THE IMPACT OF ENTERPRISE ARCHITECTURE ON BUSINESS PERFORMANCE

MASTER'S THESIS

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The Impact of Enterprise Architecture on Business Performance

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PREFACE

This thesis concludes my life as a graduate student and intern. The last six months have been devoted to reading, researching, talking, hearing and writing about Enterprise Architecture (EA). I have learned a great deal about what EA is, what it is not and I have met some of the people who practice EA daily. These months have been about balancing academic rigour with business focussed practicality. They have also been about statistics, questionnaires and round table discussions. I received help from many people with various topics and I would like to thank a few of them explicitly.

The idea for the subject of this thesis started taking shape mid-March of this year. Numerous meetings with Eric Onderdelinden and Jacco Roest in particular have helped me to find my way through the misty start of a graduation assignment. Everyone who has completed a master's thesis will recognize the difficulty of finding a subject, setting a scope, formulating questions and crafting a plan of approach. Many thanks to Eric and Jacco for their help and guidance in the beginning and throughout the entire journey.

After a plan of approach had been agreed upon with the graduation committee, it was time to leave the mist behind and set sail towards a warm and sunny destination: a completed thesis. However, writing a thesis is anything but smooth sailing: rough seas need to be conquered along the way. Overcoming such difficulties would have been nearly impossible on my own. Luckily, there was always help from fellow sailors. Nothing helps better to soften the blow of a high wave than having coffee with other interns. I would therefore like to thank Remco Westenberg, Ruurd de Schipper and Sander van den Bosch for their advice and support in both the clear and the stormy days of the last six months.

Inevitably, I occasionally noticed that I was going in the wrong direction. These deviations from the planned route often feel like a waste of time. However, if it wasn't for an unplanned detour, Columbus would have never discovered America. This, and many more, uplifting advice and analogies came from Michiel Wolbers. I would like to thank him especially for his understanding and for challenging me to go outside my comfort zone.

Completing a thesis cannot be done properly without people who know the territory well. I would therefore like to thank Benedikt Kratz, Marten van Sinderen and Maria Iacob for their excellent counselling, guidance and feedback. Additionally, I would like to thank the people of Deloitte Consulting and the Enterprise Architecture service line in particular for their help and time.

Finally, as with all journeys, there are many stories to tell and experiences to share. I would like to thank Lindi Deeben for always listening to me and helping me travel along the unfamiliar winds of statistics.

For now, I wish you an insightful journey through my thesis. Hopefully, it will bring you as much as it did for me.

Regards,

Erik Bookholt

EXECUTIVE SUMMARY

"The industrial age is now and forever over and the game has forever changed!" This was the reaction of John Zachman to people who asked him how to cost-justify Enterprise Architecture (EA). His frustration towards this essential question illustrates an ever present issue of the field of EA: an understanding of how EA improves business performance remains elusive. The vast amount of qualitative claims about alleged benefits from practitioners and researchers alike does not help to provide clarity in this ambiguous field. One thing has become clear though, EA certainly has benefits, yet they do not impact business performance directly. Hence the difficulty in establishing how business performance is impacted by EA. This research therefore aims to provide insight into the way EA yields benefits for business performance. This is accomplished by clarifying which benefits EA can yield, which activities of EA are responsible for these benefits and how the benefits impact business performance.

A literature review is used to determine what activities can be distinguished in the EA field and which benefits they are alleged to yield. Additionally, the effects of these benefits on business performance are incorporated in the literature review. Relationships between the identified activities and the alleged benefits are investigated by performing multiple regression analysis on survey data from 50 respondents, primarily enterprise architects and senior executives.

That approach resulted in identification of eighteen individual EA activities distributed among four categories: EA Alignment, EA Realization, EA Development and EA Foundation. EA Alignment activities all aim to align the organization with the EA plans, EA Realization activities aim to ensure that all EA plans are implemented as intended, EA Development activities aim to establish the plans which outline how to get from the current to a future state of the organization. EA Foundation activities aim to provide every kind of support the EA staff requires to perform all previous activities.

Eleven important benefits distributed among four categories were found to influence business performance. EA Alignment and EA Foundation are found to contribute most to these benefits. Both have a positive effect on all four benefit categories. EA Realization has a positive effect on two benefit categories, while EA Development only has one effect: a negative effect on one benefit category. These relationships can be explained when the role of EA staff in the eighteen activities is inspected. In some activities EA staff provides advice to the organization, in other activities EA staff assures the architectural compliancy of projects and processes in the organization, while in the rest of the activities EA staff works on documentation and planning of the current, future and intermediate states of the enterprise. This research has determined that only the provision of advice yields benefits which influence business performance. Assuring compliancy, documentation and planning do not have any effect on business performance. However, both remain important as input for the advisory activities.

These results imply that EA improves business performance by enabling benefits for the organization through the provision of advice. Activities which focus on the development of architecture plans to describe the current, future and intermediate state of the enterprise only provide the necessary input for the advisory activities of EA. They do not yield benefits directly; they are merely a precedent to activities which do deliver benefits.

Organizations involved in EA may benefit from a shift in focus. Currently EA efforts seem to be focussed on developing the aforementioned EA plans and assuring their compliancy. These are not the activities which deliver benefits. Shifting focus to the activities which provide advice and close collaboration with the organization may therefore improve the effectivity of the entire EA effort and thereby maximizes investments made in this area.

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LIST OF ABBREVIATIONS

APC	Architecture Project Consultation, activity of EA Realization
BAD	Baseline Architecture Development, activity of EA Development
BSC	Balanced Score Card
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CIO	Chief Information Officer
CSM	Communication and Stakeholder Management, activity of EA Foundation
CTO	Chief Technology Officer
Cum Prob	Cumulative Probability
CV	Compliancy Verification, activity of EA Realization
Deloitte TTL	Deloitte Touche Tohmatsu Limited
DMK	Definition, Measurement and Evaluation of KPIs, activity of EA Foundation
EA	Enterprise Architecture
EAA	Enterprise Architecture Alignment
EAD	Enterprise Architecture Development
EAF	Enterprise Architecture Foundation
EAR	Enterprise Architecture Realization
ECM	Escalation, Exception and Change Management, activity of EA Realization
GMP	Gap Analysis and Migration Planning, activity of EA Development
H	Hypothesis
HC	Recruitment and Development of Human Capital, activity of EA Foundation
IS	Information Systems
IPC	Investment and Procurement Consultation, activity of EA Alignment
KMD	Knowledge Management and Documentation, activity of EA Realization
KPI	Key Performance Indicator
N	Sample size
NASCIO	National Association of State Chief Information Officers
P	Probability value
P–P plot	Probability – Probability Plot
PCA	Principal Component Analysis
PFD	EA Process Formalization and Documentation, activity of EA Foundation
PMC	Portfolio/Program Management Consultation, activity of EA Alignment
R	Correlation coefficient
R^2	Coefficient of determination
RACI	Responsible Accountable Consulted Informed

REM	Requirements Engineering and Management, activity of EA Development
ROI	Return On Investment
SAD	Solution Architecture Development, activity of EA Development
SC	Strategy Consultation, activity of EA Alignment
SMT	Selection and Maintenance of Tools, activity of EA Foundation
SRG	Definition and Management of Principles, Standards, Rules and Guidelines, activity of EA Development
TAD	Target Architecture Development, activity of EA Development
US DoC	United States Department of Commerce
US GAO	United States Government Accountability Office
SME	Subject Matter Expert
TOGAF	The Open Group Architecture Framework
VIF	Variance Inflation Factor

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1 INTRODUCTION

1.1 Introduction

The year 2013 marked the 25th anniversary of the initial Zachman framework: "*A Framework for Information Systems Architecture*" (Zachman, 1987). This paper introduced one of the first holistic views of an organization and its information systems. It was an important step in the development of Enterprise Architecture (EA): a field of research and nowadays also a business function (van der Raadt & van Vliet, 2008). This stream of Information Systems (IS) research has led to a better understanding of the complex reality of enterprise wide IT and its related organizational issues (Lindström, Johnson, Johansson, Ekstedt, & Simonsson, 2006). Today EA is known as a holistic approach which allows an organization to align business and IT (Langenberg & Wegmann, 2004). Section 1.2.1 will elaborate on what EA is and why it is considered to be holistic.

However, throughout its existence as a part of doing business, organizations have struggled to understand what the value of EA is and how to justify investments in this area. This was especially clear in the 2001 essay of Zachman himself, titled "You Can't Cost Justify Architecture" (Zachman, 2001). In this essay he addresses a question he often got (and probably still gets): *"Well, how do you 'cost-justify' Architecture?"* (Zachman, 2001). He explains that architecture is often perceived as taking too long, costing too much and taking too much work to deliver end results. His answer to this perception is as follows:

> *Anyone who has these perceptions simply does not understand the concept of (...) Architecture, nor do they understand that the 'Industrial Age' is now and forever over and that the game has forever changed!*
> (Zachman, 2001)

Obviously annoyed, he explains that many people do not understand the value of EA and try to justify it by identifying costs which are saved by optimizations as a result of EA; which is wrong according to Zachman. He posits instead that EA accomplishes four things: Alignment, Integration, Change and Reduction (of) Time-to-Market (Zachman, 2001). These things in turn allow the organization to save money and time. EA is therefore an asset or investment which in itself does not save money or time, but it enables the organization to do this in the end (Zachman, 2001). Note that this is merely the opinion of Zachman, not an established research result.

The somewhat aggravated essay by Zachman does illustrate an important problem of EA: the contribution to business performance of EA is indirect (Tamm, Seddon, Shanks, & Reynolds, 2011) and therefore hard to identify, let alone quantify. Since 2001, research has established that EA indeed contributes to organizations, albeit indirectly, and a number of intermediating factors have been established (Tamm et al., 2011). Such intermediating factors are also known as 'benefit enablers'. Zachman identified four of them, but these are merely examples: there are others identified in literature. Although it is fairly established to which benefit enablers EA contributes in general (Tamm et al., 2011; van Steenbergen et al., 2011), it is not clearly defined *which elements* of EA contribute to *which benefit enablers*. The aim of this thesis is therefore to contribute to the clarification of the contribution of EA to organizations by identifying which parts of EA contribute to which benefit enablers.

1.2 Background

1.2.1 Definition of EA

The ambiguity that is prevalent in EA related publications has resulted in inconsistent terminology and possibly confusing uses of the words “enterprise” and “architecture” (Lapalme, 2012). In order to avoid contributing to the confusion, the definition of EA in this thesis is formulated according the “Enterprise Integrating” school of thought in Lapalme (2012) by its scope and purpose (Lapalme, 2012, p. 38):

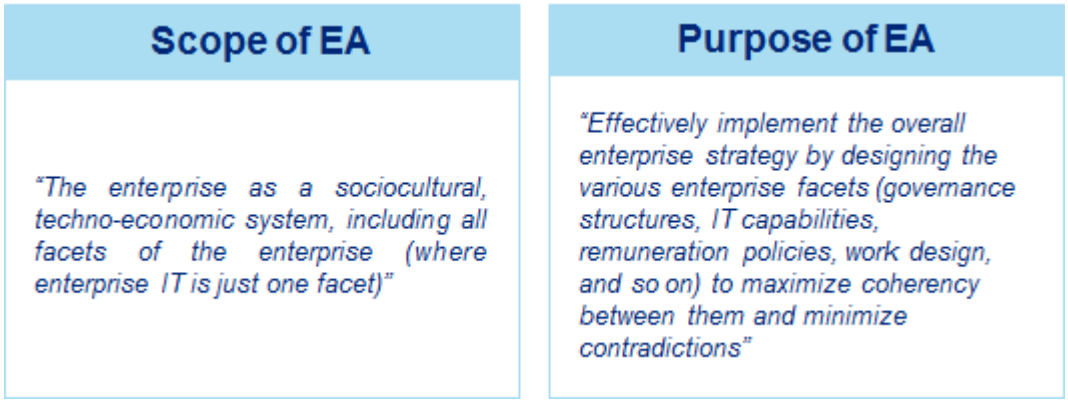


FIGURE 1: SCOPE AND PURPOSE OF ENTERPRISE ARCHITECTURE

These definitions lack an important aspect: what facets of an organization does EA include? The relevance of specifying this aspect becomes apparent when considering EA literature. Each subject-matter perspective defines its own facets, or in EA terms: domains (Boucharas, van Steenbergen, Jansen, & Brinkkemper, 2010). This has created a vast amount of different divisions into domains, contributing to the confusion surrounding EA. However, as Wagter, Van Den Berg, Luijpers, & Van Steenbergen (2005) noted, most of these can be grouped into the following three: business, information and technical. A similar distinction is made in the well-known EA framework of TOGAF (The Open Group, 2011b) and the modelling language ArchiMate (The Open Group, 2013). The business architecture domain concerns the products/services, processes and organizational architectures. The information domain (Information Systems domain in TOGAF and Application layer in ArchiMate) concerns the data and the applications of an organization. The technical architecture domain (Technology domain in TOGAF and Technology layer in ArchiMate) concerns infrastructure, platform and middleware architectures. Furthermore, because organizations nowadays rely heavily on their customers, partners, suppliers and other external entities to be competitive, such interactions have also become important to the EA field. This network is also called the ‘extended enterprise’ (Sachs, 2002) and may have touch points with all domains, since interactions with other parties may occur in each domain. The EA discipline is concerned with all these domains, their interdependencies and relationships. This is why EA is claimed to be a holistic discipline: in its practice, it considers all these domains, across the entire enterprise and its network. The domains have been visualized in Figure 2.

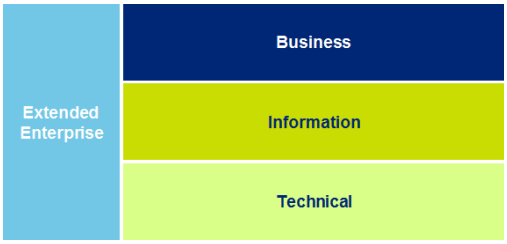


FIGURE 2: ARCHITECTURE DOMAINS

1.2.2 EA in Organizations

In an organization the EA discipline is concerned with *"the integral structure of the processes, information distribution and technological infrastructure of the enterprise"* (van Steenbergen, 2011, p. 3). It is usually positioned between business (& IT) strategy on one hand and project centred solution implementations on the other hand. In other words, EA is responsible for translating the organisation's strategy into projects that result in the achievement of a target state of the enterprise (Tamm et al., 2011). The definition of such a target state (or the "to-be" state) along with the definition of the current state (the "as-is" or "baseline" state) are considered key components of EA. The gap between the two states is to be filled by identifying and governing implementation (or solution) oriented projects. In doing so, all domains as mentioned above are considered and altered if necessary.

In some cases, EA is not only used as a top-down means of realizing an enterprise strategy, but it is also involved in the formulation of that strategy (Radeke, 2011; Ross, Weill, & Robertson, 2006). A visualization of EA's position in an organization is displayed in Figure 3.

