higher-level reference architectures can support the 'I-strategy' improvement program. The changes ripple throughout the hierarchy. All the architectures correspond to the terms of the content of the higher architectures ('NORA Familie', n.d.). The central government uses EAR as a reference architecture. EAR is a subsidiary of NORA. The central government reactivates the 'Architecture Board Rijk' and the associated EAR for the improvement program (Digitaleoverheid, 2021, p. 42). The central government seeks collaboration with NORA for matching EAR with NORA.

1.3. Research relevance

The Dutch public sector wants to change toward being more adaptive and responsive (chapter 1). To be more adaptive and responsive, van der Steen (2018) proposed to use antifragile from Taleb (2012) (section 1.1). Enterprise Architecture is defined as a tool by the Dutch public sector to support with the implementation of changes (section 1.2). However, how can the Dutch public sector achieve antifragility with support of Enterprise Architecture? What are antifragile success factors relevant to the Dutch public sector, and what are Enterprise Architecture success factors in achieving it? The answer to these questions can make an impact on the Dutch public sector. These answers will support the Dutch public sector change itself to become more adaptive and responsive to better deal with unforeseen circumstances.

However, we could not find information on the combination of antifragile and Enterprise Architecture. Let alone when we added the Dutch public sector or just the public sector context. Most research deals with antifragility in application and information architectures. A small

number of sources have investigated antifragility in combination with organisations and systems. We have to discover these answers through research. We will research what the success factors are that positively influence becoming antifragile with Enterprise Architecture in the Dutch public sector.

1.4. Research model

There is little known about antifragility and Enterprise Architecture in combination with the Dutch public sector. When we decompose the statement we made in section 1.3, we have a context of the Dutch public sector with two variables and a moderator variable. We have the Enterprise Architecture as an independent variable, antifragile as a dependent variable, and the success factors as a moderator variable (figure 1.3). Our hypothesis is that there are factors that have a positive influence on achieving antifragility in the Dutch public sector with Enterprise Architecture.

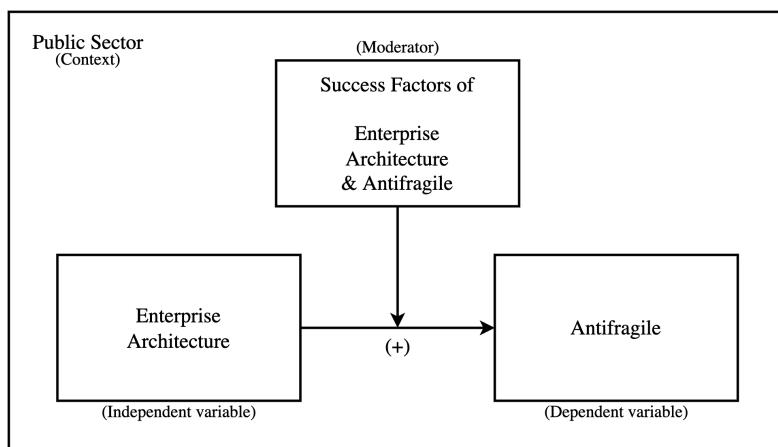


Figure 1.3.: Conceptual Research Model

1.5. Research question

Our hypothesis is that there are factors that have a positive influence on achieving antifragility in the Dutch public sector with Enterprise Architecture (figure 1.3). Following the conceptual research model, we have the following research question:

'What are success factors of Enterprise Architecture and antifragile that positively influence the contribution of Enterprise Architecture in achieving antifragility in the Dutch public sector?'

The following sub-questions support answering the research question:

1. What is the Dutch public sector?
2. What is antifragile?
3. What are success factors for antifragility?
4. What is Enterprise Architecture?

5. What are success factors of Enterprise Architecture?
6. Which success factors are relevant for the Dutch public sector?

1.6. Thesis design

The structure of this thesis follows a pattern of divergence before convergence (figure 1.4). We introduce the research (chapter 1). We present the context, explain the design of the thesis, and the necessity of the research. Following, we introduce the main concepts of the research together with a problem statement and research questions. We give a background on the concepts of the research (chapter 2). This part also contains the outcome of the literature research we performed based on the approach described in the methodology (chapter 3). The methodology explains the research design, the methods, the quality and the approach. All of these are part of the divergence of the research. We collected much data, but we still have to validate the data and narrow it down to formulate an answer to our research question. The second part of the thesis design will converge the findings.

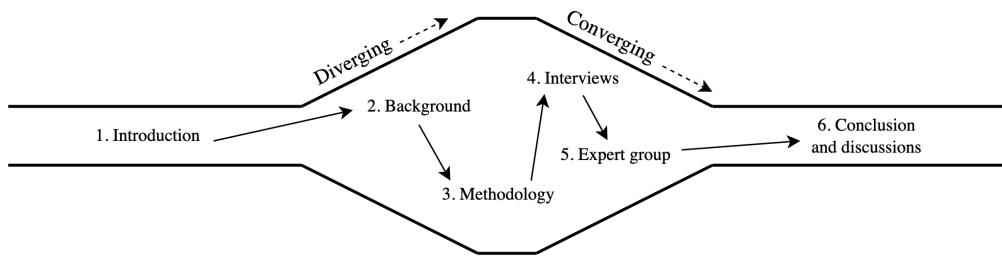


Figure 1.4.: Structure of the thesis

We validate findings with interviews (chapter 4) and an expert group (chapter 5). Converging ends with conclusion and discussions (chapter 6). This chapter contains also the limitations of the research and a retrospective. We have a glossary of terms available at the tail of the thesis to support the reader with used definitions.

2. Background

This research uses three main concepts of interest: *the public sector*, *antifragile*, and *Enterprise Architecture*. Understanding the interpretation of these concepts is essential for a shared mental model. Besides the three main concepts, it is vital to understand the concept system. The three main concepts use *system* as a concept. The concepts *public sector*, *antifragile*, *Enterprise Architecture*, and *system* are defined for a shared mental model.

2.1. System

Literature often uses the concept of system but with a different meaning (Lapalme, 2012, p. 37). System is used for many different things like software applications, interrelated people, systems of numerous interrelated elements (economical, social, technological) and others.

System has various definitions and types. E.g. open and closed, linear and non-linear, dynamic and deterministic systems (Rickles et al., 2007). A system can be an area of interest (Mannaert et al., 2016, p. 13). However, with another definition, a system is an object that is studied in the field (Rickles et al., 2007, p. 933). Both definitions are similar. Mannaert et al. (2016, pp. 13–14) acknowledged that the system is not isolated. The system of concern and systems in the environment have interactions. This behaviour is what von Bertalanffy (1968, p. 32) calls an open system. An open system is a system that exchanges matter with its environment, as where a closed system is considered to be isolated from its environment (von Bertalanffy, 1968, p. 39).

A system is more than the sum of its parts. It is an indivisible whole (Ackoff et al., 1964, p. 51–69; Ackoff, 1973, p. 664). A system loses its essential properties when taken apart. The elements of a system can also themselves be systems. Every system can be a part of another system. These systems are also called sub-systems. This managerial idea of systems thinking is to focus on the interactions of the parts rather than their behaviour separately.

A mental model to understand a system is dependent on specific characteristics of the behaviour of a system. Understanding the behaviour of a system can only be in its environment (Gharajedaghi, 2011, p. 29). The boundary of a system is defined by the variables that can be influenced or controlled by the actors of that system (Gharajedaghi, 2011, p. 182). Variables that can not be influenced or controlled but impact the viability of the system are part of the context (Gharajedaghi, 2011, p. 183) or the environment (Mannaert et al., 2016, p. 13–14). The *Why they do* and *What they do* of the actors in the environment help with influencing the environment (Gharajedaghi, 2011, p. 33). To understand the inner workings, "one needs the ability to see complementary relations in opposing tendencies and to create feasible wholes with infeasible parts" (Gharajedaghi, 2011, p. 38). However, the properties of a system are not the properties of its parts but that of the whole (Ackoff, 1973; Gharajedaghi, 2011). Because of these properties, actions intended to produce the desired outcome may generate opposite results, resulting in counter-intuitive behaviour (Gharajedaghi, 2011, p. 48).

The concepts of the public sector, Enterprise Architecture and antifragility use different specialisations of the concept system. These specialisations are *System-of-Systems*, *System-in-Environment*, and *Ecosystem*.

2.1.1. System-of-Systems and System-in-Environment

A collection of independent systems that are part of a more extensive system has unique capabilities (INCOSE, 2018). The independent systems working together have unique behaviour that they do not have on their own. A System-of-Systems is composed of multiple systems (Ackoff, 1973; Gharajedaghi, 2011). Another variation is that of a System-in-Environment. Using System-in-Environment stresses that a system is part of and should be aware of its environment (Gharajedaghi, 2011; Lapalme, 2012; Korhonen et al., 2016; Mannaert et al., 2016). System-in-Environment is a means to enforce environmental learning. With environmental learning, an enterprise adapts its desired goals to be more compatible with its environment (Lapalme, 2012, p. 41). The definitions of System-of-Systems and System-in-Environment are within the general definition of a system previously defined by Ackoff (1973), Gharajedaghi (2011, p. 183) and Mannaert et al. (2016, pp. 13–14).

2.1.2. Ecosystem

The concept of ecosystem originated from the field of ecology. It was firstly defined by Tansley (1935, p. 229) (Rich, 1988, p. 19). "But the more fundamental conception is, as it seems to me, the whole system (in the sense of physics), including not only the organism-complex but also the whole complex of physical factors in the widest sense", is the ecosystem as defined by Tansley (1935, p. 299). There are multiple transfers of the ecological ecosystem concept onto additional domains (Guggenberger et al., 2020, p. 3). A company must be viewed not as a member of a single industry but as part of a business ecosystem that crosses a variety of industries (Moore, 1993, p. 76). A business ecosystem is a concept that various businesses form value creation networks together (Guggenberger et al., 2020, p. 3). Ecosystems can be described as "a set of actors with varying degrees of multilateral, non-generic complementarities that are not fully hierarchically controlled" (Jacobides et al., 2018, p. 2255). There are different ways to order kinds of ecosystems. One way is that of dividing ecosystems into five specialisations. Business ecosystem (Moore, 1993, p. 76), platform ecosystem (Guggenberger et al., 2020, p. 5), service ecosystem (Barros & Dumas, 2006; Papazoglou & van den Heuvel, 2006; Huang et al., 2014), innovation ecosystem (Iansiti & Levien, 2004; Carayannis & Campbell, 2009; Gomes et al., 2018), and software ecosystem (Manikas & Hansen, 2013; Guggenberger et al., 2020, p. 5).

2.2. Antifragile

What is antifragile, where did it originate, what can you achieve with it, and why is antifragile important? These questions are the first things that come to mind when hearing antifragile for the first time.

Publications on the subject of antifragile often use *stressor* (Botjes, 2020, p. 32). What is a *stressor*? Ghasemi and Alizadeh (2017, p. 23) defined *stressor* based on Turner II et al. (2003) and Chrouzos (2009) as "When systems are performing effectively, they are in a predetermined condition and conversely when they are not functioning correctly, they are in an unintended state. An unintended condition can be known or unknown. *Stressors* are forces that threaten to transfer a system from an intended to an unintended condition."

Antifragile originated from the domain of risk management. Antifragile was coined for the first time by Taleb (2012) as his answer to Black Swan events. Black Swan events are "large-scale unpredictable, and rare events of massive consequences" (Taleb, 2012, pp. 6–7). The rarer the event, the less manageable, and the less we know about the frequent of its occurrence. The odds of Black Swan event are not computable. "Given the unattainability of perfect robustness, we need

a mechanism by which the system regenerates itself continuously by using, rather than suffering from, random events, unpredictable shocks, stressors, and volatility". With random events robust is not good enough. Everything with the most minute vulnerability breaks. Robustness cannot just be it, perfect robustness is needed not to end up crashing the system." (Taleb, 2012, p. 8). Fragile systems fail when exposed to stressors (Ghasemi & Alizadeh, 2017, p. 21). However, antifragile systems prosper and improve in response to unpredictability, volatile, randomness, chaos and disturbance (figure 2.1). Antifragility goes beyond robustness.

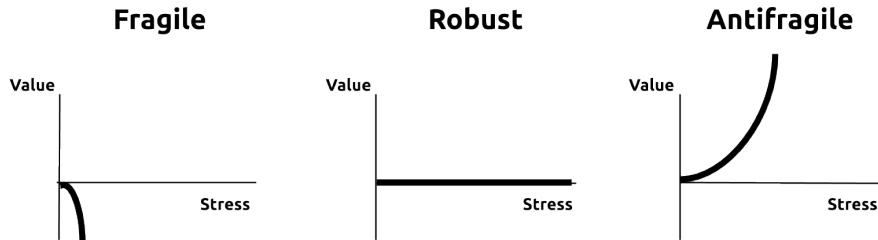


Figure 2.1.: Triad of fragile, robust, and antifragile (Botjes et al., 2021)

Antifragile means that a system gains more than it loses. Reducing possible losses will reduce the harmful effects of exposure to damaging elements such as stressors and Black Swan event (Russo & Ciancarini, 2017, p. 932). Positive asymmetry¹ is achievable by reducing possible losses. "Fragility and antifragility mean potential gain or harm from exposure to something related to volatility." (Taleb, 2012, p. 13). That something is what Taleb (2012, p. 13) calls a member of the extended disorder family. This disorder family consists of uncertainty, variability, imperfect, incomplete knowledge, chance, chaos, volatility, disorder, entropy, time, the unknown, randomness, turmoil, stressors, error, dispersion of outcomes, unacknowledged. The disorder family is interpreted by Botjes (2020, p. 12), based on the works of Taleb (2012, p. 436) and Gorgeon (2015, p. 3), as Volatility, Uncertainty, Complexity and Ambiguity from Bennis and Nanus (1985). Antifragility is not only an answer to a Black Swan event but also to random events, unpredictable shocks, stressors, and volatility (Taleb, 2012, p. 8).

2.2.1. Antifragile as a system property

A diversity of researchers define that fragility, robustness and antifragility are properties of a system (Jaaron & Backhouse, 2014; Hole, 2016; Kastner, 2017; O'Reilly, 2019; Botjes et al., 2021). Self-organisation, ownership, diversity, shared mental models and a shared vision are some of the properties that an antifragile system should posses. Botjes et al. (2021) conducted extensive research to define antifragility and the application of antifragility on organisation design. Botjes et al. used multiple sources (table 2.1) to define a list of attributes.

¹ Positive asymmetry happens when you have a lot of upside and little downside. Negative asymmetry is when you have little upside and high downside.

Sources	
Ghasemi and Alizadeh (2017)	Johnson and Gheorghe (2013)
Kennon et al. (2015)	Markey-Towler (2018)
Hendriksson et al. (2016)	Kastner (2017)
Gorgeon (2015)	Hole (2016)
O'Reilly (2019)	

Table 2.1.: Sources used for antifragile attributes (Botjes et al., 2021)

The result is the Extended Antifragile Attribute List (EAAL) (figure 2.2). The Extended Antifragile Attribute List (EAAL) is recent. Botjes et al. (2021, p. 5) created the data set through extensive literature research, but the data set only covers literature until June 2019.

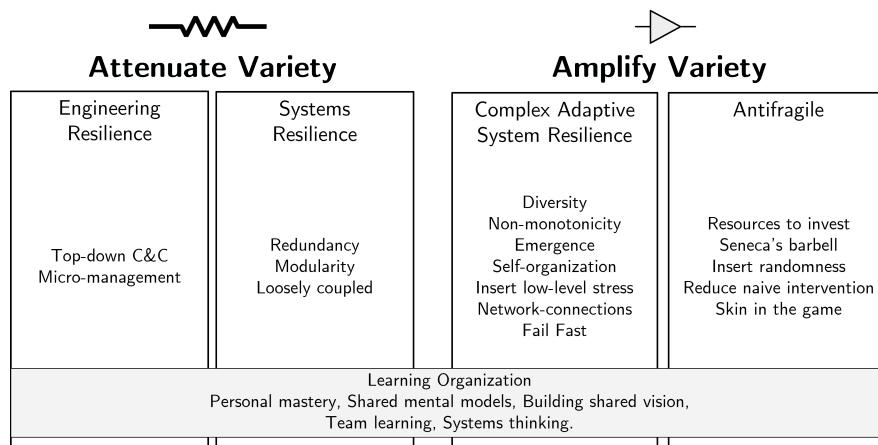


Figure 2.2.: Extended Antifragile Attribute List (Botjes et al., 2021)

Searching for *new* literature makes sure that Botjes et al. (2021) is recent and is not rebutted. Using the time frame of June 2019 until April 2022 makes sure that only new literature is found. We used the same academic search engines and keywords as Botjes et al. (2021, p. 5). The result of the search was *thirty-one* new sources. These sources are new articles, books and in-proceedings (appendix C). We rated the new findings on accessibility, if it was already part of Botjes et al. (2021), and if the sources contained information on properties and attributes of antifragility. Of those thirty-one new sources, three were already in the literature set of Botjes et al. (2021). Eight were not found or publicly available, and thirteen were not relevant. Only seven were of interest to look at. After reading them, none of the literature added something new or rebutted the work of Botjes et al. (2021). Botjes et al. (2021) is recent and contains possible attributes to become more antifragile in the Dutch public sector.

The Extended Antifragile Attribute List (figure 2.2) classifies attributes in two primary and five secondary categories. *Attenuate variety* and *amplify variety* (section 2.2.4) are the two primary categories. The five secondary categories are *engineering resilience*, *systems resilience*, *complex adaptive systems resilience* (section 2.2.2), *antifragile* and *learning organisation* (section 2.2.3). The Extended Antifragile Attribute List does not contain resilience as a secondary category but multiple types of resilience. The Extended Antifragile Attribute List assigned the secondary categories to the primary categories. *Engineering resilience* and *systems resilience* are assigned

to *attenuate variety*, while *complex adaptive systems resilience* and *antifragile* to *amplify variety*. *Learning organisation* is the only category assigned to both *attenuate variety* and *amplify variety*.

2.2.2. Resilience

Resiliency is mentioned often in relation to antifragility. Kastner (2017, loc. 280) and Botjes et al. (2021, p. 3) uses the definitions of Martin-Breen and Andries (2011, pp. 5–8). Martin-Breen and Andries (2011, pp. 5–8) identified several types of resiliency. These types are *engineering resilience* (Common Sense resilience), *systems resilience* (Robustness in economics), and *complex adaptive systems resilience*. The definitions of resiliency (table 2.2) have focus on the avoidance of harmful stressors and failure, including uncertainty and volatility (Martin-Breen & Andries, 2011, pp. 5–8).

Type	Description
Engineering resilience	Bounce back faster after stress, enduring greater stresses, and being disturbed less by a given amount of stress.
Systems resilience	Maintaining system function in the event of a disturbance. Systems resilience has been applied in governance and management, where it is often called robustness.
Complex adaptive systems resilience	The ability to withstand, recover from, and reorganise in response to crisis. The function is maintained by the system structure may not be. The main differentiator is the adaptive capacity or adaptability of the system.

Table 2.2.: Types of resilience (Martin-Breen & Andries, 2011)

2.2.3. Learning organisation

One of the secondary categories of Extended Antifragile Attribute List is learning organisation. But what is the learning organisation? The learning organisation is a way to create resilient organisations. These resilient organisations can cope better with unknown and unpredictable events. "Continuous improvement requires commitment to learning." (Garvin, 1993). The learning organisation is an organisation that is equipped for creating, acquiring, and transferring knowledge (Garvin, 1993). The result of this is that a learning organisation can modify its behaviour to reflect new knowledge and insights (Garvin, 1993). Senge (1994) defined the attributes of the learning organisation that Botjes et al. (2021) used in the Extended Antifragile Attribute List (figure 2.3). These attributes are *personal mastery*, *shared mental models*, *building shared vision*, *team learning*, and *systems thinking*.

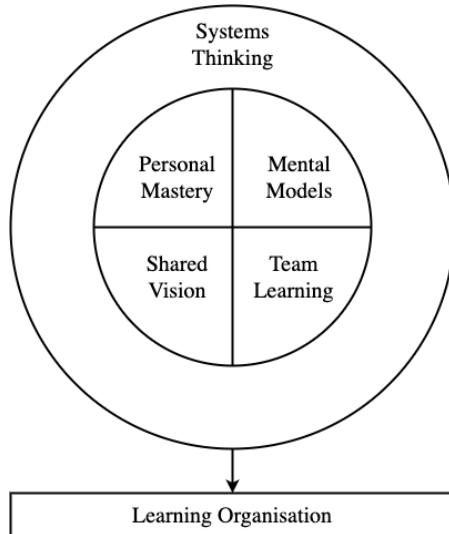


Figure 2.3.: The Fifth discipline (Senge, 1994)

2.2.4. Attenuate variety and amplified variety

The two main categories in the Extended Antifragile Attribute List are attenuate variety and amplify variety. What is attenuate variety and amplify variety? Variety originated from Cybernetics and was coined by Ashby (1956). Variety denotes the count of states of a system. Ashby and Beer stated the Law of Requisite Variety as 'variety can destroy variety' (Ashby, 1956, p. 207) and 'variety absorbs variety' (Beer, 1979, p. 286). "If a system is to be stable, the number of states of its control mechanism must be greater than or equal to the number of states in the system being controlled." (Heylighen & Joslyn, 2001). There are two types of variety manipulations (Ashby, 1956; Beer, 1979). Attenuate variety is reducing the variety in a system, while amplify variety is increasing the variety in a system. "To amplify internal variety is about increasing the chance of a higher entropy and, therefore, more capable of absorbing the increasing external variety caused by change." (Botjes et al., 2021, p. 4). Attenuate variety is about increasing the chance of a lower entropy and, therefore, less capable of absorbing increasing external variety caused by change. Engineering resilience and systems resilience are results from attenuate variety, while complex adaptive systems resilience and antifragile of amplify variety. Another interpretation is possible. Attenuate variety increases the fragility of a system, while amplify variety decreases the fragility and increases the antifragility of a system.

2.2.5. Is agility antifragility?

In the introduction on antifragility (section 1.1) we mentioned that van der Steen (2018, pp. 79–81) recognised fragility, robustness, resiliency, agility, and antifragility as manifestations of Taleb (2012). Nevertheless, agility is not used, or in some cases mentioned, by Taleb (2012), Kastner (2017), O'Reilly (2019) and Botjes et al. (2021) and others.

What is the relation between agile and antifragile? Is agile fragile, robust or antifragile? The question is agile fragile, robust or antifragile is improperly framed (Tomov, 2019, p. 6). Agility can be fragile, robust or antifragile. Antifragility and robustness are mathematically defined as properties, while agility is not. Rather than aiming to control or remove control, we have to build technical and business systems that aim to be antifragile to change (O'Reilly, 2019, p. 884).

When we architect antifragility, businesses can gain agility. When we build systems that aim to be antifragile for change is better than to control change. The result is the possibility of creating business and technical architectures that enable agility through design.

Based on experiences and observations, five trademarks and twenty-three practices are defined for organisational agility (Aghina et al., 2018, p. 7). When we combine these trademarks and practices with the Extended Antifragile Attribute List from Botjes et al. (2021, p. 7) it is clear that by using the attributes from the Extended Antifragile Attribute List it is possible to achieve agility in a system. Agility can be the result of applying antifragile attributes. Agility is a result of implementation, while antifragile is a property of a system.

2.2.6. Antifragile system attributes

The Extended Antifragile Attribute List is selected as a source and starting point for antifragile attributes (section 2.2.1). Optionality is stated as an essential attribute by Taleb (2012) and Botjes (2020, p. 64). Optionality is excluded from the Extended Antifragile Attribute List because of the overlap with diversity (Botjes, 2020, p. 64). But Taleb (2012) and Gorgeon (2015, p. 9) both use the term optionality. Optionality is an idea advanced by Taleb (2012). At the most basic level, optionality means having lots of options. The difference between optionality and diversity is very subtle. Optionality allows the buyer to retain the upper bound and be unaffected by adverse outcomes which makes the buyer antifragile (Cunff, 2020). Despite the minimal difference between optionality and diversity, optionality can still have a distinctive character in the Dutch public sector. Adding optionality to the already defined set of the Extended Antifragile Attribute List brings a total of twenty-three attributes. The Extended Antifragile Attribute List categorised the attributes into attenuate variety, amplify variety, and learning organisation. Adding optionality to amplify variety makes it equal to diversity. For the overview of the attributes for antifragile see table 2.3.

Attribute	Category
Top-Down Command & Control	Attenuate variety
Micro-Management	Attenuate variety
Redundancy	Attenuate variety
Modularity	Attenuate variety
Loosely coupled	Attenuate variety
Diversity	Amplify variety
Non-monotonicity	Amplify variety
Emergence	Amplify variety
Self-organisation	Amplify variety
Insert low-level stress	Amplify variety
Network-connections	Amplify variety
Fail-fast	Amplify variety
Resources to invest	Amplify variety
Seneca's barbell	Amplify variety
Insert randomness	Amplify variety
Reduce naive intervention	Amplify variety
Skin in the game	Amplify variety
Optionality	Amplify variety
Personal mastery	Learning organisation
Shared mental model	Learning organisation
Building shared vision	Learning organisation

Attribute	Category
Team learning	Learning organisation
Systems thinking	Learning organisation

Table 2.3.: Antifragile system attributes

2.3. Public sector

The context of this research is the public sector. We need to explain the Dutch public sector to have a common understanding that will help to place this research in its proper context. However, we will not explain how the Dutch public sector functions in depth.

In general the public sector is the collective name for all government and semi-government organisations (Pathirane & Blades, 1982, p. 261). We divide the governments into three levels: the national government, the regional government, and the local government. We see these levels also in the Dutch public sector: the central government, the provinces, and the municipalities (Libert, 2016, p. 10). The Netherlands is a decentralised unitary state. A decentralised unitary state is a form of government in which territorial units within a unitary state have independent powers (Engels & Fraanje, 2013, p. 8). The organisation of local and regional authorities is formalised in the Netherlands by the Provinces Act and the Municipalities Act. Provinces and municipalities can therefore decide on issues themselves. There is no fixed demarcation of tasks between the levels of the government. Nevertheless, provinces and municipalities have a general power to regulate and manage, which can only be limited by law. However, provinces and municipalities are obliged to cooperate in implementing rules set by higher authorities.

My observation is that, as a result, there are differences in the implementation of laws between municipalities themselves. E.g. one municipality is helping residents get financially healthier by coaching, while another municipality is employing them. In both cases it is about a law for social benefits performed by municipalities. In theory you can have n different implementations of the law with n being the number of municipalities.

The central government is the part of the government that works at the national level (Rijksoverheid, 2019). They are responsible for policy-making, passing laws and monitoring compliance. In addition, the central government is responsible for preparing plans for the government and parliament and carrying out these plans. The provinces can decide independently on many matters. E.g. the creation of new nature and building new roads. In addition, the provinces also implement several national laws. Municipalities only perform tasks that are of direct importance to their residents. Making those choices is the essential task of a municipal council. In addition, the municipalities also implement many national laws. For example, every municipality must issue passports and identity cards to its residents.

As of 2022, the national government consists of 12 ministries (Linthorst, 2021), the regional government of 12 provinces (CBS, n.d.), and the local government of 344 municipalities (CBS, n.d.). Organisations that are part of the public sector but are not classified as an organisation belonging to one of the three levels are excluded from this count.

A difference between the public sector and other sectors is public accountability. Public accountability is a form of accountability that relates specifically to the public sector (Boers et al., 2009). Public accountability should be distinguished from public responsibilities, which involve a substantive discussion about the public sector's tasks, obligations, and liabilities. Public accountability relates to public funds' expenditure and the exercise of public duties and powers. It is transparent for the public, and it is from the public good perspective. You see this also when you compare the public and private sectors on core values. Public accountability is the

most important value in the public sector, while profitability is almost non-existing (van der Wal et al., 2008, p. 472). The top five public sector core values are accountability, effectiveness, incorruptibility, reliability, and lawfulness.

2.3.1. The public sector as a system

In general, the Dutch public sector is the collective name for all government and semi-government organisations (Pathirane & Blades, 1982, p. 261). Besides the central government, provinces, and municipalities, we also have semi-government organisations that are part of the public sector. An organisation is part of the semi-government if the government finances it, performs public tasks, and serves a public good. Examples of semi-government organisations are the organisations of public transportation, healthcare, and education. When we use the theory of systems (section 2.1) we can say that the public sector is a System of Systems. But is it correct that the sub-systems are only government and semi-government organisations?

The public sector is working closely together with the private sector in so-called Public-Private Partnerships. A Public-Private Partnership is when the government and the industry work together to realise a project based on a clear division of tasks and risks (Enneman, 2007, p. 8). While at the same time retaining their own identities and responsibilities. A Public-Private Partnership realises added value—a qualitative better product for the same investment or the same quality for a lower investment. Besides the Public-Private Partnership, you see also other forms of collaboration. Like collaborations in innovations. "By working together with private companies and start-ups and learning from each other, we will develop new innovative solutions (Digitaleoverheid, 2021, p. 120). "We can also give others the space to innovate public services, for example, by releasing open data (under conditions) so that large and small companies can develop so-called 'gov tech' solutions. The government does not always have to do this innovation itself or have it commissioned." (Digitaleoverheid, 2021, p. 120). "Only through cooperation within the government and the business community, education and science can we strengthen technological developments." (Digitaleoverheid, 2021, p. 68).

The role of private sector organisations is changing more and more. Joint ventures are formed between public and private sector organisations instead of private sector organisations only delivering products and services to the public sector. Can the Dutch public sector reach its goal of being more responsive and adaptive to respond more adequately and flexible to unforeseen circumstances without the private sector? We have the opinion that they cannot. There are many dependencies and there is a high interconnectedness (coherency). We decided to place the private sector organisations working with the Dutch public sector in the System-of-Systems of the Dutch public sector (figure 2.4).

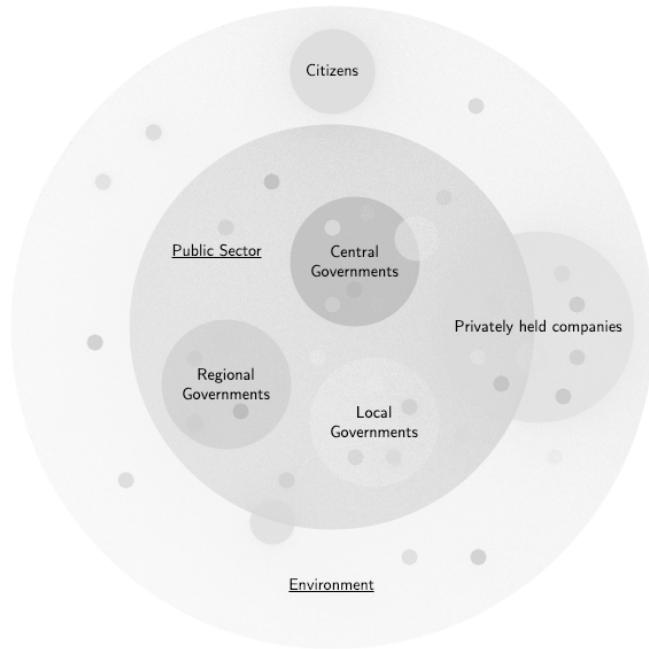


Figure 2.4.: Public Sector as a System-of-Systems

2.4. Enterprise Architecture

This research is about which success factors positively influence Enterprise Architecture in achieving antifragility in the Dutch public sector. This statement already assumes that Enterprise Architecture is a means to achieve a goal. Is this correct? Does the world have the same idea about Enterprise Architecture, or do they see it differently? Can Enterprise Architecture contribute to reaching the goals of an organisation or even a system? Regardless of the attention Enterprise Architecture gets, many researchers and practitioners have indicated that there is a lack of a shared mental model (Saint-Louis et al., 2019, p. 2). The various definitions are not always complimentary, and sometimes they are even opposite (Dietz, 2008; Hoogervorst, 2009; Lapalme, 2012; Saint-Louis et al., 2019). "Unfortunately, the term "Enterprise Architecture" has many meanings as well, meanings that are quite diverse and sometimes even contradictory." (Dietz, 2008, p. 51). A lens on Enterprise Architecture needs to be defined for this research to create a shared understanding of Enterprise Architecture. There is no shared mental model of Enterprise Architecture (Saint-Louis et al., 2019, p. 2). The lack of a shared mental model can create confusion and conflicts concerning the purpose of Enterprise Architecture and its practice (Saint-Louis et al., 2019, p. 1). The definitions vary in the scope of application. Some definitions only focus on Information Technology systems, while others focus on the business, the enterprise, the environment, or any other combination. E.g. the definitions from Gartner (n.d.), Dietz (2008), Graves (2009), Ross et al. (2014) and White (2018).

Definition of Gartner (n.d.): Enterprise Architecture analyses the execution of change toward a desired business vision and outcomes. Enterprise Architecture leads the enterprise proactively and holistically, responding to disruptive forces.

Definition of Dietz (2008, p. 53): Theoretical, architecture is the normative restriction of design freedom. Practically, architecture is a consistent and coherent set of design principles.

Definition of Graves (2009, pp. 4–5): Enterprise Architecture is a discipline through which an Enterprise can identify, develop and manage its knowledge of its purpose, its structure and itself. Enterprise Architecture will also assist in managing changes imposed on the organisation by the market, by regulations, or – at an operations level – by system failures, environmental incidents or customer complaints.

Definition of Ross et al. (2014, p. 9): Enterprise Architecture is the organising logic for business processes and IT infrastructure, reflecting its operating model's integration and standardisation requirements. It provides a long term view of a company's processes, systems and technologies so that individuals can build capabilities and not just fulfil immediate needs.

Definition of White (2018): Enterprise Architecture is the process by which organizations standardize and organize IT infrastructure to aligns with business goals. These strategies support digital transformation, IT growth and the modernization of IT as a department. Enterprise Architecture is the practice of analysing, designing, planning and implementing enterprise analysis to successfully execute on business strategies. Enterprise Architecture helps to lay out how information, business and technology flow together.

Four out of five definitions are mostly about deterministic blueprinting. The only definition that is different is that of Dietz (2008). The definition of Dietz (2008) is more about emerging architecture. We also see another difference. With the first four definitions the outcome of the architecture is often the architecture product itself while with Dietz (2008) the "architecture is not what you see but what shaped what you see.". All five Enterprise Architecture definitions provide decision-support for direction and change at any level of the enterprise. E.g. "The choices in the journey of an enterprise for an executive, the preferred technologies or process models for new developments for programme and portfolio management, as well planning when to decommission, change or replace systems" (Graves, 2009, p. 4). The real difference between the definitions is that the definition of Dietz (2008) only limits the design freedom by defining boundaries while the other definitions are more deterministic and intended. Because a shared mental model is absent, there is also no clear approach to practising Enterprise Architecture (Saint-Louis et al., 2019, p. 2).

2.4.1. Approaches of Enterprise Architecture

There are several perspectives on the practice of Enterprise Architecture (Lapalme, 2012; Kotusev et al., 2015; Ylinen & Pekkola, 2018; Ylinen & Pekkola, 2020). One of the perspectives is an approach that distinguishes two groups of Enterprise Architecture experts. A modelling-focused group forms a comprehensive view of an organisation, and a development-focused group using Enterprise Architecture for organisational development (Ylinen & Pekkola, 2020, p. 6).

However, another perspective distinguished three approaches (Kotusev et al., 2015, p. 4071). The traditional (Spewak, 1993), the Massachusetts Institute of Technology (MIT) (Ross et al., 2014), and the DYNAMIC Architecture (DYA) (Berg et al., 2005) approach (Kotusev et al., 2015, pp. 4071–4072) (table 2.4).

Approach	Description
Traditional	A four-step sequential process. Document the current (as-is, baseline) state, develop the desired future (to-be, future) state and the transition plan to migrate from the current to the target state, and implement the plan and repeat the process.
MIT	Advocates the development of a long-term enterprise-level architectural vision to be translated into concrete project-level decisions through IT governance mechanisms. These decisions involve business and IT managers on different organisational levels.
DYA	"Just enough, just in time" architecture. The development of Enterprise Architecture starts no earlier than there is a need for it. Business initiatives trigger the activities of Enterprise Architecture to make sure that needed projects fit nicely into the existing Enterprise Architecture and in the strategic plans of the enterprise.

Table 2.4.: Three approaches to Enterprise Architecture (Kotusev et al., 2015)

When you scrutinise the definitions of the three approaches, it becomes clear that the approaches are focused on organisations and not the environment. The Enterprise Architecture three schools of thought from Lapalme (2012) gives another perspective. Three possible schools of thought in the practice of Enterprise Architecture are, Enterprise IT Architecting, Enterprise Integrating, and Enterprise Ecological Adaptation (Lapalme, 2012, pp. 38–41) (table 2.5 and appendix A).

Approach	Description
Enterprise IT Architecting	Enterprise Architecture is the glue between business and IT. Enterprise Architecture is an enabler for executing the business strategy. This school is about aligning an enterprise's IT assets to execute business strategy effectively and various operations using the proper IT capabilities. The school Enterprise IT Architecting focuses on the Information Technology capabilities while not questioning the business capabilities.
Enterprise Integrating	Enterprise Integrating links strategy and execution. It is not only enabling enterprise strategy it also implements it. Designing all the organisational dimensions is fostered with systems thinking. Enterprise Integrating is aware of its environment and tries to manage the environment.

Approach	Description
Enterprise Ecological Adaptation	Enterprise Architecture fosters organisational learning by designing all facets of the enterprise. It changes the environment and systematically designs the enterprise, including its relationship to the environment. The enterprise's relationship to its environment is an indisputably connected facet. This school of thought enables innovation and System-in-Environment adaptation. It looks for bidirectional incoherence between the enterprise and its environment. Nevertheless, it is the means for organisational innovation and sustainability. It is about enterprise and environment co-evolution.

Table 2.5.: Enterprise Architecture schools of thought (Lapalme, 2012)

2.4.2. Defining a lens on Enterprise Architecture

Antifragile deals with stressors and Black Swan events originating from the (environment of the) system of interest. The Extended Antifragile Attribute List of Botjes et al. (2021) fosters organisational learning and systems thinking capabilities to deal with stressors and Black Swan events (Botjes et al., 2021, pp. 2–4). Exploring the Enterprise Architecture schools of thought (Lapalme, 2012) makes it clear that *Enterprise Ecological Adaptation* is probably the best school in the context of antifragility. *Enterprise Ecological Adaptation* has a clear focus on the environment, fosters organisational and environmental learning, and embraces systems thinking (Lapalme, 2012, pp. 40–41). Although the school *Enterprise Integrating* already has the notion of the environment, it is not changing the environment like the school *Enterprise Ecological Adaptation*. At the same time, *Enterprise IT Architecting* has its main focus on the IT organisation of the enterprise itself. If an organisation want to survive in the turbulence of today's markets, the organisation must learn to adapt and innovate (Lapalme, 2012, p. 42). The school *Enterprise Ecological Adaptation* is about adapt and innovate.

It is still necessary to define the lens we use on Enterprise Architecture. The lens on Enterprise Architecture is partly defined. '*The how*' is known. The Enterprise Architecture school of thought Enterprise Ecological Adaptation is selected. The properties of this school are known (appendix A.3). We still miss the definition of Enterprise Architecture. '*The what*' that we will use as a lens. Lapalme (2012, p 42) mapped Enterprise Architecture authors and literature to the three schools of thought (appendix B).

Author(s)	Description
Gharajedaghi	Gharajedaghi (2011) is about systems theories and does not have its focus on Enterprise Architecture.
Hoogervorst	Hoogervorst (2009) is about Enterprise Governance and Enterprise Engineering. It addresses Enterprise Architecture and provides definitions. Enterprise Architecture is more a design discipline.
Graves	Graves (2008) is about Enterprise Architecture, the goal and use of Enterprise Architecture, and it contains definitions of Enterprise Architecture.
Martin	Martin (1995) is about aligning enterprise engineering to people, technology, and strategy. Enterprise Architecture is more a design discipline.
Smith and Graves	Smith and Graves (2011) is about an Enterprise Architecture framework. It does not contain definitions on Enterprise Architecture.
Lapalme and de Guerre	Lapalme and de Guerre (2012) is not publicly available and accessible. It is about socio-technical systems strengthen Enterprise Architecture.

Table 2.6.: Authors of Enterprise Ecological Adaptation (Lapalme, 2012)

A lens on Enterprise Architecture must be aligned with the Enterprise Architecture school of thought of Enterprise Ecological Adaptation. But the definition should also support the Dutch public sector in being more adequate and flexible to unforeseen circumstances, and so antifragile. Using the list of authors and sources for the school of thought of Enterprise Ecological Adaptation (table 2.6) shows that two sources contain definitions of Enterprise Architecture. The first source that contains a definition is Hoogervorst (2009). Hoogervorst (2009, p. 8) defines Enterprise Architecture as something that provides normative guidance for design in order for the enterprise to operate satisfied. Enterprise Architecture comprises four sets of architecture business, organisation, information, and technology.

The second is that of Graves (2008). "Enterprise Architecture is the integration of everything the enterprise is and does." (Graves, 2008, p. 1). Enterprise Architecture is about the structure of the whole of the enterprise—the whole rather than a single sub-system. There are no simple states of 'as is' and 'to be'. The world is dynamic and not static. Everything in a business system depends on everything else (Graves, 2008, p. 14).

Graves's definition directly relates to the Enterprise Architecture school of thought of Enterprise Ecological Adaptation and hints towards antifragility. But its Enterprise Architecture is still mostly normative and deterministic. When we compare this with the definition of Enterprise Architecture from Dietz (2008) is the definition of Dietz more emergent. It will adapt easier to unforeseen circumstances. The definition of Dietz (2008) has a downside. It can be too conceptual to use it correctly but "it seems to be the only feasible way of 'translating' high-level statements, as can be found in mission and strategy documents, into operationally useful principles for the development of systems." (Dietz, 2008, p. 53). We decided to adopt the definition of Dietz (2008) as our lens.

2.4.3. Enterprise Architecture system attributes

The Enterprise Architecture school of thought of Enterprise Ecological Adaptation has the best alignment with antifragile (section 2.4). The attributes used for Enterprise Architecture will be those of the school of Enterprise Ecological Adaptation. It contains attributes related to learning and systems thinking. *Organisational learning*, *environmental learning*, and *system-in-environment coevolution learning* are related to learning and *Systems-in-Environment thinking*, *holistic (systemic) stance*, and *intra-organisational coherency* to systems thinking. See for a full overview table 2.7.

Attribute	Category
Systems-in-Environment thinking	Enterprise Ecological Adaptation
Holistic (systemic) stance	Enterprise Ecological Adaptation
Intra-organisational coherency	Enterprise Ecological Adaptation
Organisational learning	Enterprise Ecological Adaptation
Environmental learning	Enterprise Ecological Adaptation
System-in-environment coevolution learning	Enterprise Ecological Adaptation

Table 2.7.: Enterprise Architecture system attributes based on (Lapalme, 2012)

3. Methodology

What methods do we use to get answers to the questions asked? How can we ensure that the research is reliable? These are the questions this chapter will answer.

3.1. Research design

We need answers to the following questions before we can start with our research. What is the reliability we pursue, and how do we reach this reliability? What methods do we have for our research, and which ones do we use? What is our research model? We will design our reliability with support of quality attributes and principles. Secondly, we will briefly explain possible research methods before beginning a high-level design. We close this section with our choice of research method and how we think we can comply with the quality attributes to meet our reliability expectations.

3.1.1. Research quality

We increase the rigorousness of the research by applying four quality principles. These principles are *replicability*, *independence*, *precision* and *falsification* (Recker, 2013, p. 16–18). Replicability makes sure that a third party can repeat the research, while independence frees the research from subjective judgement. Precision assures that all the concepts, constructs, and measurements allow others to use, apply and challenge those concepts, constructs and measurements. Falsification implies that the research results can be disproven.

We find replicability and reusability essential. We believe that the results of this research should be open and available for everyone. We adopt the FAIR principles (Wilkinson et al., 2016) to support us in achieving this replicability and reusability. FAIR stands for findability, accessibility, interoperability, and reuse of digital assets. Findability assures that research data, and metadata is easy to find for both humans and computers. Accessibility is that it can also be accessed when the data is found. Interoperability is about that data must support integration with other data. The last principle is reusability. With reusability, the data and metadata are well described for combining and replicating.

3.1.2. Research method

The most popular research methods are either quantitative or qualitative (Recker, 2013, p. 65). A quantitative method uses techniques to answer a research question emphasising using quantitative data (Recker, 2013, p. 66), it has its focus measurement (Recker, 2013, p. 88), while a qualitative method is about assisting researchers in understanding a phenomenon in context. "Qualitative research is for exploratory research where a phenomenon is not yet fully understood, not well researched, or still emerging." (Recker, 2013, p. 84). With qualitative research, the focus is on text rather than numbers. Qualitative research is about what people have said, done, experienced or believe. Qualitative methods are case study research, action research, grounded theory, and others. A case study is a detailed study of a specific subject, such as a person, group, place, event, organisation, or phenomenon (Recker, 2013, p. 95). Grounded theory is about collecting

data in order to develop new theories (Recker, 2013, p. 102). Action research introduces changes and interventions into a context and studies the effects (Recker, 2013, p. 99).

3.1.3. Triangulation

Stating something by only using one method is not reliable. The result can be biased or can be coincidental. The result will get better if it is validated by multiple methods. This validation method is called triangulation. "Triangulation means seeking convergence and corroboration of results from different methods and designs studying the same phenomenon" (Recker, 2013, p. 104). Using different sources for cross-validation strengthens the findings to be more reliable and valid. The researcher gains a more nuanced picture of the situation by doing so (Recker, 2013, p. 91). Triangulation increases the validity, credibility, and authenticity of research data, analysis and interpretation. Triangulation can be used in quantitative as well as qualitative methods (Recker, 2013, p. 91). Triangulation will increase the robustness of research results.

3.1.4. Research model

The topic of antifragile is still relatively young, and as far as we have been able to find, it has not been used in practice yet in the context of systems. Let alone with a System-of-Systems, the Dutch public sector. Little information is therefore available to perform a quantitative analysis. We have chosen to use the qualitative research method. This method focuses on what people said, done, believed or experienced. The research approach explores and develops generalised success factors for antifragility in the Dutch public sector. The research focuses on a relatively new research domain, is emergent and lacks a substantive theory. This indicates that the research has a base attitude of the qualitative method, particularly Grounded Theory. The challenge of this method is the validation of the results. How can we reduce possible subjectivity? We reduce subjectivity by applying triangulation with multiple research tools.

So how do we apply the qualitative research method with triangulation? We are searching for an answer to the research question 'What are the success factors that positively influence the contribution of Enterprise Architecture in achieving antifragility in the public sector?' How can we be sure that the answer we will give is reliable and valid? To answer the main research question, we have split the question into several sub-questions (section 1.5). Studying literature will answer the first five sub-questions. The first step in the research is a literature study on antifragile, Enterprise Architecture, and the Dutch public sector. From the literature study, we distil a list of possible success factors on antifragile and Enterprise Architecture.

We need to validate these results with multiple qualitative research tools. For the first tool, we use interviews. We use interviews with CxOs in the public sector for the first validation. Attributes that are confirmed will go for validation to the expert group. It can also happen that we discover new attributes. When we have discovered new attributes, we will go back to the literature study step for validation to make sure that they do or do not occur in the literature. The result is a confirmed, cumulative but filtered list of attributes. There is a possibility that the newly found attributes are specific to the Dutch public sector. Therefore, we do not rule them out and put them on the list to be validated by an expert group.

An expert group is the second qualitative tool we use. The expert group consists of experts in Enterprise Architecture, antifragility, and the Dutch public sector. We use a rating session to validate the attributes. We use a brainstorming session before the rating session to collect possible missing attributes from the perspective of the experts. These attributes are part of the rating session. The result is a list of attributes that the expert group confirmed. As we did with the newly found attributes of the interviews, we will go back to the interview transcripts and the literature study to make sure we did not miss the new attributes. The end result is a confirmed

list of attributes, confirmed by interviews and an expert group. These attributes can be possible success factors to answer our research question. This approach is summarised in our research model (figure 3.1).

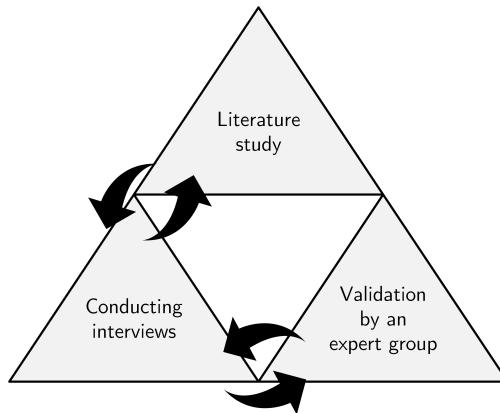


Figure 3.1.: Research model

3.2. Research approach

How will we conduct the literature study, interviews, and the validation with an expert group? This question is what this section will answer. This section describes the approach in detail to make the research replicable.

3.2.1. Literature study

The literature study answers the first five sub-question section 1.5 of this research. We use specific keywords to find literature in online scientific libraries. The online scientific libraries we use are Web of Science, Researchgate, Google Scholar, and Semantic Scholar. We use the full name and the abbreviation of the concept to search for literature. E.g. Enterprise Architecture and . Literature is accepted if it complies with quality attributes. These quality attributes are accuracy, authority, objectivity, currency and coverage (of Hong Kong, 2021). For currency, we assessed if the information is current and that it was published. We used a rule of thumb of 15 years to be current. For coverage, we assess the literature on relevance. The literature must be on the concept itself, but there must be a link with one or more concepts of this research. For replicability and reusability, we administrate the found literature.

System

We use two key references for the system concept. These two sources are Ackoff (1973) and Gharajedaghi (2011). Gharajedaghi (2011) is one of the authors recognised by Lapalme (2012) as a follower of the Enterprise Architecture school of thought of Enterprise Ecological Adaptation. Ackoff (1973) was one of the pioneers of modern systems science. He used the work of von Bertalanffy (1968), who coined systems theory in 1940, as a base for his research. We researched citations on the works of Ackoff (1973) and Gharajedaghi (2011) to start the literature study on system. We broaden the scope by using the following keywords for the online scientific libraries:

system, System-of-Systems, System-in-Environment, ecosystem, antifragile system, and Enterprise Architecture system.

Antifragile

We use two key references for the antifragile concept. These two references are Taleb (2012) and Botjes et al. (2021). Taleb (2012) is the author who coined the concept of antifragile while Botjes et al. (2021) conducted extensive literature research on antifragility. We do not search for literature on antifragile before July 2019, but only between July 2019 and April 2022. The research of Botjes et al. (2021) ended in June 2019 so we only need literature after the research of Botjes et al. (2021). We used the same academic search engines and keywords as Botjes et al. (2021, p. 5).

Enterprise Architecture

We use four references to start the literature research. These sources are Dietz (2008), Graves (2008), Hoogervorst (2009) and Lapalme and de Guerre (2012). Why these references? The literature of these authors do align best with the concepts antifragile, System-of-Systems and System-in-Environment. We use the following keywords for the online scientific libraries: Enterprise Architecture, Enterprise Architecture success factors, Enterprise Architecture antifragile system, Enterprise Architecture ecosystem, Enterprise Architecture public sector, Enterprise Architecture System-in-Environment, Enterprise Architecture System-of-Systems.

Public sector

We use two key references for the concept of public sector to start off the literature research. These two references are van der Wal et al. (2008) and Nurmi (2021). van der Wal et al. (2008) compares the public and private sectors on core values while Nurmi (2021) researches the use of ecosystems in the public sector. We use the following keywords for the online scientific libraries: public sector, public sector antifragile, public sector resilient, public sector system, public sector ecosystem, public sector System-of-Systems, public sector System-in-Environment, public sector collaboration with the private sector, and public sector differences to the private sector.

3.2.2. Interviews

We use semi-structured interviews to have the possibility to capture more information than a structured interview. The benefits of a semi-structured interview are that a semi-structured interview encourages two-way communication (Recker, 2013, p. 91). We can validate our findings while at the same time we can collect new data. Furthermore, the interviewees may discuss sensitive issues more easily. We select interviewees from the public sector with a different profile than the expert group. The different profile helps with the triangulation of the research. We decided to use CxOs for the interviews to get the business perspective of the Dutch public sector. We defined a set of topics for discussion. These topics are *Enterprise Architecture, agility, uncertainty, unexpected events, risk appetite, diversity and optionality*. We expect to cover all the selected attributes (sections 2.2.6 and 2.4.3) using the topics. The interviews are recorded and transcribed for future processing.

3.2.3. Expert Group

The expert group will brainstorm for possible new attributes, discuss the attributes, and rate the attributes. The expert group is an qualitative tool. By using different tools, we strengthen the findings to be more reliable and valid (Recker, 2013, p. 91). We use a different perspective for the expert group members than for the interviewees. Instead of using a business perspective, we decide to use the Enterprise Architecture perspective of the Dutch public sector. A group support system supports the expert group session with the administration, reporting and needed tools. The expert group session is recorded and transcribed for future processing.

3.2.4. Conclusion and discussions

Before we can answer the research question, we combine the triangulation results so we can sort and rate the attributes. An attribute is probably a success factor when the literature identifies the attribute, the interviews confirm it, and the expert group agree with it. However, with this approach, we risk missing attributes that are specific to the public sector. These attributes can be essential distinguishing factors for the public sector. The attributes from the literature are not specific to the public sector but generic. We decided on an additional rule to overcome this shortcoming. An attribute a success factor with some probability when the attribute meets two out of three requirements. Attributes that do not meet these two rules are not confirmed to be a success factor. This result gives us an answer to the main research question "What are the success factors that positively influence the contribution of Enterprise Architecture in achieving antifragility in the public sector?"

3.3. Implementation of research quality

The research model is defined. But how do we ensure that this approach also fulfils our quality requirements? We have two sets of quality principles we want to fulfil. The principles of Recker (2013) and the FAIR principles of Wilkinson et al. (2016).

It is not always possible to fulfil the quality attributes we want to achieve. The privacy of the participants in our research is of higher importance. We will ask all our participants if we are allowed to make recordings and transcriptions. However, we will not publicly publish data sets containing information related to the participants because of privacy reasons. We know that the Antwerp Management School must comply with the statutory obligations for (re)accreditations and visitations. Because of this, we share all the related data sets when we submit this thesis.

Replicability, independence, precision, and falsification are the principles (Recker, 2013, pp. 15–17). We ensure that the thesis contains a detailed approach for replication. The used data sets are made publicly available to support replicability. By rationalising everything, we remove as much subjectivity as possible. The output of the interviews and the expert group are normalised to remove possible bias from the system. This approach supports the principle of independence. Defining every concept supports the principle of precision. For every concept, there is a clear definition available. When there are more definitions, research is necessary. Using a rationale makes it clear why we did choose a particular definition. All the definitions are available in chapter 2 or the *Glossary of Terms* at the tail of this thesis. Identifying the research limitations and discuss the results (sections 6.2 and 6.3) helps with the falsification of this research.

Findable, accessible, interoperable, and reusable are the principles of FAIR (Wilkinson et al., 2016). Keywords, links, structures, and metadata that can be indexed support findability. GitHub, Zenodo, and Researchgate publish the thesis and the used data sets. We created objects with a location for acquiring the references that are not published publicly. Publishing this thesis

as Open Access supports the principle of accessibility. The principle that is least relevant for this research is interoperable. It is least relevant because this principle is mostly for quantitative methods. Nevertheless, the datasets are available as Microsoft Excel files for analysis. The files are easy to import, reuse, or combine in other environments to support the principle of reusability. The publication of the thesis and the used datasets use a Creative Commons license (CC-BY-SA 4.0). The thesis and the used data sets can be shared and adapted as long as the original author is attributed and the possible derivate uses the same license.

3.4. Research infrastructure and tooling

We describe how we worked with the tools we used to increase the quality of the research. We expect to increase replicability, findability, accessibility, interoperability, and reusability. We describe this in three subsections: the research execution, the administration and the creation.

3.4.1. Research execution

For the administration of literature research, Apple Numbers¹ is used. The administration is saved as a Microsoft Excel² file for accessibility and reusability. The literature is administrated with the following columns: ID (for a unique ID per item), search terms used, scope, title, subtitle, author(s), year, type, BibLATEX citation key, title relevance, abstract relevance, content relevance, found at, doi/isbn, url, date found, duplicate, date used, use for, and notes. Researchgate³, Web of Science⁴, Google Scholar⁵, and Semantic Scholar⁶ are the main sources for searching for literature. PaperPanda⁷ is used for hard to find literature. The literature administration is, together with the publicly available literature, stored in the repository of the master thesis⁸. For non-public available literature, the administration contains the location where the literature is retrievable. We add the literature to a bibLATEX file for future reference. For traceability, the entries in the bibLATEX file contain the same Unique ID in the comments field. We work paperless. All the literature is in pdf or in ebook format. We use Acrobat Reader DC⁹ and an Amazon Kindle Oasis¹⁰ for reading. We use Microsoft Teams for interviews. We use the transcript and session recording functionality. The transcripts and recordings contain sensitive information and are not publicly available. The transcripts and recordings are securely stored and are available upon request by the Antwerp Management School. We use QDA Data Minder Lite¹¹ to label transcripts so that analysis can be done with Apple Numbers. For the Expert Group, Meetingwizard¹² is used for brainstorming, surveys and rating. The Antwerp Management School supplies the license for using Meetingwizard. The data set of the Meetingwizard session is stored

1 <https://apps.apple.com/us/app/numbers/id409203825>

2 <https://www.microsoft.com/en-us/microsoft-365/excel>

3 <https://www.researchgate.net/>

4 <https://app.webofknowledge.com/>

5 <https://scholar.google.com/>

6 <https://www.semanticscholar.org/>

7 <https://paperpanda.app/>

8 <https://github.com/JRBlikendaal/master-thesis/tree/main/literature>

9 <https://get.adobe.com/reader/>

10 <https://www.amazon.com/dp/B07L5GJD99>

11 <https://provalisresearch.com/products/qualitative-data-analysis-software/freeware/>

12 <https://www.meetingwizard.nl/>

as a Microsoft Excel file in the repository of the thesis¹ (anonymised).

3.4.2. Research administration

We use a non-public GitHub repository to store privacy-sensitive information. The same GitHub repository is used for staging thesis parts that still need to be anonymised. For note-taking, Leuchtturm1917² notebooks are used together with a mechanical pencil of Rotring³ and a Tombow Mono Zero eraser⁴.

3.4.3. Thesis creation

An Apple Macbook Air⁵ with model number A2337 is used to write the thesis. We use the markup language L^AT_EX⁶ with the typesetting environment of MacTex⁷ with the document type of "scrreprt" from KOMA-Script⁸. The editor TexStudio⁹ is used as an integrated development environment with BibL^AT_EX¹⁰ for managing references with the style of APA 7th Edition¹¹. We store the thesis files on Apple iCloud¹² that is used by GitHub Desktop¹³ to synchronise with a public GitHub repository¹⁴. GitHub¹⁵ is used for source control and for reviewing and discussing the topics with the research organisation. The thesis source files are archived in zip format and copied to an Amazon S3 Blob¹⁶ for backup. We use a backup rotation of seven versions. Using MSP360 Explorer¹⁷ helps us with storing backups. Grammarly¹⁸ (with a paid subscription) performs spelling, grammar, style, and plagiarism checking. Microsoft Visio Professional¹⁹ and draw.io²⁰ are used to create figures. The GitHub repository contains all the sources²¹.

1 https://github.com/JRBliekendaal/master-thesis/blob/4c7bb1dc7c6b17ff7cbe68269fcad12ae3043325/datasets/expertgroup/dataset_expertgroup.xlsx

2 <https://www.leuchtturm1917.us/notebook-classic.html>

3 https://www.rotring.com/rotring-600-mechanical-pencil-1/SAP_1904443.html

4 https://www.tombow.com/en/products/mono_zero/

5 [https://en.wikipedia.org/wiki/MacBook_Air_\(Apple_silicon\)](https://en.wikipedia.org/wiki/MacBook_Air_(Apple_silicon))

6 <https://www.latex-project.org/>

7 <https://www.tug.org/mactex/>

8 <https://ctan.org/pkg/koma-script>

9 <https://www.texstudio.org/>

10 <https://ctan.org/pkg/biblatex/>

11 <https://apastyle.apa.org/>

12 <https://www.icloud.com/>

13 <https://desktop.github.com/>

14 <https://github.com/JRBliekendaal/master-thesis>

15 <https://github.com/>

16 <https://aws.amazon.com/s3/>

17 <https://www.msp360.com/explorer/windows/amazon-s3.aspx>

18 <https://www.grammarly.com>

19 <https://www.microsoft.com/en-ww/microsoft-365/visio/>

20 <https://app.diagrams.net/>

21 <https://github.com/JRBliekendaal/master-thesis/tree/main/images/sources>

4. Interviews

For triangulation the defined attributes (section 2.2.6) are validated by conducting interviews. The main concern for the interviews is to get an understanding of the state of antifragility and Enterprise Architecture in the Dutch public sector. We selected interviewees from the Dutch public sector with a different profile than the expert group. The different profile helped with the triangulation of the research. We used CxOs for the interviews to get the business perspective of the Dutch public sector. Four C-level Executives of the public sector participated in the interviews (table 4.1). We used a set of topics for discussion. These topics were *Enterprise Architecture, agility, uncertainty, unexpected events, risk appetite, diversity and optionality*. We expected to cover all the attributes using the topics. The interviews were limited to an hour due to time constraints on the agenda's of the interviewees.

Interviewee	Role
1	A Chief Information Officer from the Central Government
2	A Chief Technology Officer from the Local Government
3	A Chief Executive Officer from an Independent Software Vendor
4	A Chief Operations Officer from a Service Provider

Table 4.1.: Interviewees

It was not possible to talk in-depth on Enterprise Architecture. The in-depth knowledge on the workings on Enterprise Architecture were less available with the interviewees. Instead of analysing the separate attributes of Enterprise Architecture, the analysis was on the Enterprise Architecture schools of thought (Lapalme, 2012) (table 2.5). The attributes (appendix A) are implicitly part of that particular school of thought.

We presented the case to the CxOs as short as possible before we started talking about our topics. We started with a topic on Enterprise Architecture. We were particular interested in how Enterprise Architecture was practised in the organisations of the CxOs. The rest of the topics were on the Dutch public sector in general. How agile is the Dutch public sector, how fast can the Dutch public sector adapt to changes in the environment? Are there mechanisms in place to learn and improve? Other topics were on the Dutch public sector handles uncertainty. Does the Dutch public sector embraces the uncertainty or are they mitigating it? How is the Dutch public sector dealing with unexpected events. How many risks does the Dutch public sector wants to take? How diverse is the Dutch public sector and does the Dutch public sector has options to choose from? We ended the interview with subjects the participants think that we missed and possible other ideas the interviewees had on mind. We used a standard format to guide us (table 4.2).

The interviewees all wished to remain anonymous. Because of this, the transcriptions, recordings and the files used for analysis are not publicly available. All the interviewees gave consent to transcriptions and recordings for this research. Instead of sharing the transcriptions and recordings, this thesis contains summaries of the interviews (appendix D). The interviewees validated these summaries, and gave their consent to publish those instead.