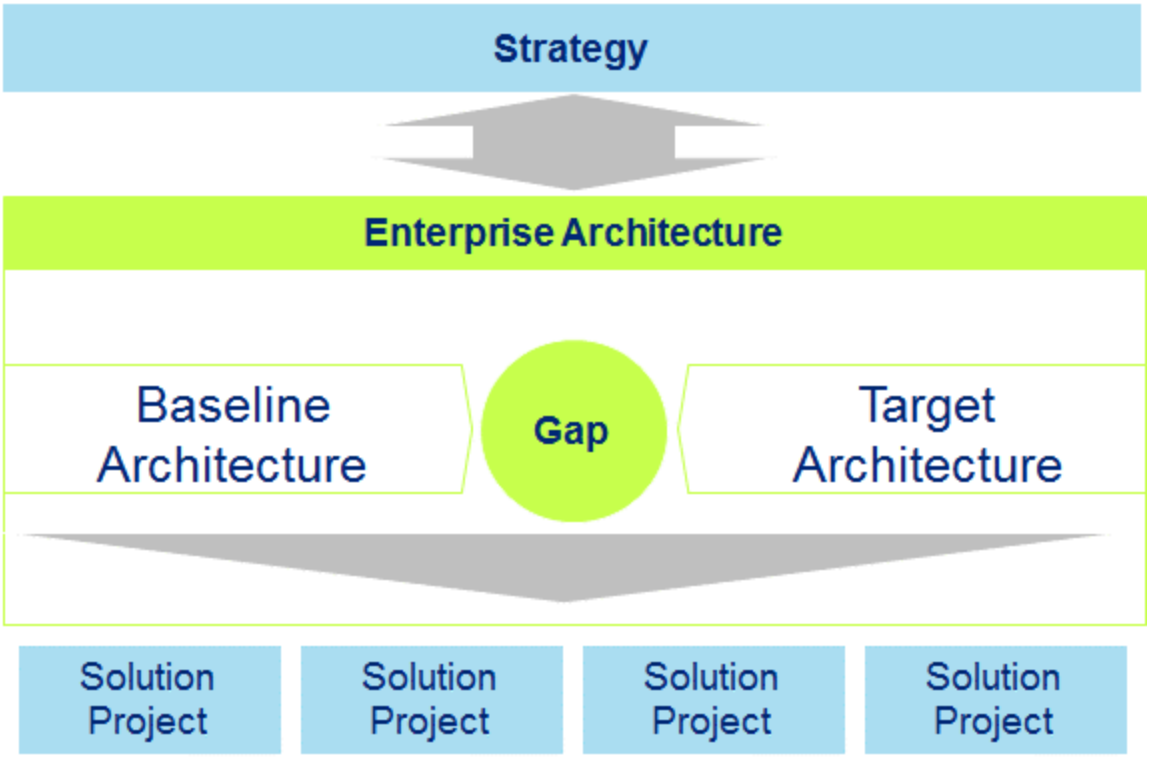


FIGURE 3: POSITION OF EA IN ORGANIZATIONS

Organizations may choose to invest in EA for a number of reasons, but one of the most important ones is the objective of greater business & IT alignment. (S. Aziz & Obitz, 2007). Other important reasons include: facilitating IT strategy planning, optimizing business processes, increasing architecture conformance of projects and improvement of portfolio management capabilities (Aler, Riege, & Winter, 2008). How EA achieves such objectives becomes clear in this thesis.

1.2.3 EA Stakeholders

EA endeavours have to deal with many stakeholders due to the holistic nature of EA. This section describes the relationship of EA with its stakeholders in organizations. An overview of the stakeholders is presented in Figure 4.

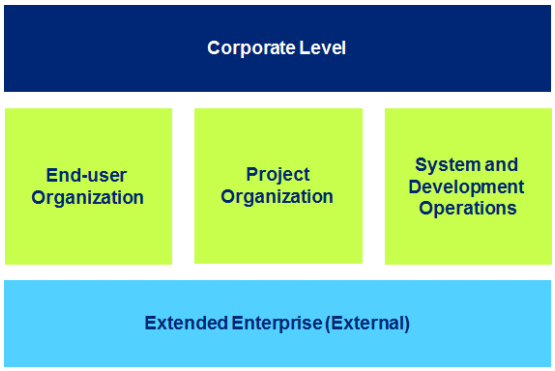


FIGURE 4: EA STAKEHOLDERS, ADAPTED FROM: THE OPEN GROUP (2011)

CORPORATE LEVEL

Since EA has a close relationship with enterprise strategy as mentioned in Section 1.2.2, it is not surprising that besides the EA project organization also corporate level stakeholders are involved in EA. Board members such as the Chief Executive Officer (CEO), Chief Financial Officer (CFO), Chief Information Officer (CIO) and Chief Technical Officer (CTO) are involved in decision making regarding the target state of the enterprise (van der Raadt, Schouten, & van Vliet, 2008). Furthermore, functions such as Human Resources, Procurement, Quality Assurance, the Program Office and Security need to cooperate with the EA function in order for it to operate as desired (The Open Group, 2011a).

END-USER ORGANIZATION

EA projects oftentimes have far-reaching consequences for end-users. The end-user organization is therefore one of the stakeholders of EA. This includes operational level management as well as business process engineers, data owners, domain experts and information systems experts (The Open Group, 2011a; van der Raadt et al., 2008).

PROJECT ORGANIZATION

The project organization is responsible for implementing high impact changes in the enterprise (van der Raadt & van Vliet, 2008). This usually involves various roles ranging from executives to technical specialists, including a range of project managers (e.g. business, information systems and/or infrastructure), process designers, information analysts and software designers (The Open Group, 2011a; van der Raadt et al., 2008).

SYSTEM AND DEVELOPMENT OPERATIONS

Besides the corporate and end-user stakeholders, EA has a close relationship with IT departments in organizations, or more generally put ‘System Operations’. The architectural nature of EA means that achieving the ‘target’ state of an organization frequently requires radical IT related changes. This requires close collaboration with information systems and infrastructure related functions as well as development operations including software development managers, infrastructure management and platform managers. (The Open Group, 2011a; van der Raadt et al., 2008).

EXTENDED ENTERPRISE (EXTERNAL)

Beside stakeholders within the enterprise, EA functions may need to interact with stakeholders in other organizations: the extended enterprise. Cooperation with suppliers, customers, partners and/or regulatory bodies is required to ensure the ‘to-be’ state is properly designed and implemented (The Open Group, 2011a). Moreover, regulatory bodies may impose laws and regulations which form a source of requirements for an organization.

1.2.4 EA Contribution to Business Performance

This section shorty describes how current literature suggests EA contributes to business performance.

From the previous sections it should be clear that in order for an organization to involve in EA, it needs to undertake certain activities. For example, the baseline and the target state of the organization (or a part of it) need to be determined and a gap analysis should identify possibilities to reach the target state. And in this process, a lot of interaction with stakeholders is required as is described in the previous section. All such components of EA (establishing baseline, establishing target, gap analysis, stakeholder management etc.) are defined as *EA Activities* in this thesis. Which specific activities exist, is discussed in Section 2.2.

These activities are executed for a reason: in the end they are supposed to contribute positively to business performance. Both academic and practitioner literature contain an abundance of EA contribution claims (Boucharas et al., 2010; Tamm et al., 2011). The contribution of EA in literature is expressed in terms of its benefits for the organization as a whole, for example: EA contributes to cost reductions. Such benefits ultimately result in a positive impact on business performance. Yet, closer inspection of these benefits gives a slightly more nuanced view. EA benefits do not contribute directly to business performance, but act as an enabler of other benefits which in turn contribute to business performance (Boucharas et al., 2010; Tamm et al., 2011). As mentioned in the introduction, such intermediate benefits are called *Benefit Enablers.* Which specific benefit enablers are described in literature is discussed in Section 2.3.

The resulting relationships are visualized in the general EA contribution model of Figure 5, which depicts the way EA contributes to business performance.

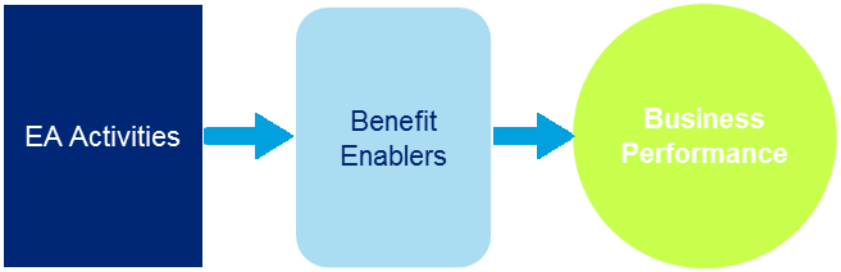


FIGURE 5: GENERAL EA CONTRIBUTION MODEL

1.3 Research Design

1.3.1 Problem Statement

Since the introduction of EA roughly two decades ago, many organisations have incorporated architecture related practices (Langenberg & Wegmann, 2004). However, the exact value of EA activities remains elusive in academic research (Tamm et al., 2011). More generic statements about its contribution to business performance have been largely accepted, however specific insight into contribution at activity level is still missing (Langenberg & Wegmann, 2004; Tamm et al., 2011). This makes the justification for investing in EA difficult: if the value or contribution to business performance of the various EA activities is unclear, how can a decision about investing in this area be made? How can a scope for the various activities be defined if the effects of these activities are unknown? How can a budget be divided if it is uncertain what the contribution of each component is?

1.3.2 Research Objective

Summarizing, the problem is a lack of insight into the benefits for organizations of specific activities of the EA discipline. Organizations require this insight in order to make decisions regarding their EA related efforts. The main goal of this research is therefore to reduce the ambiguity surrounding the contribution of EA to organizations. This is accomplished by explaining the relationships between EA Activities, Benefit Enablers and Business Performance as is depicted in the research framework in Figure 6.

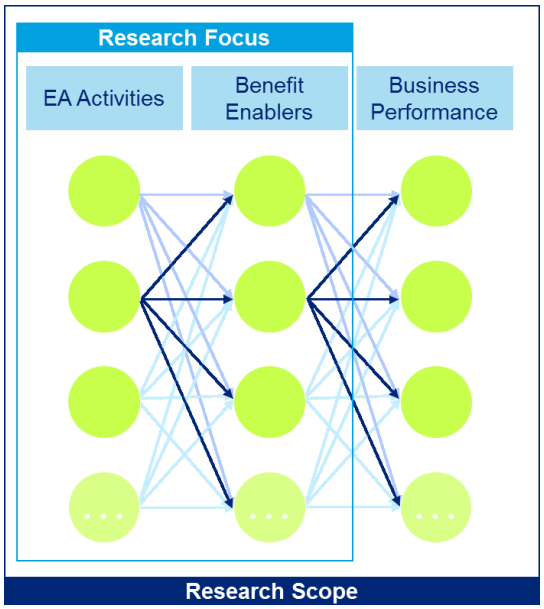


FIGURE 6: RESEARCH FRAMEWORK, SCOPE AND FOCUS

1.3.3 Research Scope and Focus

The scope of this research comprises the relationships between EA Activities, Benefit Enablers and Business Performance. Contextual factors which may influence these relationships are identified, but not considered to be part of the scope due to time constraints. It should be noted however that the *focus* of the research is on the relationships between EA Activities and Benefit Enablers, since this area is least investigated empirically as of yet (Tamm et al., 2011). These relationships are therefore examined with an empirical research method while the relationships between Benefit Enablers and Business Performance are investigated based on literature research. The distinction between the scope and focus is visualized in Figure 6.

1.3.4 Research Questions

In order to achieve the research objective the following question is answered:

Main Research Question: How does Enterprise Architecture impact Business Performance?

To answer this question, the following sub questions are answered:

1. *Which EA Activities can be distinguished?*
    a. *What does EA staff do in each activity?*
    b. *What is the organizational scope of each activity?*

In the first question the various activities are identified which together comprise the EA discipline. Various sources suggest different approaches to EA and as such, different activities. Take for example the TOGAF Architecture Development Method. This could be regarded as a set of EA activities. However, this set is not necessarily the same as the activities in other frameworks and literature. The answer to the first question should therefore synthesize the various sources into a single list of activities.

2. *Which Benefit Enablers can be identified?*

A similar argument as made for the first question can also be made for the second question. Zachman mentioned a number of benefit enablers in his essay, however other sources may provide a different set of benefit enablers. The answer to question two will synthesize the different views into a coherent and complete set of benefit enablers.

3. *What is the relationship between EA Activities and Benefit Enablers?*
    a. *Which activities have influence on which Benefit Enablers?*

Question three is included to provide the first part of the answer to the main question. As can be seen in the research framework in Figure 6, EA Activities influence Benefit Enablers, which in turn influence business performance. In order to know what the final effect on business performance is, the effects of EA on the Benefit Enablers needs to be clear first.

4. *What is the relationship between Benefit Enablers and Business Performance?*

Question four is included to provide the second part of the answer to the main question. When the effect of EA on Benefit Enablers is explained in question three, the answer to question four will complete the picture by explaining how the Benefit Enablers in turn influence Business Performance.

1.3.5 Research Process and Methodology

The questions as stated above are answered using the process and methods as depicted in Figure 7 and described in this section.

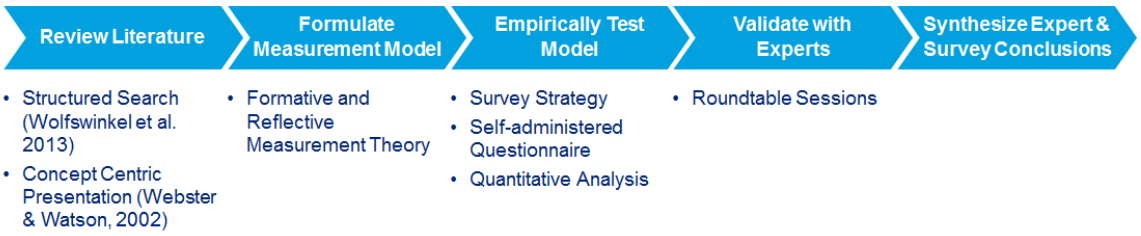


FIGURE 7: RESEARCH PROCESS AND METHODOLOGY OVERVIEW

Due to time constraints only one research question is answered empirically. As mentioned in the research scope in Section 1.3.3, the focus of this research is on the relationship between EA

Activities and Benefit Enablers. Hence research question three is answered empirically and research questions one, two and four are answered by means of a literature review.

By structurally surveying all relevant literature and synthesizing the different views into a coherent set of activities, benefits and relationships a solid theoretical foundation is constructed. The search process is structured using the approach as described in Wolfswinkel, Furtmueller, & Wilderom (2013). The literature review content is presented using the concept centric method of Webster & Watson (2002). More details on the employed literature review method are provided in Appendix A *Literature Review Methodology*. This approach to literature review answers research questions one, two and four.

Research question three is answered empirically. The explanatory nature of this question calls for a technique which allows hypothetical relationships to be confirmed or refuted. In this case a survey strategy with a self-administered electronic questionnaire is used as the means of primary data collection. This is chosen because it is an efficient way of collecting standardized data which allows for a substantial quantitative analysis to confirm or refute alleged relationships. More details on the development of the questionnaire can be found in Appendix C *Scale Development Details*.

The questionnaire data is analysed using multiple regression analysis. This statistical technique provides the possibility to test for the existence of claimed relationships using the data obtained with the survey. These results indicate which EA Activities impact which Benefit Enablers and to what extent. This gives an answer to research question three.

In order to achieve preliminary validation of the empirical and desk research conclusions as well as to achieve more detailed insight into the research questions, a second means of data collection is necessary. In this case in-depth discussions with subject matter experts (SME) in the form of round table sessions are used. A round table session allows for profound discussions of a topic and is therefore considered to be a useful source of additional data. The insights of these sessions are included in Chapter 6 *Discussion*.

The combination of a structured literature review, quantitative analysis of survey data and in-depth discussions with subject matter experts will answer the research questions and give a good understanding of how EA improves business performance.

1.3.6 Document Structure

This thesis is structured as follows: Chapter 2 presents the literature review which answers research questions one, three and four. Chapter 3 describes how the literature is used to define a conceptual model which can be tested. Chapter 4 shows how a measurement instrument is developed to test the conceptual model in practice. Chapter 5 presents the statistical results of the regression analysis using the questionnaire data. Chapter 6 elaborates what the results implicate both theoretically as well as for EA practitioners. Finally, Chapter 7 presents the conclusions and concise answers to the research questions.

2 LITERATURE REVIEW

2.1 Literature Review Methodology Overview

A structured approach is used to conduct the literature search process in order to ensure that all relevant literature is included in the review. The search process consists of the DEFINE, SEARCH & SELECT stages of the process as described in Wolfswinkel, Furtmueller, & Wilderom (2013). While this provides a way of searching for literature, it does not dictate a structure for the review section in this document. To this end, the concept-centric approach of Webster & Watson (2002) is used. It consists of structuring the following sections according to relevant concepts of this thesis and synthesizing all relevant literature for each particular concept. For a more detailed description of the employed literature review methodology refer to Appendix A *Literature Review Methodology*.

To identify the relevant concepts, the logic of Section 1.2.4 *EA Contribution to Business Performance* is followed. The activities of EA in an organization are claimed to contribute to business performance in two steps: EA activities create an intermediate advantage for the business. These benefits of EA in turn enable other benefits which affect Business Performance. Therefore this thesis considers the following concepts: EA activities, EA Contribution to Benefit Enablers and EA Contribution to Business Performance. Figure 8 provides an overview of these concepts.

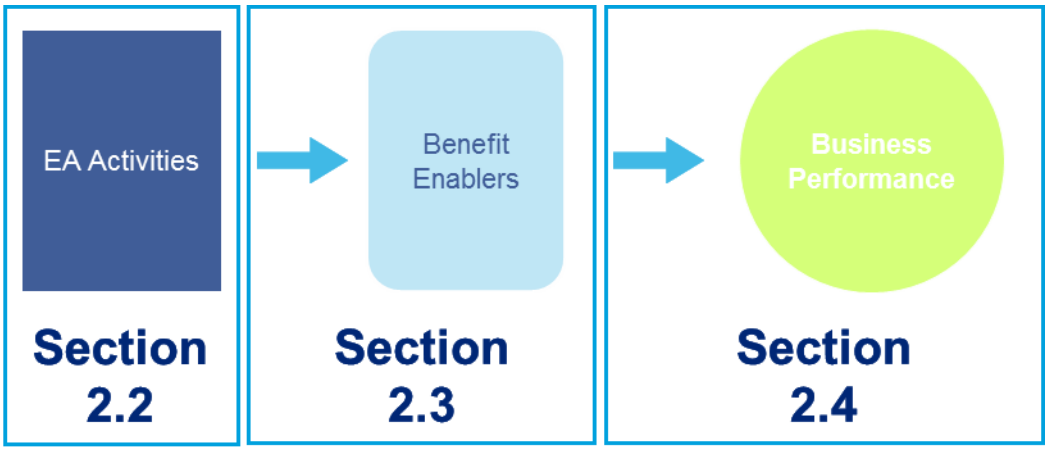
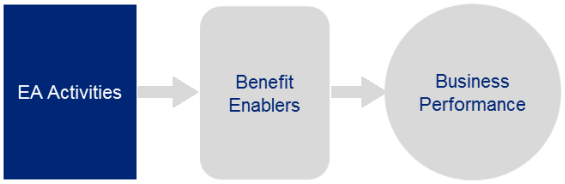


FIGURE 8: LITERATURE REVIEW OVERVIEW

The remainder of this chapter elaborates on these concepts and their relationships. First the activities of EA are identified, second the contribution of these activities to benefit enablers are introduced and finally the contribution of EA to business performance is discussed.

2.2 EA Activities

This section discusses all relevant EA activities which are found in literature. First a definition is given of what an activity is, followed by the descriptions of the activities.



2.2.1 Definition of Activity

An 'activity' is a somewhat ambiguous concept. Since it can be defined at multiple levels of granularity, an explicit definition is helpful to delineate what an activity is and what not. This thesis uses the definition of the Business Process Modelling Notation: "*An activity is work that is performed within a Business Process. An Activity can be atomic or non-atomic (compound)*" (OMG, 2011). This means an activity can, though not necessarily, consist of sub process(es).

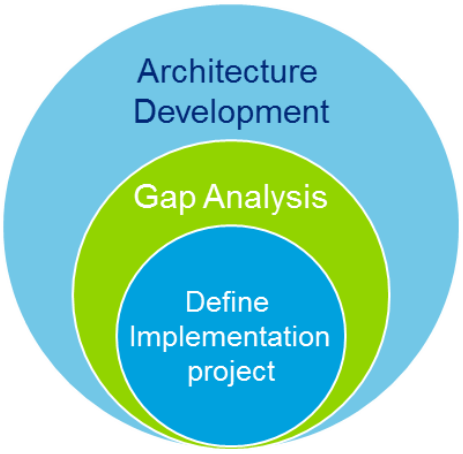


FIGURE 9: EXAMPLE OF PROCESS AND ACTIVITY

Consider the following example. *Architecture Development* can be a business process of the EA department. It involves aspects such as determining the as-is situation, determining the to-be situation, performing a gap analysis and more. This means that the business process *architecture development*, contains various activities: *determine as-is*, *to-be*, *gap analysis* etc. Closer examination of these activities reveals that they in turn consist of sub-processes. The gap analysis activity may for example involve the definition of projects to overcome an identified gap. This means that the *architecture development* business process involves an activity *gap analysis* which in turn involves a sub process to *define an implementation project*. This thesis is interested in the activity level of granularity; the gap analysis in this example. This example is visualized in Figure 9.

2.2.2 EA Activity Definitions

In order to determine which activities literature describes, both the content of the activities as well as the scope of the activities was considered. These aspects were compared among the various activities defined in literature. The search for activity definitions included EA maturity models, EA frameworks, books and academic publications. After the literature had been synthesized into a list of categories of activities, it was validated among EA experts. After multiple validation iterations the final list as it is presented in this section was constructed. A more detailed description of the definition and validation process can be found in Section A.2 of Appendix A *Literature Review Methodology*. That process resulted in the definition of the activities in Figure 10.

The division of activities into the four categories of the pyramid in Figure 10 is based on the pyramids in Roest (2014) and Lankhorst (2005). The activities are grouped in the following categories, according to similarity in their purpose: EA Alignment (EAA), EA Realization (EAR), EA Development (EAD) and EA Foundation (EAF). This makes the list of activities easier to comprehend and allows for the creation of more parsimonious models than a long list of singleton activities.

Note that the last category, EA Foundation, concerns activities related to keeping the EA organization running, while all other categories concern activities which involve changing the enterprise and its architecture.

As mentioned before, the scope of the activities as they are defined in literature is also investigated. This results in the following scope distinction:

- Enterprise Level Activities, which have impact across the entire enterprise,
- Segment Level Activities, which have impact in a part of the enterprise (for example a business unit, business function or program),
- Project Level Activities, which have impact in a single project,
- EA Level Activities, which have impact for EA staff only.

Most names speak for themselves, though *segment* might be ambiguous. The exact definition depends on the organization at hand. It can be a business unit, a business function, a program (i.e. a set of related projects) or a department. In any case it is an abstraction level in between activities which concern the entire enterprise on one hand and activities which consider a single project on the other hand. This thesis recognizes that different organizations may have different structures for their EA efforts and therefore the segment concept is used for this intermediate abstraction level. This is similar to the segment definition in TOGAF (The Open Group, 2011b).
All activities which are found in literature are discussed in this section. The scope at which each activity may be found in an organization is indicated between brackets in the title of the activity.

Refer to Appendix B *EA Activity Overview* for an overview of all categories, activities and their scope.

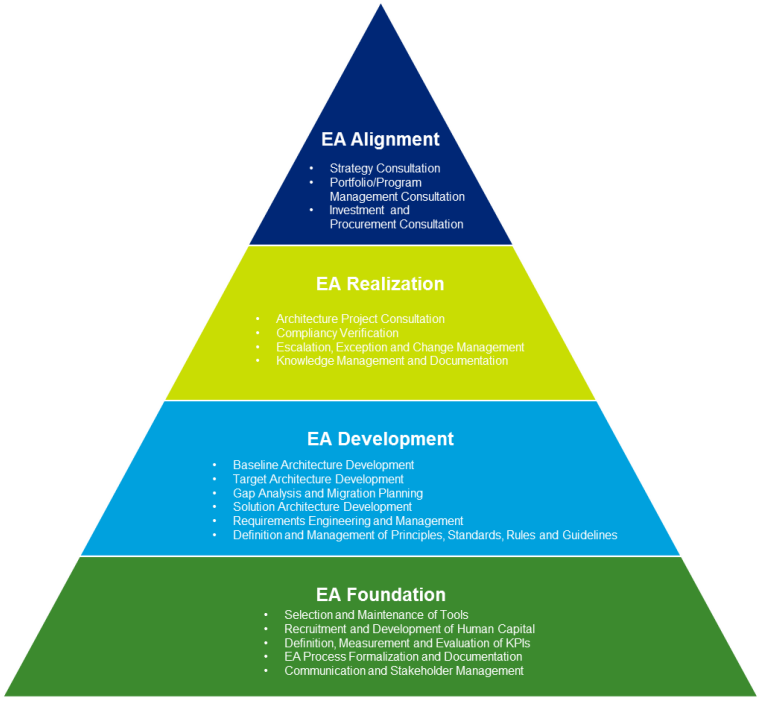


FIGURE 10: EA ACTIVITY OVERVIEW

EA ALIGNMENT

EA Alignment refers to the extent to which EA contributes to aligning the organization's strategy with its resources and vice versa. Table 1 presents an overview of all activities in this category.

	Activity	Scope	Sources
EA Alignment	*Strategy Consultation*	Enterprise Level	(Luftman & Kempaiah, 2007; NASCIO, 2003; Schekkerman, 2006; Lapkin, 2008; Radeke, 2011)
		Segment Level	(Lapkin, 2008; Radeke, 2011)
	Portfolio/Program Management Consultation	Enterprise Level	(Ross, Weill & Roberson, 2006; Schekkerman, 2006)
		Segment Level	(Schekkerman, 2006)
	Investment and Procurement Consultation	Enterprise Level	(NASCIO, 2003; Schekkerman, 2006)
		Segment Level	(US DoC, 2007)

TABLE 1: EA ALIGNMENT ACTIVITIES

Strategy Consultation (SC) (Enterprise and/or Segment Level)
Since EA staff are concerned with an enterprise's business, information and technical infrastructure, their input may be valued in the strategy definition processes of various parts of the enterprise. This combination of business and technical insight allows EA staff to comment on strategic options from different perspectives. They may promote the option which best solves the challenges of moving the enterprise to the target state and help to identify the IT initiatives which provide the necessary capabilities. Both enterprise wide strategy (hence the Enterprise Level scope) as well as segments such as IT strategy or business unit strategy processes may therefore involve EA staff (hence Segment Level scope).

Portfolio/Program Management Consultation (PMC) (Enterprise and/or Segment Level)
EA staff may also be involved in the portfolio management processes of the enterprise or its segments (a business unit) (hence the Enterprise and Segment Level scope). EA staff have a good understanding of the interdependencies of the projects/programs and can bring transparency to their prioritization and management (Radeke, 2011). Furthermore, EA helps identification of shared services and may therefore avoid redundant efforts among projects.

Investment and Procurement Consultation (IPC) (Enterprise and/or Segment Level)
EA staff's understanding of the interdependencies of projects and systems helps identifying suitable investment and procurement options. Furthermore, prioritization of such options may be facilitated by the transparency which EA staff can provide about the impact in the organization. The diverse view of an enterprise which EA staff has also aids in the assessment of the potential value of various investments.

EA REALIZATION

EA Realization are all activities of EA staff members related to the realization of architecture plans. Table 2 presents an overview of all activities in this category.

	Activity	Scope	Sources
EA Realization	*Architecture Project Consultation*	Project Level	(Ross et al., 2006; Schekkerman, 2006; van der Raadt & van Vliet, 2008)
	Compliancy Verification	Project Level	(Deloitte TTL, 2013; Lapkin, 2008; NASCIO, 2003; Radeke, 2011; van der Raadt & van Vliet, 2008)
	Escalation, Exception and Change Management	Enterprise Level	(Deloitte TTL, 2013; Lapkin, 2008; Nikpay, Selamat, Rouhani, & Nikfard, 2013; Ross et al., 2006; Schekkerman, 2006; US DoC, 2007; US GAO, 2010)
		Segment Level	(Deloitte TTL, 2013; Schekkerman, 2006; US GAO, 2010; van der Raadt, Schouten, & van Vliet, 2008)
	Knowledge Management and Documentation	Enterprise Level	(Deloitte TTL, 2013; The Open Group, 2011; US GAO, 2010)
		Segment Level	(Deloitte TTL, 2013; The Open Group, 2011)
		Project Level	(The Open Group, 2011)

TABLE 2: EA REALIZATION ACTIVITIES

Architecture Project Consultation (APC) (Project Level)
Some EA staff may be involved in the management and/or execution of projects that implement architecture solutions or projects which are heavily affected by architecture changes. Moreover, EA staff is often involved in giving advice to such projects. This category refers to both such activities.

Compliancy Verification (CV) (Project Level)
Projects need to be checked for compliance with the target architecture and enterprise principles, standards, rules and guidelines. If projects deviate from any of these, a governance body may need to make a decision whether this is tolerated or not and how to handle the situation. This activity category refers to the compliancy checks while the handling of exceptions is part of the next category activity.

Escalation, Exception and Change Management (ECM) (Enterprise and/or Segment Level)
If a compliancy check has resulted in the identification of a mismatch between the target architecture and the solution actually being implemented, or the solution does not comply with the established principles, standards, rules and guidelines, a governance body needs to make a decision on how to handle such an exception. Furthermore, unexpected changes may occur in the organization which require a decision to be made by a governance body in order to ensure that all projects handle the change coherently. However, not all such exceptions can be evaluated enterprise wide, especially in large organizations. Therefore governance bodies and compliancy processes may exist on segment level which govern the projects in that segment.

Knowledge Management and Documentation (KMD) (Enterprise, Segment and/or Project Level)
EA practices involve the production of a broad range of documents. Literature stresses that it is important to ensure that the knowledge embedded in the documents and developed during the creation of the documents is stored in a structured way. This activity category refers to the identification and storage of possibly useful artefacts for the future. A storage facility for knowledge is often referred to as a repository. An example is the Architecture Repository as defined in the TOGAF standard (The Open Group, 2011b). The required tools and frameworks should be in place as described in the EA Foundation activity "*Selection and Maintenance of Tools".*

EA DEVELOPMENT

EA Development concerns the construction of various architecture related artefacts and plans such as architecture blueprints, principles/guidelines etc. Table 3 Table 4 present an overview of all activities in this category.

	Activity	Scope	Sources
EA Development (1/2)	*Baseline Architecture Development*	Enterprise Level	(Deloitte TTL, 2013; Lapkin, 2008; Ross et al., 2006; The Open Group, 2011; US GAO, 2010; van der Raadt & van Vliet, 2008)
		Segment Level	(US GAO, 2010; van der Raadt & van Vliet, 2008)
	Target Architecture Development	Enterprise Level	(Deloitte TTL, 2013; Lapkin, 2008; Ross et al., 2006; The Open Group, 2011; US GAO, 2010; van der Raadt & van Vliet, 2008)
		Segment Level	(US GAO, 2010; van der Raadt & van Vliet, 2008)
	Gap Analysis and Migration Planning	Enterprise Level	(Deloitte TTL, 2013; Radeke, 2011; Spewak & Hill, 1993; The Open Group, 2011; US GAO, 2010; van der Raadt & van Vliet, 2008)
		Segment Level	(US GAO, 2010; van der Raadt & van Vliet, 2008)
	Solution Architecture Development	Project Level	(Lapkin, 2008; The Open Group, 2011)
	Requirements Engineering and Management	Enterprise Level	(Lapkin, 2008; Schekkerman, 2006; The Open Group, 2011)
		Segment Level	(Ross et al., 2006; The Open Group, 2011)
		Project Level	(The Open Group, 2011)

TABLE 3: EA DEVELOPMENT ACTIVITIES PART 1 OF 2

	Activity	Scope	Sources
EA Development (2/2)	*Definition and Management of Principles, Standards, Rules and Guidelines*	Enterprise Level	(Deloitte TTL, 2013; Ross et al., 2006; Schekkerman, 2006; The Open Group, 2011; van der Raadt & van Vliet, 2008)
		Segment Level	(Deloitte TTL, 2013; Luftman & Kempaiah, 2007; van der Raadt & van Vliet, 2008)
		Project Level	(Deloitte TTL, 2013; Luftman & Kempaiah, 2007)

TABLE 4: EA DEVELOPMENT ACTIVITIES PART 2 OF 2

Baseline Architecture Development (BAD) (Enterprise and/or Segment)
The *Baseline Architecture Development* activity category concerns all activities which an organization undertakes to determine the current business, information and/or technical domains. This is usually captured in various artefacts such as diagrams and matrices. The creation of the documents containing these artefacts involve the identification of what is currently present in the domains: the baseline. This may be done for aspects which concern the entire enterprise and/or a particular segment (hence the Enterprise and Segment Level scope). Baseline Architecture Development with a project scope is in this thesis to be considered part of Solution Architecture Development.