Number	Question	Concept
1a.	How is your organisation applying Enterprise Architecture?	Enterprise Architecture
1b.	Who is accountable for Enterprise Architecture in your organisation?	Enterprise Architecture
1c.	How is Enterprise Architecture enabling your organisation to quickly adapt to changes (external influences)?	Enterprise Architecture
2a.	Does the operational model of the public sector foster agility?	Antifragile
2b.	How is the Enterprise Architecture of your organisation contributing to foster agility in the public sector?	Enterprise Architecture
3a.	How does the public sector deal with uncertainty?	Antifragile
3b.	How is the Enterprise Architecture of your organisation contributing to dealing with uncertainty in the public sector?	Enterprise Architecture
4a.	How is the public sector dealing with unexpected events?	Antifragile
4b.	How is Enterprise Architecture of your organisation contributing to dealing with unexpected events in the public sector?	Enterprise Architecture
5a.	Could you describe the risk appetite of the public sector?	Antifragile
5b.	How does the Enterprise Architecture of your organisation match the risk appetite of the public sector?	Enterprise Architecture
6a.	How is diversity and optionality used in the public sector?	Antifragile
6b.	How does Enterprise Architecture of your organisation support diversity and optionality in the public sector?	Enterprise Architecture
Closing	Did you miss an important subject or do you want to add something else?	non-specific

Table 4.2.: Interview questions

4.1. Interview results

We could not use the raw output of the interviews for validation and analysis. It was all text. It was not directly comparable between the interviewees and with the attributes. We transformed these results into information that we could analyse and validate. We used Qualitative Data Analysis for this. We created labels to code the text of the transcriptions. For every attribute, we had two labels. We created a label for when the attribute is identified in the Dutch public sector and one for when it was not identified, but the interviewee indicated that it is necessary for the Dutch public sector. For the Enterprise Architecture schools of thought, we had only one label per school. A school does exist or not. Whenever we suspected to have identified a new attribute, we created the labels accordingly. The result of this analysis is available as a data set in a publicly accessible GitHub repository¹.

We added graphs to accompany the interpretations. These graphs support our findings. The first graph is about the *frequency of an attribute*. The second graph shows us the *% of cases (interviews)* where an attribute occurs. The interpretation was done on the categories *attenuate variety, amplify variety, learning organisation, the Enterprise Architecture schools of thought, and the newly found attributes*. For each of those categories we will present the results and the

¹ https://github.com/JRBliekendaal/master-thesis/blob/57f1489c59832d4c94d8bd6726d4e260f8ad544e/datasets/interviews/raw_interview_data_and_charts.xlsx

interpretation of the results. If applicable we use examples from the interviews to support the interpretations.

4.1.1. Interview results on attenuate variety

The frequency of the attributes *Top-Down Command & Control* and *Micro-Management* scored the highest (figure 4.1). All four interviewees mentioned both attributes (100% of the cases). During the interviews, the interviewees explained that most of the sub-systems of the public sector have a severe risk-avoiding attitude. Everything must be predefined and planned because of public accountability. There is a quick result in crises, but with possible consequences later on because of 'Adviescollege ICT-toetsing' audits or parliamentary inquiries (appendices D.1 and D.3). One of the interviewees said that to get things done the government should be in continuous crisis (appendix D.3). The consequences are the main reason why the public sector gets very insecure from uncertainty. The public sector does not know how to deal with uncertainty and tries to control it. The common reflex is that the public sector tries to push uncertainty back into a state that it is certain again (appendix D.2). In this way, the public sector can control the environment again.

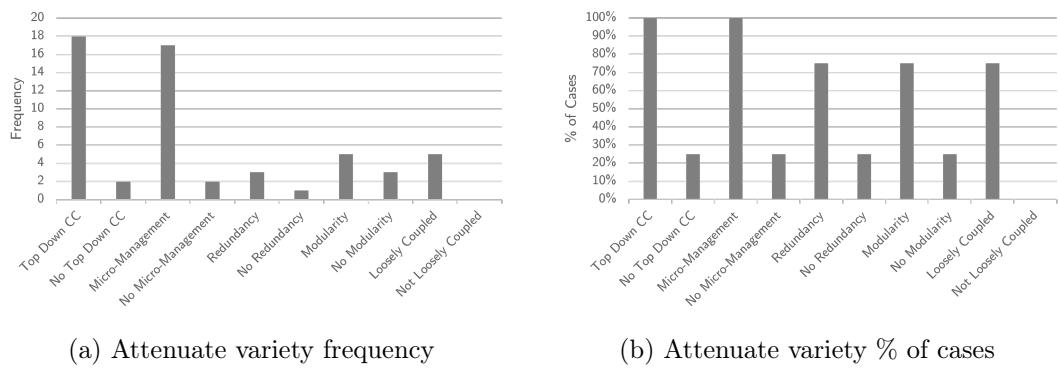


Figure 4.1.: Interview results attenuate variety

E.g. a missing law with the introduction of electric steps (appendix D.2). It is not a bike, not a motorcycle or a car. The electric step did not fit into the current laws and regulations. The result was that the policy-makers did not approve and tolerated it until law-making was finished. Both *modularity* and *loosely coupled* scored (Figure 4.1) because the public sector consists of many sub-systems. Every sub-system has a clear goal and a reason to exist. E.g. local tax offices have the goal of collecting local taxes, while the social services are in charge of paying benefits. Communication between those sub-systems is going through standardised interfaces and is predictable. Although redundancy is almost non-existent. Every sub-system has its particular goal and reason to exist and cannot take on public tasks another sub-system is performing (appendix D.2).

4.1.2. Interview results on amplify variety

The attribute of amplify variety that scored the highest was the attribute *insert low-level stress* (Figure 4.2). It is not that there is much tinkering going on in the public sector. Experimentations are (almost) not possible because of public accountability (appendix D.2). However, because of continuous changing laws, policies and regulations, the sub-systems of the public sector are

continuously under stress. Nevertheless, the amount of stress differs per layer of the government. Most interviewees stressed that the central government has less stress than the local governments (appendices D.2 to D.4). The central government performs public tasks when it is impossible at a more local level. The central government is more about policymaking and is a source of stress for the local governments.

A dimension of stress is the factor of time. Implementing the laws and policies cannot take longer than until the next elections. The standard period of reign is four years before the new elections. The policy-makers want to finish the implementation before replacement. It happens that it is not achievable in the time given. Because of social coherence of public servants, they still try to implement a law or policy within the given time, but they often fail (appendices D.2 and D.3).

What stands out is that the attributes *no non-monotonicity* and *no fail-fast* are often mentioned. Both have something to do with each other. *Fail-fast* is about experimentations and working in an agile way. Experimentations are almost non-existing because of public accountability. Working in an agile way is hard for the public sector. The end state is not always clear enough with the agile way of working, which is in conflict with public responsibility and the importance of the attributes *Top-Down Command & Control* and *Micro-Management* for the public sector. With an agile way of working, the attribute *self-organisation* must be present. The *self-organisation* was not mentioned that often in the interviews (figure 4.2). In this case the attribute *self-organisation* conflicts with *Top-Down Command & Control* and *Micro-Management*. The public sector has a very low risk appetite. Everything must be known and explained in advance (appendices D.1 to D.4).

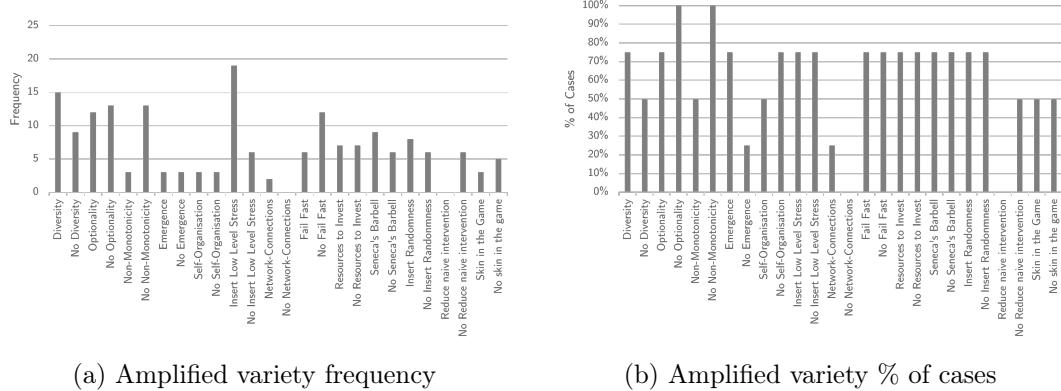


Figure 4.2.: Interview results amplified variety

Non-monotonicity is about learning from previous negative and positive experiences. The attribute *non-monotonicity* is not a common practice in the public sector (appendices D.1 and D.3). One interviewee even deliberately ignored questions about feedback loops, learning and improving.

No optionality scored high in frequency, and all the interviewees talked about this in the interviews. The private sector is applying optionality more often. An example given by one of the interviewees of the Shell (appendix D.3). The interviewee told us that the Shell has multiple suppliers for the same product or service. It gives Shell the option to choose between suppliers at any moment in time. Having multiple suppliers for the same product or service are not possible with the public sector. The public sector is obliged to comply with the government procurement law. The tender process is mandatory (appendices D.1 to D.4) (EuropeanUnion, 2014).

4.1.3. Interview results on learning organisation

All interviewees mentioned that when a crisis occurs that they are glad that there are so many artisans working in the public sector. With a crisis, everyone works toward solutions and acts without conflict of interest. After the crisis is over, everyone falls back into previous behaviour (appendices D.2 to D.4). Many attributes of a learning organisation are in place in the public sector. The attributes related to this behaviour are *personal mastery*, *shared mental models*, and *building shared vision*. Figure 4.3 shows the same.

On the other hand *systems thinking* is less common in the public sector. Every subsystem has its particular goal and reason to exist and cannot perform public tasks another subsystem is responsible for (section 4.1.1). The public sector does not foster thinking outside of a sub-system.

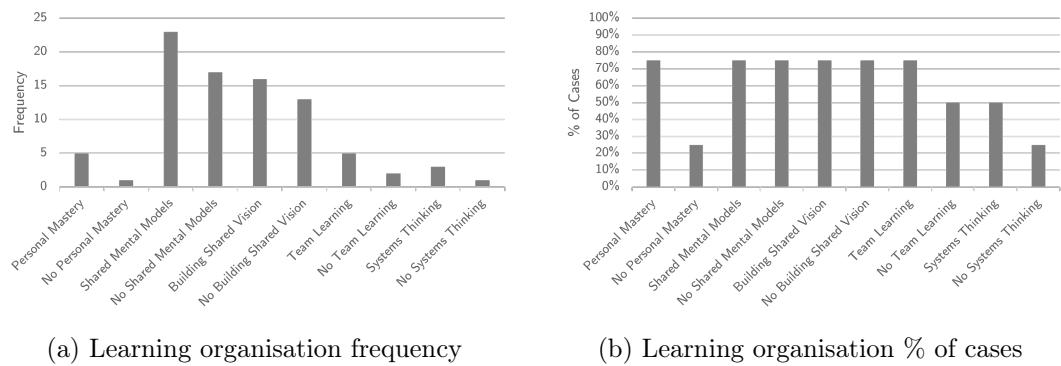


Figure 4.3.: Interview results learning organisation

4.1.4. Interview results on Enterprise Architecture schools of thought

The concern for this category was what the most common Enterprise Architecture school of thought (section 2.4.1) is in the Dutch public sector. All three schools of thought were present in the interviews. Nevertheless, the school of thought *Enterprise IT Architecting* was present in three interviews (figure 4.4). In contrast, the schools *Enterprise Integrating* and *Enterprise Ecological Adaptation* were present in two, but different, interviews.

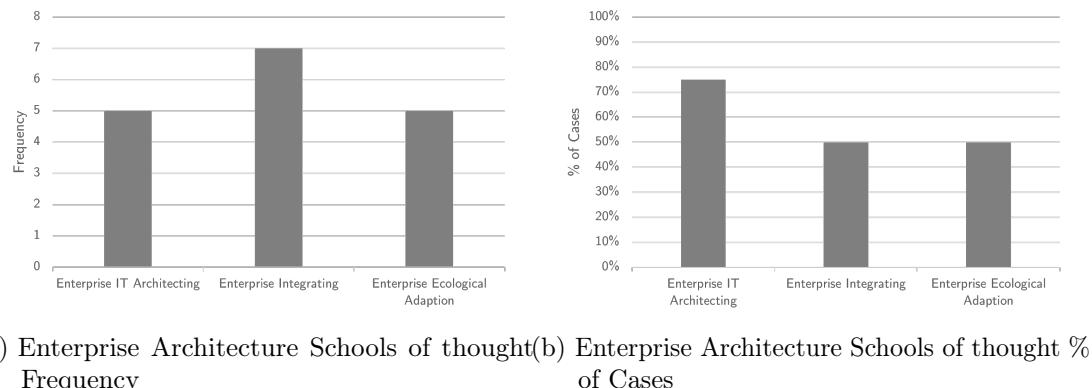


Figure 4.4.: Interview results Enterprise Architecture schools of thought

The sessions show that there are differences in the practice of Enterprise Architecture between the organisations of the interviewees. Two of the interviewees are practising Enterprise Architecture mainly in the school of thought *Enterprise IT Architecting* (appendices D.1 and D.2). One of the interviewees is in the school of thought *Enterprise IT Architecting* but has already started to show signs of *Enterprise Integrating* (appendix D.4). They are more aware of the environment, and they are starting to use Enterprise Architecture as a means to implement the enterprise strategy of the organisation. The last interviewee operates mainly in the school of thought *Enterprise Integrating* and is moving more to *Enterprise Ecological Adaptation* (appendix D.3). The organisation of the interviewee is not only using Enterprise Architecture to manage the environment, but they are starting to use Enterprise Architecture to change the environment. They do this by actively participating in decision-making and policy-making in the Dutch public sector. However, most of the interviewees agree that practising Enterprise Architecture in the Dutch public sector as a System-of-Systems is probably the Enterprise Architecture school of thought of *Enterprise IT Architecting*.

With the interviews, it became clear that the interviewees have the opinion that the Dutch public sector is not using Enterprise Architecture as an instrument for decision-making (appendices D.1 to D.3). Enterprise Architecture follows after decision-making in the sub-systems. The result is that Enterprise Architecture is always running behind on the policies, laws and decisions. Accordingly to the interviewees, this has its origin in that the policy-makers and decision-makers do not understand Enterprise Architecture. One interviewee gave the example of the land surveyor¹ profession (appendix D.2). The land surveyor learns to speak the language of its stakeholders. By using the stakeholder's natural language to communicate measurements and concerns, the stakeholders understand the meaning. All interviewees have the opinion that Enterprise Architecture does not communicate in the stakeholder's natural language. As long as Enterprise Architecture does not communicate in the natural language of the stakeholder, Enterprise Architecture will not be involved in decision-making and policy-making. This finding resulted in a possible new attribute regarding success factors. This new attribute is noted in figure 4.5.

4.1.5. Interview results on possible new attributes

The last category of attributes for discussion is the category of new findings. The newly found attributes (figure 4.5) were discovered conducting interviews. Most of the findings are already discussed in the previous sub-sections. These are findings like *adapt to business language*, *limited Enterprise Architecture*, *governance*, *public responsibility* and *risk avoidance*.

¹ <https://en.wikipedia.org/wiki/Surveying>

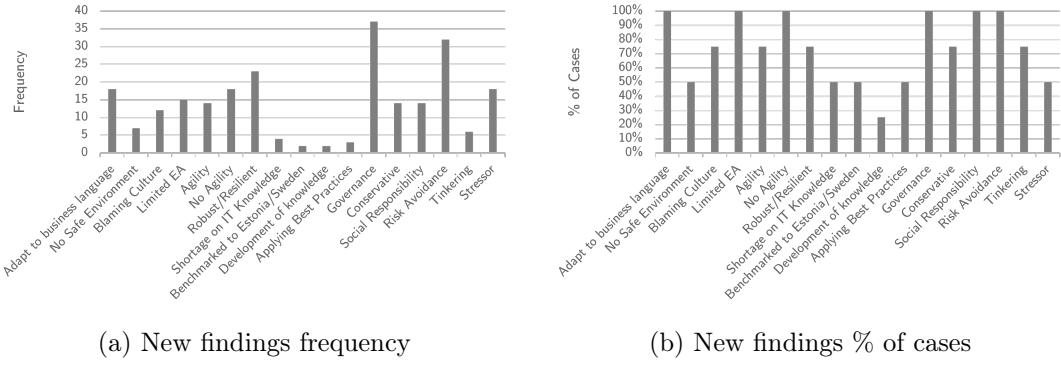


Figure 4.5.: Interview results new findings

Of the new findings that are not yet treated, the most important two are *blaming culture* and *no safe working environment*. The two were mentioned often across all the topics. The two are related. *No safe working environment* can be the result of a *blaming culture*. All the interviews talked about how in a crisis, people do anything to solve it. However, since the public sector is all about public accountability, all processes need to be followed. Everything must be predefined and planned (section 4.1.1). Most of the time, the processes are slowing it down, while it should go faster in a crisis. After the crisis, there are possible parliamentary inquiries, and there is who is responsible for overseeing and auditing all IT projects of the central governments. Both are not accepting deviations in processes. Even with a successful result, there is a possibility of severe consequences. This is what we call a *blaming culture*. The result of this behaviour in the public sector is that people are not willing to take risks. They are afraid of possible repercussions. There is not a safe working environment in the public sector for people to self-organise or to excel. However, it is not this black and white. It is less with the regional and local governments. It is the strongest with the central governments (appendices D.2 and D.3).

4.2. Qualitative data analysis

Until now, we have interview results with an explanation of attribute presence in the Dutch public sector. However, with these results, we cannot say which attributes are of any significance for antifragile and Enterprise Architecture in the public sector. As already stated earlier in section 4.1, we need Qualitative Data Analysis for data interpretation. The data set used for the Qualitative Data Analysis is available as a structured Microsoft Excel workbook with multiple worksheets. This file is available in the GitHub repository of this research¹. The first step in the Qualitative Data Analysis is analysing and merging labels (table 4.3). Positive and negative labels were created for the main categories for possible overarching findings. Merging findings with already existing attributes was next. The attributes left are new, not an attribute but something else, or just a note to remember something. The analysis did not include the last two.

¹ https://github.com/JRBliekendaal/master-thesis/blob/57f1489c59832d4c94d8bd6726d4e260f8ad544e/datasets/interviews/qda_steps.xlsx

Step	Description	Rationale
1	Create, positive and negative main categories of Engineering, Systems, CAS, antifragile, and Learning organisation.	Need extra categories for merging overarching subjects.
2	Merge agility into CAS	How agility is interpreted is the same as CAS
3	Merge tinkering into Learning Organisation	How tinkering is interpreted it is the same as Learning Organisation.
4	Merge robust and resilient into Engineering Resilience	How robust and resilient is interpreted by interviewees is the same as Engineering Resilience.
5	Merge Governance into Engineering Resilience	How Governance is interpreted is the same as Top-Down Command & Control and Micro-Management.
6	Merge Shortage on IT Knowledge into no resources to invest	Shortage on IT Knowledge can be interpreted as a resource that is not there
7	Merge Applying Best practices into non-monotonicity	Applying Best practices is learning from the past.
8	Merge Development of Knowledge into Learning Organisation	Development of Knowledge within an organisation can be seen as the learning capability of an organisation.
9	Merge Blaming Culture into No Safe Environment	No Safe Environment is a result of a Blaming Culture.
10	Merge Limited Enterprise Architecture into Enterprise IT Architecting	Limited Enterprise Architecture is interpreted as the school of thought Enterprise IT Architecting
11	Merge conservative into Risk Avoidance	Risk Avoidance is a result of conservative
12	Ignored Public Responsibility and Risk Avoidance as attributes as possible success factors	Public Responsibility and Risk Avoidance are attributes of the public sector and are less relevant as an attribute for antifragile and Enterprise Architecture.

Table 4.3.: Merging similar labels

Normalising the frequency of attributes prevented bias of the interviewees. The presence of an attribute was only counted once per question per interview. Twenty-eight was the maximum score with four interviews and seven main questions.

Interpretation is still not possible at this moment in the Qualitative Data Analysis. There are still two attributes for most attributes, one negative and one positive. Subtracting the negative attribute from the positive resulted in a score for the primary attribute. The result of normalisation is that the attributes are comparable. If the score is positive, the attribute is already a property of the public sector and inversely. A positive attribute is not of any significance, but a negative attribute could be. A negative attribute is a property that is absent in the Dutch public sector.

Before defining the significance of attributes, it is necessary to determine how widely supported an attribute is. An attribute only mentioned during one interview is not a widely supported attribute. The chance that this is a success factor for the Dutch public sector is low. It is at most

a success factor for the sub-system of the interviewee. We decided to use a threshold of three out of four (75%). When three or more interviews mentioned the attribute, it can be an attribute of any significance.

After performing Qualitative Data Analysis, the interview findings are interpreted. When there is a score of zero or less for attenuate variety, amplify variety, and learning organisation attributes, then the attribute has some degree of certainty that it has a positive influence on achieving antifragility in the public sector. Attributes that scored 0 or less are *optionality*, *non-monotonicity*, *self-organisation*, *fail-fast*, *resources to invest* and *Seneca's barbell* (figure 4.6). All of these attributes are from the category amplify variety. Amplify variety increases the antifragility of a system (section 2.2.4).

The interpretation of the score of the newly found attributes is different. The interpretation of these attributes is that they must exist. Both the attributes mentioned have some degree of certainty that it has a positive influence on achieving antifragility in the public sector. These attributes are *adapt to business language* and *safe working environment* (figure 4.6).

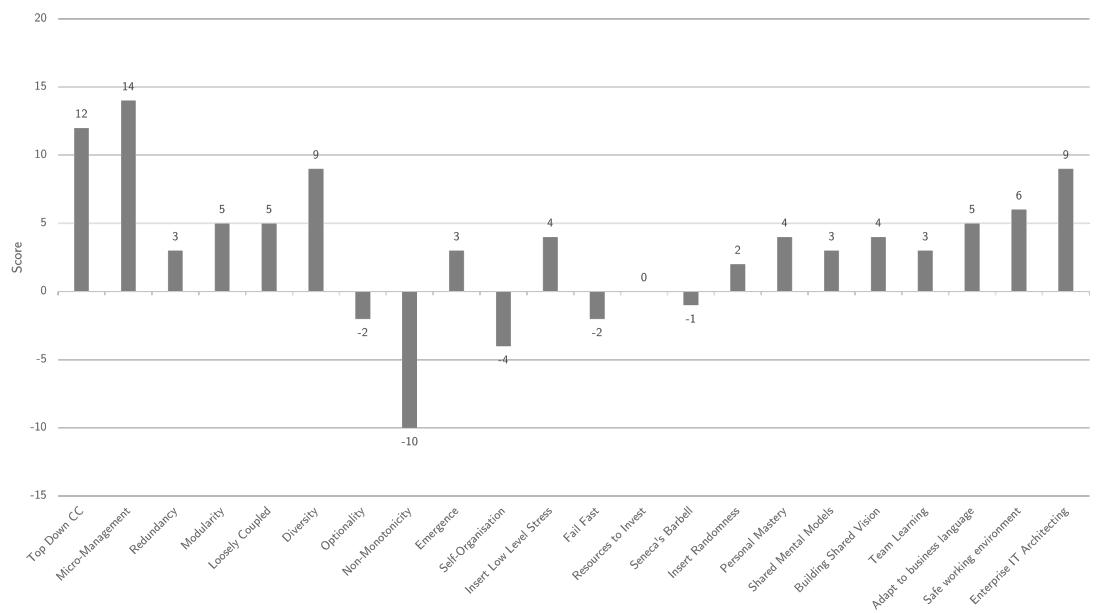


Figure 4.6.: Score of attributes from interviews

The Enterprise Architecture school of thought is the last that needs interpretation. The questions on Enterprise Architecture were on Enterprise Architecture practices in the public sector. The interviews show that in the Dutch public sector the leading school of thought is probably Enterprise IT Architecting. However, the literature study shows that the most probable school of thought to support antifragility in the Dutch public sector is the school of thought of Enterprise Ecological Adaptation (section 2.4).

4.3. Attributes most probable to be success factors

The result of the analysis of the interviews is the selection of fourteen attributes (table 4.4) that are possible attributes that have a positive influence on Enterprise Architecture in achieving

antifragility in the Dutch public sector. We replaced the Enterprise Architecture school of thought of Enterprise Ecological Adaptation with its attributes.

Attribute	Category
Optionality	Amplify variety
Non-monotonicity	Amplify variety
Self-organisation	Amplify variety
Fail-fast	Amplify variety
Resources to invest	Amplify variety
Seneca's barbell	Amplify variety
Systems-in-Environment thinking	Enterprise Ecological Adaptation
Holistic (systemic) stance	Enterprise Ecological Adaptation
Organisational learning	Enterprise Ecological Adaptation
Environmental learning	Enterprise Ecological Adaptation
Intra-organisational coherency	Enterprise Ecological Adaptation
System-in-environment coevolution learning	Enterprise Ecological Adaptation
Safe working environment	New finding
Adapt to business language	New finding

Table 4.4.: Possible success factors identified from interviews

5. Expert group

The attributes, as a result of the interviews (section 4.3), probably have a positive influence on Enterprise Architecture in achieving antifragility in the Dutch public sector. We used these attributes for validation by an expert group. All the expert group participants were selected to have experience with Enterprise Architecture and the Dutch public sector. The expert group was composed of experts from different organisations of the Dutch public sector. A survey on experience with Enterprise Architecture, antifragility, and the public sector was part of the expert group session (table 5.1). Central governments, local governments, independent software vendors, service providers, and universities all had delegates in the expert group. A total of ten experts participated in an online session.

The duration of the expert group session was two hours. The expert group session was online with support of Microsoft Teams and Meetingwizard. The session was recorded and automatically transcribed. All participants gave their consent for the recording and transcription.

Question	Average years	Variability	Abstains
How many years of experience do you have in the field of Enterprise Architecture?	9,8	8%	0
How many years have you worked as an (Enterprise) Architect?	10,6	12%	0
How many years of experience do you have in the field of complexity sciences (like anti-fragile)?	7,4	16%	0
How many years of experience do you have with the public sector?	12,2	17%	0
How many years of experience do you have with working in publicly-held organisations?	10	16%	0
How many years of experience do you have with working in privately-held organisations?	17,2	21%	0

Table 5.1.: Average experience of expert group participants

All the participants received information beforehand. This information contained the invite, the goal of the session, the agenda and all relevant definitions. Three recorded seminars given by Nassim Nicholas Taleb^{1,2,3} were shared to ensure that the participants had a basic understanding of antifragility. All participants confirmed that they did see at least one of the videos. The book of Taleb (2012) was read by multiple participants.

1 <https://youtu.be/B2-QCv-hChY>

2 <https://youtu.be/1NXaafTpVjM>

3 https://youtu.be/C40zwpdc_yo

We used the following agenda for the session:

1. Introduction
2. Survey on the experience of the participants
3. Presentation on the results of the research up to now¹
4. Validation of antifragile attributes
5. Validation of the Enterprise Architecture schools of thought and the attributes of Enterprise Architecture
6. Survey on the relevance of the research

Meetingwizard supported the surveys and validations. The data set of the surveys and validations is publicly available as a Microsoft Excel file in the public GitHub repository² of this research.

5.1. Validation of attributes

The two newly found attributes *safe working environment* and *adapt to business language* (section 4.3) were moved to the antifragile attributes and Enterprise Architecture attributes. We used brainstorming to make sure that we did not miss possible attributes that are specific to the Dutch public sector. Through brainstorming as a group, the participants could add new attributes. The expert group explained, discussed, combined and sorted the added attributes. The participants validated the attributes one by one. They used a scale from one to ten, one for least and ten for most probable. There was a validation for the attributes of antifragility, Enterprise Architecture and for the Enterprise Architecture schools of thought. The participants validated the attributes by answering the following questions:

1. For the attributes: "To what extent is the attribute a success factor for antifragility in the public sector?"
2. For the Enterprise Architecture schools of thought: "To what extent is the Enterprise Architecture school of thought a success factor for antifragility in the public sector?"

5.1.1. Validation of antifragile attributes

While brainstorming, the participants came up with twelve new attributes. After discussion, only two remained. These two were '*Outside-In and Collaboration*' and '*Data Governance Planes*'. The others were the same as another attribute or were a child of one of the other attributes. The participants validated a total of nine attributes. There are three attributes that have a variability of more than 40%, and only two attributes had an average rating of six (table 5.2). The new attributes were among those. There was one abstain on three attributes. Appendix F.1 contains the details of the validation per attribute.

1 <https://github.com/JRBliekendaal/master-thesis/blob/3666f93bb95308572722082393e684ba40caa5cb/datasets/expertgroup/validationsession.pdf>

2 https://github.com/JRBliekendaal/master-thesis/blob/3666f93bb95308572722082393e684ba40caa5cb/datasets/expertgroup/dataset_expertgroup.xlsx

Attribute	Average rating	Variability	Abstains
Optionality	6,9	32%	0
Non-monotonicity	7	51%	0
Self-organisation	8,2	23%	0
Fail-fast	7,8	35%	0
Resources to invest	6,7	36%	1
Seneca's barbell	5,8	37%	1
Safe working environment	7,4	31%	0
Outside-In and Collaboration	6,2	55%	0
Data Governance Planes	4,4	56%	1

Table 5.2.: Validation of antifragile attributes

5.1.2. Validation of Enterprise Architecture schools of thought

Validating the Enterprise Architecture schools of thought needed a somewhat different approach. The presentation¹ given to the expert group introduced the attributes of antifragile and Enterprise Architecture. The expert group could extend the list of attributes with new attributes by brainstorming. There is a high chance of influencing the expert group when presenting the Enterprise Architecture school of thought with the probability of being a success factor. The approach was to use the expert group to validate the findings in a non-biased way. Because of this, the validation used all three schools of thought. The expert group could rate the probability of the school of thought positively influencing Enterprise Architecture in achieving antifragility in the Dutch public sector.

The validation had low variability, and no abstains (table 5.3). *Enterprise IT Architecting* had the lowest average rating and *Enterprise Ecological Adaptation* had the highest with *Enterprise Integrating* in between. The validation confirmed the results of the literature research (section 2.4.2) and the interviews (section 4.2). Appendix F.2 contains the details of the validation per Enterprise Architecture school of thought.

School of thought	Average rating	Variability	Abstains
Enterprise IT Architecting	5,6	34%	0
Enterprise Integrating	7,2	16%	0
Enterprise Ecological Adaptation	8,8	27%	0

Table 5.3.: Validation of Enterprise Architecture schools of thought

5.1.3. Validation of Enterprise Architecture attributes

The validation of the Enterprise Architecture attributes used the same approach like that of the antifragile attributes. The validation contained the attributes of the Enterprise Architecture school of thought of Enterprise Ecological Adaptation. Brainstorming resulted in nine new identified attributes. After discussion, five remained. These five were *Agile Enterprise*, *Real-Time*

¹ <https://github.com/JRBliekendaal/master-thesis/blob/3666f93bb95308572722082393e684ba40caa5cb/datasets/expertgroup/validationsession.pdf>

Trust, foster dialogue, architecture validation and *Always Fitting Enterprise Architecture*. The participants rated all the attributes.

The validation shows that five attributes have a variability of 40% or higher, and only one attribute got a rating of less than six (table 5.4). Three of the five new attributes had a variability of 40% or higher. There were only two abstains on a total of two attributes. Appendix F.3 contains the details of the rating per attribute.