Target Architecture Development (TAD) (Enterprise and/or Segment)
Besides the baseline, organizations may also define what state of its business, information and/or technical domain it strives to attain. The activities involved in that are related to this Defining Target activity category. This may also be done for enterprise level or segment level aspects (hence the Enterprise and Segment Level scope). Target Architecture Development with a project scope is in this thesis to be considered part of Solution Architecture Development.

Gap Analysis and Migration Planning (GMP) (Enterprise and/or Segment)
In order for the organization to actually reach the target state as defined in the activity above, a plan of action needs to be made. This is done by comparing the baseline with the target and identifying the differences. These differences, or gaps, need to be overcome. To overcome the gaps, solutions need to be defined and planned according to their interdependencies. This activity category refers to the process of identifying these gaps and setting up a plan of action (also roadmap or migration plan) to get from the baseline to the target state. This may be done for an entire enterprise or segment.

Solution Architecture Development (SAD) (Project Level)
The higher level plans made at Enterprise and/or Segment Level are translated into concrete solutions within this activity. These solution architectures are realized in the execution of projects. The actual execution of the project is not in scope of this activity, only the formulation of a solution level architecture. This may concern a baseline or target architecture.

Requirements Engineering and Management (REM) (Enterprise, Segment and/or Project Level)
As in any development project, the stakeholder demands need to be taken into account. Such demands are called *requirements.* The set of requirements needs to be available and up-to-date in order for them to be incorporated in the architecture. This activity category concerns the process of identifying requirements and keeping them up-to-date by verifying, extending, adjusting or discarding them. Requirements from the enterprise level should also be used by the segments and projects, however, it might be necessary to make them more specific or add new ones. This category therefore has a scope of Enterprise Level, Segment Level and/or Project Level.

Definition and Management of Principles, Standards, Rules & Guidelines (SRG) (Enterprise, Segment and/or Project Level)
EA makes use of guiding principles, standards, rules and guidelines (Winter & Aier, 2011). These concepts refer to rules the organization has to follow when a decision is made. Stelzer (2010) distinguishes two kinds of principles: design principles and representation principles: "*Design principles are fundamental propositions guiding the construction and evaluation of architectures, e.g. separation of concerns, modularity, or loose coupling. Representation principles are fundamental propositions for describing and modelling architectures, as well as for evaluating architectural representations. Examples for representation principles are understandability, consistency, and completeness."* (Stelzer, 2010). Apart from principles, an organization might agree to adhere to certain standards (for example: industry or regulatory standards). An organization should take time to agree upon a consistent set of principles, standards, rules and guidelines which ought to be used when decisions regarding exceptions are made. These should be regularly updated to reflect the current situation. This activity category refers to all the activities which concern the setup and maintenance of principles, standards, rules and guidelines. Although defining them at enterprise level should result in the most consistent execution of projects, it might be required to refine some of them to make them specific for the segment or project at hand. Hence the scope indication of Enterprise Level, Segment Level and/or Project Level.

EA FOUNDATION

EA Foundation refers to all EA activities which are required to support the EA staff in their work. Table 5 presents an overview of all activities in this category.

	Activity	Scope	Sources
EA Foundation	Selection and Maintenance of Tools	EA Level	(Deloitte TTL, 2013; Spewak & Hill, 1993; US GAO, 2010)
	Recruitment and Development of Human Capital	EA Level	(Deloitte TTL, 2013; Lapkin, 2008; Luftman & Kempaiah, 2007; Ross et al., 2006; Spewak & Hill, 1993; US GAO, 2010)
	Definition, Measurement and Evaluation of KPIs	EA Level	(Lapkin, 2008; Luftman & Kempaiah, 2007; Radeke, 2011; Ross et al., 2006; The Open Group, 2011; US GAO, 2010)
	EA Process Formalization and Documentation	EA Level	(Deloitte TTL, 2013; US DoC, 2007; US GAO, 2010; NASCIO, 2003;)
	Communication and Stakeholder Management	EA Level	(Deloitte TTL, 2013; Lapkin, 2008; Luftman & Kempaiah, 2007; Nikpay et al., 2013; Radeke, 2011; Ross et al., 2006; Schekkerman, 2006; The Open Group, 2011; US DoC, 2007; US GAO, 2010; van der Raadt & van Vliet, 2008)

TABLE 5: EA FOUNDATION ACTIVITIES

Selection and Maintenance of Tools (SMT) (EA Level)
The *Selection and Maintenance of Tools* activity involves spending time on ensuring the tools which are used or needed to support all activities are the right ones and are accessible and usable for the right people. This can refer to all tools which may be needed, such as: modelling, repository/storage, communication or analysis tools. This also involves configuring the tools as required. A tool in this context can be a software tool but also a logical framework or methodology.

Recruitment and Development of Human Capital (HC) (EA Level)
This activity refers to all tasks which are required to find and secure the right people for the right jobs on EA related positions and to invest in their training and development. This may involve formulating job descriptions and career paths, doing interviews, setting and maintaining remuneration systems, defining and assigning roles (both for the EA function as well as in projects),

evaluating job satisfaction and performance. But also the development, execution and attendance of formal training and certification programmes for EA personnel. Evaluation of skills and the selection of appropriate development plans is also an essential part of this activity.

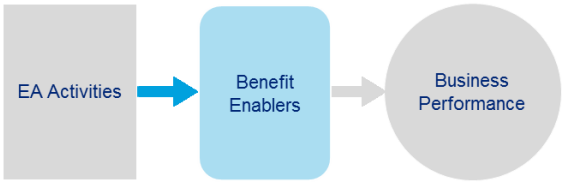
Definition, Measurement and Evaluation of KPIs (DMK) (EA Level)
Literature suggests that it is important for EA teams to regularly evaluate its performance. This involves defining and measuring KPIs, evaluating them and implementing improvements. This is relevant for all main activity categories.

EA Process Formalization and Documentation (PFD) (EA Level)
Literature suggests that it is important for EA staff to formalize and document the processes and methods which the team uses. This activity refers to the agreement, formalization and documentation of the processes and methods which EA staff use to do their work.

Communication and Stakeholder Management (CSM) (EA Level)
As Section 1.2.3 pointed out, EA involves many stakeholders. This category concerns the interaction with these stakeholders. This may involve making and executing communication plans, involving various levels of management in EA processes, involving management in EA projects and gaining sponsorship.

2.3 EA Contribution to Benefit Enablers

This section discusses which Benefit Enablers EA is claimed to influence according to literature. The relationship between the EA activities and the Benefit Enablers is also clarified.



2.3.1 Benefit Enablers

Taking a close look at the literature about EA benefits results in the conclusion that these benefits do not have a direct influence on business performance. An example is the benefit of information accuracy as claimed in Spewak & Hill (1993). Having accurate information available to make a decision improves the chance of making the correct one. Making the correct decision can, depending on the context of the decision, result in cost savings, cost efficiencies etc. These are things which contribute directly to business performance. However, note in this example that the availability of accurate information *enables* the organisation to make the correct decision, which in turn leads to contributions to business performance such as cost reductions. The accurate information in itself is no benefit for business performance, it merely enables the realization of other benefits. Benefits claimed in literature have similar effects. Rigorous literature reviews have previously identified this notion (Boucharas et al., 2010; Tamm et al., 2011) and Tamm et al. (2011) coined these intermediate benefits *Benefit Enablers*. Figure 11 presents an overview of all Benefit Enablers.

FIGURE 11: BENEFIT ENABLERS OVERVIEW

This section identifies these benefit enablers as found in literature. Instead of finding a new way to structure benefits, this thesis presents the benefits according to the structure of the EA Benefits Model of Tamm et al. (2011). Main reason for this choice is the rigorous literature review of said authors which led to the identification of this structure. Furthermore, the structure was found to suit the literature which was identified in the literature search of this thesis.

Each section starts with the definition of Tamm et al. (2011) of that category. The remainder of each section elaborates on the meaning of the respective benefit enabler and the way EA achieves it.

Every section ends with a visual model of the identified relationships. The numbers in the circles and ovals refer to references in Table 6 on page 32, which presents an overview of all relationships and the corresponding research. A circle concerns exactly one relationship, while an oval indicates that the source(s) describe multiple relationships. Arrows without a number denote a relationship for which indications were found in literature but not enough evidence was found to attribute it to specific authors. They are included in the figures to provide a complete overview, but they are not included in Table 6 and not used any further in this thesis.

ORGANIZATIONAL ALIGNMENT

"The extent to which an organisation's subunits share a common understanding of its strategic goals, and contribute towards achieving these goals" (Tamm et al., 2011).

One of the benefits that receives a lot of attention in literature is organizational alignment (Chan & Reich, 2007). Especially the alignment of business and IT is something which is often claimed to be supported by EA (Brown, 2004; Radeke, 2011; Shah & Kourdi, 2007; Tamm et al., 2011; van der Raadt et al., 2008). This refers to the notion that IT strategy and all its resultant deliverables and investments are fuelled by business strategies or that the business learns to adapt its business strategy to accommodate for the technology situation in the organization. Either of these perspectives would result in business and IT alignment (J. C. Henderson & Venkatraman, 1993). Such alignment should ensure that the strategic needs of an organization are supported in the best possible way by the IT investments (Tamm et al., 2011). Thereby optimizing IT spending to create cost efficiencies and creating the required business opportunities and capabilities. However, alignment is not limited to business and IT. It also encompasses the other areas of an organization. Ensuring coherent and consistent changes and operation between different domains and business units is also claimed to be supported by EA (van der Raadt et al., 2008). In more general terms, EA is claimed to help an organization achieve its strategy by identifying and solving gaps between the baseline and target state of an organization in a coherent and consistent manner (van der Raadt et al., 2008). This is also enabled by improved decision making capabilities which EA is claimed to provide (Richardson, Jackson, & Dickson, 1990). The following section elaborates on the role of EA in all the mentioned aspects.

The Role of EA

The EA Development Activities turn out to play a key role in Organizational Alignment. Because EA begins with establishing an understanding of business processes, it can bring IT in closer alignment with these processes by providing said newfound understanding (Gregor, Hart, & Martin, 2007; Ross et al., 2006). The EA Development activities do span more than just IT however. This creates a broader impact in the organization, by facilitating dialogue and understanding of the potential synergies and interdependencies of the various business processes (Segars & Grover, 1996). The insight into the organization which EA staff has due to their work makes them ideal to involve in strategy formulation (Lapkin, 2008; Sauer & Willcocks, 2002; Strano & Rehmani, 2007). Furthermore, such insight also allows for the right people to be involved in decision making and conflict resolution in all levels of the organization, thus improving decision making in terms of both time involved and quality of the outcome (Bernard, 2012; The Open Group, 2011b). This is enhanced by the objective decision criteria that EA principles provide (Richardson et al., 1990). All this together improves decision making by reducing subjectivity and brings both business and IT in close alignment with strategy. Such alignment is also supported by EA by enabling communication and dialogue within the organization (Segars & Grover, 1996). EA enables such dialogue by the knowledge management and subsequent knowledge exchange provided by the *Knowledge Management and Documentation* activity (van Steenbergen et al., 2011). *Compliancy Verification* is mentioned as another activity to enable such communication and dialogue as well as to enable Business and IT Alignment (van Steenbergen et al., 2011).

The relationships as identified above are visualised in Figure 12.

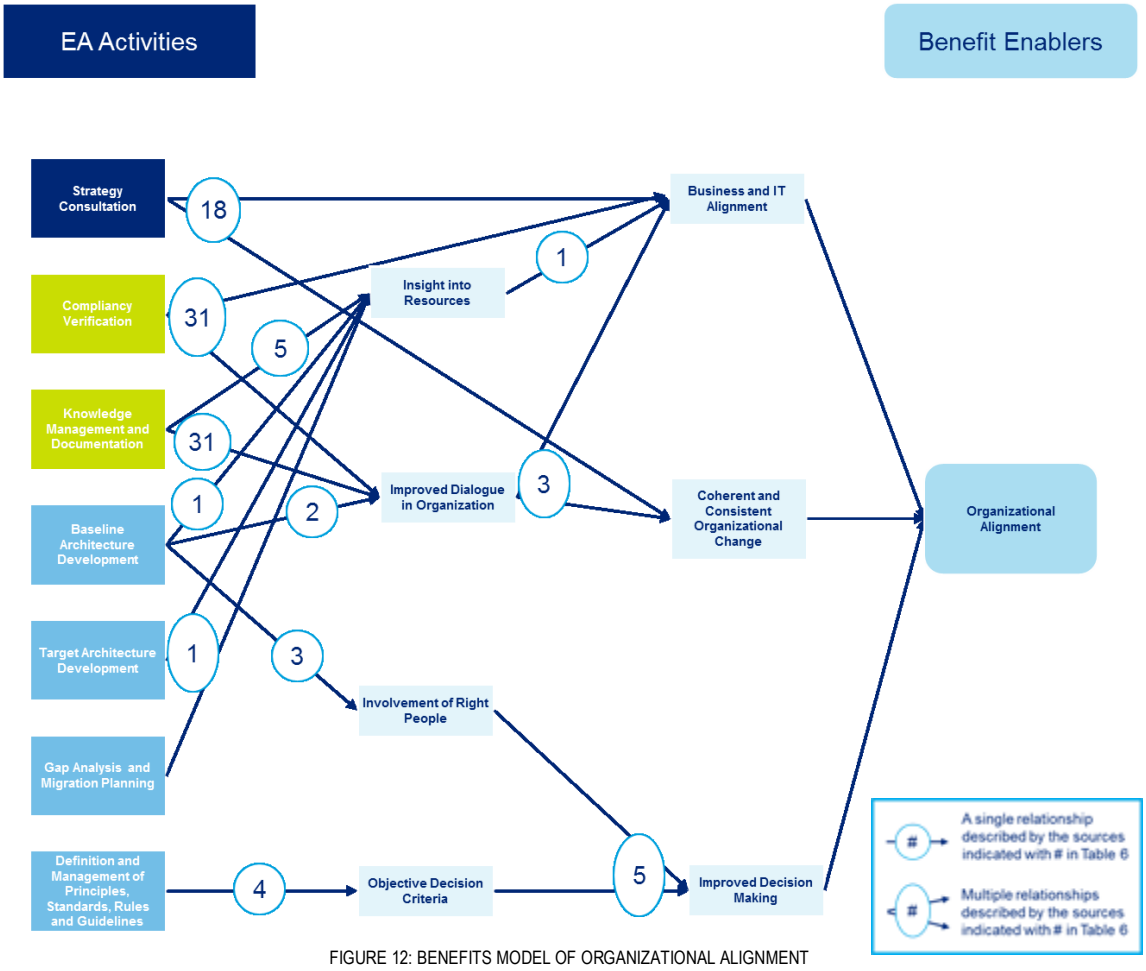


FIGURE 12: BENEFITS MODEL OF ORGANIZATIONAL ALIGNMENT

INFORMATION AVAILABILITY

"The extent of useful, high-quality information accessible to organisational decision makers" (Tamm et al., 2011).

The information quality to which the definition refers encompasses aspects such as accuracy, accessibility and completeness, (Lee, Strong, Kahn, & Wang, 2002; Wang & Strong, 1996). It is claimed in literature that EA has the possibility to contribute to all these aspects (Tamm et al., 2011). The next section will elaborate on the role of EA in contributing to these aspects.

The Role of EA

The mentioned aspects are improved in two ways: by providing and improving the information about the organization's processes as well as the information about its clients, suppliers and transactions (Tamm et al., 2011). Insights into such resources is a direct benefit of the EA Development activities which, as previously mentioned, develop an understanding about an organization's processes and IT (Bernard, 2012; Brown, 2004; Lange & Mendling, 2011; van der Raadt et al., 2008). This may reveal interdependencies or inefficiencies that were previously unknown. The insights into clients, suppliers and transactions is a result of the implementation of EA solution implementation projects. Aforementioned information is traditionally stored in various databases across the organization. EA is suggested to aid in the disclosure of this information through planned integration of the information systems which contain said data (Boh & Yellin, 2007; Ross et al., 2006; Spewak & Hill, 1993). The reduced data redundancy which results from such EA Realization activities may increase data accuracy (Venkatesh, Bala, Venkatraman, & Bates, 2007).

Furthermore, the operating platform which EA supports is claimed to be more stable and as such provides increased information accessibility (Ross et al., 2006). The insights into resources may complement the information available to decision makers and thereby improves the information completeness aspect of Information Availability (Boh & Yellin, 2007).

The relationships as identified above are visualised in Figure 13.

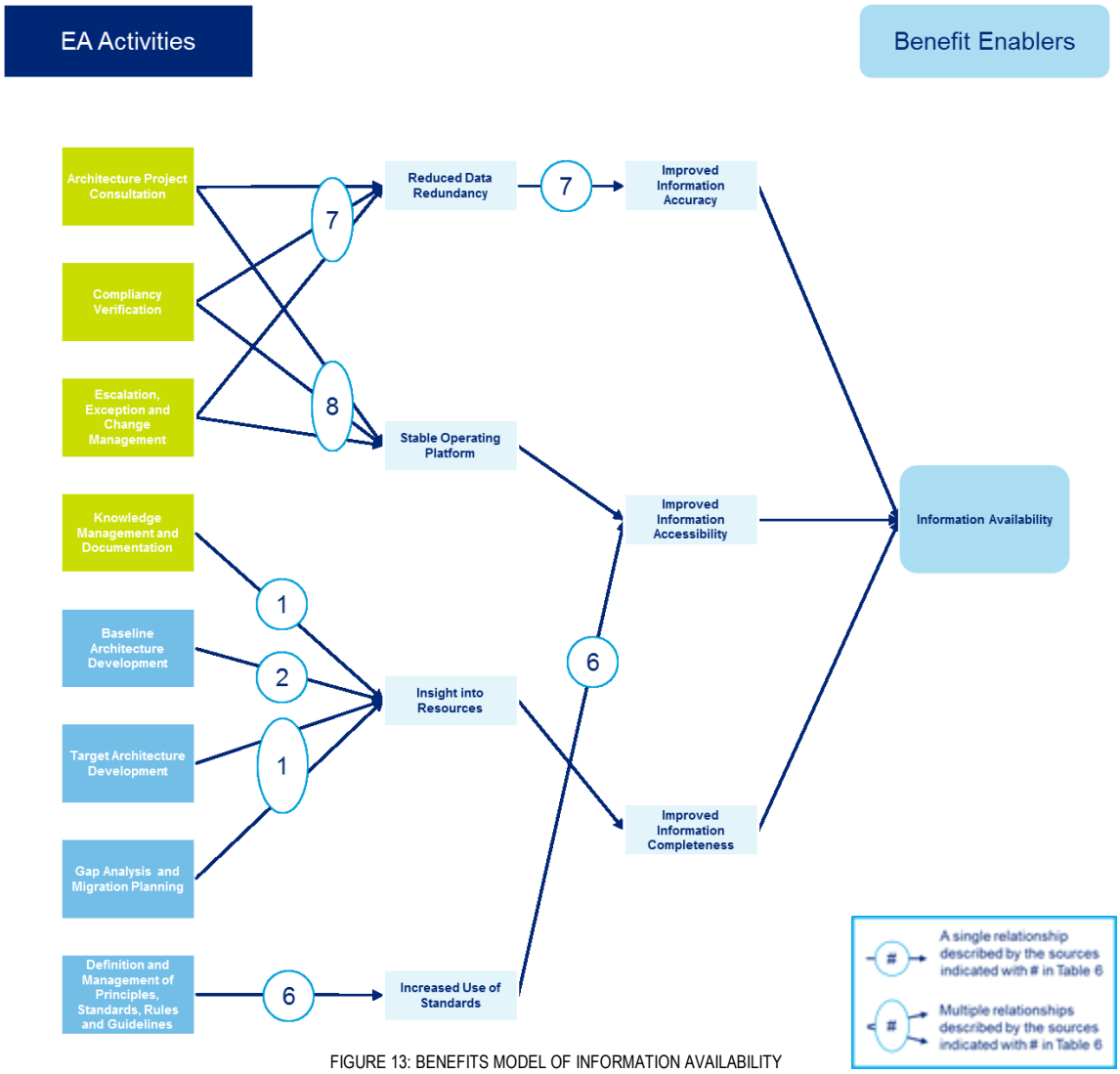


FIGURE 13: BENEFITS MODEL OF INFORMATION AVAILABILITY

RESOURCE PORTFOLIO OPTIMIZATION

"The extent to which an organisation leverages its existing resources, invests in resources that target performance gaps, and minimises unnecessary investments in duplicated resources" (Tamm et al., 2011).

The definition refers to organizational resources, which is an ambiguous term. For EA, the most important resources are human resources, IT and organizational processes. Optimization might therefore refer to the removal of non-value-adding human or technology resources and/or replacing them with resources that suit the achievement of organizational goals better (Tamm et al., 2011).

The Role of EA

The mentioned optimizations may be realized in a number of areas. Firstly, the analysis of the baseline state of the organization may lead to the identification of redundant or suboptimal resources. Literature suggests that EA solution implementation projects contribute to optimization through the unification and integration of such resources (Boh & Yellin, 2007; Brown, 2004; Espinosa, Boh, & DeLone, 2011; Ross et al., 2006; Shah & Kourdi, 2007; Spewak & Hill, 1993; van Steenbergen et al., 2011). Additionally, the use of principles, standards, rules and guidelines promotes the use of standards which contributes to the unification and integration of resources (Boh & Yellin, 2007; Spewak & Hill, 1993). Van Steenbergen et al. (2011) showed that such standardization and integration is also supported by EA knowledge management and Compliancy Verification activities. Secondly, because EA staff documents many aspects of their work as well as aspects of the organization, the risk of missing information due to replacement of personnel is significantly decreased (Iyer & Gottlieb, 2004). EA also helps in structuring resources in a way which promotes and facilitates reuse of components (Espinosa et al., 2011). This makes removing redundancy, automation and/or replacement of individual components easier and speeds up solution delivery time (Brown, 2004; Espinosa et al., 2011; Ross et al., 2006). Finally, EA improves the IT landscape by providing a higher visibility of legacy components as well as a clear view of the target architecture. (Espinosa et al., 2011; van Steenbergen et al., 2011).

The relationships as identified above are visualised in Figure 14.

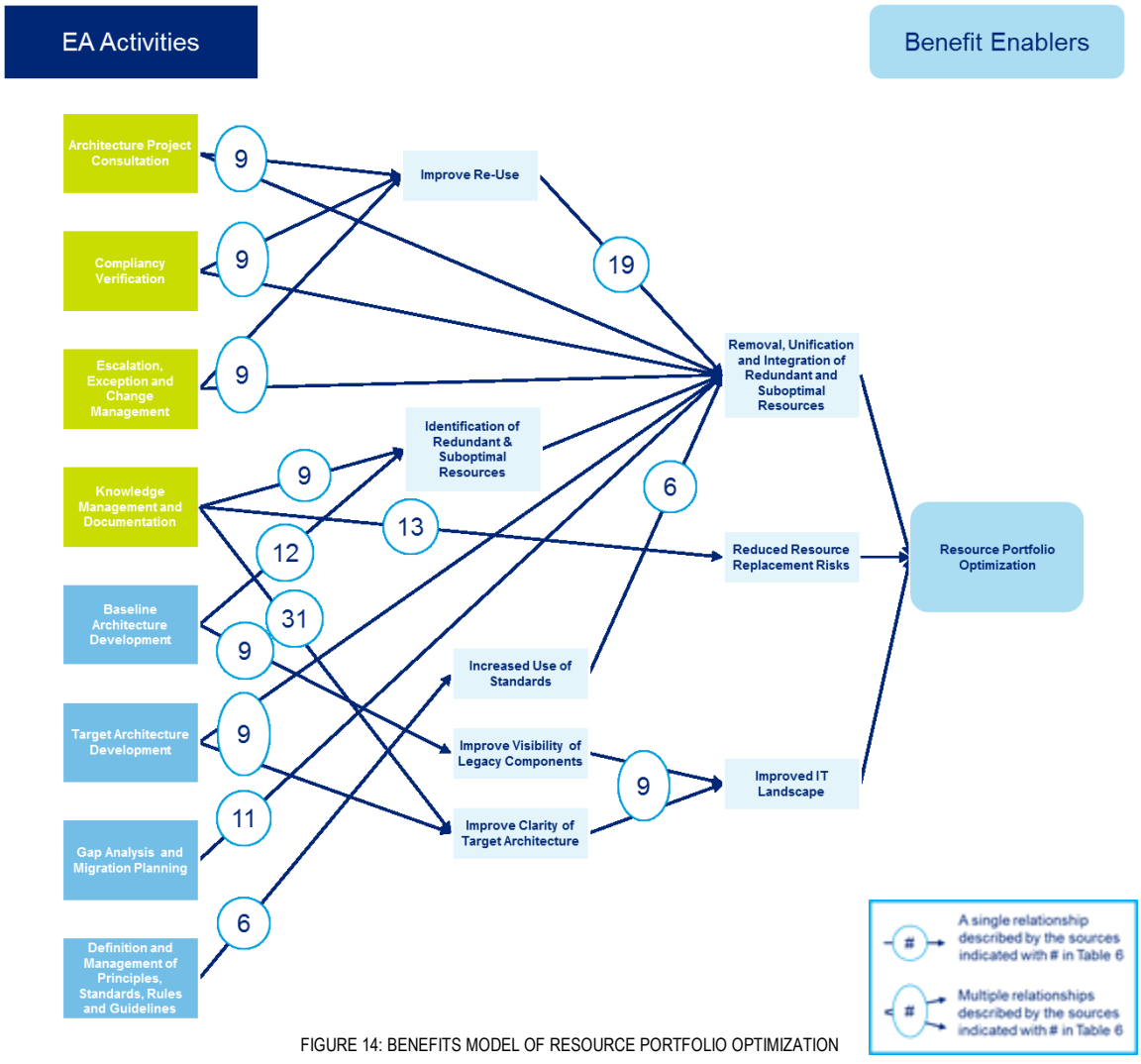


FIGURE 14: BENEFITS MODEL OF RESOURCE PORTFOLIO OPTIMIZATION

RESOURCE COMPLEMENTARITY

"The extent to which the organisation's resources synergistically support the pursuit of its strategic goals" (Tamm et al., 2011).

This last category of benefit enablers is seemingly similar to the previous one. However, where the previous category refers to optimising resources by removing redundancy, this category refers to combining these resources in new and unique ways. Such unique combinations are claimed to provide a company with a competitive advantage according to the theory of the Resource-Based-View (Amit & Schoemaker, 1993). This is caused by two aspects: first, the difficulty to imitate complex configurations of resources due to causal ambiguity (Lippman & Rumelt, 1982) and second, the reinforcing nature of complementary resources (Porter, 1996).

The Role of EA

EA helps in this regard first and foremost by identifying possible synergies and providing a roadmap to accomplish these (Prahalad & Hamel, 1990). Similar to the previous category, this originates from the holistic view of the enterprise which EA takes and the resulting insights into the relations of its resources. This insight results mainly from the EA Development activities in which the current and target state are examined (Bernard, 2012; Gregor et al., 2007). Furthermore, EAs involvement across many projects allows further synergies to be identified and realized (Espinosa et al., 2011). This refers to the EA Realization activities in which EA staff consults projects as well as the Compliancy Verification and exception handling activities.

Identifying and realizing such synergies results in what Henderson & Clark (1990) called an 'architectural innovation': an improvement in a system caused by an enhanced reconfiguration of components. EA helps to realize these improvements which eventually supports a firm's innovation (Lange & Mendling, 2011). The relationships as identified above are visualised in Figure 15.

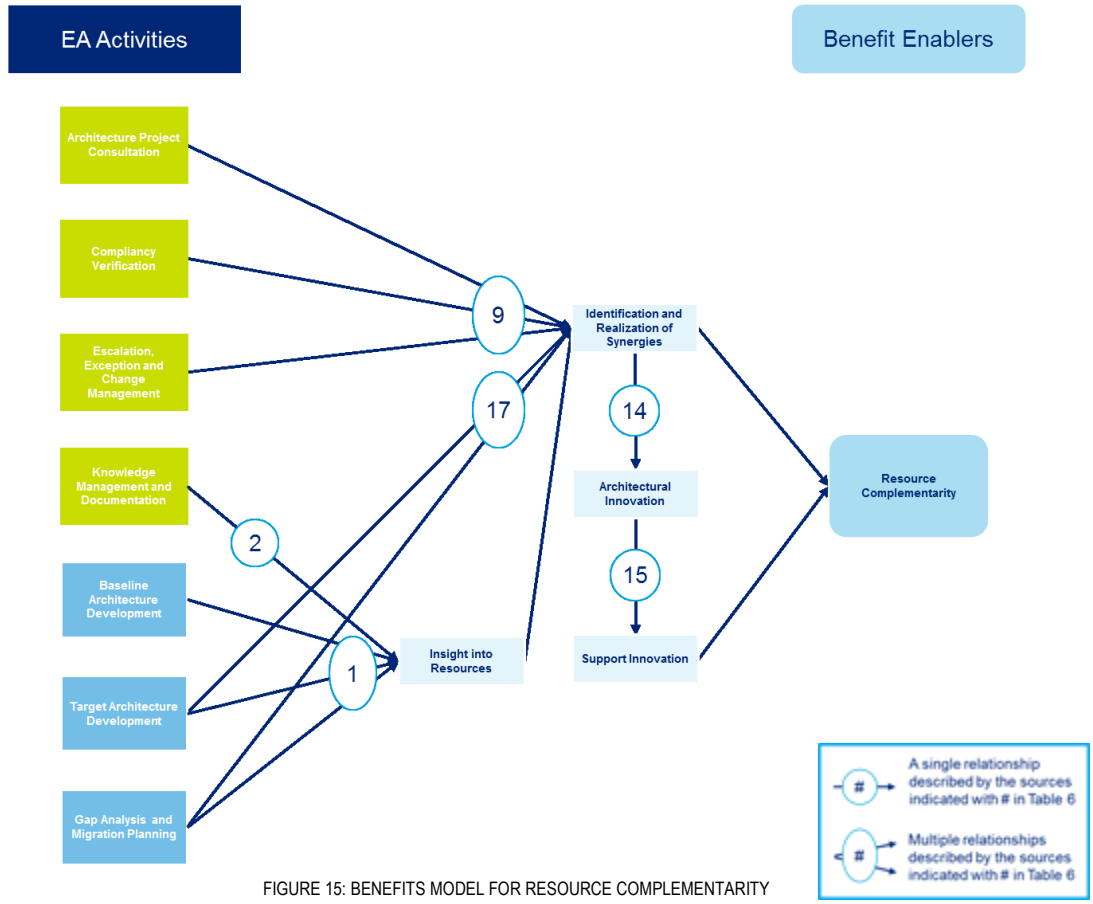


FIGURE 15: BENEFITS MODEL FOR RESOURCE COMPLEMENTARITY

2.4 EA Contribution to Business Performance

This section discusses the benefits of EA which have an impact on business performance. This includes how the benefit enablers influence business performance.

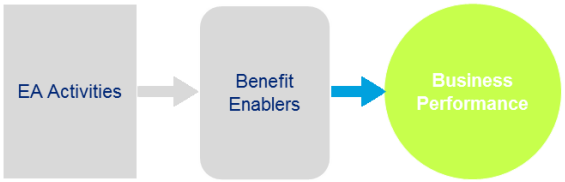


FIGURE 16: BUSINESS PERFORMANCE BENEFITS

The impact of EA on business performance can be defined in different ways. This thesis has derived its structure from the semantically similar concept of business objectives. A well-known approach to structuring business objectives is the Balanced Score Card (BSC) of Kaplan and Norton (Kaplan & Norton, 1996). They propose four perspectives that group similar business objectives. A business objective is a goal which an organization strives to attain because it will positively impact business performance (for example "reduce operational costs by 5 %"). A benefit of EA is semantically similar as it is also a desirable organizational result (for example: cost reduction as a result of process optimizations). Although syntactically different, the underlying effect on the organization is similar: it takes less money to operate the business. This example illustrates the similarity of the 'business objectives' and 'EA Contribution to Business Performance' concepts. Therefore the BSC structure is deemed to be appropriate to structure EA benefits. This notion is supported by Boucharas et al. (2010) and Plessius, Slot, & Pruijt (2012), which both used a similar approach.