Attribute	Average rating	Variability	Abstains
Systems-in-Environment thinking	7,7	28%	0
Holistic (systemic) stance	7	47%	0
Organisational learning	7,3	44%	0
Environmental learning	7,7	29%	0
Intra-organisational coherency	6,4	31%	0
System-in-environment coevolution learning	6,6	36%	0
Adapt to business language	7,1	35%	0
Agile Enterprise	6,4	50%	0
Real-Time Trust	5,6	54%	1
Foster dialogue	6,9	32%	0
Architecture validation	7,4	24%	0
Always Fitting Enterprise Architecture	5,8	46%	1

Table 5.4.: Validation of Enterprise Architecture attributes

5.2. Relevance of the research

The final part of the expert group session was about the relevance of the research. A survey determined the research's relevance. The expert group rated the research on different areas of application. These areas of relevance were, *in general, for themselves, for the public sector* and *for the organisation of the expert*. The last question asked was if the expert group session fulfilled the expectations.

The variability of the survey was low. There was only one abstain on the relevance of the research for the public sector. The question that scored the least was about the relevance for the organisation of the expert. The expert group finds the research relevant. They rated it with a rating of 8,2 (table 5.5). Appendix F.4 contains the details of the survey per question.

Question	Average rating	Variability	Abstains
To what extent do you find the research relevant?	8,2	23%	0
To what extent did this session fulfil your expectations?	8	24%	0
To what extent do you think that the research can be used by yourself?	7,7	10%	0
To what extent do you think that the research can be used in the public sector?	7,2	32%	1
To what extent do you think that the research can be used by your organisation?	6,6	33%	0

Table 5.5.: Validation on the relevance of the research

5.3. Potential success factors

The used research approach is a qualitative method. The number of participants was ten. We believe that $n=10$ is too small of a sample size to use pure quantitative tools. We decided to use variability and the average rating as discriminators. We did not use the abstains as discriminator. If there was an abstain it was with a maximum of one. We decided to use the following rules for selection.

1. **Variability.** We decided that an attribute must have a variability of 40% or less. Exceptions are possible when the expert group decided on it after discussion. If there is an exception it will be noted.
2. **Average rating.** The attributes left after applying the first rule must have a average rating of 6 or higher to be noted as an attribute with potential.

5.3.1. Selected antifragile attributes

Applying the rules for selection resulted in four dropped and five accepted attributes (table 5.6). The four dropped attributes are non-monotonicity, Seneca's barbell, Outside-In and Collaboration, and Data Governance Planes. The accepted attributes are *optionality*, *self-organisation*, *fail-fast*, *resources to invest*, and *safe working environment*. None of the expert group's proposed attributes were selected. The rule dropped only two attribute from the literature study, *non-monotonicity* and *Seneca's barbell*.

Attribute	Variability	Average rating	Selected
Optionality	32%	6,9	✓
Non-monotonicity	51%	7	
Self-organisation	23%	8,2	✓
Fail-fast	35%	7,8	✓
Resources to invest	36%	6,7	✓
Seneca's barbell	37%	5,8	
Safe working environment	31%	7,4	✓
Outside-In and Collaboration	55%	6,2	
Data Governance Planes	56%	4,4	

Table 5.6.: Identified probable antifragile attributes by the expert group

5.3.2. Selected Enterprise Architecture attributes

Applying the rules for selection resulted in five dropped attributes and seven selected attributes (table 5.7). The five dropped attributes are *holistic (systemic) stance*, *organisational learning*, *Agile Enterprise*, *Real-Time Trust*, and *Always Fitting Enterprise Architecture*. The seven selected attributes are *Systems-in-Environment thinking*, *environmental learning*, *intra-organisational coherency*, *system-in-environment coevolution learning*, *adapt to business language*, *foster dialogue*, and *architecture validation*. Two out of five attributes that were proposed by the expert group are selected. *Agile Enterprise*, *Real-Time Trust*, and *Always Fitting Enterprise Architecture* were dropped.

Attribute	Variability	Average rating	Selected
Systems-in-Environment thinking	28%	7,2	✓
Holistic (systemic) stance	47%	7	
Organisational learning	44%	7,3	
Environmental learning	29%	7,7	✓
Intra-organisational coherency	31%	6,4	✓
System-in-environment coevolution learning	36%	6,6	✓
Adapt to business language	35%	7,1	✓
Agile Enterprise	50%	6,4	
Real-Time Trust	54%	5,6	
Foster dialogue	32%	6,9	✓
Architecture validation	24%	7,4	✓
Always Fitting Enterprise Architecture	46%	5,8	

Table 5.7.: Identified Enterprise Architecture attributes by the expert group

5.3.3. Selected attributes as probable success factors

Combining both sets (tables 5.6 and 5.7) gives an overview. This overview summarises the attributes that are rated best by the expert group (table 5.8). These attributes can be of significance in achieving antifragility with Enterprise Architecture in the Dutch public sector. The

set contains fifteen attribute. Six antifragile attributes from which one new discovered attribute. Furthermore, nine Enterprise Architecture attributes from which two new discovered attributes.

Attribute	Category
Optionality	Antifragile
Non-monotonicity	Antifragile
Self-organisation	Antifragile
Fail-fast	Antifragile
Resources to invest	Antifragile
Safe working environment	New Antifragile
Systems-in-Environment thinking	Enterprise Architecture
Holistic (systemic) stance	Enterprise Architecture
Organisational learning	Enterprise Architecture
Environmental learning	Enterprise Architecture
Intra-organisational coherency	Enterprise Architecture
System-in-environment coevolution learning	Enterprise Architecture
Adapt to business language	Enterprise Architecture
Foster dialogue	New Enterprise Architecture
Architecture validation	New Enterprise Architecture

Table 5.8.: Probable success factors identified by the expert group

6. Conclusion and discussions

We followed the steps of the research, and we answered our sub-questions. We did our literature research and interviews. We validated the findings with an expert group and finished it with analysis. There is only one thing left to do: interpret the results and give a conclusion to this research on particular our main research question. After our conclusion, we will discuss possible limitations, start discussions and give recommendations. We will end this chapter with a retrospective on the research process, the organisation and the researcher.

6.1. Conclusion

We combined the literature study results, interviews, and expert group for triangulation (section 3.1.3). We analysed the attributes on the occurrences over the three tools and ranked the potential success factors (appendix G). We selected potential success factors with three occurrences as potential success factors (first seven). We also selected potential success factors with two occurrences (last seven). We dropped those with only one occurrence.

We can conclude — based on our used data sets — that there are fourteen attributes that are potential success factors for the Dutch public sector (table 6.1).

#	Attribute	Category
1	Optionality	Antifragile
2	Fail-fast	Antifragile
3	Resources to invest	Antifragile
4	Systems-in-Environment thinking	Enterprise Architecture
5	Environmental learning	Enterprise Architecture
6	Intra-organisational coherency	Enterprise Architecture
7	System-in-environment coevolution learning	Enterprise Architecture
8	Non-monotonicity	Antifragile
9	Self-organisation	Antifragile
10	Seneca's barbell	Antifragile
11	Safe working environment*	Antifragile
12	Holistic (systemic) stance	Enterprise Architecture
13	Organisational learning	Enterprise Architecture
14	Adapt to business language*	Enterprise Architecture

* Not found in literature

Table 6.1.: Potential success factors

We identified the first seven potential success factors in all three research tools. We identified the last seven in two of three research tools. Alternatively, through literature and confirmed by

interviews or through interviews and validated by the expert group. An important observation is that the potential success factors *safe working environment* and *adapt to business language* do not originate from the literature research. In our opinion, these could make the difference for the Dutch public sector as possible key differentiators.

We did answer our main research question with the first seven potential success factors.

'What are success factors of Enterprise Architecture and antifragile that positively influence the contribution of Enterprise Architecture in achieving antifragility in the Dutch public sector?'

Optionality, fail-fast, and resources to invest are the success factors to be more antifragile in the Dutch public sector while the success factors *Systems-in-Environment thinking, environmental learning, intra-organisational coherency, and system-in-environment coevolution learning* have a positive influence on achieving antifragility in the public sector. The Dutch public sector can go one step further by using the last seven probable success factors. However, these are somewhat less certain that they are success factors.

We used sub-questions to answer the main research question and give this conclusion. We found the answers to the first five sub-questions through literature studies. We conducted interviews and validated the findings with the expert group to determine the answer 'Which success factors are relevant for the Dutch public sector?' (table 6.2).

#	Question	Answer
1	What is the Dutch public sector?	section 2.3
2	What is antifragile?	section 2.2
3	What are success factors for antifragility?	section 2.2.6
4	What is Enterprise Architecture?	section 2.4
5	What are success factors of Enterprise Architecture?	section 2.4.3
6	Which success factors are relevant for the Dutch public sector?	section 5.3.3 and appendix G

Table 6.2.: Answers to sub-questions

6.2. Research limitations

This research is subject to several limitations. The study is of a qualitative method. After literature research, we gathered most of the results through interviews and an expert group. The sample size used for the interviews and the expert group was small. We only interviewed four CxO's of different Dutch public sector organisations to get different views. It was hard to find the participants who fulfilled the profile of knowing Enterprise Architecture. We had a high attendance during the expert group session. Ten of eleven participants joined the expert group session. We carefully selected people with a profile of experience with Enterprise Architecture from different Dutch public sector organisations. We tried to balance the various organisations like the central government, the local governments and suppliers. However, this selection also narrowed our options. We have deliberately chosen to work with experts for an excellent qualitative result. But this is not large enough to have a real impact. Everything was about interpretation. We tried to overcome this with multiple methods with triangulation with numerous strategies and the composition of the interview and expert group participants. We did not use a blind expert group to foster dialogue and discussion between the participants to get a shared mental model. Nevertheless, it is still possible that the results can differ if we replicate the research with other participants. The results are only trustworthy for the collected data sets.

Another limitation is the absence of literature on the research subjects, particularly in Enterprise Architecture, antifragility, with the Dutch public sector. Literature and research are scarce on this combination of subjects. The result of this research can be rebutted when more information comes available. But at least now there is information available, and we hope this will support further research.

The interpretation of data sets is also a limitation. The coding of the transcriptions is our interpretation of what is said. An interviewee or an expert group participant rarely uses the same names and phrases as the codes. We tried to overcome these limitations in multiple ways. One of the methods was creating summaries of the interview transcriptions in our own words and validating these with the interviewees. For the expert group, we used an open group with the possibility of discussions and dialogue. If something was not evident, the participants explained it themselves.

The last limitation is that of the chosen boundary of the research. We focussed only on the central and local governments with suppliers. The public sector contains more, e.g. semi-governmental organisations, healthcare, education, public transportation, and others. When other public sector organisations are put into the scope of this research, there is a possibility of different results. We see the same limitation by narrowing it down to only one part of the public sector, e.g., the local government. Also, in this case, the results are only trustworthy for the data we collected during the research.

6.3. Discussions

6.3.1. The relevance of this research

The relevance of the research is always a discussion. We may find it relevant but does our target audience also thinks it is relevant? Until now, everyone is enthusiastic about the research and the study results. As an example, the results of a rating with the expert group (table 6.3). We asked them to what extent do you find this research relevant, with a rating between one and ten. One for least relevant and ten for most relevant. The results surprised us. The expert group participants find the research relevant. They rated it with an 8,2 with low variability.

Question	Rating	Variability	Abstains
To what extent do you find the research relevant?	8,2	23%	0
To what extent do you think that the research can be used by yourself?	7,7	10%	0
To what extent do you think that the research can be used in the public sector?	7,2	32%	1
To what extent do you think that the research can be used by your organisation?	6,6	33%	0

Table 6.3.: What is the relevance of this research?

6.3.2. Is antifragile and Enterprise Architecture in the Dutch public sector a timely topic?

What about the timeliness of the topic of antifragility and Enterprise Architecture? At this moment, many things are happening in the environment of the Dutch public sector that they

cannot control. We are (hopefully) at the end of the COVID-19 pandemic, and the subsequent unexpected events are happening already. Unforeseen circumstances for which the public sector cannot prepare themselves. Think about the refugee crisis caused by the war between Russia and Ukraine and the energy crisis because of this war with tremendous consequences for not only Russia and Ukraine. Think about the possible shortage of oil and gas because of this. If we need the capability to respond adequately and be flexible for unforeseen circumstances, it is now. With this, we do not say that antifragile with Enterprise Architecture is the silver bullet for the Dutch public sector. But it will undoubtedly support the Dutch public sector in being more responsive and more adaptive. What if we had embedded the system attribute optionality for our gas and oil supply. Would we still have issues on this matter?

6.3.3. Is the Dutch public sector different than that from other countries?

We did not perform wide-scale research on public sector worldwide. But in general, the Dutch public sector is relatively unique. Yes, it has the same three-layer structure as most democratic countries. However, The Netherlands is a decentralised unitary state, while most comparable countries have a centralised unitary state. This is one of the main reasons that the Estonian model¹ does not work one-on-one with The Netherlands. We see this in practice with the fact that we have n possible implementation of the law with the municipalities where n is the number of municipalities. What about the results of this research. Can it be scaled towards other countries? We scoped this research on the Dutch public sector on purpose. We do have access to the Dutch public sector resources, and we do not have that with other countries. This research is a master's thesis and not a PhD. There is not enough time to do that research thoroughly. So we do not know. Nevertheless, it can be an excellent topic for research.

6.3.4. Differences between the central and local Dutch governments

While performing the research, we realised that you could not just say the Dutch public sector as a generalisation of everything in the Dutch public sector. E.g. we noticed differences in the way of working and culture between the central government and the local governments. The local governments have more possibilities to experiment and do things differently than the central government. This difference makes the local governments also more antifragile. As Taleb (2012) tells us, diversity and optionality makes us antifragile. The more fragile systems in a system, the more antifragile the system is. Taleb (2012, pp. 87–90) even give an example of Switzerland on this subject. But most of the time the Dutch local governments do not have the attribute resources to invest as a system property. They are continuously under stress by performing the laws with less budget every year. Most interesting for further research is to repeat the same research but only for one type of government and see the differences.

6.3.5. Blaming culture in the Public Sector

While conducting interviews, we noticed that there is a lot of blaming going on in the public sector, especially with the central governments. One little misstep can already have major repercussions because of public accountability, even if that misstep solves a problem or delivers a positive effect. People are getting afraid of deviating from prescribed paths because of this. This behaviour is an antipattern in becoming antifragile which stimulates e.g. fail-fast, insert randomness, and insert low-level stress. This is the main reason that the safe working environment attribute was found in the interviews. In the end safe working environment was rated as likely. It was not discovered

1 <https://www.cnbc.com/2019/02/08/how-estonia-became-a-digital-society.html>

with literature research. This finding can be a key differentiator for the Dutch public sector to become more antifragile.

6.3.6. Adapt to business language

Interviewees and expert group participants said that Enterprise Architecture is not seen as of value by the policymakers. As long as Enterprise Architecture does not speak the *natural* language of the policymakers, Enterprise Architecture will be confronted with decisions instead of being involved with decision making. One interviewee explained it well (appendix D.2). This statement ended up as a new attribute as adapt to business language. It is categorised as a *likely* success factor because it was not a result of the literature research. We think that this attribute is extremely important and should be solved first. Otherwise, Enterprise Architecture cannot "respond adequately and flexibly to unforeseen circumstances." (Huijts, 2017). But we also think this problem is not unique to the Dutch public sector or the public sector in general. From my experience, this topic is already on the agenda of many researchers for years. One of the expert group participants even said we need to be more business-savvy but beware that the other side of the table should become more Information Technology-savvy. We think the attribute adapt to business language should be a pre-condition—a pre-condition for Enterprise Architecture to support the Dutch public sector in being more antifragile. Maybe there is not one solution that will fit all. It could be that research on a particular organisation, system or type will give us an answer on how to deal with this on a smaller scale.

6.3.7. Enterprise Architecture in general

The more we descended into the depths of Enterprise Architecture, the more we became aware that researchers and practitioners agreed to disagree. Agree to disagree on what Enterprise Architecture is. Let alone how we should practice it. The result is that every organisation and enterprise architect uses Enterprise Architecture differently. Even worse, with their definition of it. Although I have been working as an (Enterprise) Architect for 25 years, I was never as aware of this as I am now. But if there is no consensus on what Enterprise Architecture is, is it possible to determine the success factors? At least they agree that there are multiple definitions, approaches, strategies and schools of thought. So the best I could do for this research was to make the most likely choice for an antifragile system.

6.3.8. Was reinstating the attribute optionality a good approach?

The Extended Antifragile Attribute List of Botjes et al. (2021) merged optionality into diversity because of an overlap between both attributes (section 2.2.6). We decided to reinstate this attribute and added it to the attributes that could be a possible success factor for the Dutch public sector. Despite the overlap in definitions, there is also a very subtle difference between diversity and optionality. We had the foresight that optionality could be important for the Dutch public sector. We were right. The Dutch public sector is already diverse, but does not have a lot of optionality. The interviews and the expert group confirmed this. Diversity did not end up in the list of attributes that can be a possible success factor, but optionality did. It even ended up in the list of most potential success factors.

6.4. Recommendations

The previous sections already gave a lot of recommendations for further research or action. Nevertheless, we still have one left.

6.4.1. How to start with antifragile in the Dutch public sector

Should everything in the Dutch public sector be antifragile? No, this is not the approach that is suggested by Taleb (2012). A system consisting out of many small fragile sub-systems is also antifragile. You see this in practice in Switzerland but also in software architecture with the philosophy of disposable software. Also think of the antifragile system attribute Seneca's barbell. There is a negative asymmetry if you have more to lose than to benefit from events, you are fragile. With success, you have a positive asymmetry. You gain more than you lose, and so you are antifragile. We think it is evident that we really like positive asymmetry. Taleb (2012) advocates a strategy of going for two extremes that balance each other out. He uses Seneca's barbell to describe a dual attitude of playing it safe in some areas (robust to negative Black Swan events) and taking a lot of small risks in others (open to positive Black Swan events), hence achieving antifragility.

When we apply this to the Dutch public sector, we need a stable core with an extreme risk aversion, while on the other hand, we need parts of the Dutch public sector that are on the other side of the Seneca's barbell to take high risks. The payoff will be the largest (you gain more than lose). So, where do we need the most responsiveness and adaptivity to make us more flexible to unforeseen circumstances? Start with small experimentations with parts of the Dutch public sector where it is needed the most. But make the parts of the Dutch public sector that do not need to be antifragile as robust as possible. What about the support from Enterprise Architecture? We have seen that the public sector primarily works with intentional deterministic architecture. This approach is a great method to make your system extremely robust. However, this approach is less suitable for an antifragile system. A more emerging method for Enterprise Architecture should be more appropriate.

Start with the first seven success factors (table 6.1). These are the success factors that are confirmed by three research tools (literature, interviews, and an expert group), and so they support the Dutch public sector towards an antifragile Dutch public sector. This set of success factors consists of three success factors for antifragility that are most important for the Dutch public sector. The other four success factors help Enterprise Architecture of the Dutch public sector support this change and to make sure that the Dutch public sector and Enterprise Architecture are prepared to respond adequately and flexibly to unforeseen circumstances.

There is also a possibility of using the other seven success factors. These are confirmed by two of three research tools. They still need research, but there is a possibility that they support the Dutch public sector and Enterprise Architecture. From this set of success factors, we would start with at least safe working environment and adapt to business language. Interviews and the expert group confirm these two success factors. Because they were not confirmed by literature—new for the Body of Knowledge—they are potentially key success factors for the Dutch public sector. Start small with a loosely coupled system, fail-fast and apply non-monotonicity to advance.

6.5. Retrospective

My research was on an emerging topic, antifragility. Having an entire research organisation helps tremendously in making this research a success.

I had a co-promotor besides only a promotor. The co-promotor did research on antifragility in the past. With an emerging topic without that many qualitative research papers, it is great to have someone to discuss the subject. Besides the fact that a co-promoter has a lot of content knowledge, a co-promoter is often easier to reach for operational problems.

For day-to-day matters, I had contact with my co-promotor over Signal. Every week we had an online meeting for an hour to talk things through in detail. My promotor joined every fourth weekly meeting to guard the right processes and govern the quality aspects. When we had an issue we could not solve, the promotor was always available to support us in those matters. One of the success factors of this research was having a co-promotor with a lot of knowledge on the topic and the time to spare.

But this was not the whole research organisation. Before researching, I asked people from my organisation and the public sector to support me. Glad I did this. It saved my research a couple of times. It was hard to find the right people for interviews. One of the people in my research organisation used his network to solve this. Also, finding particular information that you need to substantiate your findings can be very difficult, especially if you are looking for information from the Dutch public sector. All information is public, but it is a lot of information. Sometimes it is just a needle in a haystack. Having the former CIO of the Dutch government in your research organisation is a blessing.

Was my research without any real issues? No, there were lots of problems. It is tough to balance your life when you have responsibilities with your family and employer, follow masterclasses, do assignments, conduct research, and write your thesis all at the same time. It is hard, but sometimes you must make choices—the same with me. I had to choose in December 2021 to pause my research and writing my thesis temporarily. It was too much to handle. But I managed to get back in the saddle and restarted the research in February 2022.

I was used to know the destination of my journeys. My promotor taught me that you do not know where you will end up with scientific research, so you have to enjoy the ride and not only the destination. A problem with not knowing exactly where you will end up is that your timelines are very fluid. That fluid, that I had to take two weeks off to work dedicated on the research and thesis, and even that was not enough. I was thrilled that my organisation backed me. They gave me the possibility to finish the research during business hours. It was great to see that many colleagues took it into account, replanned meetings, and supported me by taking on work amongst other things.

If you ask me what I have learned from this journey, I will not answer that I know more about antifragility than when I started. That one is obvious, but there are still many unknowns on this subject. I will not tell what I would do differently next time I do extensive research like this. Every situation is different, '*life is flux*', and I learned from Taleb (2012) that I can see this research as a rare event. You cannot predict what will happen. So how can I prepare myself better than just having a good plan and just embrace the randomness. But what I really learned and what I want to share is that while performing scientific research I discovered the following:

I discovered that I have found out how little I actually know.

References

- Ackoff, R. L. (1973). Science in the systems age: Beyond ie, or, and ms. *Operations Research*, 21(3), 661–671. <https://doi.org/10.1287/opre.21.3.661>
- Ackoff, R. L., Ashby, W. R., Boulding, K. E., Charnes, A., Churchman, C. W., Cooper, W. W., Drenick, R. F., Gerard, R. W., Kalaba, R., Linvill, W. K., & Mesarović, M. D. (1964). *Views on general systems theory. proceedings of the second systems symposium at case institute of technology*. J. Wiley. <https://www.amazon.com/dp/B002EZJH4Y>
- Aghina, W., Ahlback, K., Smet, A. D., Lackey, G., Lurie, M., Murarka, M., & Handscomb, C. (2018, January). *The five trademarks of agile organizations*. Retrieved February 25, 2022, from <https://www.mckinsey.com/business-functions/people-and-organizational-performance/our-insights/the-five-trademarks-of-agile-organizations>
- Ashby, W. R. (1956). *An introduction to cybernetics*. ISBN: 978-04-166-8300-4 <http://www.worldcat.org/oclc/256234995>
- Barros, A., & Dumas, M. (2006). The rise of web service ecosystems. *IT Professional*, 8(5), 31–37. <https://doi.org/10.1109/MITP.2006.123>
- Beer, S. (1979). *The heart of enterprise*. Wiley. ISBN: 978-04-719-4837-7 <http://www.worldcat.org/oclc/832281857>
- Bennis, W. G., & Nanus, B. (1985). *Leaders: The strategies for taking charge: The four keys of effective leadership*. Harper; Row. ISBN: 978-00-601-5246-8 <http://www.worldcat.org/oclc/464103496>
- Berg, M. v. d., Luijpers, J., Steenbergen, M. van, & Wagter, R. (2005). *Dynamic enterprise architecture*. John Wiley & Sons. ISBN: 978-04-716-8272-1 <http://www.worldcat.org/oclc/928551730>
- Boers, I., Bovenkamp, H. van de, Bovens, M., & Brandsma, G. J. (2009, May 19). *Handboek publieke verantwoording*. Boom Bestuurskunde. ISBN: 978-90-593-1511-2 <http://www.worldcat.org/oclc/8006779262>
- Botjes, E. A. (2020). *Defining antifragility and the application on organisation design* (Master's thesis). Antwerp Management School. Antwerp, Belgium, Zenodo. <https://doi.org/10.5281/ZENODO.3719389>
- Botjes, E. A., Berg, M. van den, Gils, B. van, & Mulder, H. (2021). Attributes relevant to antifragile organizations. *23rd IEEE International Conference on Business Informatics*. <https://doi.org/10.1109/CBI52690.2021.00017>
- Carayannis, E. G., & Campbell, D. F. (2009). 'mode 3' and 'quadruple helix': Toward a 21st century fractal innovation ecosystem. *International Journal of Technology Management*, 46(3-4), 201–234. <https://doi.org/10.1504/ijtm.2009.023374>

- CBS. (n.d.). Regionale kerncijfers nederland. Retrieved May 13, 2022, from <https://opendata.cbs.nl/statline/?dl=16D63#/CBS/nl/dataset/70072ned/table>
- Chrousos, G. P. (2009). Stress and disorders of the stress system. *Nature Reviews Endocrinology*, 5(7), 374–381. <https://doi.org/10.1038/nrendo.2009.106>
- Cunff, A.-L. L. (2020, May). *The optionality fallacy*. Retrieved April 5, 2022, from <https://nesslabs.com/optionality-fallacy>
- Dietz, J. L. (2008). *Architecture: Building strategy into design* [available at <http://www.sapiol.nl/wp-content/uploads/2013/05/Architecture.pdf>]. ISBN: 978-90-125-8086-1 retrieved May 1, 2022, from <http://www.worldcat.org/oclc/317248252>
- Digitaleoverheid. (2021, September). *I-strategie rijk 2021 – 2025: Doorpakken op digitale transformatie* (Goverment Document). Ministerie van Binnenlandse Zaken en Koninkrijksrelaties. The Hague, The Netherlands. Retrieved September 16, 2021, from <https://www.digitaleoverheid.nl/wp-content/uploads/sites/8/2021/09/I-Strategie-Rijk-2021-2025.pdf>
- Engels, J., & Fraanje, R. (2013). *De bestuurlijke organisatie in nederland: Historie, grondslagen, werking en debat*. Kluwer. ISBN: 978-90-131-1911-4 <http://www.worldcat.org/oclc/6893223446>
- Enneman, B. (2007, June). *De doelmatigheid van publiek private samenwerking in een neo-institutioneel economisch perspetief* (Master Thesis). Universiteit Twente. Retrieved May 13, 2022, from https://essay.utwente.nl/57934/1/scriptie_Endeman.pdf
- EuropeanUnion. (2014, February 26). *Directive 2014/24/eu of the european parliament and of the council of 26 february 2014 on public procurement* (Government Document No. 32014L0024). The European Parliament. Retrieved May 13, 2022, from <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02014L0024-20180101&from=EN>
- Gartner. (n.d.). *Definition of enterprise architecture (ea)*. Retrieved April 5, 2021, from <https://www.gartner.com/en/information-technology/glossary/enterprise-architecture-ea>
- Garvin, D. A. (1993). *Building a learning organisation*. Retrieved April 29, 2022, from <https://hbr.org/1993/07/building-a-learning-organization>
- Gharajedaghi, J. (2011). *Systems thinking: Managing chaos and complexity a platform for designing business architecture* (Third Edition). Morgan Kaufmann. ISBN: 978-01-238-5915-0 <http://www.worldcat.org/oclc/1103560139>
- Ghasemi, A., & Alizadeh, M. (2017). Evaluating organizational antifragility via fuzzy logic: The case of an iranian company producing banknotes and security paper. *Operations Research and Decisions*, (2), 21–43. <https://doi.org/10.5277/ord170202>
- Gomes, L., Facin, A., Salerno, M. S., & Ikenami, R. (2018). Unpacking the innovation ecosystem construct: Evolution, gaps and trends. *Technological Forecasting and Social Change*, 136, 30–48. <https://doi.org/10.1016/j.techfore.2016.11.009>
- Gorgeon, A. (2015). Anti-fragile information systems. In T. A. Carte, A. Heinzl & C. Urquhart (Eds.), *Proceedings of the international conference on information systems - exploring the information frontier, ICIS 2015, fort worth, texas, usa*,

- december 13-16, 2015.* Association for Information Systems. <http://aiselaisnet.org/icis2015/proceedings/BreakoutIdeas/6>
- Graves, T. (2008). *Real enterprise architecture: Beyond it to the whole enterprise*. Tetradian Books. ISBN: 978-19-066-8100-5 <http://www.worldcat.org/oclc/815729887>
- Graves, T. (2009). *Enterprise architecture: A pocket guide*. IT Governance Publishing (ITGP). ISBN: 978-18-492-8016-7 <http://www.worldcat.org/oclc/697598744>
- Greefhorst, D., Grefen, P., Saaman, E., Bergman, P., & Beek, W. van. (2008). Referentie-architectuur: Off-the-shelf architectuur. Retrieved May 3, 2022, from <https://www.archixl.nl/assets/files/referentie-architectuur-off-the-shelf-architectuur.pdf>
- Guggenberger, T., Möller, F., Haarhaus, T., Gür, I., & Otto, B. (2020). Ecosystem types in information systems. https://aiselaisnet.org/ecis2020_rp/45/
- Hendriksson, V., Houten, C. van, & Spiß, M. (2016). *To master disaster: How sme managers can thrive and benefit from economic crises* (Master Thesis). Linnaeus University. <http://urn.kb.se/resolve?urn=urn:nbn:se:lnu:diva-53185>
- Heylighen, F., & Joslyn, C. (2001). *The law of requisite variety*. Retrieved April 6, 2022, from <http://pespmc1.vub.ac.be/REQVAR.html>
- Hole, K. J. (2016). *Anti-fragile ict systems* (First Edition). Springer International Publishing. ISBN: 978-33-193-0068-9 <http://www.worldcat.org/oclc/958800432>
- Hoogervorst, J. P. (2009). *Enterprise governance and enterprise engineering* (First Edition). Springer Berlin Heidelberg. ISBN: 978-35-409-2670-2 <http://www.worldcat.org/oclc/1156015507>
- Huang, K., Fan, Y., & Tan, W. (2014). Recommendation in an evolving service ecosystem based on network prediction. *IEEE Transactions on Automation Science and Engineering*, 11(3), 906–920. <https://doi.org/10.1109/tase.2013.2297026>
- Huijts, P. H. A. M. (2017, March 28). *Brief secretarissen-generaal aan informateur* (Government document No. 3931240). Overleg van Secretarissen-Generaal. Retrieved May 5, 2022, from <https://kennisopenbaarbestuur.nl/media/254560/2017-sgo-brief.pdf>
- Iansiti, M., & Levien, R. (2004). Strategy as ecology. *Harvard business review*, 82(3), 68–78.
- INCOSE. (2018). *Systems of systems primer*. Retrieved March 22, 2022, from <https://www.incose.org/products-and-publications/sos-primer>
- Jaaron, A. A. M., & Backhouse, C. J. (2014). Building antifragility in service organisations: Going beyond resilience. *International Journal of Services and Operations Management*, 19, 491–513. <https://doi.org/10.1504/IJSOM.2014.065671>
- Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. *Strategic Management Journal*, 2255–2276. <https://doi.org/10.1002/smj.2904>
- Johnson, J., & Gheorghe, A. V. (2013). Antifragility analysis and measurement framework for systems of systems. *International Journal of Disaster Risk Science*, 4, 159–168. <https://doi.org/10.1007/s13753-013-0017-7>
- Kastner, D. (2017). *Antifragile organisation design: A framework of self-organisation practices in today's complex and unpredictable economy*. (Master's thesis). University of Arts. London, Great Britain.