Each of the following sections first introduces the BSC perspective and then continues with an explanation of the corresponding EA benefits which have impact on Business Performance. Figure 16 presents an overview of all benefits.

Every section ends with a visual model of the identified relationships. The notation of these models is identical to the notation used in the previous section. The numbers in the circles and ovals refer to references in Table 6 on page 32, which presents an overview of all relationships and the corresponding research. A circle concerns exactly one relationship, while an oval indicates that the source(s) describe multiple relationships. Arrows without a number denote a relationship for which indications were found in literature but not enough evidence was found to attribute it to specific authors. They are included in the figures to provide a complete overview, but they are not included in Table 6 and not used any further in this thesis.

FINANCIAL

The financial perspective of the BSC is used to describe outcomes of an organization's strategy in the form of financial indicators (Kaplan & Norton, 1996). Such indicators include a firm's profitability, its Return on Investment (ROI) etc. In this section all benefits with a financial advantage for an organization will be discussed.

The total ROI is generally improved by the Organizational Alignment benefit enabler as it reduces the minimal overhead required to achieve the strategic goals (Tamm et al., 2011). The contribution of the Resource Portfolio Optimization benefit enabler to the financial perspective mainly concerns

cost reductions which result in a better ROI (Tamm et al., 2011). Another, frequently claimed benefit in this perspective is the reduction of IT costs. Due to the resource portfolio optimisation benefit enablers, such as reuse, time savings and resource integrations organizations can reduce their IT spending significantly (Sohel Aziz, Obitz, Modi, & Sarkar, 2005; Brown, 2004; Espinosa et al., 2011; Ross et al., 2006; Spewak & Hill, 1993). This includes the reduction of support and acquisition costs (Sohel Aziz et al., 2005; Morganwalp & Sage, 2004). Figure 17 visualizes these aspects.

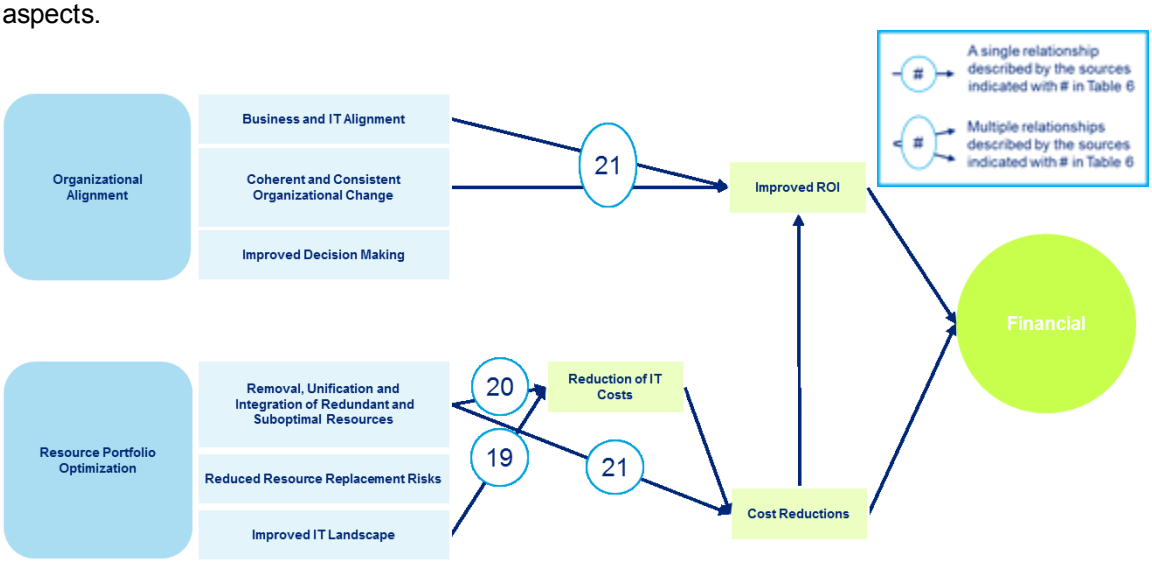


FIGURE 17: FINANCIAL BUSINESS PERFORMANCE BENEFITS

CUSTOMER

In the BSC approach, the customer perspective describes indicators which relate to organizations' value propositions for its customers (Kaplan & Norton, 1996). Such indicators include the number of subscribers to a service or newsletter, customer satisfaction indices, number of products etc. This section will describe EA benefits which contribute to the organization's value proposition for the customer.

As the rigorous literature review of Boucharas et al. (2010) reveals, customer related benefit claims are rare. Customer intimacy and product leadership are the most prominent benefits in this perspective (Boucharas et al., 2010). Customer intimacy results from a better understanding of customer needs and should ultimately lead to increased customer satisfaction (Butler, 2000). EA can contribute to such understanding and satisfaction by prescribing an architecture which enables disclosing and integrating all information which an organization possesses about its customers (Ross et al., 2006). This is a result of the Information Availability Resource Enabler. Product leadership refers to offering state-of-the-art products or services to your customers. EA enables this by identifying innovation opportunities as is described in the Resource Complementarity Benefit Enabler in Section 2.3.1. Additionally, the Resource Portfolio Optimization Benefit Enabler contributes to the customer perspective by enabling improved product and/or service quality and reliability (Davenport & Short, 1990). Figure 18 on page 28 visualizes these aspects.

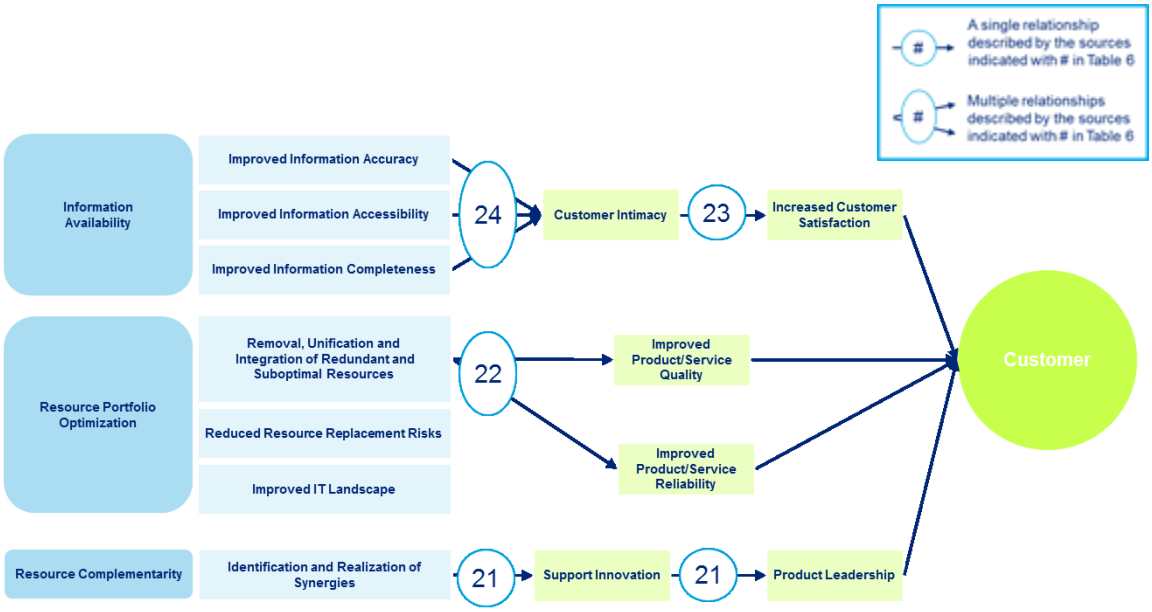


FIGURE 18: CUSTOMER RELATED BUSINESS PERFORMANCE BENEFITS

INTERNAL

The BSC's internal perspective concerns indicators about key processes which are critical for the realization of the outcomes in the financial and customer perspectives (Kaplan & Norton, 1996). This concerns various organizational processes such as operations management, customer management, innovation, as well as regulatory and social processes. This section will identify EA benefits which result in advantages in these areas.

Risk management is claimed to be facilitated by EA by enabling the provision of the required information to decision makers, i.e. this is the result of the Information Availability benefit enabler (Boucharas et al., 2010). This allows an organization to identify, reduce and manage their risks better (Sohel Aziz et al., 2005; Ross et al., 2006; Shah & Kourdi, 2007). For example, EA can help by identifying a high staff turnover risk and positioning the company's knowledge management resources in the business processes such that staff turnover is no longer a major risk (Sohel Aziz et al., 2005; Shah & Kourdi, 2007). Additionally, the documentation of knowledge by EA staff themselves also contributes to managing such risks as mentioned in the Resource Portfolio Optimization Benefit Enabler (Sohel Aziz et al., 2005; Shah & Kourdi, 2007). Another important benefit in the internal perspective is related to operational excellence. EA helps organizations achieve higher levels of operational efficiency by facilitating automation and optimizations in multiple domains as mentioned in the Resource Portfolio Optimization benefit enabler (Ross et al., 2006; Tamm et al., 2011). Figure 19 on page 29 visualizes these aspects.

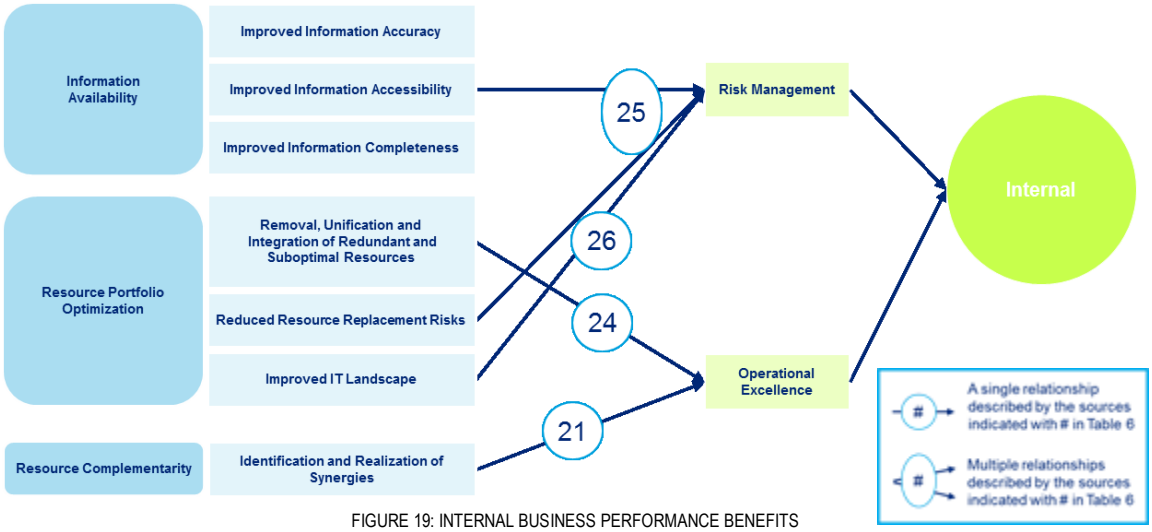


FIGURE 19: INTERNAL BUSINESS PERFORMANCE BENEFITS

LEARNING & GROWTH

The learning & growth perspective describes a number of rather intangible business outcomes in the original BSC (Kaplan & Norton, 1996). It concerns "*what jobs, which systems, and what organizational characteristics (e.g. culture, alignment, knowledge sharing) are necessary in order to support an organization's (…) strategy*" (Boucharas et al., 2010). These are divided into the human capital, information capital and organizational capital categories. This section will introduce the EA benefits which result in an advantage in these areas.

Regarding human capital, EA is claimed to improve managers' abilities to make decisions by the information availability benefit enablers (Boucharas et al., 2010; Johnson, Lagerström, Närman, & Simonsson, 2007; Tamm et al., 2011). Ross et al. (2006) add to this that EA also improves decision making by clarifying which information is required to make a decision.

In the information capital area EA is claimed to make IT complexity more manageable (Shah & Kourdi, 2007) resulting in more responsive IT (Ross et al., 2006) as well as a more efficient and flexible IT landscape (Schmidt & Buxmann, 2011). These are results of the Resource Portfolio Optimization benefit enabler.

On the organizational capital front, EA is proven to make strategic complexity more manageable (Roest, 2014). A more manageable organization is claimed to result in a faster time-to-market (Sohel Aziz et al., 2005) and allows it to respond and adapt to changes quicker (Shah & Kourdi, 2007). The stimulation of adaptability and agility of an enterprise, is a prominent benefit in literature (S. Aziz & Obitz, 2007; Brown, 2004; Espinosa et al., 2011; Radeke, 2011; Ross et al., 2006; Shah & Kourdi, 2007). In general, EA guides an organization in its transformation resulting in purposeful evolution of an enterprise (Radeke, 2011). Flexibility of both business processes and IT are key aspects which contribute to this. Figure 20 on page 30 visualizes these aspects.

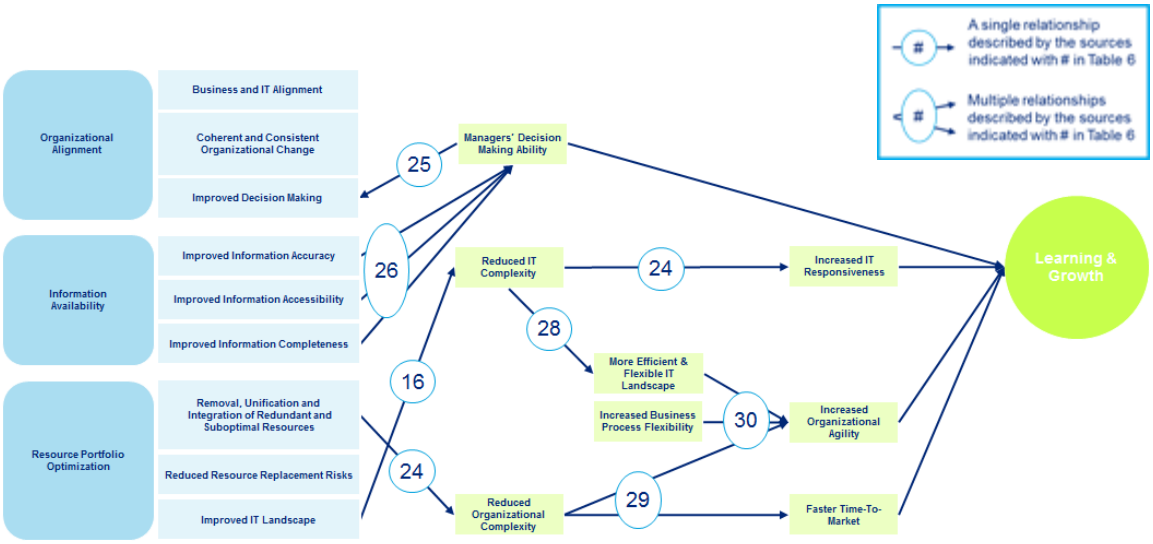


FIGURE 20: LEARNING AND GROWTH RELATED BUSINESS PERFORMANCE BENEFITS

2.5 Contextual Factors

EA literature suggests that reaping benefits from EA depends on a number of factors. These factors impact the effect EA activities have on achieving the benefits. This implies that two different companies might perform similar EA activities and yet experience different levels of benefits. This section describes the various factors suggested to influence the effects of EA efforts.

COMPLEXITY AND SIZE

Bernard (2012) suggests that organizations with complex IT environments, mostly found in large organizations, will benefit more from EA than organizations with smaller and less complex environments. The benefit enablers seem to support this notion. Complex environments encompass a more diverse resource portfolio and are therefore more likely to benefit from Resource Portfolio Optimization than smaller, less complex environments (Tamm et al., 2011). Furthermore, the Organizational Alignment benefit enabler will likely have more effect on environments where there is potentially significant misalignment: in larger, complex organizations (Tamm et al., 2011).

OPERATING MODEL

An organization's operating model is, according to Ross et al. (2006) characterized by its levels of integration (sharing of data) and standardization (commonality of processes and systems). The authors argue that companies with low levels in these two aspects will achieve significant benefits by using EA to improve them.

OPERATING PLATFORM

Bernard (2012) also raises the issue of the quality of the operating platform of the organization. A platform with high redundancy and/or quality issues may allow for larger potential benefits from Resource Portfolio Optimization. Moreover, such performance gaps may create a bigger need for the Information Availability benefit enabler and its consequential benefits (Tamm et al., 2011).

RATE OF ORGANIZATIONAL CHANGE

An aspect introduced by Spewak & Hill (1993) is the rate of organizational change. The authors claim that organizations who change frequently and/or change significantly achieve greater benefits from EA. This can be explained with the benefit enablers. The Information Availability benefits include a better understanding of the interdependencies of processes and systems. Large

changes will inevitably require changes to these components and in such situations a thorough understanding is helpful (Tamm et al., 2011). Furthermore, a more integrated set of resources will allow for easier and cheaper changes. This may be achieved with the benefits of the Resource Portfolio Optimization benefit enabler.

INFORMATION INTENSITY

Organizations who rely heavily on information in providing their products/services or organizations whose product/service *is* information are likely to experience greater benefits from EA (Tamm et al., 2011). The Information Availability benefit enabler is likely to provide an organization of such kind with more benefits than less information intensive organizations.

ORGANIZATIONAL CULTURE

The effect of organizational culture on EA practices is investigated in van Steenbergen (2011). It is argued that three particular aspects of organizational culture seem to impact the outcomes of EA to the greatest extent: *"the amount of autonomy within an organization, the extent of collaboration found in the organization and the extent to which the organization is process or result oriented"* (van Steenbergen, 2011, p. 191). Organizations with a strong autonomous workforce need to focus on governance and decision making in their EA efforts. It is in the nature of EA to create coherence and alignment in decision making. As such, it needs to focus its attention on where decisions are made. In an autonomous workforce decision making occurs ad-hoc and distributed and therefore EA efforts need to take this into account (van Steenbergen, 2011). The extent of collaboration in an organization has a strong influence in the effect of the communication efforts of EA. Organizations with a workforce who work closely together and rely heavily on collaboration will act upon communications of the EA department without further ado. In organizations where employees are less inclined to collaborate, more effort needs to be undertaken by the EA staff in order to accomplish the same effect (van Steenbergen, 2011).

EA MATURITY

A factor investigated in Roest (2014) is that of EA maturity. This refers to the extent an organization is capable of performing EA by having the right tools, processes, owners etc. Roest (2014) shows that higher maturity levels will result in better business performance. In other words: the benefits from EA are larger if the maturity level is higher.

2.6 EA Benefit Relationships in Literature

Table 6 provides an overview of the relationships between all benefits and activities that are identified in literature. The numbers in the table refer to the numbers in the circles and ovals in the benefit models in Figure 12, Figure 13, Figure 14, Figure 15, Figure 17, Figure 18, Figure 19 and Figure 20 in Sections 2.3 and 2.4.

#	Sources	Respective Relationship Evidence
1	(Bernard, 2012; Gregor et al., 2007)	Qualitative
2	(Bernard, 2012; Gregor et al., 2007; Ross et al., 2006)	Qualitative
3	(Segars & Grover, 1996)	Qualitative
4	(Bernard, 2012)	Qualitative
5	(Richardson et al., 1990)	Qualitative
6	(Boh & Yellin, 2007; Spewak & Hill, 1993)	Quantitative, Qualitative
7	(Venkatesh et al., 2007)	Qualitative
8	(Ross et al., 2006)	Qualitative
9	(Espinosa et al., 2011)	Qualitative
10	(Lange & Mendling, 2011; van der Raadt et al., 2008)	Qualitative
11	(Bernard, 2012; Espinosa et al., 2011)	Qualitative
12	(Bernard, 2012; Boh & Yellin, 2007; Espinosa et al., 2011)	Qualitative, Quantitative, Qualitative
13	(Iyer & Gottlieb, 2004)	Qualitative
14	(R. M. Henderson & Clark, 1990)	Qualitative
15	(Lange & Mendling, 2011)	Qualitative
16	(Shah & Kourdi, 2007)	Qualitative
17	(Prahalad & Hamel, 1990)	Qualitative
18	(Lapkin, 2008; Sauer & Willcocks, 2002; Strano & Rehmani, 2007)	Qualitative
19	(Brown, 2004; Espinosa et al., 2011)	Quantitative, Qualitative
20	(Espinosa et al., 2011)	Qualitative
21	(Tamm et al., 2011)	Qualitative
22	(Davenport & Short, 1990)	Qualitative
23	(Butler, 2000)	Qualitative
24	(Ross et al., 2006)	Qualitative
25	(Boucharas et al., 2010)	Qualitative
26	(Sohel Aziz et al., 2005; Shah & Kourdi, 2007)	Qualitative
27	(Boucharas et al., 2010; Johnson, Lagerström, Närman, & Simonsson, 2007; Tamm et al., 2011)	Qualitative
28	(Schmidt & Buxmann, 2011)	Qualitative
29	(Roest, 2014)	Quantitative
30	(S. Aziz & Obitz, 2007; Brown, 2004; Espinosa et al., 2011; Radeke, 2011; Ross et al., 2006; Shah & Kourdi, 2007)	Qualitative, Quantitative, Qualitative, Qualitative, Qualitative, Qualitative
31	(van Steenbergen et al., 2011)	Quantitative

TABLE 6: RELATIONSHIPS IDENTIFIED IN LITERATURE

Table 6 presents an important conclusion: most literature about EA benefits is of a qualitative nature. This thesis contributes to this research field by incorporating these qualitative benefit claims in a quantitative study.

3 CONCEPTUAL MODEL DEFINITION

As explained in Section 1.3 *Research Design*, the relationships between the identified EA Activities and Benefit Enablers are empirically tested. This requires data to be collected and analysed. The first step in a statistical data collection approach is the definition of a conceptual model. Such a model provides a representation of reality which enables the next steps in the data collection approach: the development of measurement scales and consecutive analyses of the measurement data. This section describes how the theory as identified in the literature review is represented in a conceptual model which can be tested.

A conceptual model consists of constructs, measures and their relationships. More specifically, a conceptual model consists of two underlying models: a measurement model and a structural model. The measurement model indicates the relationships between a construct and its measures, while the structural model indicates the relationships between the constructs (Freeze & Raschke, 2007). Section 3.1 introduces the measurement model for this thesis, while Section 3.2 introduces the corresponding structural model.

3.1 Measurement Model

A measurement model indicates the relationships between constructs and their respective measures. This section first elaborates on the options available to a researcher in the formation of the measurement model. Second, the choices made for the model in this thesis are elaborated. Third, all construct-measure relationships are introduced which are necessary to model the relevant theory identified previously in the literature review.

3.1.1 Modelling Options

The concept of *construct* is used to model an unobservable phenomenon and can be considered a verbal surrogate for the actual phenomenon (Freeze & Raschke, 2007). Constructs are also known as latent variables. Because constructs are unobservable by definition, they cannot be measured directly. The concept of *measures* is used to be able to indirectly observe constructs. Measures are observed scores gathered by a measurement instrument. These measures are either influenced by a construct or they influence a construct. This allows a researcher to observe a construct indirectly by observing one or more measures which are deemed to be related to the construct. Measures are also known as indicators or observed variables (Freeze & Raschke, 2007).

To illustrate the concepts of constructs and measures, consider the example of a person's happiness. This could be a construct: it cannot be observed directly. However, one *can* observe how often that person smiles in one day. The amount of smiles per day could in that case be a measure of the construct happiness[1].

A problem present in 30% of IS research papers is that of misspecification of constructs (Petter, Straub, & Rai, 2007). Misspecification in this context refers to incorrectly identifying the direction of causality between a construct and its measures. A measure which is influenced by a construct is called a reflective measure and a measure which influences a construct is called a formative measure (Bollen & Lennox, 1991). Constructs which influence their measures are called "reflective constructs" because their measures are a reflection of the construct. Constructs whose measures

[1] *This is merely an imaginary example for explanatory purposes. Measures used in actual research should always be based on a sound theoretical foundation.*

influence the construct are called formative because the measures together form the construct. These differences are presented in Figure 21. In the example of happiness such misspecification could also occur. Who is to say if the amount of smiles per day causes a person to be happy or if the amount of smiles per day is the result of a person's happiness? If the former would be the true case but a researcher forms his model according to the latter direction of causality (or vice-versa), then misspecification has occurred. The consequences of misspecification can vary depending on the context and elaboration is outside the scope of this master thesis. However, it should be clear that the validity and reliability of results and conclusions based on misspecified models are compromised (Petter et al., 2007). Proper theoretical foundation of the construct-measure relationships and a sound statistical approach may prevent such errors.

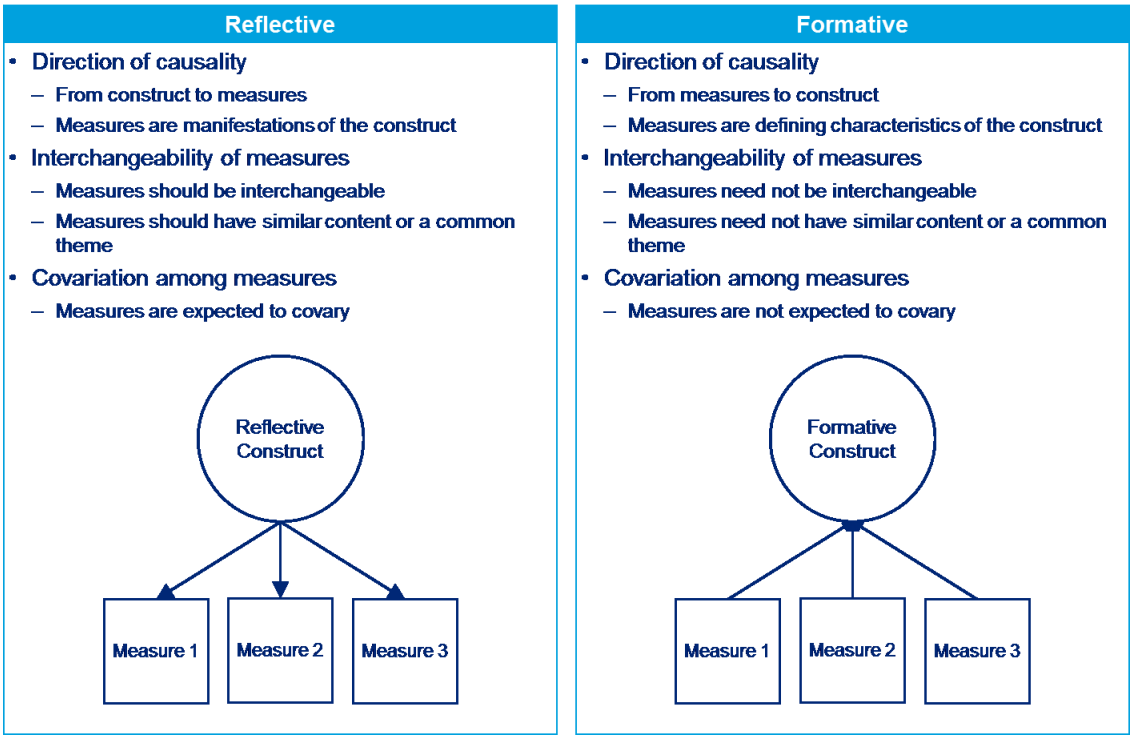


FIGURE 21: OVERVIEW OF REFLECTIVE AND FORMATIVE CONSTRUCT CHARACTERISTICS

As described in Diamantopoulos & Siguaw (2006), when a researcher attempts to develop a scale to measure an organizational construct *"(s)he can either treat the (unobservable) construct as giving rise to its (observable) indicators, or view the indicators as defining characteristics of the construct*" (Diamantopoulos & Siguaw, 2006). This implies that for each construct in this thesis a choice has to be made between formative and reflective measures. However, a researcher also has the option to model a construct as being multidimensional (Petter et al., 2007). In that case a construct is divided into subcomponents known as dimensions. Each dimension measures a different portion of the overall construct. Consider this in contrast to a unidimensional construct, where all measurement items measure the same (part of) the construct. The relationship between a multidimensional construct and it's dimensions is therefore formative, while the dimensions themselves can be measured with either reflective or formative measures (Petter et al., 2007).

This leaves the researcher with the choice to model a construct as reflective, formative or multidimensional. In case of a multidimensional construct, the researcher has to decide between formative or reflective measures for each dimension (Petter et al., 2007). The following section discusses these modelling choices for the constructs in this thesis.

3.1.2 Modelling Choices

The constructs present in this thesis are introduced in the literature review: the various Benefit Enablers (Organizational Alignment, Information Availability, Resource Portfolio Optimization and Resource Complementarity) as well as the various EA Activities (EA Alignment, EA Realization, EA Development and EA Foundation) all represent constructs. Both groups are discussed separately.

EA ACTIVITIES

Each construct in the EA Activity category contains a number of subcomponents. Consider for example the EA Foundation construct. This contains, among others, the activities "Selection and Maintenance of Tools" and "Recruitment and Development of Human Capital". These two components comprise very different activities of architects and as such different parts of the EA Foundation construct. The different nature of these subcomponents means a multidimensional construct is in order: each component measures a different portion of the overall construct (Petter et al., 2007). As previously mentioned, a multidimensional construct is always formative.
After carefully considering all EA Activities and their subcomponents it appears that the same argument can be made for each construct. This means that all EA Activity categories are modelled as multidimensional constructs with formative dimensions.

Dimensions of a construct can be measured with either formative or reflective measures. The choice depends on whether the measures are defining characteristics of the dimension or whether the measures are manifestations of the dimension (Diamantopoulos & Siguaw, 2006). To make this choice, the type of measurement instrument is considered. In this thesis the measurement instrument is a self-administered questionnaire in a survey, as mentioned in Section 1.3.5 *Research Process and Methodology*. This means that the measures are items in the questionnaire.

The choice between reflective and formative can thus be stated as follows: are the questions manifestations of what architects do or are they defining characteristics of what architects do?
Choosing the latter involves having one item in the questionnaire for each defining characteristic of each activity. This creates three problems

- Dividing an activity into its defining characteristics is difficult: there is no definitive source for each activity's characteristics
- Since there is no definitive source for activity definitions, it is difficult to ensure all the required characteristics are present in the questionnaire
- It is likely that each activity has a substantial amount of defining characteristics, this would make the questionnaire long

Choosing the former involves making a number of interchangeable items which all cover the entire activity and are considered a manifestation of what the architect does in its daily life. These two options are illustrated with an example in Figure 22. The reflective example on the left contains measures which all describe the same concept entirely. They are therefore interchangeable with each other. Several of these measures would be included in a questionnaire to reduce the effect of a respondent misinterpreting a certain phrasing. The formative example on the right contains measures which each describe only one particular aspect of the concept. The questions on the right are not interchangeable and must all be included to measure the entire construct.