- Kennon, D., Schutte, C. S., & Lutters, E. (2015). An alternative view to assessing antifragility in an organisation: A case study in a manufacturing sme. *CIRP Annals*.
- Koolmees, W., & Ark, T. van. (2019, June 18). *Evaluatie gebruik uwv informatieplan (uip) – deelrapportage* (Goverment document No. 2019-0000099566). Ministerie van Financieën. Retrieved May 5, 2022, from <https://www.rijksoverheid.nl/documenten/kamerstukken/2019/06/28/bijlagen-2a-t-m-5e-bij-aanbiedingsbrief-uitvoering-sociale-zekerheid>
- Korhonen, J. J., Lapalme, J., McDavid, D., & Gill, A. Q. (2016). Adaptive enterprise architecture for the future: Towards a reconceptualization of ea. *2016 IEEE 18th Conference on Business Informatics (CBI)*. <https://doi.org/10.1109/CBI.2016.38>
- Kotusev, S., Singh, M., & Storey, I. (2015). Consolidating enterprise architecture management research. *2015 48th Hawaii International Conference on System Sciences*, 4069–4078. <https://doi.org/10.1109/hicss.2015.489>
- Lapalme, J. (2012). Three schools of thought on enterprise architecture. *IT Professional*, 14, 37–43. <https://doi.org/10.1109/MITP.2011.109>
- Lapalme, J., & Guerre, D. W. de. (2012). Can a re-discovery of open socio-technical systems strengthen ea? *Journal of Enterprise Architecture*, 8, 55–62.
- Libert, A. (2016). *Thorbeckiaans gedraai: Een onderzoek naar de discussie over het functioneren van het huis van thorbecke tussen 1945-2016* (Masters). Radboud University. Nijmegen. https://theses.ubn.ru.nl/bitstream/handle/123456789/3620/Libert%2C_A.J._1.pdf?sequence=1
- Linders, B. (2013, September 18). *Uitvoerbaarheid blinde vlek in den haag*. Retrieved May 5, 2022, from <https://ibestuur.nl/weblog/uitvoerbaarheid-blijft-blinde-vlek-in-den-haag>
- Linthorst, R. (2021, December 30). *Posten* (Government Document). Bureau woordvoering kabinetsformatie. Retrieved May 13, 2022, from <https://www.kabinetsformatie2021.nl/binaries/kabinetsformatie/documenten/publicaties/2021/12/30/invulling-posten/Posten+VVD+D66+CDA+ChristenUnie.pdf>
- Manikas, K., & Hansen, K. M. (2013). Software ecosystems – a systematic literature review. *Journal of Systems and Software*, 86(5), 1294–1306. <https://doi.org/10.1016/j.jss.2012.12.026>
- Mannaert, H., Verelst, J., & Bruyn, P. D. (2016). *Normalized systems theory: From foundations for evolvable software toward a general theory for evolvable design*. Kermt NSI-Press. ISBN: 978-90-771-6009-1 <http://www.worldcat.org/oclc/1050060943>
- Mark, J. J. (2010, July 14). *Heraclitus of Ephesus*. Retrieved September 20, 2021, from https://www.worldhistory.org/Heraclitus_of_Ephesus/
- Markey-Towler, B. (2018). Antifragility, the black swan and psychology: A psychological theory of adaptability in evolutionary socioeconomic systems.
- Martin, J. (1995). *The great transition : Using the seven disciplines of enterprise engineering to align people, technology, and strategy*. AMACON. ISBN: 978-08-144-0315-0 <http://www.worldcat.org/oclc/732355708>
- Martin-Breen, P., & Anderies, J. M. (2011). Resilience: A literature review.

- Meijer, A., Meijer, M. T. S., & Branderhorst, M. (2019). Principes voor goed lokaal bestuur in de digitale samenleving: Een aanzet tot een normatief kader. *Bestuurswetenschappen*, 73(4), 8–23. https://dspace.library.uu.nl/bitstream/handle/1874/389163/Principes_voor_god_lokaal_bestuur_in_de_digitale_samenleving.pdf
- Moore, J. F. (1993). Predators and prey: A new ecology of competition. *Harvard business review*, 71(3), 75–86. <http://blogs.harvard.edu/jim/files/2010/04/Predators-and-Prey.pdf>
- Nijssen, M., Vermeeren, B., Vermeer, L., & Visser, J. (2018). Wat wendbare organisaties doen (en laten). *Bestuurskunde*, 27, 79–93. <https://doi.org/10.5553/Bk/092733872018027004007>
- Nora. (n.d.). *Enterprise-architectuur*. Retrieved May 8, 2022, from <https://www.noraonline.nl/wiki/Enterprise-architectuur>
- Nora familie*. (n.d.). Retrieved May 6, 2022, from https://www.noraonline.nl/wiki/NORA_Familie
- Nurmi, J. (2021). *Enterprise architecture in public sector ecosystems: A systems perspective* (Doctoral dissertation). University of Jyväskylä. <https://jyx.jyu.fi/handle/123456789/73650>
- Hong Kong, C. U. of. (2021, December 30). *Evaluating sources*. City University of Hong Kong. Retrieved January 10, 2022, from <https://libguides.library.cityu.edu.hk/litreview/evaluating-sources/>
- O'Reilly, B. M. (2019). No more snake oil: Architecting agility through antifragility. *Procedia Computer Science*, 151, 884–890. <https://doi.org/10.1016/j.procs.2019.04.122>
- Papazoglou, M. P., & Heuvel, W. J. van den. (2006). Service-oriented design and development methodology. *International Journal of Web Engineering and Technology*, 2(4), 412–442. <https://doi.org/10.1504/ijwet.2006.010423>
- Pathirane, L., & Blades, D. W. (1982). Defining and measuring the public sector: Some international comparisons. *Review of Income and Wealth*, 28(3), 261–289. <https://doi.org/10.1111/j.1475-4991.1982.tb00617.x>
- PsychTimes. (n.d.). *Metathesiophobia (fear of change)*. Retrieved November 12, 2021, from <https://psychtimes.com/metathesiophobia-fear-of-change/>
- Recker, J. (2013). *Scientific research in information systems: A beginner's guide*. Springer Publishing Company, Incorporated. ISBN: 978-36-423-0047-9 <http://www.worldcat.org/oclc/835896025>
- Rich, P. H. (1988). The origin of ecosystems by means of subjective selection. In *Concepts of ecosystem ecology* (pp. 19–27). Springer. https://doi.org/10.1007/978-1-4612-3842-3_2
- Rickles, D., Hawe, P., & Shiell, A. (2007). A simple guide to chaos and complexity. *Journal of Epidemiology & Community Health*, 61(11), 933–937. <https://doi.org/10.1136/jech.2006.054254>
- Rijksoverheid. (2019, February). *The constitution of the kingdom of the netherlands 2018* (Government Document). Ministry of the Interior and Kingdom Relations. Retrieved May 13, 2022, from <https://www.rijksoverheid.nl/binaries/rijksoverheid/>

- documenten / rapporten / 2019 / 02 / 28 / grondwet - voor - het - koninkrijk - der - nederlanden-2018/WEB_119406_Grondwet_Koninkrijk_ENG.pdf
- Ross, J. W., Weill, P., & Robertson, D. (2014). *Enterprise architecture as strategy: Creating a foundation for business execution*. Harvard Business Review Press. ISBN: 978-14-221-4817-4 <https://www.worldcat.org/oclc/1015886391>
- Russo, D., & Ciancarini, P. (2017). Towards antifragile software architectures. *Procedia Computer Science*, 109, 929–934. <https://doi.org/10.1016/j.procs.2017.05.426>
- Saint-Louis, P., Morency, M., & Lapalme, J. (2019). Examination of explicit definitions of enterprise architecture. *International Journal of Engineering Business Management*, 11. <https://doi.org/10.1177/1847979019866337>
- Seibt, J. (2022). Process philosophy. In E. N. Zalta (Ed.), *The stanford encyclopedia of philosophy* (Spring 2022). Metaphysics Research Lab, Stanford University. Retrieved May 5, 2022, from <https://plato.stanford.edu/archives/spr2022/entries/process-philosophy>
- Senge, P. M. (1994). *The fifth discipline: The art and practice of the learning organization* (First Currency Paperback Edition). Doubleday/Currency. ISBN: 978-03-852-6095-4 <http://www.worldcat.org/oclc/318247346>
- Smith, K. L., & Graves, T. (2011). *An introduction to peaf: Pragmatic enterprise architecture framework*. Pragmatic EA Ltd. ISBN: 978-19-084-2401-3 <http://www.worldcat.org/oclc/796252093>
- Spewak, S. (1993). *Enterprise architecture planning: Developing a blueprint for data, applications, and technology*. Wiley. ISBN: 978-04-715-9985-2 <http://www.worldcat.org/oclc/1106823246>
- Taleb, N. N. (2012). *Antifragile: Things that gain from disorder* (Paperback Edition). Random House. ISBN: 978-08-129-7968-8 <http://www.worldcat.org/oclc/1012852528>
- Tangi, L., Janssen, M., Benedetti, M., & Noci, G. (2020). Barriers and drivers of digital transformation in public organizations: Results from a survey in the netherlands. *International Conference on Electronic Government*, 42–56. https://doi.org/10.1007/978-3-030-57599-1_4
- Tansley, A. G. (1935). The use and abuse of vegetational concepts and terms. *Ecology*, 16(3), 284–307. <https://doi.org/10.2307/1930070>
- Tomov, L. (2019). Is agile antifragile? *Computer Science and Education in Computer Science*, 15(1), 14–20.
- Turner II, B. L., Kasperson, R., Matson, P., McCarthy, J., Corell, R., Christensen, L., Selin, N., Kasperson, J., Luers, A., Martello, M., Polksky, C., Pulsipher, A., & Schiller, A. (2003). A framework for vulnerability analysis in sustainability science. *Proceedings of the National Academy of Sciences of the United States of America*, 100(14), 8074–8079. <https://doi.org/10.1073/pnas.1231335100>
- Steen, M. A. van der. (2018, February 8). Organiseren voor een voorspelbaar verrassende toekomst. In P. Mettau (Ed.). Z. Hulsenboom (Ed.), *Adaptief bestuur: Essays over adaptiviteit en openbaar bestuur* (pp. 73–83). Ministerie van Binnenlandse Zaken en Koninkrijksrelaties. Retrieved May 5, 2022, from <https://kennisopenbaarbestuur.nl/media/255279/adaptief-bestuur.pdf>

- Wal, Z. van der, Graaf, G. de, & Lasthuizen, K. (2008). Similarities and differences between the organizational values of the public and private sector. *Public Administration*, 86(2), 465–482. <https://doi.org/10.1111/j.1467-9299.2008.00719.x>
- Eck, S. van, Ham, L. van den, & Velde en Maarten Veldhuizen, T. de. (2009). *Navigeren transformeren in publieke organisaties: Tussen wendbaarheid en koersvastbaarheid*. Capgemini Consulting. Retrieved May 4, 2022, from https://www.capgemini.com/nl-nl/wp-content/uploads/sites/7/2017/07/Navigerend_Transformeren_in_publieke_organisaties_0.pdf
- von Bertalanffy, K. L. (1968). *General system theory: Foundations, development, applications*. Braziller. ISBN: 0-80-760452-6 <http://www.worldcat.org/oclc/1263587160>
- White, S. K. (2018). *What is enterprise architecture?* Retrieved August 4, 2021, from <https://www.cio.com/article/3313657/what-is-enterprise-architecture-a-framework-for-transformation.html>
- Wiebes, E. D. (2014, May 19). Brief van de staatssecretaris van financiën [31066 nr. 201]. *Tweede Kamer der Staten-Generaal*. Retrieved May 4, 2022, from <https://zoek.officielebekendmakingen.nl/kst-31066-201.html>
- Wilkinson, M. D., Dumontier, M., Aalbersberg, I. J., Appleton, G., Axton, M., Baak, A., Blomberg, N., Boiten, J.-W., Silva Santos, L. B. da, Bourne, P. E., Bouwman, J., Brookes, A. J., Clark, T., Crosas, M., Dillo, I., Dumon, O., Edmunds, S., Evelo, C. T., Finkers, R., ... Mons, B. (2016). The fair guiding principles for scientific data management and stewardship. *Scientific Data*, 3(1), 160018. BriefCommunication. <https://doi.org/10.1038/sdata.2016.18>
- Ylinen, M., & Pekkola, S. (2018). Enterprise architecture as a scapegoat for difficulties in public sector organizational transformation [International Conference on Information Systems]. *International Conference on Information Systems (ICIS'2018)*.
- Ylinen, M., & Pekkola, S. (2020). Jack-of-all-trades torn apart: Skills and competences of an enterprise architect. *Proceedings of the 28th European Conference on Information Systems (ECIS)*. ISBN: 978-17-336-3251-5 <https://aisel.aisnet.org/ecis2020/>

List of Figures

1.1. The antifragile triad	2
1.2. Architecture subsidiaries, based on Greefhorst et al. (2008)	3
1.3. Conceptual Research Model	4
1.4. Design of the thesis	5
2.1. Triad of fragile, robust, and antifragile (Botjes et al., 2021)	8
2.2. Extended Antifragile Attribute List (Botjes et al., 2021)	9
2.3. The Fifth discipline (Senge, 1994)	11
2.4. Public Sector as a System-of-Systems	15
3.1. Research model	23
4.1. Interview results attenuate variety	30
4.2. Interview results amplified variety	31
4.3. Interview results learning organisation	32
4.4. Interview results Enterprise Architecture schools of thought	32
4.5. Interview results new findings	34
4.6. Score of attributes from interviews	36
F.1. Rating of antifragile attribute Optionality	94
F.2. Scoring of antifragile attribute Mono-Monotonicity	95
F.3. Scoring of antifragile attribute Self-Organisation	96
F.4. Scoring of antifragile attribute Fail-Fast	97
F.5. Scoring of antifragile attribute Resources to Invest	98
F.6. Scoring of antifragile attribute Seneca's Barbell	99
F.7. Scoring of antifragile attribute Safe working environment	100
F.8. Scoring of antifragile attribute Outside-In and Collaboration	101
F.9. Scoring of antifragile attribute Data Governance Planes	102
F.10. Scoring of school of thought Enterprise IT Architecting	103
F.11. Scoring of school of thought Enterprise Integrating	104
F.12. Scoring of school of thought Enterprise Ecological Adaptation	105
F.13. Scoring of Enterprise Architecture attribute Systems-in-Environment thinking . .	107
F.14. Scoring of Enterprise Architecture attribute Holistic (systemic) stance	108
F.15. Scoring of Enterprise Architecture attribute Organisational learning	109
F.16. Scoring of Enterprise Architecture attribute Environmental learning	110
F.17. Scoring of Enterprise Architecture attribute Intra-Organisational coherency . . .	111
F.18. Scoring of Enterprise Architecture attribute System-in-Environment Co-Evolution learning	112
F.19. Scoring of Enterprise Architecture attribute adapt to business language	113
F.20. Scoring of Enterprise Architecture attribute Agile Enterprise	114
F.21. Scoring of Enterprise Architecture attribute Real Time Trust	115
F.22. Scoring of Enterprise Architecture attribute Foster Dialogue	116

F.23. Scoring of Enterprise Architecture attribute Architecture validation	117
F.24. Scoring of Enterprise Architecture attribute Always fitting ea	118
F.25. To what extent do you find the the research relevant?	119
F.26. To what extent did this session fulfil your expectations?	120
F.27. To what extent do you think that the research can be used by yourself?	121
F.28. To what extent do you think that the research can be used in the public sector? .	122
F.29. To what extent do you think that the research can be used by your organisation? .	123

List of Tables

2.1. Sources used for antifragile attributes (Botjes et al., 2021)	9
2.2. Types of resilience (Martin-Breen & Andries, 2011)	10
2.3. Antifragile system attributes	13
2.4. Three approaches to Enterprise Architecture (Kotusev et al., 2015)	17
2.5. Enterprise Architecture schools of thought (Lapalme, 2012)	18
2.6. Authors of Enterprise Ecological Adaptation (Lapalme, 2012)	19
2.7. Enterprise Architecture system attributes based on (Lapalme, 2012)	20
4.1. Interviewees	28
4.2. Interview questions	29
4.3. Merging similar labels	35
4.4. Possible success factors identified from interviews	37
5.1. Average experience of expert group participants	38
5.2. Validation of antifragile attributes	40
5.3. Validation of Enterprise Architecture schools of thought	40
5.4. Validation of Enterprise Architecture attributes	41
5.5. Validation on the relevance of the research	42
5.6. Identified probable antifragile attributes by the expert group	43
5.7. Identified Enterprise Architecture attributes by the expert group	43
5.8. Probable success factors identified by the expert group	44
6.1. Potential success factors	45
6.2. Answers to sub-questions	46
6.3. What is the relevance of this research?	47
A.1. Properties of Enterprise IT Architecting (Lapalme, 2012)	73
A.2. Properties of Enterprise Integrating (Lapalme, 2012)	74
A.3. Properties of Enterprise Ecological Adaptation (Lapalme, 2012)	75
B.1. Authors of the Enterprise Architecture schools of thought (Lapalme, 2012)	76
C.1. Literature search June 2019–March 2022 all sources	79
E.1. Interview findings Engineering Resilience	90
E.2. Interview findings Systems Resilience	90
E.3. Interview findings Complex Adaptive Systems Resilience	91
E.4. Interview findings Antifragile	91
E.5. Interview findings Learning Organisation	92
E.6. Interview findings Enterprise Architecture schools of thought	92
E.7. Interview findings new attributes	93
F.1. Rating of antifragile attribute Optionality	94

F.2. Scoring of antifragile attribute Mono-Monotonicity	95
F.3. Scoring of antifragile attribute Self-Organisation	96
F.4. Scoring of antifragile attribute Fail-Fast	97
F.5. Scoring of antifragile attribute Resources to Invest	98
F.6. Scoring of antifragile attribute Seneca's Barbell	99
F.7. Scoring of antifragile attribute Safe working environment	100
F.8. Scoring of antifragile attribute Outside-In and Collaboration	101
F.9. Scoring of antifragile attribute Data Governance Planes	102
F.10. Validation of Enterprise Architecture schools of thought	103
F.11. Scoring of school of thought Enterprise IT Architecting	103
F.12. Scoring of school of thought Enterprise Integrating	104
F.13. Scoring of school of thought Enterprise Ecological Adaptation	105
F.14. Validation of Enterprise Architecture attributes	106
F.15. Scoring of Enterprise Architecture attribute Systems-in-Environment thinking . .	107
F.16. Scoring of Enterprise Architecture attribute Holistic (systemic) stance	108
F.17. Scoring of Enterprise Architecture attribute Organisational learning	109
F.18. Scoring of Enterprise Architecture attribute Environmental learning	110
F.19. Scoring of Enterprise Architecture attribute Intra-Organisational coherency . .	111
F.20. Scoring of Enterprise Architecture attribute System-in-Environment Co-Evolution learning	112
F.21. Scoring of Enterprise Architecture attribute adapt to business language	113
F.22. Scoring of Enterprise Architecture attribute Agile Enterprise	114
F.23. Scoring of Enterprise Architecture attribute Real Time Trust	115
F.24. Scoring of Enterprise Architecture attribute Foster Dialogue	116
F.25. Scoring of Enterprise Architecture attribute Architecture validation	117
F.26. Scoring of Enterprise Architecture attribute Always fitting Enterprise Architecture	118
F.27. To what extent do you find the the research relevant?	119
F.28. To what extent did this session fulfil your expectations?	120
F.29. To what extent do you think that the research can be used by yourself?	121
F.30. To what extent do you think that the research can be used in the public sector? .	122
F.31. To what extent do you think that the research can be used by your organisation? .	123
F.32. Follow-up Survey	123
G.1. Possible success factors	125

Glossary of Terms

A | B | C | D | E | F | H | I | J | L | M | N | O | P | Q | R | S | T | U | V

A

adapt to business language

speak the natural language of your stakeholders such as Directors, Politicians, Public Administrators, and others.

adviescollege ict-toetsing

the advisory board on ict assessment advises the cabinet and the Senate and House of Representatives on improving the management of ICT projects and information systems, particularly the risk and success rate of ICT projects effectiveness and efficiency of the maintenance and management of information systems.

agile

the ability to adjust before failure happens.

agile enterprise

agile organisations are characterised as a network of teams operating in rapid learning and decision-making cycles.

agility

the state of being agile.

always fitting enterprise architecture

an architecture that is abstract enough so it is always correct and usable.

amplify variety

amplifying or increasing the possible outcomes / states. A light that can be turned on and off has the variety of 2. Introducing the possibility of setting the light intensity increases the possible states.

antifragile

the ability to strive for and evolve under stress.

antifragility

the state of being antifragile.

architecture validation

always validate the architecture with a peer from the public sector. Not only validate the architecture in your own organisation.

attenuate variety

dampening or reducing the possible outcomes / states. A light that can be turned on and off has the variety of 2. Your hand during Rock, paper, scissors has the variety or 3.

attribute

a quality or characteristic that someone or something has.

B**black swan event**

a black swan is an unpredictable event that is beyond what is normally expected of a situation and has potentially severe consequences. Black swan events are characterized by their extreme rarity, severe impact, and the widespread insistence they were obvious in hindsight.

building shared vision

a practice of unearthing shared pictures of the future that foster genuine commitment and enrollment rather than compliance.

C**complex adaptive systems resilience**

the system is able to become more resilient and to generate new system relationships by reorganisation. The function is maintained, but the system's structure may change. A continuously evolving system.

cxo

the generalisation of c-level officers.

D**data governance planes**

data control planes represent a unifying architecture that combines data engineering, data intelligence, policy management, and continuous data observability to provide a backbone for DataOps and data governance disciplines at organizations competing in the digital economy.

dependent variable

a dependent variable is the variable that changes as a result of the independent variable manipulation. It's the outcome you're interested in measuring, and it "depends" on your independent variable.

diversity

diversity is internally not being a mono-culture and externally having options. For example having two different coffee suppliers. Or having a diverse team.

E**emergence**

emergence refers to the existence or formation of collective behaviors, what parts of a system do together that they would not do alone.

engineering resilience

prevent disruption and changes and to bounceback to the fixed function/basis.

enterprise architecture

theoretical, architecture is the normative restriction of design freedom. Practically, architecture is a consistent and coherent set of design principles..

enterprise ecological adaptation

enterprise architecture is the means for organizational innovation and sustainability.

enterprise integrating

enterprise architecture is the link between strategy and execution.

enterprise it architecting

enterprise architecture is the glue between business and IT.

entropy

the entropy of the universe increases in all natural processes. Isolated systems tend towards greater disorder and entropy is a measure of that disorder.

environmental learning

use environmental learning to adapt the enterprise desired goals to be more compatible with the environment.

F

fail-fast

the attributes "diversity", "non-monotonicity", "emergence", "self-organisation", "insert low-level stress", and "network-connections" combined enables the possibility to execute the strategy to embrace the adagium "Fail Fast" ..

foster

to promote the growth or development of.

foster dialogue

encourage dialogue.

fragile

the quality of being easily broken or destroyed.

fragility

the state of being fragile.

H

holistic (systemic) stance

the enterprise architecture process must not only think of a single domain but about the combination of domains (IT domains and business domains) together. Addressing any IT and business architecture sub-domains separately and trying to adapt the other sub-domains accordingly will probably produce an ineffective and unsustainable outcome.

I

immemorial

reaching beyond the limits of memory, tradition, or recorded history.

independent variable

an independent variable is the variable you manipulate or vary in an experimental study to explore its effects. It's called "independent" because it's not influenced by any other variables in the study.

insert low-level stress

continuous Improvement is achieved by inserting low-level of stress continuously into a learning system. This will keep the system sharp all the time.

insert randomness

when insert-low-level stress and fail fails delivers no issues the next step is to insert randomness into the systems. A great example of this is Chaos Engineering by Netflix or the HackerOne bug-bounty system.

intra-organisational coherency

Its possible to make the organisation conducive to ecological learning, environmental influencing, and coherent strategy execution by reinforce wanted intra-dynamics and attenuate unwanted ones.

J

joint venture

a joint venture is a business entity created by two or more parties, generally characterized by shared ownership, shared returns and risks, and shared governance.

L

learning organisation

the learning organisation is a way to create resilient organizations which let them cope with unknown and unpredictable events.

loosely coupled

loosely coupled is the degree of dependency on the exact working of another module. For example when the color-schema of a website is changed it is preferred that this does not impact the functioning of the website. Another example is that when there are new employees introduced at the finance department the taste of the coffee changes. It is important to understand that there is always some degree of coupling.

M

micro-management

micro-management is about the freedom in the use of the product. When there are minituous working instructions available in a business process the employee has no freedom in the execution of the job. Another great example is a lego building block. It is engineered and fabricated into the greatest detail creating a building block that is almost completely robust. Lego has a very small resilience behaviour through engineering.

moderater variable

a moderator influences the level, direction, or presence of a relationship between variables. It shows you for whom, when, or under what circumstances a relationship will hold.

modularity

modularity is the degree that components may be separated and recombined, often with the benefit of flexibility. For example the finance team and the marketing team. Another example is the user-interface module and the data storage module.

N

network-connections

a network is created by connections to other nodes. More connections increases potential for optionality for new constructions and also new functionalities.

non-monotonicity

non-monotonicity is about not only learning from the good but also from the bad. For example the lessons learned during a retrospective session.

O

optionality

optionality is an idea advanced by Nassim Taleb in his book Antifragile. At the most basic level, optionality just means having lots of options. If you develop a skill with many possible job opportunities, you have more optionality than someone who develops a skill that only has one or two job opportunities.

organisational learning

to enable innovation and system-in-environment adaptation, Enterprise Architecture is about organisational learning. Designing all facets of the enterprise, including its relationship to the environment, will foster organisational learning.

outside-in and collaboration

use the view from others and collaborate.

P

parliamentary inquiry

the parliamentary committee of inquiry is a particular type of temporary committee of the House. The parliamentary inquiry is the most powerful instrument the Dutch parliament has at its disposal to carry out its duty to scrutinize the work of the government.

personal mastery

personal mastery is a discipline of continually clarifying and deepening our personal vision, of focusing our energies, of developing patience, and of seeing reality objectively.

public sector

the Public Sector is comprised of organisations that are owned and operated by the government and exist to provide services for its citizens..

Q

qualitative data analysis

qualitative data analysis involves the identification, examination, and interpretation of patterns and themes in textual data and determines how these patterns and themes help answer the research questions at hand.

R

real-time trust

using trustfactors for a rules and policies.

reduce naive intervention

Intervention based on a model and reductionistic logic and ignoring the experience. An example is not listening to the experienced but not so articulate employee, or by ignoring the balance nature has found in a ecosystem.

redundancy

redundancy is about having not a single point of failure by making use of duplication. An example is a backup electricity generators. Another example is local government as backup system of the central government.

resiliency

the state of being resilient.

resilient

the ability to recover from failure.

resources to invest

opportunities can only be seized when there are resources free to do see. This can be money but also time and labour. To Survive a black swan investment should be possible.

robust

the ability to resist failure.

robustness

the state of being robust.

S

safe working environment

when you create a safe work environment for employees, you set yourself up for business success, by reducing problem avoidance, accelerating trouble shooting, and increasing innovation. Taking this approach to errors demonstrates a leader's acceptance that people need to make mistakes in order to improve so that your business can achieve ever-greater goals.

self-organisation

self-Organisation is a process where some form of overall order arises from local interactions between parts of an initially disordered system. For example students sitting together in the school cafeteria.

seneca's barbell

to be antifragile you need a robust sub-system to which 80%/90% predictable value with low risk is situated. The 20%/10% should be used for high return on investment activities.

shared mental model

mental models are deeply ingrained assumptions, generalizations, or even pictures of images that influence how we understand the world and how we take action.

skin in the game

make certain that the one making the decision and doing the work has a pain and gain relation with the outcome. This goes beyond having a feedback system in place. This is good beyond having KPI's in place. An example is that when working Agile scrum, the product owner should be a co-worker in the team for whom the solution is being build.

specialisation

an element that is a particular kind of another element. E.g. a travel insurance is a specialisation of insurance.

stressor

when systems are performing effectively, they are in a predetermined condition and conversely when they are not functioning correctly, they are in an unintended state. An unintended condition can be known or unknown. Stressors are forces that threaten to transfer a system from an intended to an unintended condition. In short you can also say that a stressor is an event from outside the system that causes stress.

system-in-environment

stresses that a system is part of and should be aware of its environment.

system-in-environment coevolution learning

system-in-environment coevolution is the combination of environmental learning, intra-organisational coherency and attenuating unwanted forces.

system-of-systems

a collection of independent systems that are part of a more extensive system has unique capabilities.

systems resilience

the system is able to withstand the impact of any interruption and recuperate while resuming its operations, the function of the system stays the same over time.

systems thinking

a discipline for seeing wholes. It is a framework for seeing inter-relationships rather than things, for seeing patterns of change rather than static snapshots. The fifth discipline of Senge states that it must contain personal mastery, shared mental models, building shared vision, and team learning for a learning organisation..

systems-in-environment thinking

a system (enterprise) in its environment, including not only the enterprise but also its environment and the bidirectional relationship and transactions between the enterprise and its environment.

T

team learning

team learning starts with 'dialogue', the capacity of members of a team to suspend assumptions and enter into genuine 'thinking together'.

the house of thorbecke

in 1848, as minister, Thorbecke laid the foundations for the current administrative division and task demarcation. In 1850 and 1851 he established the Provinces Act and the Municipalities Act. We therefore also speak of 'the House of Thorbecke'.

top-down command & control

top-Down command and control is in an organisation that a employee is not free to decide to go left or right but has to follow orders. The careful design of an iPhone or a good pen is also an example of limited freedom of movement in the product itself.

triad

a group or set of three related people or things.

triangulation

triangulation means you are seeking convergence and corroboration of results from different methods and designs studying the same phenomenon.

U**uncertainty**

the state of being uncertain.

V**volatile**

likely to change in a very sudden or extreme way.

volatility

the state of being volatile.

Abbreviations

A | B | C | D | E | G | I | K | M | N | S | U | V

A

API

Application Programming Interface.

B

BoK

Body of Knowledge.

C

CAS

Complex Adaptive System.

CCO

Chief Commercial Officer.

CEO

Chief Executive Officer.

CIO

Chief Information Officer.

COO

Chief Operations Officer.

CTO

Chief Technology Officer.

D

DYA

DYnamic Architecture.

E

EAAL

Extended Antifragile Attribute List.

EAR

Enterprise Architecture Rijksdienst.

EEA

Enterprise Ecological Adaptation.

EIRA

European Interoperability Reference Architecture.

G**GEMMA**

Gemeentelijke Model Architectuur.

I**idEA**

Interactive Dynamic Enterprise Architecture.

ISV

Independent Software Vendor.

IT

Information Technology.

K**KPI**

Key Performance Indicator.

M**MIT**

Massachusetts Institute of Technology.

N**NORA**

Nederlandse Overheids Referentie Architectuur.

S**SaaS**

Software-as-a-Service.

U**UWV**

Uitvoeringsinstituut Werknemersverzekeringen.

V**VNG-R**

'Vereniging Nederlandse Gemeenten - Realisatie'.

VUCA

Volatility, Uncertainty, Complexity and Ambiguity.

A. Properties of the Enterprise Architecture schools of thought

This appendix describes the Enterprise Architecture school of thoughts in more details. It will help the reader with detailed understanding of the three schools of thought.

A.1. The properties of Enterprise IT Architecting

The school of thought Enterprise IT Architecting (Lapalme, 2012, p. 39) is summarised in the following table.

Enterprise IT Architecting school of thought	
Motto	Enterprise architecture is the glue between business & IT
Objectives and concerns	Effectively enable the enterprise strategy Support IT planning and reduce cost Enable business
Principles and assumptions	Apply reductionist (mechanistic) stance Don't question business strategies Design organisational dimensions independently Don't worry about non-IT dimensions; they are not your concerns
Skills	Have technical competence and engineering knowledge
Challenges	Convince the organisation to accept the designed plans
Insights	Permits the design of robust and complex technological solutions Fosters the creation of high-quality models and planning scenarios
Limitation	Can produce inadequate or unfeasible solutions for the larger organizational context Struggles with solution acceptance and implementation barriers Susceptible to “perfect” designs that support unsustainable strategies

Table A.1.: Properties of Enterprise IT Architecting (Lapalme, 2012)

A.2. The properties of Enterprise Integrating

The school of thought Enterprise Integrating is summarised in the following table.

Enterprise Integrating school of thought	
Motto	Enterprise Architecture is the link between strategy and execution
Objectives and concerns	Effectively implement the enterprise strategy Support organizational coherence
Principles and assumptions	Apply a holist (systemic) stance Don't question business strategies and objectives Manage the environment
Skills	Jointly design all organisational dimensions Facilitate small-group collaboration Apply systems thinking
Challenges	Understand organizational systemic dynamics Collaborate across the organization Encourage systems thinking and paradigm shifts
Insights	Permits the design of comprehensive solutions Enables significant organizational efficiency by eliminating unnecessary contradictions and paradoxes
Limitation	Susceptible to “perfect” designs that support unsustainable strategies Requires a paradigm shift from reductionism to holism

Table A.2.: Properties of Enterprise Integrating (Lapalme, 2012)

A.3. The properties of Enterprise Ecological Adaptation

The school of thought Enterprise Ecological Adaptation is summarised in the following table.

	Enterprise Ecological Adaptation school of thought
Motto	Enterprise Architecture is the means for organizational innovation and sustainability
Objectives and concerns	Innovate and adapt Support organizational coherence Encourage System-in-Environment co-evolution
Principles and assumptions	Apply a holist (systemic) stance System-in-Environment co-evolution Environment can be changed Jointly design all organisational dimensions
Skills	Foster dialogue Apply system and thinking Facilitate larger-group collaboration
Challenges	Foster sense making Encourage systems thinking and paradigm shifts Collaborate across the organisation
Insights	Fosters System-in-Environment co-evolution and enterprise coherency Fosters organisational innovation and sustainability
Limitation	Requires many organisational preconditions for management and strategy creation

Table A.3.: Properties of Enterprise Ecological Adaptation (Lapalme, 2012)

B. Authors of the Enterprise Architecture schools of thought

This appendix indicates which authors in the Body of Knowledge are related to which school of thought. Lapalme (2012, p. 42) mapped enterprise architecture authors from the Body of Knowledge according to the three schools of thought.

Enterprise IT Architecting	Enterprise Integrating	Enterprise Ecological Adaptation
Clive Finkelstein	Peter Bernus and Colleagues (editors)	Jamshid Gharajedaghi
Inge Hanschke	Ronald Giachetti	Tom Graves
Col Perks and Tony Beveridge	Leon Kappelman (editor)	Jan Hoogervorst
Jeanne Ross and colleagues	Martin Op't Land and colleagues	James Martin
Steven Spewak and Steven Hill		Kevin Smith and Tom Graves
Martin van den Berg and Marlies van Steenbergen		James Lapalme and Donald de Guerre

Table B.1.: Authors of the Enterprise Architecture schools of thought (Lapalme, 2012)

C. Antifragile literature June 2019–April 2022

This appendix contains the newly found literature as a catch-up on the literature research of Botjes et al. (2021).

Title	Author	Year
A Barbell Strategy-oriented Regulatory Framework and Compliance Management	Gallina, Barbara	2020
A collaborative approach to resilient and antifragile business ecosystems	Ramezani, Javaneh and Camarinha-Matos, Luis M.	2019
A Game Theoretic Approach for Quality Assurance in Software Systems Using Antifragility-Based Learning Hooks	Vimaladevi, M. and Zayaraz, G.	2020
A Literature Review of Organizational Resilience	Ping, Li Peter and Jiazhe, Zhu	2021
A Philosophy of Security Architecture Design	Koien, Geir M.	2020
Agile architecture	Kruchten, Philippe	2013
An Introduction to Residuality Theory: Software Design Heuristics for Complex Systems.	O'Reilly, Barry M.	2020
Antifragility as a design criterion for modelling dynamic systems	de Bruijn, Harald and Groessler, Andreas and Videira, Nuno	2020
Approaches for resilience and antifragility in collaborative business ecosystems	Ramezani, Javaneh and Camarinha-Matos, Luis M.	2020
Architecture Principles for Resilience Beyond Resilience in Sociotechnical Systems	Furrer, Frank J	2019
Black-Swan Type Catastrophes and Antifragility/Supra-resilience of Urban Socio-Technical Infrastructures	Simonette, Marcel and Magalhaes, Mario and Bertassi, Eduardo and Spina, Edison	2019
Conceptualizing resilience in engineering systems: An analysis of the literature	Timashev, S. A.	2020
Cybersecurity in the Internet of Things in Industrial Management	Wied, Morten and Oehmen, Josef and Welo, Torgeir	2020
	Raimundo, Ricardo Jorge and Rosario, Alberico Travassos	2022

Title	Author	Year
Ecosystem antifragility: beyond integrity and resilience	Equihua, Miguel and Espinosa Aldama, Mariana and Gershenson, Carlos and Lopez-Corona, Oliver and Munguia, Mariana and Perez-Maqueo, Octavio and Ramirez-Carrillo, Elvia	2020
Emerging risk management in industry 4.0: an approach to improve organizational and human performance in the complex systems	Brocal, Francisco and Gonzalez, Cristina and Komljenovic, Dragan and Katina, Polinpapilinho F and Sebastian, Miguel A	2019
Enterprise Architecture Resilience by Design: A Method and Case Study Demonstration	Aldea, Adina and Vaicekauskaite, Egle and Daneva, Maya and Piest, Jean Paul Sebastian	2021
Enterprise Development Management through managed chaos	Kasianova, Nataliia and Tarasova, Elena and Kravchuk, Nataliia	2019
Facing uncertainty: An entrepreneurial view of the future?	Bridge, Simon	2021
Microservice Architecture	Nadareishvili, Irakli and Mitra, Ronnie and McLarty, Matt and Amundsen, Mike	2019
No More Snake Oil: Architecting Agility through Antifragility	O'Reilly, Barry	2019
On the meaning and operationalization of antifragility: Comment on the paper by Grossler	van Daalen, Els	2020
Resilience, robustness, and antifragility: Towards an appreciation of distinct organizational responses to adversity	Munoz, Albert and Billsberry, Jon and Ambrosini, Veronique	2022
Self-Improving Autonomic Systems for Antifragile Cyber Defence: Challenges and Opportunities	Chhetri, Mohan Baruwal and Uzunov, V, Anton and Vo, Quoc Bao and Nepal, Surya and Kowalczyk, Ryszard	2019
The Business Transformation Framework and Enterprise Architecture Framework for Managers in Business Innovation The role of legacy processes in automated business environments	Trad, Antoine and IBISTM, France and Kalpic, Damir	2017
The Machine in the Ghost: Autonomy, Hyperconnectivity, and Residual Causality	O'Reilly, Barry M.	2021
The Philosophy of Residuality Theory	O'Reilly, Barry M.	2021
The Tao way to anti-fragile software architectures: the case of mobile applications	Grassi, Vincenzo and Mirandola, Rafaela	2021
Toward a commonly shared public policy perspective for analyzing risk coping strategies	Li, Yanwei and Taeihagh, Araz and de Jong, Martin and Klinke, Andreas	2021
Tutorial on systems with antifragility to downtime	Hole, Kjell Jorgen	2022

Title	Author	Year
We need more Anti-Fragility!	Dirzus, Dagmar	2020

Table C.1.: Literature search June 2019–March 2022 all sources

D. Interview summaries

This appendix contains summaries per interview. This appendix gives the reader of this thesis more details on the answers given by the interviewees. These summaries are created from the recorded interviews and transcriptions belonging to these recordings.

D.1. Interview central government

Question 1 / Enterprise Architecture

Enterprise Architecture is not used and we are not agile. Enterprise Architecture is too difficult for the public administrators. In addition, we are also responsible for other sectors. There is not one architecture. We have multiple reference architectures. What we have to do in the public sector depends on the political decision making within the period of governing (four years until new elections). Enterprise Architecture is at the end of the chain of administrative decision-making.

Question 2 / Agility of the public sector

It is hard to be agile within the public sector. Everything needs to be predefined and planned. Agile working is very difficult within the government. The end goal is not very clear with agile working. It is unclear how the public money is spent on precisely what.

Question 3 / Dealing with uncertainty and unexpected events

The public sector cannot deal with uncertainty. Everything must be predefined and planned. There must be accountability for how public money is spent. All missteps are magnified. There is a quick result in crises, but with possible consequences later on because of 'Adviescollege ICT-toetsing' audits or parliamentary inquiries.

Question 5 / The risk appetite of the public sector

There is no risk appetite. Everything must be known and explainable in advance. If it is found that the procedures are not used, it can result in political consequences later on. Afterwards, positive lessons learned are not used to make adjustments within the public sector. Experimentation is (almost) not possible. (note: blaming culture)

Question 6 / The use of diversity and optionality in the public sector

It would be nice to work with optionality and smaller units within the public sector and Enterprise Architecture to make it easier to adapt. Think about in Enterprise Architecture disposable microservices. Nevertheless, it remains that ea is not important. It is at the end of the chain and is not used in administrative decision-making. Enterprise architecture is confronted with decision-making.

Closing statements

Antifragile is not directly applicable for the central government, but it can have a lot of benefits for suppliers in the public sector. Do not advertise it but exploit it to become better. In the case of an Independent Software Vendor (ISV) think about many disposable micro-services so it will be easier to deal with the public sector.

D.2. Interview local government

Question 1 / Enterprise Architecture

There is somewhat of an Enterprise Architecture, but we are not using it that broadly. As an organisation, we do not have a real Enterprise Architecture. Our organisation is best compared to that of a consultancy firm. Our core task is lobbying advocacy. We guide the things we do, and then again, it concerns the things we do for municipalities or on behalf of municipalities. We have a multi-year vision. We use guiding principles for the things we do. Nevertheless, there are processes in the making for portfolio management. What do we do, what don't we do, and how do they relate to each other. There is not one responsibility on the Enterprise Architecture. It is a stepped responsibility that lies with committees and the services board. When it comes to IT, the responsibility lies with the Directory of Information Society. Enterprise Architecture is used for assay the request for subsidy. When there is a request for a subsidy that is not in line with the goals, it is not requested by the (European) government. The case of how Enterprise Architecture contributes to the agility of the public sector is complicated. The public administrators are not architects and vice versa. Enterprise Architecture is hard to understand. Enterprise Architecture does not provide answers for the problems of today. Ultimately Enterprise Architecture should deliver this so the change can start tomorrow. It is essential to clarify the problems that public administrators are having. Both the facts as well the underlying causes. Enterprise Architecture should clarify the differences. Make it clear where we need to go and map out a path to get there, based on little steps that ultimately lead to the goal. Moreover, in the language public administrators understand. The architect must use the language of the stakeholders to make Enterprise Architecture successful (note: success factor).

Question 2 / Agility of the public sector

The public sector is more about risk aversion. Legality is about holding on to what is known. So, it is exactly known what the municipalities do, and we know precisely what the Land Registry does. All the subsystems of the public sector have a defined assignment. Moreover, it would be best if it stayed between the lines. Think, for example, about purpose limitation. Purpose Limitation will hold it back when public sector wants to be agile. The public sector cannot experiment that easily with rules like these. It will put experimentation at the edge. The operating model of the public sector does not offer the freedom to do so that easily. The public sector can not experiment, discover and then say this was a nice experiment; let us go further. It is impossible to take decisions on the whole, such as within the social domain. If you have the right to confiscate a car, you cannot decide that there need to be a taxi to drive kids to school. It is a responsibility of a different part of the public sector. This all has to do with the House of Thorbecke¹ together with the current legislation and regulations. It does not mean that the public sector does not want to be more agile. It is not about separate parts of the government any more. There is more and more collaboration based on federation. The public sector wants to be more agile. It is

¹ https://www.denederlandsegrondwet.nl/id/vieqcpdzf0gw/bestuurlijke_indeling

often a subject of conversation. Nevertheless, it gets stuck in the administrative decision-making processes.

Question 3 / Dealing with uncertainty

The reflex on uncertainty of the public sector is that the public sector gets very insecure from uncertainty. So the public sector does not know how to deal with uncertainty. The common reflex is to push the uncertainty back to robust/resilient, so it is under control again. Robust & resilient is back to its previous state but then sturdier, more robust (note: Risk avoidance). However, the public sector claims that they can deal with it. See, for example, the energy transition. The public sector defined the framework for this transition. It can contribute to the economy with many new jobs and a new knowledge model. We did see that also in the past with road and waterway engineering. Nevertheless, then they forget about the mechanisms needed to accomplish it. So the public sector does want to deal with uncertainty, but the public sector is not creating the right conditions or the freedom of acting to be able to do so. The available Enterprise Architecture's within the public sector do not help either. It does not contribute to accept uncertainty. At the most, our new vision on Information, Common Ground¹, is contributing to this. An important principle in that vision is the "community" principle that could help with this uncertainty (note: shared mental models). This principle states that municipalities, chain partners, market parties and the VNG-R work together as a community in realisation. It is the certainty that it is uncertain. There are always new issues, and organising collaboration will help us to better deal with this uncertainty, especially in the public sector.

Question 4 / Dealing with unexpected events

We, fortunately, live in a country where the public sector is staffed with good people who understand what citizens need or what is needed in a disaster area. So help is available pretty quickly. For example the fires at Moerdijk², near Rotterdam. Or the plane crash of Turkish Airlines³ at Schiphol. Before we knew it, the fires were already distinguished. However, the public sector is not able to ascertain if it is an incident or a structural problem. If the problem takes too long, we see the reflex to control it again, so we fall back to our past habits. Adopting newly learned patterns is hard with the current legislation and regulations. Maybe we must be in a continuous crisis, so we have the freedom to do what we have to do. It is easier to be more agile in a crisis. With the local governments, there is only one who can decide what to do in a crisis, and this is the mayor as part of the triangle⁴. It seems that the local governments have two organisation & operational models. A model for running the municipality in a normal state and one in a state of crisis. (note: Seneca's Barbell?)

Question 5 / The risk appetite of the public sector

Drive and urge for innovation and change, which could perhaps be another interpretation of the word risk. People in the public sector want to find out if it can be done differently, but it is very dependent on the person. So actually, that depends on people in the public sector. Not on the public sector as a whole, based on intrinsic motivation to make things better for citizens and entrepreneurs. We have even set up our organisation in such a way that we can support

1 <https://commonground.nl/>

2 https://nl.wikipedia.org/wiki/Brand_Moerdijk_5_januari_2011

3 https://en.wikipedia.org/wiki/Turkish_Airlines_Flight_1951

4 [https://nl.wikipedia.org/wiki/Driehoek_\(overheid\)](https://nl.wikipedia.org/wiki/Driehoek_(overheid))

this. Nowadays we have a department for research and innovation. But after something new is thought of it will go to the department to create it and finally to a department to maintain it. Sometimes we are limited because it influences the standing legislation and regulations.

Question 6 / The use of diversity and optionality in the public sector

The public sector is not supporting diversity and optionality, but on the other hand the public sector is based on the absolute premise that all organisations are autonomous. (note: with a clear goal per organisation so no options). The implementation of the policies is extremely diverse. For example, there are various approaches known for people who are unemployed. One municipality forces people to perform work before they receive benefits, while another municipality supports them to be financially healthy again. Both achieve the obligation to provide care to a citizen so that the citizen has an income again. Diversity and optionality are less important. The local authorities simply have to implement the policies. It is all set down in the law and regulations. There is quite a diversity in how municipalities organize things. One municipality collects the household waste itself, while another has outsourced it. In both cases, the collection of household waste is arranged. Nobody prescribes how you arrange it, as long as it is arranged. You see the same thing within IT. However, you see here that for transitions and transformations an Enterprise Architecture is enormously needed to support the new world.

Closing statements

The government will not disappear, but that trust in the government will. Some government organizations or parts of them can undoubtedly disappear. (note: does not fit with the questions but find it an important statement). The public sector needs a cross-sector Enterprise Architecture. It's no longer just about your organization. You have to work together more and more. The Enterprise Architecture can then be further tailored to your own organization.

D.3. Interview Independent Software Vendor

Question 1 / Enterprise Architecture

Enterprise Architecture is developed to bring the business units together under one single architecture firstly. A common architecture brings synergy. It is reusing common components. Develop common language (note: Learning Organisation attribute shared mental model). It will bring us efficiency. Starting with architecture as a steering mechanism (note: engineering resiliency attribute Command & Control) and currently focusing on the internal organisation, the enterprise (note: mostly the first school of thought of Enterprise Architecture (Lapalme, 2012)). It is emerging that the current architecture is used as a communication mechanism to the external context (note: first steps into the second school of thought of Enterprise Architecture (Lapalme, 2012)). Our Enterprise Architecture is supporting us with the transformation towards a Software-as-a-Service (SaaS) provider. The Enterprise Architecture is used more and more as a mechanism for explaining. The focus of the Enterprise Architecture is at this moment 80% on the internal organisation and 20% on the external context (note: not yet the third school of thought of Enterprise Architecture). Enterprise Architecture is the responsibility of the Chief Operations Officer (COO) but the group of executive management is accountable. This group contains the Chief Executive Officer (CEO), the COO and the Chief Commercial Officer (CCO). (note: with placing the responsibility on Enterprise Architecture with the COO the primary purpose of Enterprise Architecture will be efficiency). The interviewee (CEO) does

not worry about this because in the end everything ends up with the Enterprise Architecture. Enterprise Architecture must be part of the executives. Enterprise Architecture is essential for business operations. Our Enterprise Architecture supports us to be agile. Our crown jewels (our applications) are a stable core around which we can be flexible and agile to follow external contexts such as new laws and legislation. Think about the Application Programming Interface (API) layer (note: systems resiliency attribute Loosely Coupled) that is being built that makes it easier to respond to these changes. Eventually, our Enterprise Architecture must enable us to change to support our customers with their social tasks. We are not there yet. The transformation towards Software-as-a-Service (SaaS) alone takes us multiple years. This is, at this moment, not a problem yet. The public sector is even moving slower, and there is not that much competition, but it is changing rapidly. The pace of change is increasing. It can be said that sometimes there is already a permanent state of change. Take the replanning of the municipalities and shifting tasks from the centralised government to the local government. The role of technology gets even more critical, the civilians are getting more empowered, and the participation rate in society increases. The influence of the external contexts does have more and more influence. Only the digital transformation itself is a stressor on the public sector. It already was there, but we see an increase. At this moment, the policymakers (politics) limit the speed of change. These are not isolated incidents. An example is the "Digitaal Stelsel Omgevingswet", which is again being postponed. This is not sustainable in the near future. If this does not change, the public sector will get stuck.

Question 2 / Agility of the public sector

The current operational model of the public sector is old and moves slowly because of the regulations, legislation and qualified-majority decision-making. However, when there is a crisis, everything is possible. But only under extraordinary conditions. The should be in a continuous crisis (note: looks like the antifragile attribute of insert randomness). After a crisis, lessons learned are not used to improve the public sector (note: attribute part of the learning organisation). There is no feedback loop. The system is not supporting this. Changes to the current systems are slow, complex and large. Because of this, there are not that many suppliers on some solutions. For several solutions, there is only a choice between two (note: the CAS attribute diversity and optionality is not available.). In the worst case, there is only one solution, like with the taxes administration of the Ministry of Finance. The architectures in the cannot support it because it misses alignment with business language. It misses stakeholder specific views in the language of the stakeholders. A good example is the Interactive Dynamic Enterprise Architecture (idEA)¹ method of the government. However, they stopped using it. Most IT management in the Public Sector is not IT Savvy. It would be better to have IT Savvy Management experienced with policymaking. The IT Systems contain much technical debt. To the extent that the systems with new functionality often use encapsulation. Adjusting IT Systems take much time with many risks. The impact of a new coalition agreement is high. With a coalition agreement, many high-impact system adjustments must be made. The policymakers expect changes to be executed in only a couple of days. In the past, public sector organisations were loosely coupled and were highly cohesive (clear goal). With all those policy changes, organisations even got strangled and cannot be adjusted that easily any more, like with the taxes administration of the Ministry of Finance as an Example. The taxes administration was specialised in collecting taxes (note: Systems Resilience attribute Loosely Coupled (High Cohesion)). Policymakers also forced them to disbursement (note: Systems Resilience attribute antipattern with result tightly coupled with low cohesion). The same departments, processes and systems were used.

¹ <https://www.ictu.nl/projecten/idea-beeldtaal-maakt-it-infrastructuur-begrijpelijk>

Question 3 / Dealing with uncertainty

You cannot define uncertainty on the public sector as a whole. The average size of municipalities is growing because of the reordering of Municipalities. Municipalities that are too small are merged (note: decrease of modularity, self-organisation and diversity). The scaling of municipalities is not always in the best interest of the civilians. It does not always improve the services to the residents of the municipalities. There are cases where a civilian needs to cycle 10km for a passport while it was less in the old situation. The services given are more business-like without a personal touch. If you look at the public sector for the last 200 years, the public sector is capable of adjusting when it needs to be adjusted (note: resilient/robust). The public sector can deal with uncertainty. However, if the way the public sector deals with uncertainty is the most efficient way is the question. The social cohesion that the civil servants of the public sector have is enormous. The public sector can handle uncertainty. The will is intrinsic available. If they get an assignment, they are going for it. If it must be done within four years (the duration of a coalition agreement), they will go for it. Even if the change is too big or complex and the planning is not realistic. An example of the effect is that of the childcare benefits scandal¹. Decentralisation of governmental tasks was the cause of this. Because of the absence of Enterprise Architecture and the usage of Enterprise Architecture within the domains, such as social domain, taxes, finance, a.o., these examples are not an incident. Enterprise Architecture can prevent these causes and effects. The fact that the public sector did not organise Enterprise Architecture is a cause of the incidents. The actual absence is an Enterprise Architecture process that guides the governments. This behaviour is especially shown with the local governments. They are continuously reinventing the wheel (note: No overarching Command & Control). The public sector has to go back to the drawing board for every change to develop a new approach.

Question 4 / Dealing with unexpected events

The public sector is handling unexpected events better than uncertainty. The public sector handles unexpected events better than the political decisions made by coalition agreements. In a crisis situation, the public sector is capable of working very effectively. Should the public sector be in an ongoing crisis? No. The public sector is in need for antifragile solutions. Better is to continuously add a small amount of stress to the public sector system (note: antifragile attribute insert randomness). This is in contrast to sitting back and watching until something happens. It seems that the rules do not apply any more with an unexpected event. The public sector has many talents to deal with these situations, but they all seem too busy with their careers, salaries, what should go to which ministry, and others. This is the thing that needs to be solved. Strange because most of the time, the employees in the public sector enjoy working in a crisis. It makes them feel proud that they accomplished something. There were initiatives to use Enterprise Architecture, and it proved to be supporting the changes. Overarching examples are, for example, the consolidation of 66 datacenters to two private and two public datacenters (note: diversity and optionality), the common desktop standard (project "goud") (note: part of the stable part of Seneca's barbell strategy). Re-usability, an ICT dashboard, and many more initiatives were worked on. Later on, these initiatives fell apart, and the ministries picked it up again in their silo. It all was carried by a select group of people in the public sector. It all fell apart when some of them left the public sector. If it does not have assignments from the government members, it is dependent on the willingness to cooperate. The dominance of the separate ministries take the overhand, and people fall back in the old habits. To sustain the use of Enterprise Architecture it should not depend on a selective group of people but on the public sector itself (note: success

¹ https://en.wikipedia.org/wiki/Dutch_childcare_benefits_scandal

factor). The mutual differences are gone when there is a common enemy (an unexpected event). At that moment, the solution will overarch the public sector. Changes following the process have less effect than changes initiated by chaos. The feedback from unexpected events is not fed into the system so that it can be changed (note: learning organisation not in place).

Question 5 / The risk appetite of the public sector

For the risk appetite of the public sector, the government members have an essential role. At this moment, there is no culture of risk-taking. Even worse, taking risks can have serious consequences. Think about, for example, commission "Elias"¹. Because of this commission, a new department, 'Adviescollege ICT-toetsing', was started as part of the Ministry of Home Affairs with the assignment to assess all the IT Projects within the centralised government (note: Engineering Resilience attribute Command & Control). Because of this, people are not willing to take risks any more (note: insert randomness, tinkering, naive interventions, monotonicity, fail-fast, and others). Some are busy shielding their bosses and managers for possible errors (note: antifragile attribute: (no) skin in the game). At this moment, the public sector is showing risk avoidance behaviour. The base attitude of the public sector is that it does not have a risk appetite. Partly because of public opinion. It is all about the use of public funds. Before you know it, there will be negative attention in the media. Enterprise Architecture is mostly used in a prescriptive way (note: Engineering Resilience attribute Command & Control). The public sector is not foster a safe environment for experimentation. Even when a good solution is implemented in a time of crisis (unexpected events), punishment will happen afterwards because it did not comply in the way it usually should. The public sector created an environment in which the public sector is a fragile "glass house" together with a culture of blaming. So the risk appetite is getting less and less.

Question 6 / The use of diversity and optionality in the public sector

Optionality does not have a chance in the public sector because of European tender obligations. The European tenders are mostly about risk reduction. The European tenders contain many legal conditions. But not only legal conditions but also a lot of technical conditions. Everything is defined in a way that you have no options any more. The conditions are even so that you cannot choose, for example, multiple suppliers so you will have options during the contract periods. The private sector has this already for a long time. There are private companies who have multiple suppliers for a domain. If one supplier is not delivering the quality any more another supplier is taking over. European tenders did not help us to become more flexible, resilient, and agile. But there are changes. It would be nice to see if the 'Vereniging Nederlandse Gemeenten - Realisatie' (VNG-R) will be thinking of a broker construction with multiple suppliers. By using this strategy the local governments can choose a supplier by only using bids. It is easier to switch and having options. Another thing that can help optionality is defining right Key Performance Indicator (KPI)'s. If you define a KPI in such a way that the performance of a supplier is measured by the ease of transitioning to another supplier it will get easier to switch suppliers. This has a positive influence on executing optionality. But this way of working is not sustained in, for example, the Enterprise Architecture.

¹ https://nl.wikipedia.org/wiki/Parlementair_onderzoek_ICT-projecten_bij_de_overheid

Closing statements

The digital transformation must be important to everyone and not only to a minister of digital affairs. How do you make sure that business management of the public sector find it normal to discuss IT, budget, personnel, organisational configuration, and others? If they start thinking like this, they will find out what Enterprise Architecture can do for them. If we know how to close this gap, digital transformation will get the proper attention. We also have to thank ourselves for this because of the use of non-business language.

D.4. Interview consultancy firm/service provider

Question 1 / Enterprise Architecture

We have, to an extent, an Enterprise Architecture with the necessary elements for the products and services we develop ourselves. We do not have a dedicated enterprise architect. Other types of architects maintain the current Enterprise Architecture. The CTO is accountable for the Enterprise Architecture. In the end, everything rolls up to the CEO.

Our Enterprise Architecture is, at this moment, mostly about our products and services and addresses our primary concerns. The concerns are the connections between data, how they should communicate, and the impact on our products and services. With the Enterprise Architecture, we can determine our solution gaps and steer towards procurement of applications and integrations. The integrations are with the sales, finance, HR, and delivery capabilities. We still have two separate worlds in our organisation. These two worlds are the supporting and delivery capabilities of our organisation. Bringing these two worlds together will be on the roadmap for next year so we can work with an integrated Enterprise Architecture. Both worlds come together when we think about our customers. We will realise that when we develop features for our platform, we can connect to the propositions that we offer to our customers. The lack of an Enterprise Architecture slows us down from achieving this. We do not have a business architecture, but we advise our customers on business architecture. We have to close this gap.

With the current Enterprise Architecture we can make adjustments to our products and services very fast and flexible. Our Enterprise Architecture supports it because it contains the architecture of our products and services and our infrastructure down to the data models that we use for our customers. However, we do not have control over our supporting applications, such as Salesforce. Our products and services are robust & resilient and support us to be agile. Sometimes we disconnect a server to see what happens (note: insert randomness / SRE / Chaos Engineering). We continuously improve ourselves to get better (note: learning organisation).

Question 2 / Agility of the public sector

There is a low degree of agility in the public sector. This low agility is possible because of the lack of IT knowledge and skills in politics and policymakers. If we look at the electoral lists of the central and local elections, we can state that there is a shortage of knowledge, skills and fundamental IT knowledge. There are exceptions, but not that much.

If we compare this to, for example, the Estonian model, we see a world of difference. We are not there (yet). We have to invest more in this. If we think of the public sector as an aggregate and you go lower in the aggregation, you already see that it is going better. We see that the public sector has been taking significant steps in the last ten years. Administrative governmental agencies have more responsibilities to operationalise, develop and maintain systems. We have been able to leave a mark in the on the technical quality of systems. It is a good development that the exists. The operating model of the public sector is extending. Compared to the private sector, the

government is at a good average. Maybe this is already a good position for the government. We will see more and more connections and integrations with specific ministries and administrative agencies. The digital transformation is progressing. More and more is shared online and is easy to access. We see this as a positive effect. We can help the public sector further because of this by bringing in best practices. How should we unlock our data, what can we do with this data, and what is the effect on IT and Governance. Enterprise Architecture can support us in this.

Question 3 / Dealing with uncertainty

We see the desire for robustness & resilience. The public sector tries to push it back to how it was. As an example, the regulations on electric steps. It is a new development, and it falls outside the scope of current regulations. It is not a scooter or a bicycle, and it does not fit in any other regulations. The reaction of the policymakers is to rule it out. It is not allowed until there is an agreement on new regulations. The Dutch model is to push it back to how it was. The electric steps are allowed if there is an agreement on how to allow them. We see the same behaviour with the IT capability. Policymaking takes time. It slows down new developments. The choices are made based on robustness, certainty and clarity. The behaviour has everything to do with the risk aversion of the public sector.

The basic attitude of the public sector is to avoid mistakes. When a choice has a risk, they do not decide until everything is clear. There is an implicit postponement in this behaviour. The risk of this behaviour is that the public sector is missing great opportunities. The founding of is an excellent thing to have some certainty, but it is concerning that the whole public sector is moving towards control and risk mitigation. It removes agility from the system while the government plays a facilitating role in our society. All risks should be avoided, and everything needs to be traceable, making no mistakes. By this approach, the public sector is probably missing out on options that can make a difference, and it inhibits realising potentials. The public sector is using Enterprise Architecture as a way to attenuate.

Question 4 / Dealing with unexpected events

If something happens, there is the will to act by setting up something new, reworking systems, and other things. Nevertheless, there still is a considerable delay after the unexpected event happened. After achieving the goal is directly followed up by attenuation. The public sector does not want to make mistakes, so the public sector will do as minimal as possible to achieve the goal because of risk mitigation.

If something happens, the public sector deals with that. However, because of the aversion to risks, the public sector is not getting the most out of it. If the public sector exploits the situation, instead of familiar ways, with more radical approaches, the result will be a significant progression, even when there is uncertainty. It is another way of doing so with the risk that something will go wrong. If it goes wrong, there is a risk that the press will magnify it because it is about spending public money. Unfortunately, successes do not get attention.

Question 5 / The risk appetite of the public sector

We want to play a role in this world by being more innovative. We allow some governmental bodies to go a little further in experimentation and development, but this is mainly on a project-by-project basis. For these projects, we accepted that it would cost us public money and that making mistakes is allowed. However, generically, the trajectories we see do not have a risk appetite and are even risk-averse. Most of the time, this is good for a reliable government. Use, for risk-taking cases, specific demarcated parts of the public sector.

Question 6 / The use of diversity and optionality in the public sector

We see an improvement on this topic over the past years in the public sector. We see a growth in knowledge, from an IT perspective, in multiple areas in the public sector. E.g. architecture, implementation, development, code quality and other qualitative aspects of IT. We see, at this moment, this contribution mainly from the central government and not so much from the local governments. We think that this improvement will continue. We do hope that this improvement will reach the electoral lists. If we look at the systems, we do not see any uniformity. We do see differences in designs and the ways of looking at things.

E. Interview findings

This appendix describes the interview findings in more details. This appendix can be used by the reader of the thesis with more detailed information.

E.1. Interview findings Engineering Resilience attributes

Code	Count	% Codes	Cases	% Cases
Top Down CC	18	3,10%	4	100,00%
No Top Down CC	2	0,30%	1	25,00%
Micro-Management	17	2,90%	4	100,00%
No Micro-Management	2	0,30%	1	25,00%

Table E.1.: Interview findings Engineering Resilience

E.2. Interview findings Systems Resilience attributes

Code	Count	% Codes	Cases	% Cases
Redundancy	3	0,50%	3	75,00%
No Redundancy	1	0,20%	1	25,00%
Modularity	5	0,90%	3	75,00%
No Modularity	3	0,50%	1	25,00%
Loosely Coupled	5	0,90%	3	75,00%
Not Loosely Coupled				

Table E.2.: Interview findings Systems Resilience

E.3. Interview findings Complex Adaptive Systems Resilience attributes

Code	Count	% Codes	Cases	% Cases
Diversity	15	2,60%	3	75,00%
No Diversity	9	1,60%	2	50,00%
Optionality	12	2,10%	3	75,00%
No Optionality	13	2,30%	4	100,00%
Mono-Monotonicity	3	0,50%	2	50,00%
No Mono-Monotonicity	13	2,30%	4	100,00%
Emergence	3	0,50%	3	75,00%
No Emergence	3	0,50%	1	25,00%
Self-Organisation	3	0,50%	2	50,00%
No Self-Organisation	3	0,50%	3	75,00%
Insert Low Level Stress	19	3,30%	3	75,00%
No Insert Low Level Stress	6	1,00%	3	75,00%
Network-Connections	2	0,30%	1	25,00%
No Network-Connections				
Fail Fast	6	1,00%	3	75,00%
No Fail Fast	12	2,10%	3	75,00%

Table E.3.: Interview findings Complex Adaptive Systems Resilience

E.4. Interview findings Antifragile attributes

Code	Count	% Codes	Cases	% Cases
Resources to Invest	7	1,20%	3	75,00%
No Resources to Invest	7	1,20%	3	75,00%
Seneca's Barbell	9	1,60%	3	75,00%
No Seneca's Barbell	6	1,00%	3	75,00%
Insert Randomness	8	1,40%	3	75,00%
No Insert Randomness	6	1,00%	3	75,00%
Reduce naive intervention	6	1,00%	2	50,00%
Skin in the Game	3	0,50%	2	50,00%
No skin in the game	5	0,90%	2	50,00%

Table E.4.: Interview findings Antifragile

E.5. Interview findings learning organisation attributes

Code	Count	% Codes	Cases	% Cases
Personal Mastery	5	0,90%	3	75,00%
No Personal Mastery	1	0,20%	1	25,00%
Shared Mental Models	23	4,00%	3	75,00%
No Shared Mental Models	17	2,90%	3	75,00%
Building Shared Vision	16	2,80%	3	75,00%
No Building Shared Vision	13	2,30%	3	75,00%
Team Learning	5	0,90%	3	75,00%
No Team Learning	2	0,30%	2	50,00%
Systems Thinking	3	0,50%	2	50,00%
No Systems Thinking	1	0,20%	1	25,00%

Table E.5.: Interview findings Learning Organisation

E.6. Interview findings Enterprise Architecture schools of thought

Code	Count	% Codes	Cases	% Cases
Enterprise IT Architecting	5	0,90%	3	75,00%
Enterprise Integrating	7	1,20%	2	50,00%
Enterprise Ecological Adaption	5	0,90%	2	50,00%

Table E.6.: Interview findings Enterprise Architecture schools of thought

E.7. Interview findings new attributes

Code Description	Count	% Codes	Cases	% Cases
Adapt to business language	18	3,10%	4	100,00%
No Safe Environment	7	1,20%	2	50,00%
Blaming Culture	12	2,10%	3	75,00%
Limited ea	15	2,60%	4	100,00%
Agility	14	2,40%	3	75,00%
No Agility	18	3,10%	4	100,00%
Robust/Resilient	23	4,00%	3	75,00%
Fragile				
Shortage of IT Knowledge	4	0,70%	2	50,00%
Benchmarked to Estonia/Sweden	2	0,30%	2	50,00%
Development of knowledge	2	0,30%	1	25,00%
Applying Best Practices	3	0,50%	2	50,00%
Governance	37	6,40%	4	100,00%
Conservative	14	2,40%	3	75,00%
Social Responsibility	14	2,40%	4	100,00%
Risk Avoidance	32	5,50%	4	100,00%
Tinkering	6	1,00%	3	75,00%
Stressor	18	3,10%	2	50,00%

Table E.7.: Interview findings new attributes

F. Expert group findings

This appendix contains all the detailed information on the ratings of the expert group participants. Those details are the scoring of the individual participants and the overview of the rating, variability and abstains per attribute. It follows the same structure and order of chapter 5.

F.1. Validation of antifragile attributes

F.1.1. Validation of optionality

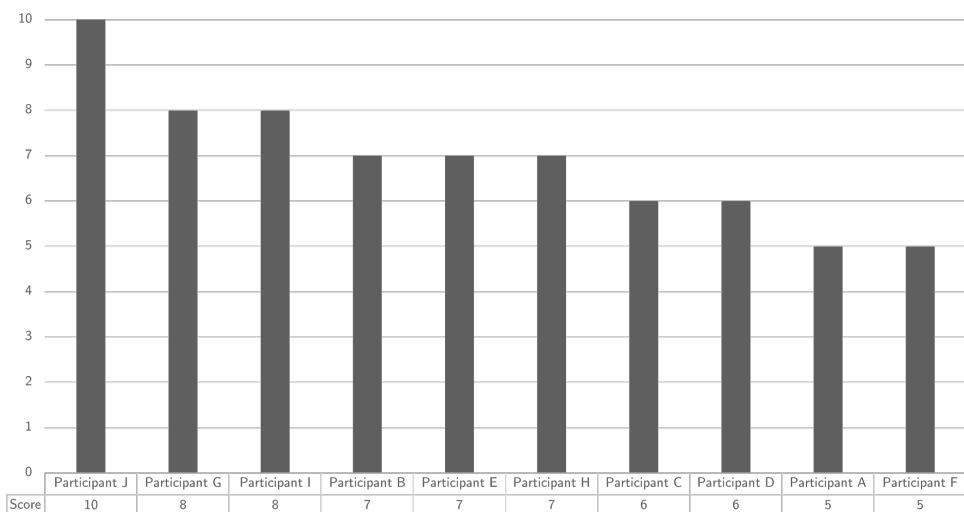


Figure F.1.: Rating of antifragile attribute Optionality

Attribute	Rating	Variability	Abstains
Optionality	6,9	32%	0

Table F.1.: Rating of antifragile attribute Optionality

F.1.2. Validation of non-monotonicity

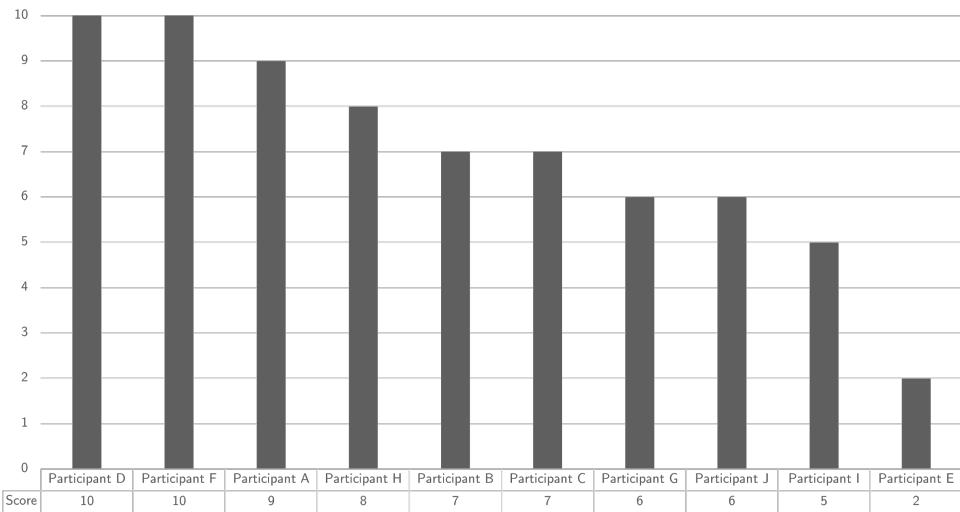


Figure F.2.: Scoring of antifragile attribute Mono-Monotonicity

Attribute	Rating	Variability	Abstains
Mono-Monotonicity	7	51%	0

Table F.2.: Scoring of antifragile attribute Mono-Monotonicity

F.1.3. Self-Organisation

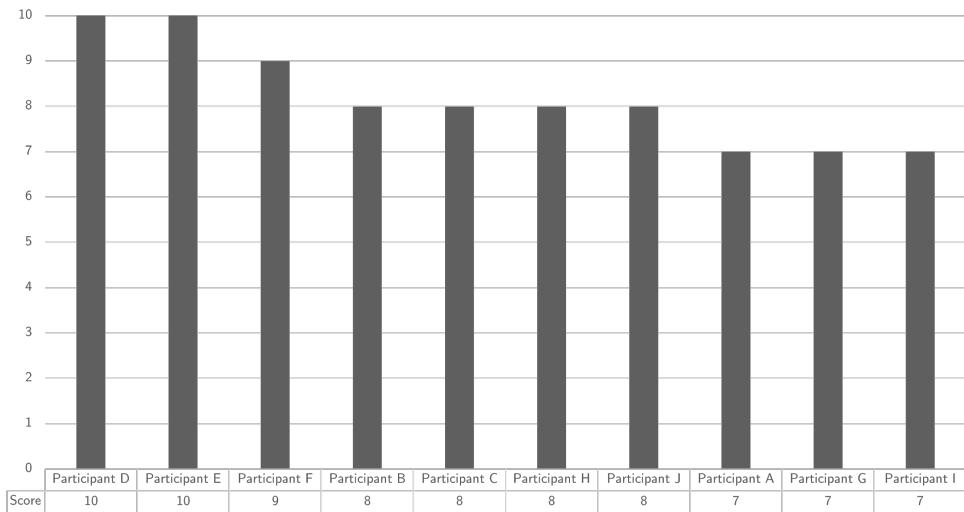


Figure F.3.: Scoring of antifragile attribute Self-Organisation

Attribute	Rating	Variability	Abstains
Self-Organisation	8,2	23%	0

Table F.3.: Scoring of antifragile attribute Self-Organisation

F.1.4. Fail-Fast

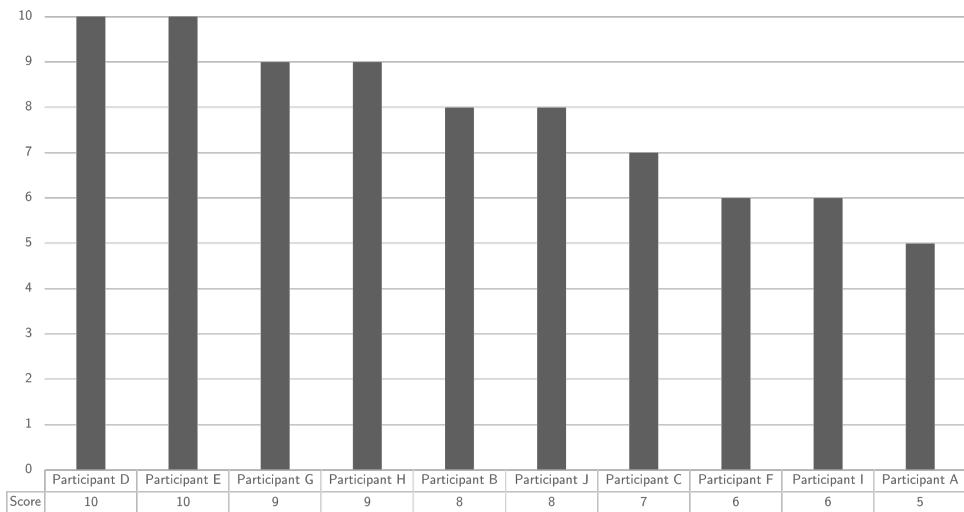


Figure F.4.: Scoring of antifragile attribute Fail-Fast

Attribute	Rating	Variability	Abstains
Fail-Fast	7,8	35%	0

Table F.4.: Scoring of antifragile attribute Fail-Fast

F.1.5. Resources to invest

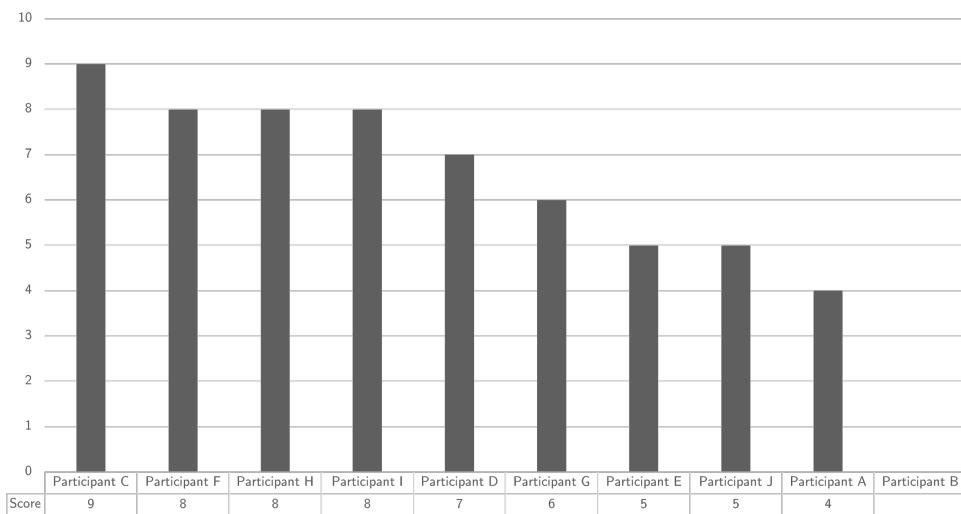


Figure F.5.: Scoring of antifragile attribute Resources to Invest

Attribute	Rating	Variability	Abstains
Resources to Invest	6,7	36%	1

Table F.5.: Scoring of antifragile attribute Resources to Invest

F.1.6. Senenca's Barbell

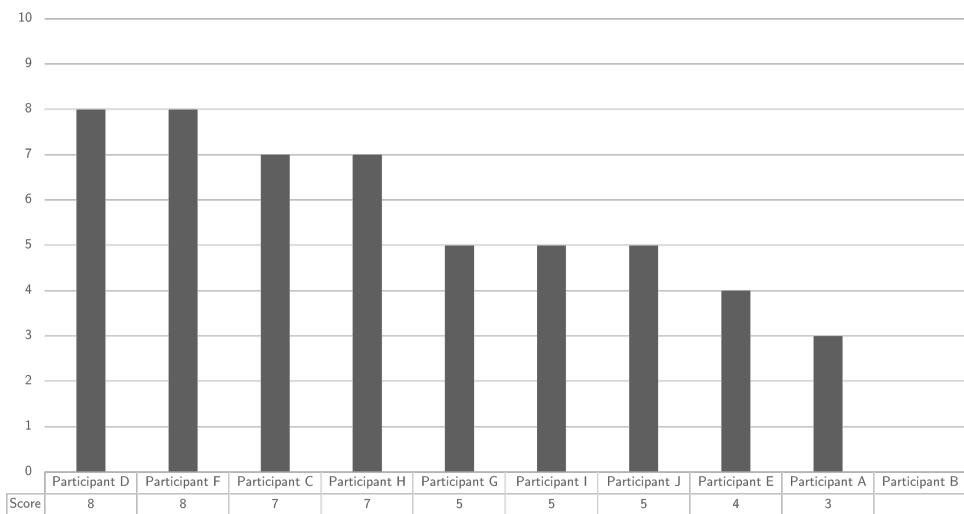


Figure F.6.: Scoring of antifragile attribute Seneca's Barbell

Attribute	Rating	Variability	Abstains
Seneca's Barbell	5,8	37%	1

Table F.6.: Scoring of antifragile attribute Seneca's Barbell

F.1.7. Safe working environment

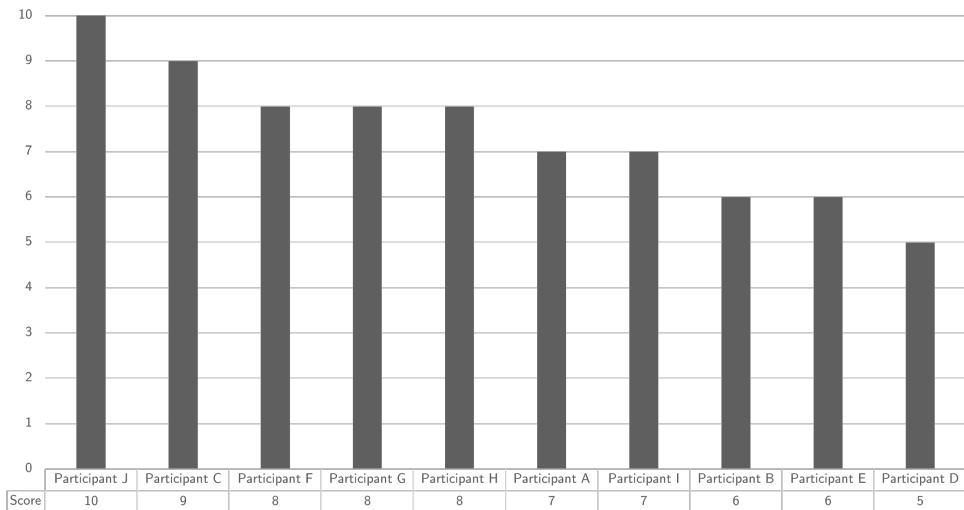


Figure F.7.: Scoring of antifragile attribute Safe working environment

Attribute	Rating	Variability	Abstains
Safe working environment	7,4	31%	0

Table F.7.: Scoring of antifragile attribute Safe working environment

F.1.8. Outside-In and Collaboration

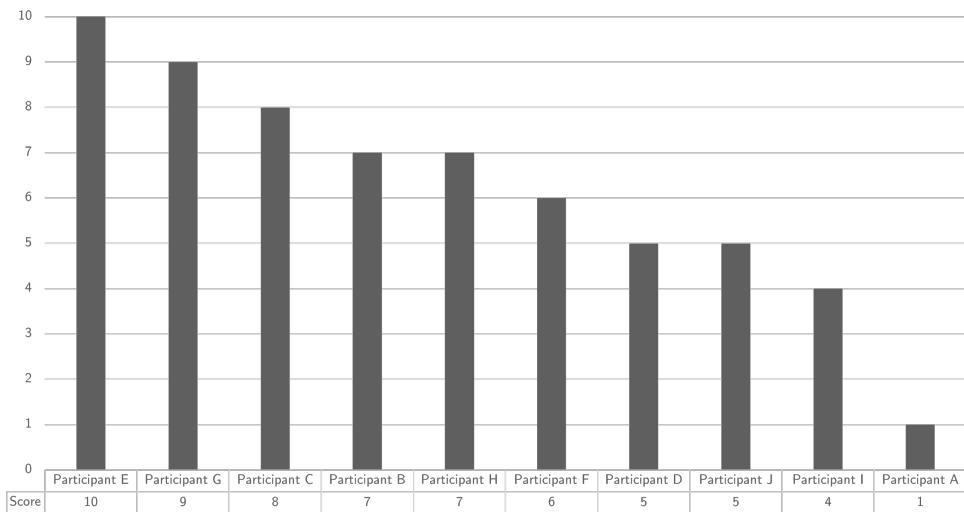


Figure F.8.: Scoring of antifragile attribute Outside-In and Collaboration

Attribute	Rating	Variability	Abstains
Outside-In and Collaboration	6,2	55%	0

Table F.8.: Scoring of antifragile attribute Outside-In and Collaboration

F.1.9. Data Governance Planes

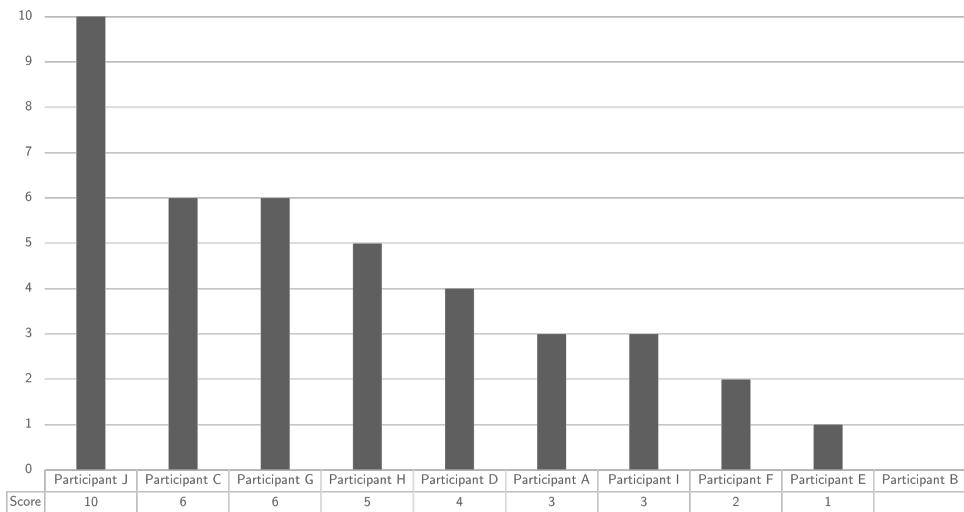


Figure F.9.: Scoring of antifragile attribute Data Governance Planes

Attribute	Rating	Variability	Abstains
Data Governance Planes	4,4	56%	1

Table F.9.: Scoring of antifragile attribute Data Governance Planes

F.2. Validation of Enterprise Architecture schools of thought

School	Rating	Variability	Abstains
Enterprise IT Architecting	5,6	34%	0
Enterprise Integrating	7,2	16%	0
Enterprise Ecological Adaptation	8,8	27%	0

Table F.10.: Validation of Enterprise Architecture schools of thought

F.2.1. Enterprise IT Architecting

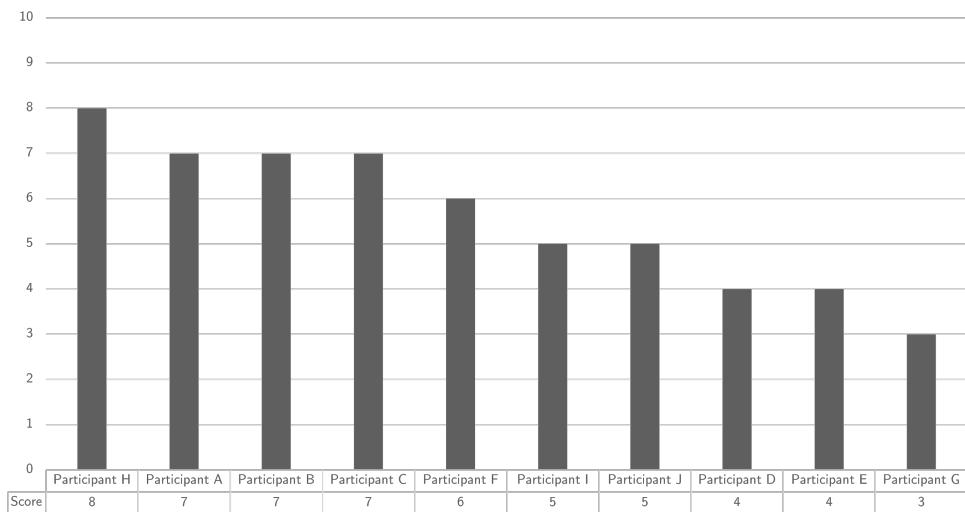


Figure F.10.: Scoring of school of thought Enterprise IT Architecting

Attribute	Rating	Variability	Abstains
Enterprise IT Architecting	5,6	34%	0

Table F.11.: Scoring of school of thought Enterprise IT Architecting

F.2.2. Enterprise Integrating

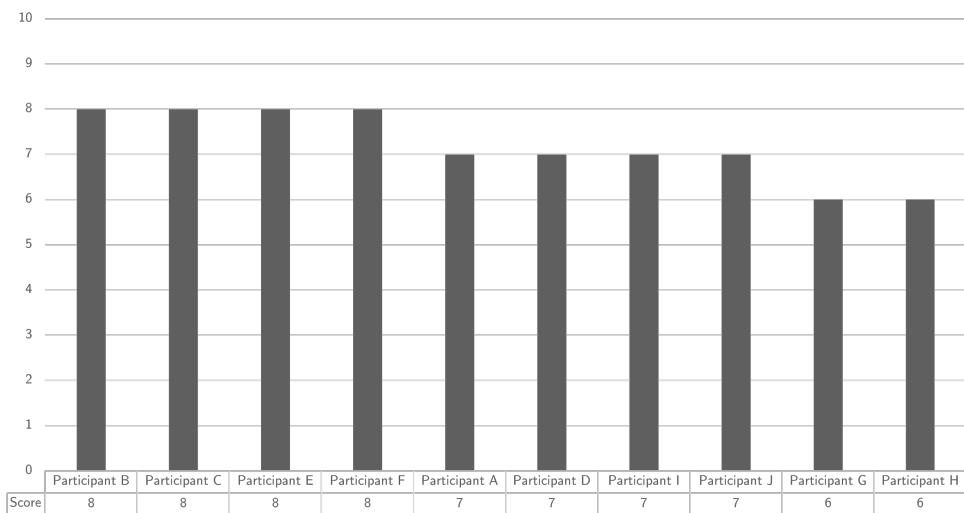


Figure F.11.: Scoring of school of thought Enterprise Integrating

Attribute	Rating	Variability	Abstains
Enterprise Integrating	7,2	16%	0

Table F.12.: Scoring of school of thought Enterprise Integrating

F.2.3. Enterprise Ecological Adaptation

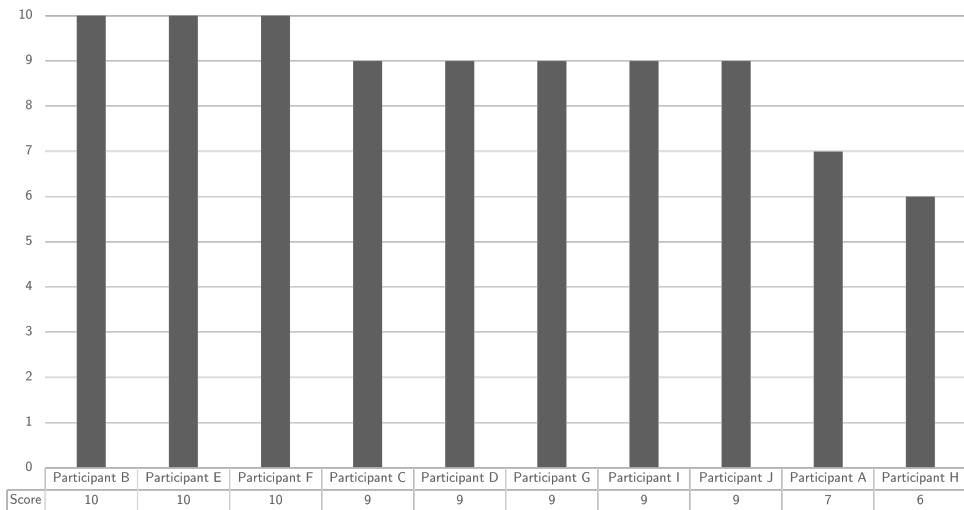


Figure F.12.: Scoring of school of thought Enterprise Ecological Adaptation

Attribute	Rating	Variability	Abstains
Enterprise Ecological Adaptation	8,8	27%	0

Table F.13.: Scoring of school of thought Enterprise Ecological Adaptation

F.3. Validation of Enterprise Architecture attributes

Attribute	Rating	Variability	Abstains
Systems-in-Environment thinking	7,7	28%	0
Holistic (systemic) stance	7	47%	0
Organisational learning	7,3	44%	0
Environmental learning	7,7	29%	0
Intra-organisational coherency	6,4	31%	0
System-in-environment coevolution learning	6,6	36%	0
Adapt to business language	7,1	35%	0
Agile Enterprise	6,4	50%	0
Real-Time Trust	5,6	54%	1
Foster dialogue	6,9	32%	0
Architecture validation	7,4	24%	0
Always Fitting Enterprise Architecture	5,8	46%	1

Table F.14.: Validation of Enterprise Architecture attributes

F.3.1. Systems-in-Environment thinking

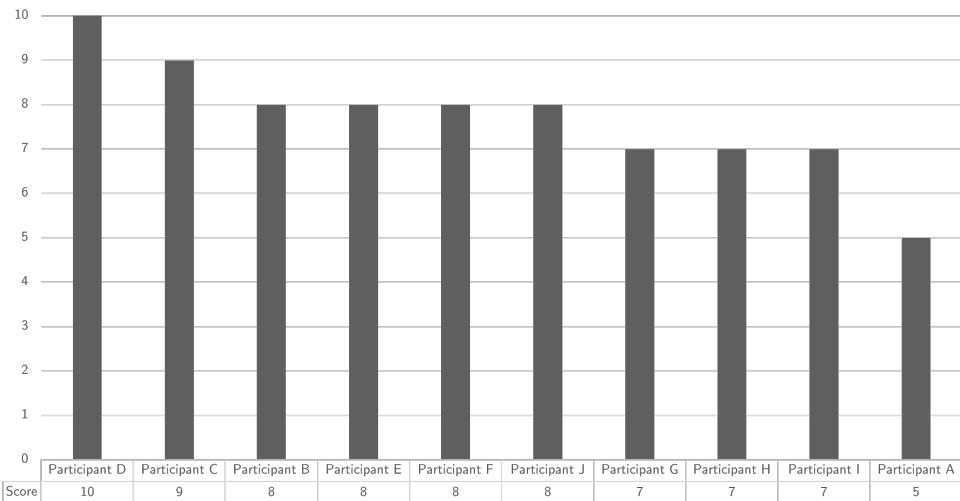


Figure F.13.: Scoring of Enterprise Architecture attribute Systems-in-Environment thinking

Attribute	Rating	Variability	Abstains
Systems-in-Environment thinking	7,7	28%	0

Table F.15.: Scoring of Enterprise Architecture attribute Systems-in-Environment thinking

F.3.2. Holistic (systemic) stance

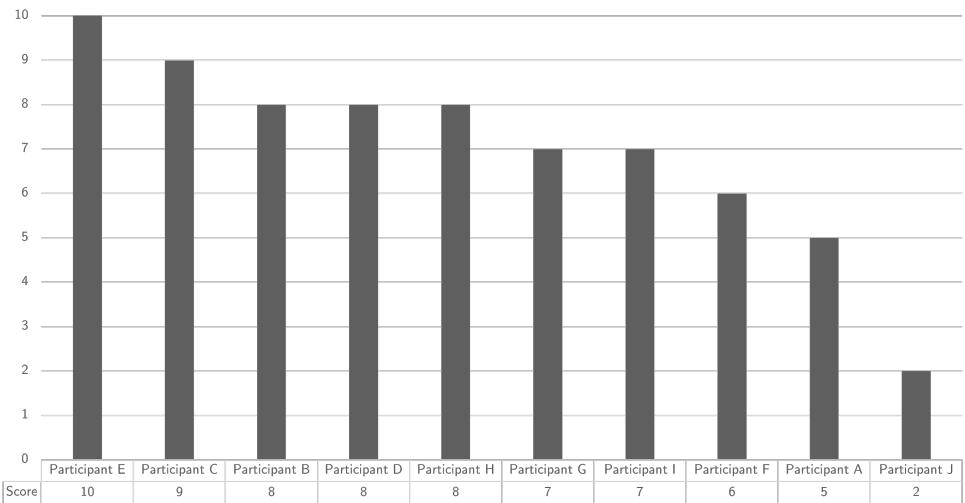


Figure F.14.: Scoring of Enterprise Architecture attribute Holistic (systemic) stance

Attribute	Rating	Variability	Abstains
Holistic (systemic) stance	7	47%	0

Table F.16.: Scoring of Enterprise Architecture attribute Holistic (systemic) stance

F.3.3. Organisational learning

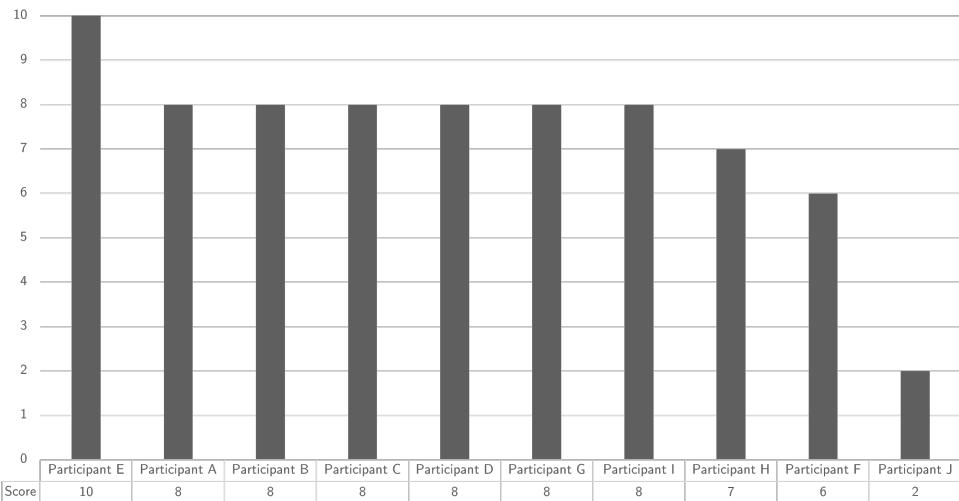


Figure F.15.: Scoring of Enterprise Architecture attribute Organisational learning

Attribute	Rating	Variability	Abstains
Organisational learning	7,3	44%	0

Table F.17.: Scoring of Enterprise Architecture attribute Organisational learning

F.3.4. Environmental learning

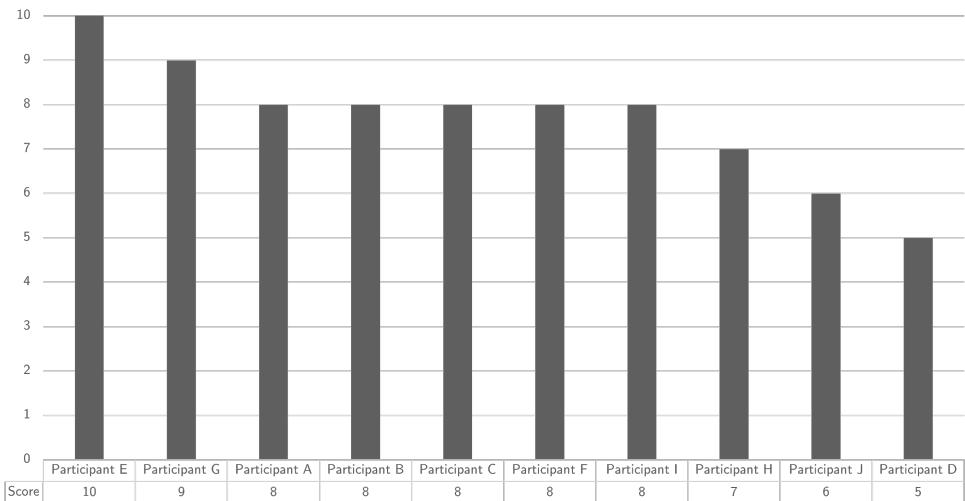


Figure F.16.: Scoring of glsea attribute Environmental learning

Attribute	Rating	Variability	Abstains
Environmental learning	7,7	29%	0

Table F.18.: Scoring of Enterprise Architecture attribute Environmental learning

F.3.5. Intra-organisational coherency

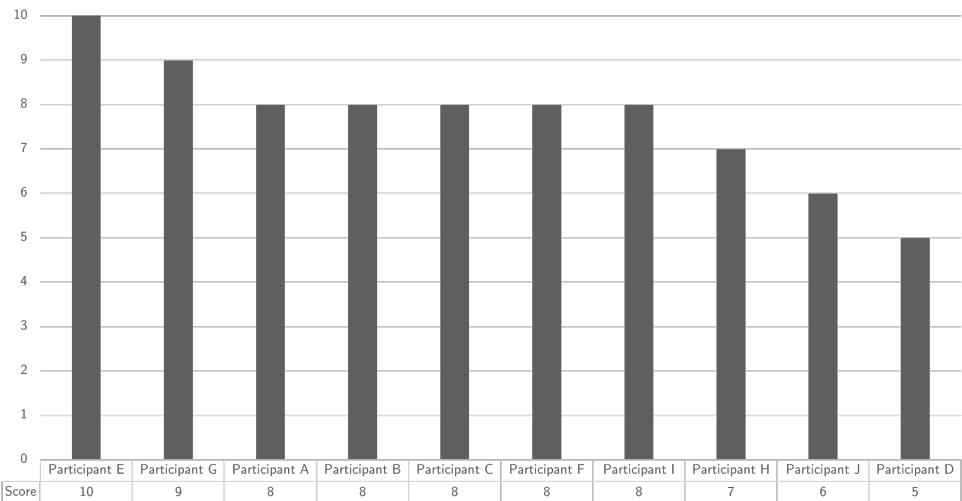


Figure F.17.: Scoring of Enterprise Architecture attribute Intra-Organisational coherency

Attribute	Rating	Variability	Abstains
Intra-organisational coherency	6,4	31%	0

Table F.19.: Scoring of Enterprise Architecture attribute Intra-Organisational coherency

F.3.6. System-in-Environment Co-Evolution learning

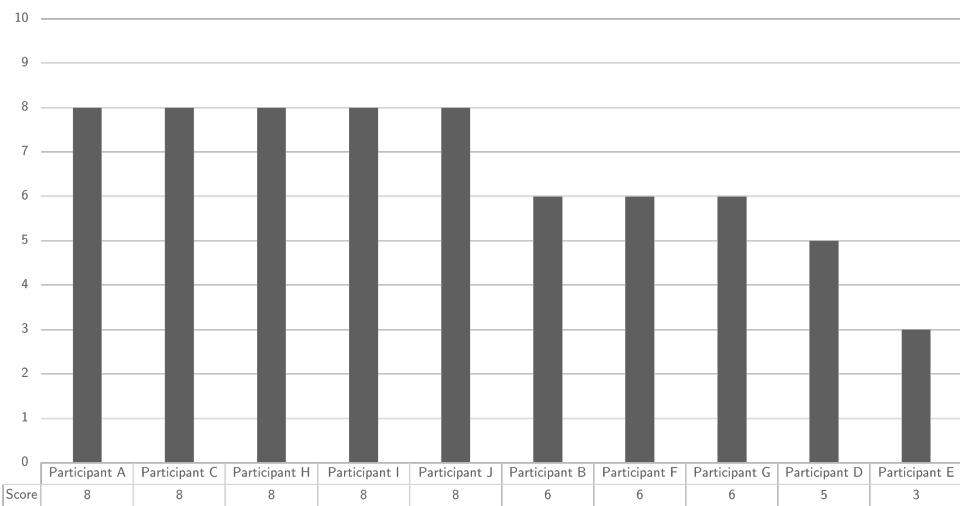


Figure F.18.: Scoring of Enterprise Architecture attribute System-in-Environment Co-Evolution learning

Attribute	Rating	Variability	Abstains
System-in-environment coevolution learning	6,6	36%	0

Table F.20.: Scoring of Enterprise Architecture attribute System-in-Environment Co-Evolution learning

F.3.7. Adapt to business language

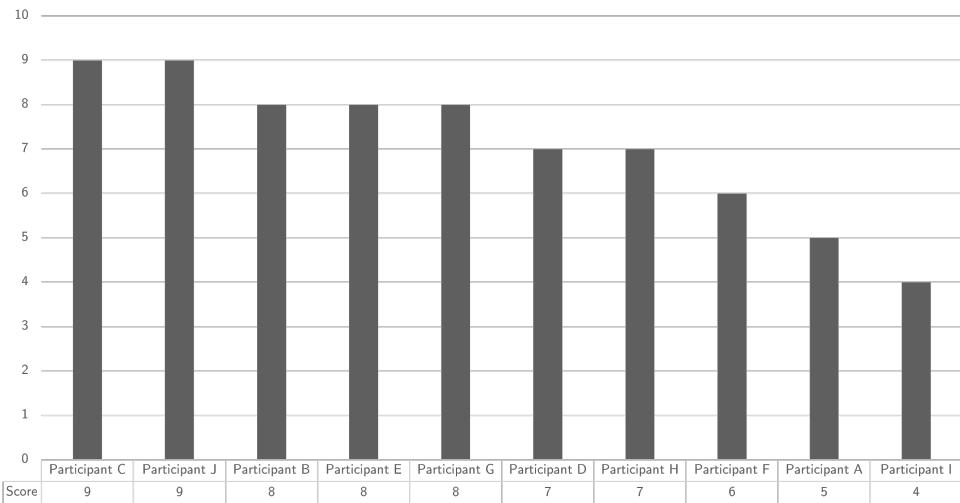


Figure F.19.: Scoring of Enterprise Architecture attribute adapt to business language

Attribute	Rating	Variability	Abstains
Adapt to business language	7,1	35%	0

Table F.21.: Scoring of Enterprise Architecture attribute adapt to business language

F.3.8. Agile Enterprise

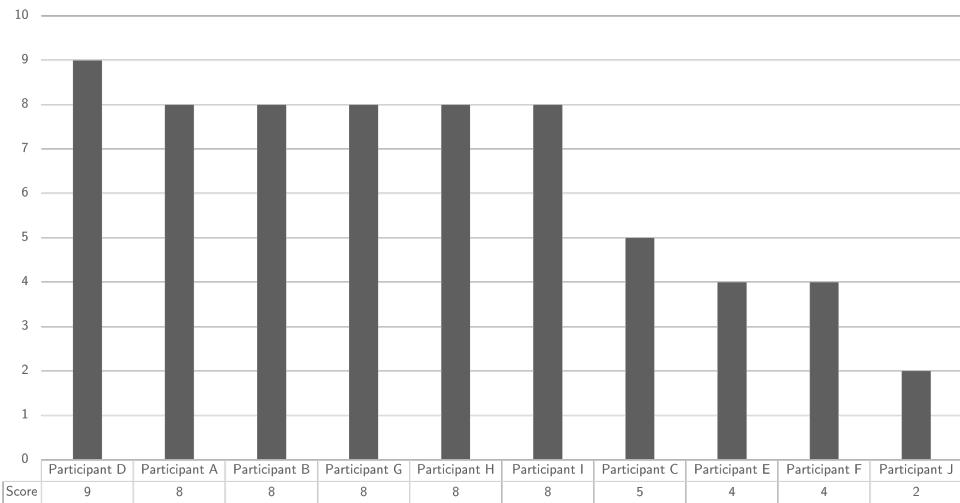


Figure F.20.: Scoring of Enterprise Architecture attribute Agile Enterprise

Attribute	Rating	Variability	Abstains
Agile Enterprise	6,4	50%	0

Table F.22.: Scoring of Enterprise Architecture attribute Agile Enterprise

F.3.9. Real Time Trust

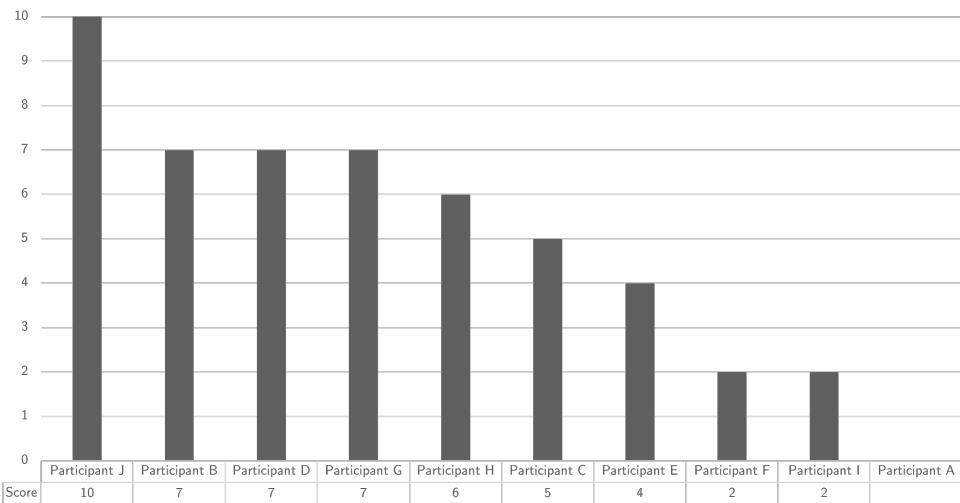


Figure F.21.: Scoring of Enterprise Architecture attribute Real Time Trust

Attribute	Rating	Variability	Abstains
Real-Time Trust	5,6	54%	1

Table F.23.: Scoring of Enterprise Architecture attribute Real Time Trust

F.3.10. Foster Dialogue

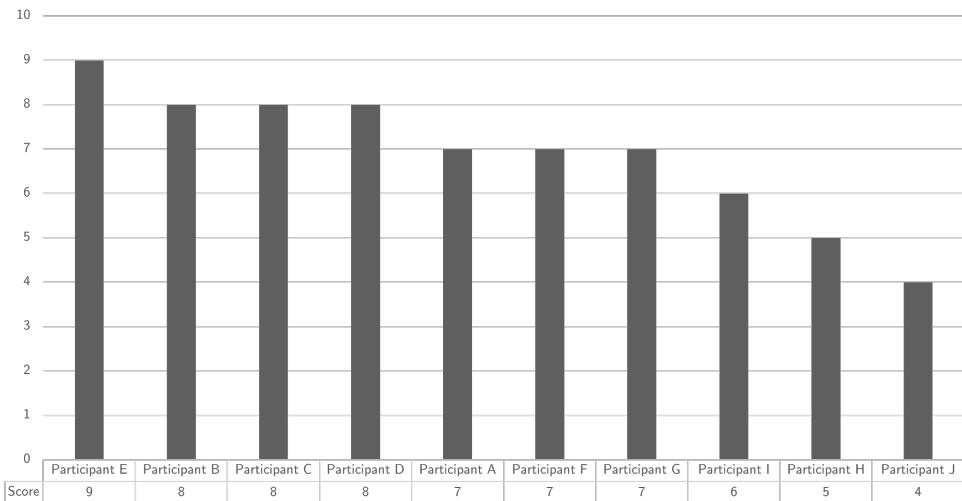


Figure F.22.: Scoring of Enterprise Architecture attribute Foster Dialogue

Attribute	Rating	Variability	Abstains
Foster dialogue	6,9	32%	0

Table F.24.: Scoring of Enterprise Architecture attribute Foster Dialogue

F.3.11. Architecture validation

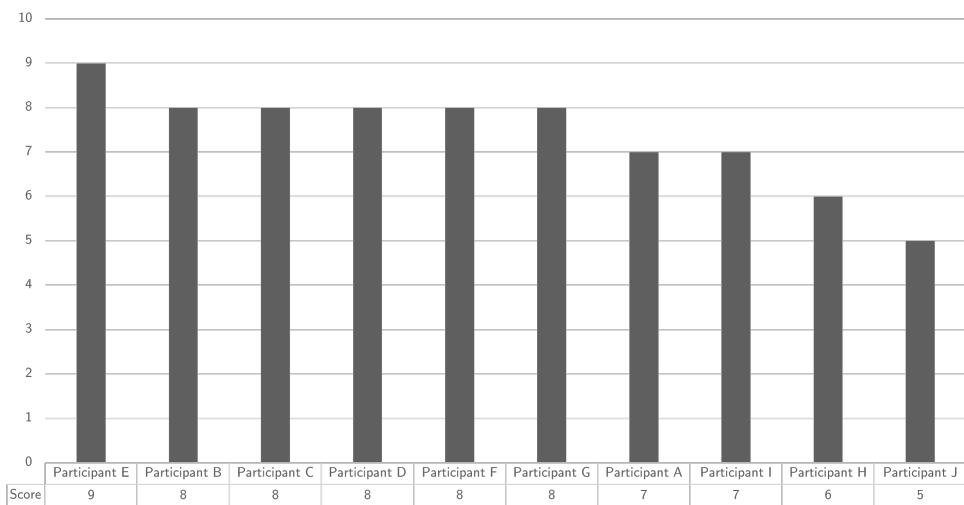


Figure F.23.: Scoring of Enterprise Architecture attribute Architecture validation

Attribute	Rating	Variability	Abstains
Architecture validation	7,4	24%	0

Table F.25.: Scoring of Enterprise Architecture attribute Architecture validation

F.3.12. Always fitting Enterprise Architecture

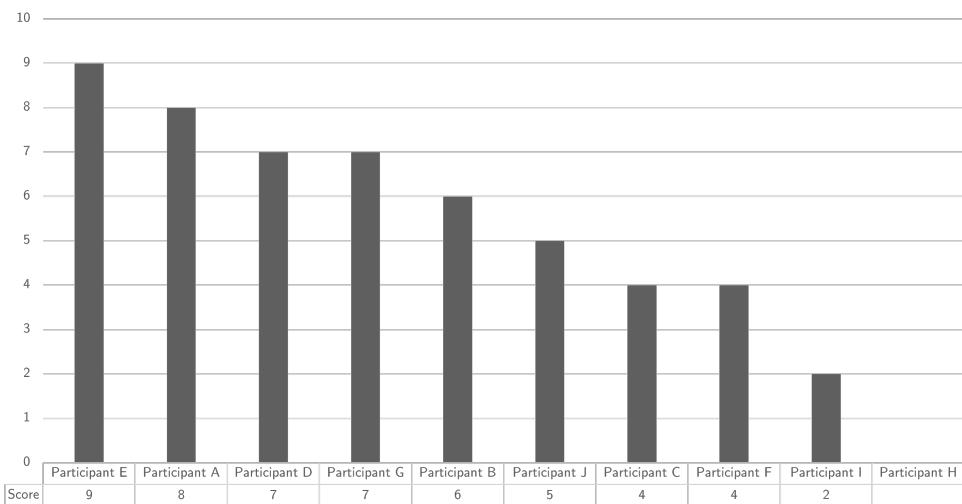


Figure F.24.: Scoring of Enterprise Architecture attribute Always fitting ea

Attribute	Rating	Variability	Abstains
Always Fitting Enterprise Architecture	5,8	46%	1

Table F.26.: Scoring of Enterprise Architecture attribute Always fitting Enterprise Architecture

F.4. Relevance of the research

F.4.1. To what extent do you find the research relevant?

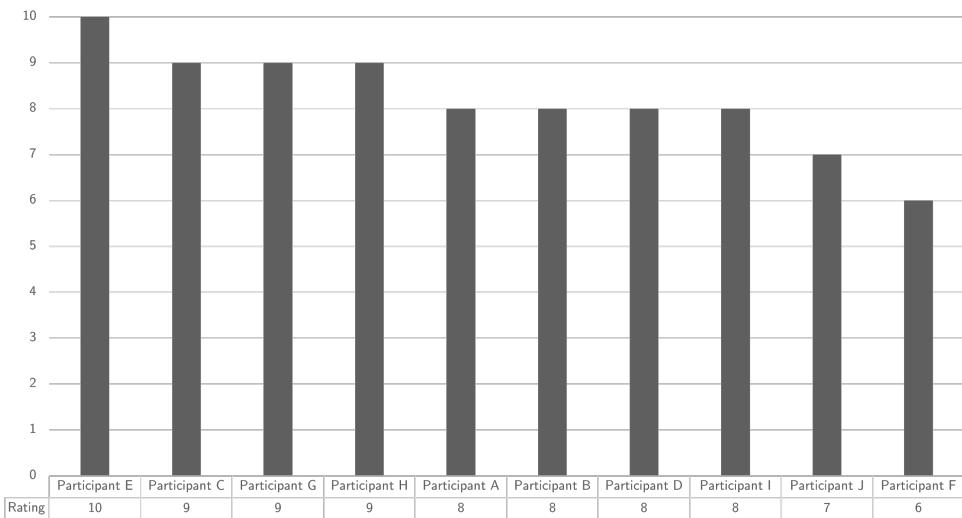


Figure F.25.: To what extent do you find the the research relevant?

Question	Rating	Variability	Abstains
To what extent do you find the the research relevant?	8,2	23%	0

Table F.27.: To what extent do you find the the research relevant?

F.4.2. To what extent did this session fulfil your expectations?

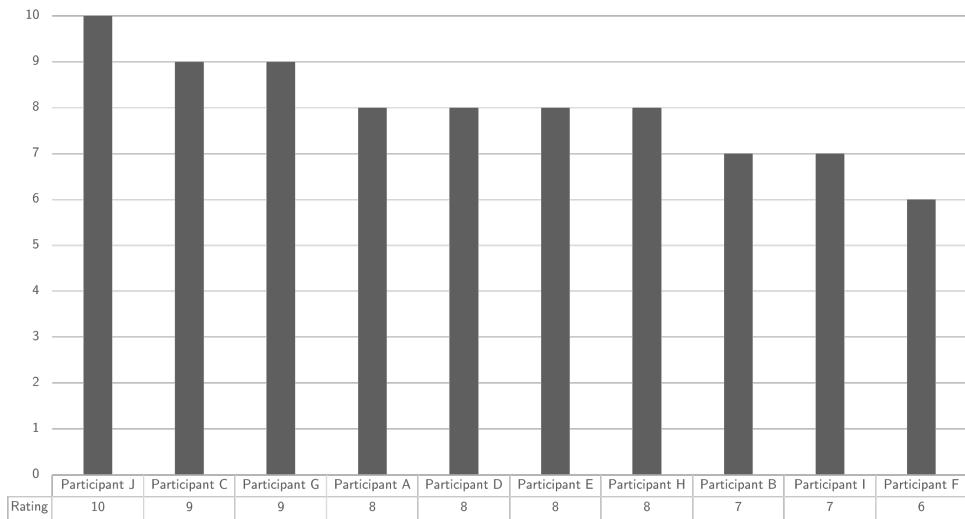


Figure F.26.: To what extent did this session fulfil your expectations?

Question	Rating	Variability	Abstains
To what extent did this session fulfil your expectations?	8	24%	0

Table F.28.: To what extent did this session fulfil your expectations?

F.4.3. To what extent do you think that the research can be used by yourself?

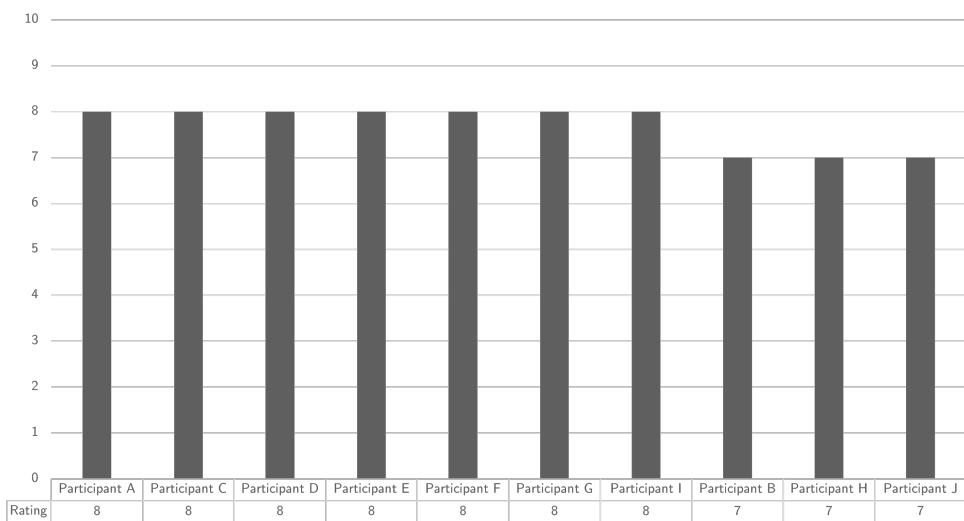


Figure F.27.: To what extent do you think that the research can be used by yourself?

Question	Rating	Variability	Abstains
To what extent do you think that the research can be used by yourself?	7,7	10%	0

Table F.29.: To what extent do you think that the research can be used by yourself?

F.4.4. To what extent do you think that the research can be used in the public sector?

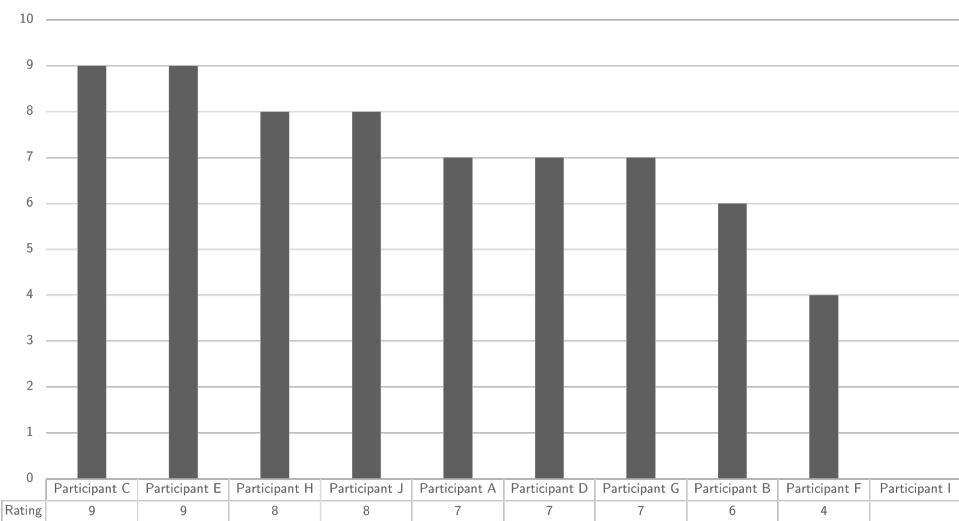


Figure F.28.: To what extent do you think that the research can be used in the public sector?

Question	Rating	Variability	Abstains
To what extent do you think that the research can be used in the public sector?	7,2	32%	0

Table F.30.: To what extent do you think that the research can be used in the public sector?

F.4.5. To what extent do you think that the research can be used by your organisation?

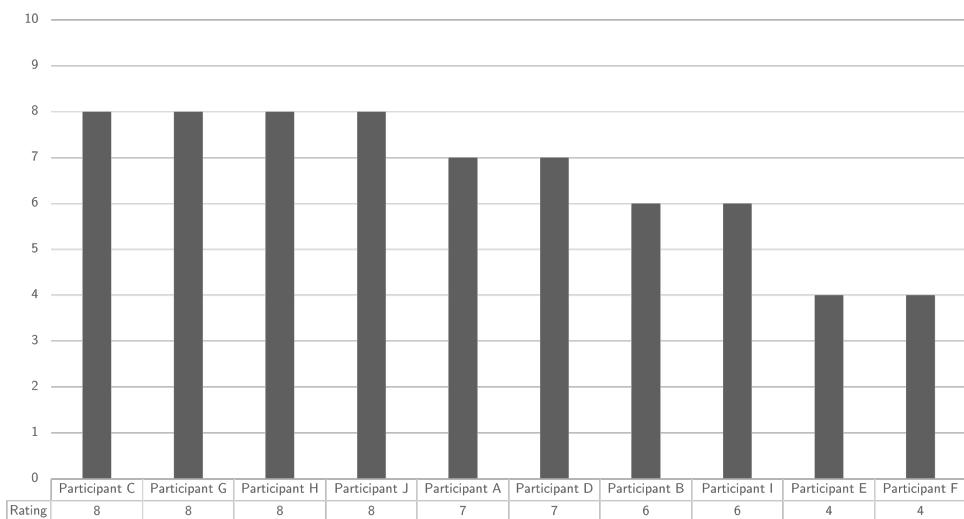


Figure F.29.: To what extent do you think that the research can be used by your organisation?

Question	Rating	Variability	Abstains
To what extent do you think that the research can be used by your organisation?	6,6	33%	0

Table F.31.: To what extent do you think that the research can be used by your organisation?

F.5. Follow-Up Survey

Question	Rating	Variability	Abstains
I want to receive possible updates on this research.	9	0%	1
I want to know when the thesis is published.	9	0%	1

Table F.32.: Follow-up Survey

G. Combined findings

We use this appendix to combine all the attributes with the three different qualitative research methods. In which research method were the attributes mentioned? The table knows multiple columns. The first column is the attribute itself. The second column is if it was mentioned in literature, while the third column shows if it was selected by the expert group. The final column shows the results of a scoring. In how many methods was the attribute mentioned or selected.

Attribute	Literature	Interviews	Validation group	Score (n out of 3)
Top-Down Command & Control	✓			1
Micro-Management	✓			1
Redundancy	✓			1
Modularity	✓			1
Loosely coupled	✓			1
Diversity	✓			1
Optionality	✓	✓	✓	3
Non-monotonicity	✓	✓		2
Emergence	✓			1
Self-organisation	✓	✓		2
Insert low-level stress	✓			1
Network-connections	✓			1
Fail-fast	✓	✓	✓	3
Resources to invest	✓	✓	✓	3
Seneca's barbell	✓	✓		2
Insert randomness	✓			1
Reduce naive intervention	✓			1
Skin in the game	✓			1
Personal mastery	✓			1
Shared mental model	✓			1
Building shared vision	✓			1
Team learning	✓			1
Systems thinking	✓			1
Safe working environment*		✓	✓	2
Outside-In and Collaboration**				
Data Governance Planes**				
Systems-in-Environment thinking	✓	✓	✓	3

* New attribute of the data set of the interviews.

** New attribute of the data set of the expert group.

Attribute	Literature	Interviews	Validation group	Score (n out of 3)
Holistic (systemic) stance	✓	✓		2
Organisational learning	✓	✓		2
Environmental learning	✓	✓	✓	3
Intra-organisational coherency	✓	✓	✓	3
System-in-environment coevolution learning	✓	✓	✓	3
Adapt to business language*		✓	✓	2
Agile Enterprise**				
Real-Time Trust**				
Foster dialogue**			✓	1
Architecture validation**			✓	1
Always Fitting Enterprise Architecture**				

* New attribute of the data set of the interviews.

** New attribute of the data set of the expert group.

Table G.1.: Possible success factors