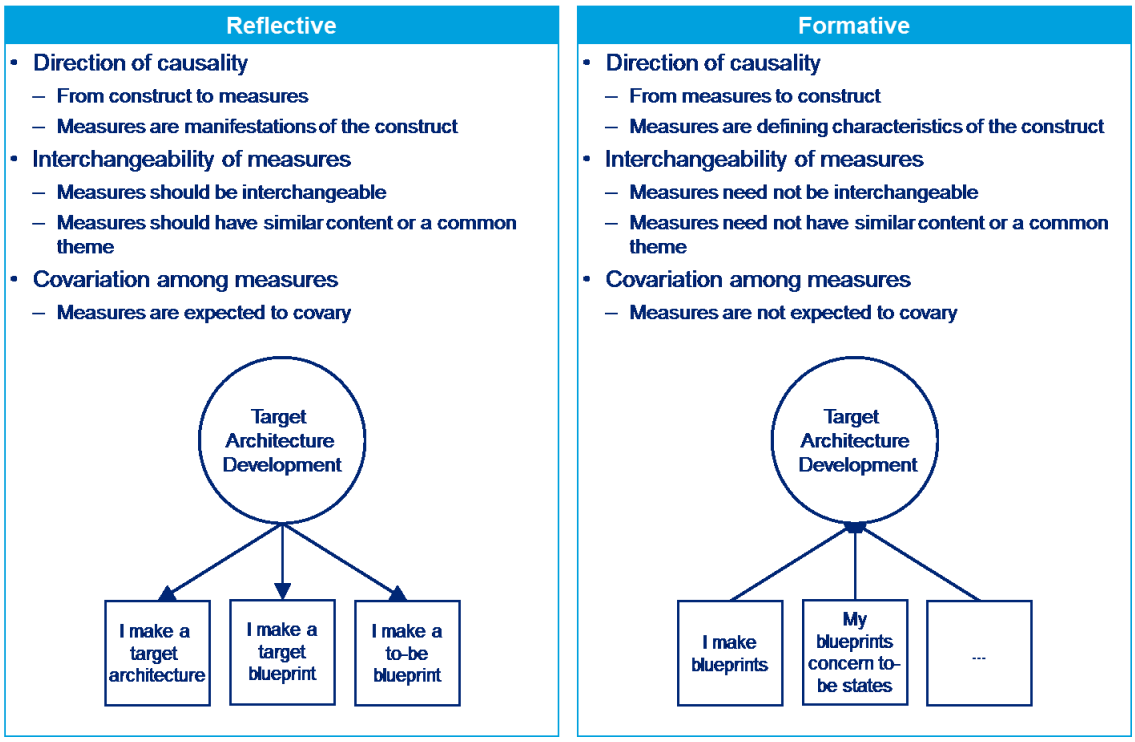


FIGURE 22: SIMPLIFIED REFLECTIVE AND FORMATIVE EA ACTIVITY EXAMPLE

Due to the issues with formative measures as described above this thesis uses reflective measures for the EA activity dimensions. As a consequence, the EA Activities are modelled as multidimensional constructs with formative dimensions and reflective measures.

BENEFIT ENABLERS

The main constructs of the Benefit Enabler category comprise: Organizational Alignment, Information Availability, Resource Portfolio Optimization and Resource Complementarity. Each of these constructs contain multiple subcomponents. As is depicted in the figures in Section 2.3.1 of the literature review, each Benefit Enabler has a chain of benefits according to current literature. A choice about which benefits to include in the conceptual model needs to be made. Including too many constructs would harm the parsimony of the final model and would require a larger research endeavour than this master thesis. Therefore only the final benefits in each chain are included. In other words: only the benefits with a direct arrow to the respective benefit enabler in the figures of Section 2.3.1.

Take for example the Organizational Alignment construct. This contains “Business & IT Alignment”, “Coherent and Consistent Organizational Change” and “Improved Decision Making” as its subcomponents. These are conceptually different parts of the Organizational Alignment construct. As explained in the previous section, such a situation indicates that this should be modelled as a multidimensional construct, with formative dimensions. After careful consideration, it is concluded that all other Benefit Enablers seem to possess this property. As such, all Benefit Enablers are modelled as multidimensional constructs with formative dimensions.

Similar to the EA Activities in the previous sections, the dimensions of the Benefit Enablers need measures which ought to be modelled as either reflective or formative. Considering the fact that the measurement instrument is a self-administered questionnaire, the items represent a reflection of respondents’ ideas of the truth about each dimension. This implies that the existence of a certain Benefit Enabler has shaped the idea of the respondent, which he/she in turn transfers onto the questionnaire. This contains a causality which is in line with reflective modelling of measures, as

the existence of the Benefit Enabler shapes the answer in the questionnaire and not vice versa. The measures of the Benefit Enabler dimensions are therefore modelled as reflective in this research.

As a consequence, the Benefit Enablers are modelled as multidimensional constructs with formative dimensions and reflective measures.

GENERAL CONSIDERATIONS

Besides the question of modelling measures as either formative or reflective, a choice needs to be made about how many measures per dimension are included in the model, and consequentially as items in the questionnaire. Two things are important in this consideration: the length of the final questionnaire and the accuracy of the measurements. On one hand the researcher must ensure that the items cover the dimension aptly and on the other hand the researcher needs to consider the time it takes for respondents to complete the questionnaire. Long questionnaires may put respondents off and can make it difficult to acquire enough responses. This thesis has relatively many dimensions to measure. To keep the questionnaire at an acceptable length, having only few questions per dimension is required. However, as mentioned in Section 1.2, the EA field contains many ambiguities. This is an argument in favour of incorporating several questions per dimension in order to verify whether respondents consistently fill in the questions and whether they interpret the questions as intended. These arguments of questionnaire length and possible ambiguity led to the incorporation of two measures per dimension. That way the questionnaire has an acceptable length and verification of question interpretation is still possible by assessing the statistical covariance of the items which belong to the same dimension.

Having multiple measures for a dimension gives rise to another modelling choice. The value of the dimension itself is determined by the values of the corresponding measures. However, there are two mathematical options for calculating the dimension value as a function of its measures: taking the sum or the mean. Using a mode or median function would not attribute equal influence to all measures and are therefore not suitable. Using the mean is useful in situations where data is missing since the mean value is less susceptible to extreme (or missing) values. Using the sum value is more precise since the values are added up which results in a scale for the dimension as large as all scales of the measures put together. Since the electronic questionnaire used in this thesis technically prohibits values to be omitted when the respondent answers the questions, no data is missing. However, not all dimensions have the same amount of corresponding measures. Summing the measures would therefore result in unequal scales, which would result in biased values for the construct to which the dimension belongs. Hence the mean is used to calculate the values of the dimensions. The constructs do not have equal amounts of dimensions. However, the constructs are independent and only used as predictors in regression analysis. The sum of the dimension values is therefore used to calculate the final construct values.

The next section presents the aforementioned choices visually in the form of measurement models.

3.1.3 Measurement Models

A measurement model is a graphical representation of a construct, its measures and their relationships. A construct is represented as a circle, a measure is represented as a rectangle and relationships are represented by arrows. The direction of the arrow indicates the causality of the relationships (Hair, Celsi, Money, Samouel, & Page, 2011).

The measurement instrument in this thesis is a questionnaire. The measurement models should therefore be interpreted as follows. The rectangles represent items in the questionnaire which measure the reflective dimension to which it is connected. Together, the dimensions measure the formative construct to which they are connected.

This section introduces all constructs with their corresponding measurement models. Note that the theoretical foundation of all constructs can be found in Chapter 2 *Literature Review* and is therefore not included here.

EA ALIGNMENT

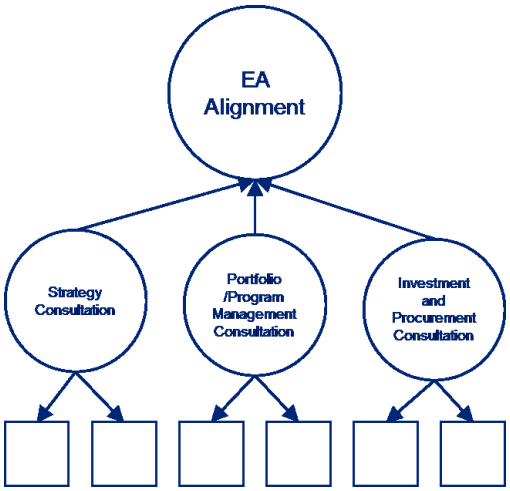


FIGURE 23: MEASUREMENT MODEL OF EA ALIGNMENT

The EA Alignment construct concerns *the extent to which EA staff spends time on aligning enterprise strategy execution with intended strategy results*. This construct is composed of the following formative dimensions:

- Strategy Consultation (SC)
- Portfolio/Program Management Consultation (PMC)
- Investment and Procurement Consultation (IPC)

Figure 23 presents the corresponding measurement model.

EA REALIZATION

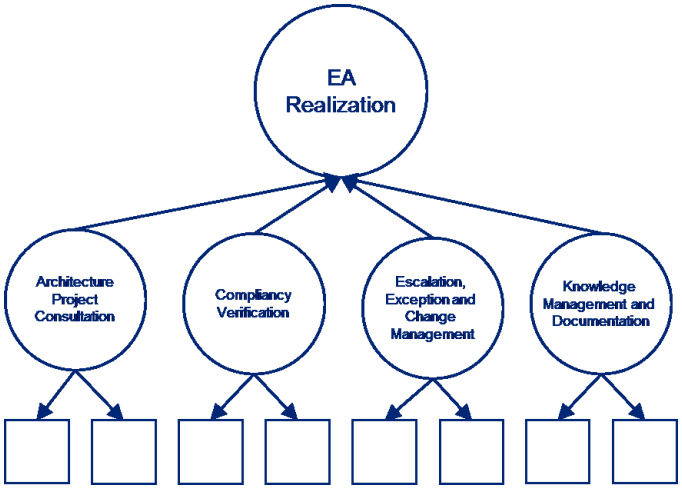


FIGURE 24: MEASUREMENT MODEL OF EA REALIZATION

The EA Realization construct concerns *the extent to which EA staff spends time on ensuring architectural artefacts are implemented in practice in line with architectural plans.* This construct is composed of the following formative dimensions:

- Architecture Project Consultation (APC)
- Compliancy Verification (CV)

- Escalation, Exception and Change Management (ECM)
- Knowledge Management and Documentation (KMD)

Figure 24 presents the corresponding measurement model.

EA DEVELOPMENT

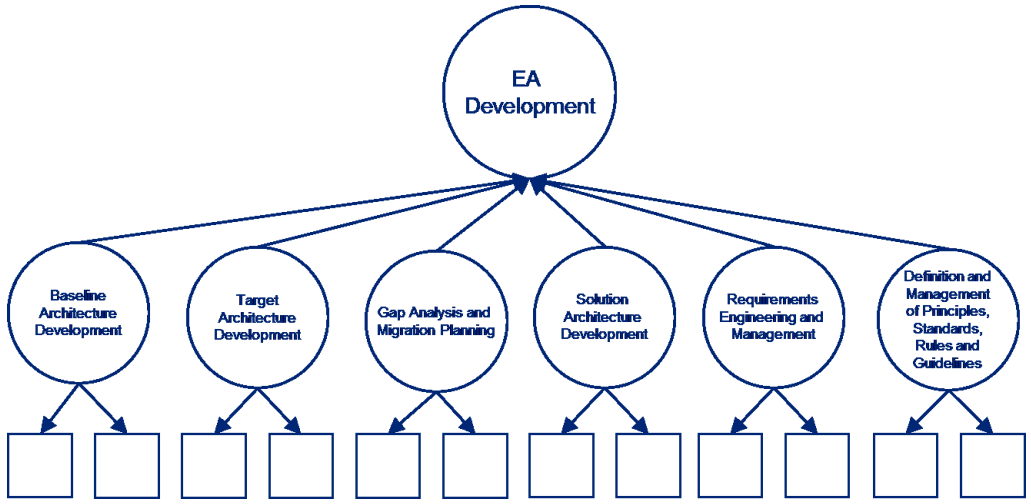


FIGURE 25: MEASUREMENT MODEL OF EA DEVELOPMENT

The EA Development construct concerns *the extent to which EA staff spends time on developing architectural plans and all necessary prerequisite artefacts*. This construct is composed of the following formative dimensions:

- Baseline Architecture Development (BAD)
- Target Architecture Development (TAD)
- Gap Analysis and Migration Planning (GMP)
- Solution Architecture Development (SAD)
- Requirements Engineering and Management (REM)
- Definition and Management of Principles, Standards, Rules and Guidelines (SRG)

Figure 25 presents the corresponding measurement model.

EA FOUNDATION

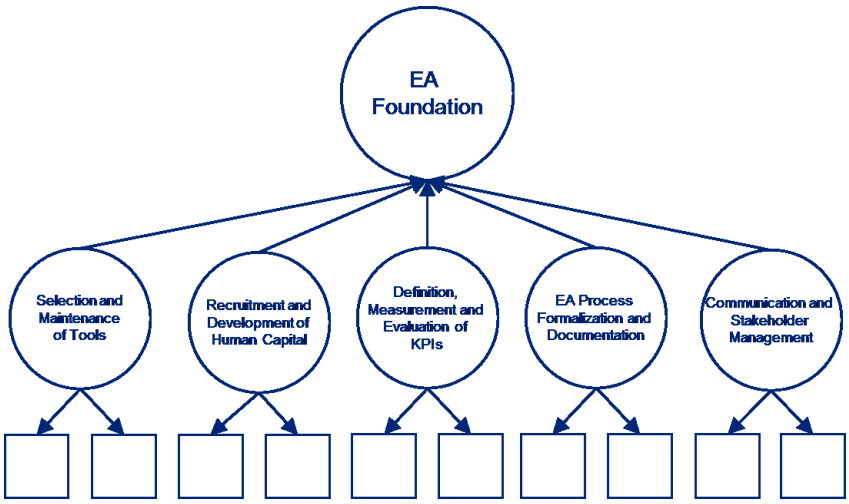


FIGURE 26: MEASUREMENT MODEL OF EA FOUNDATION

The EA Foundation construct concerns *the extent to which EA staff spends time on all necessary activities to support the work of the EA Alignment, EA Realization and EA Development categories.* This construct is composed of the following formative dimensions:

- Selection and Maintenance of Tools (SMT)
- Recruitment and Development of Human Capital (HC)
- Definition, Measurement and Evaluation of KPIs (DMK)
- EA Process Formalization and Documentation (PFD)
- Communication and Stakeholder Management (CSM)

Figure 26 presents the corresponding measurement model.

ORGANIZATIONAL ALIGNMENT

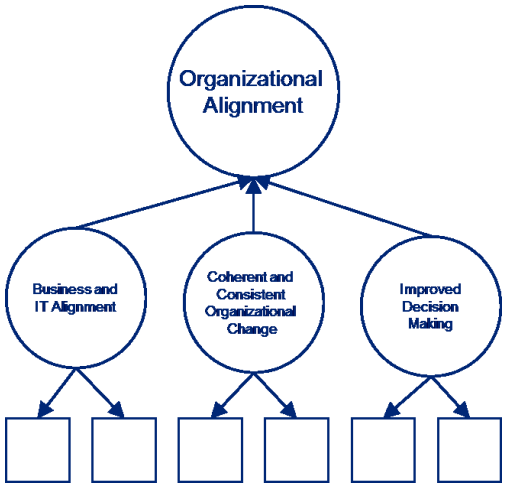


FIGURE 27: MEASUREMENT MODEL OF ORGANIZATIONAL ALIGNMENT

The Organizational Alignment construct concerns *"the extent to which an organisation's subunits share a common understanding of its strategic goals, and contribute towards achieving these goals"* (Tamm et al., 2011). This construct is composed of the following formative dimensions:

- Business and IT Alignment
- Coherent and Consistent Organizational Change
- Improved Decision Making

Figure 27 presents the corresponding measurement model.

INFORMATION AVAILABILITY

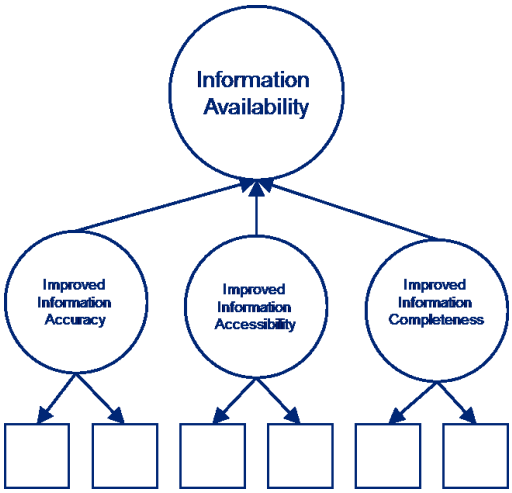


FIGURE 28: MEASUREMENT MODEL OF INFORMATION AVAILABILITY

The Information Availability construct concerns *"the extent of useful, high-quality information accessible to organisational decision makers"* (Tamm et al., 2011). This construct is composed of the following formative dimensions:

- Improved Information Accuracy
- Improved Information Accessibility
- Improved Information Completeness

Figure 28 presents the corresponding measurement model.

RESOURCE PORTFOLIO OPTIMIZATION

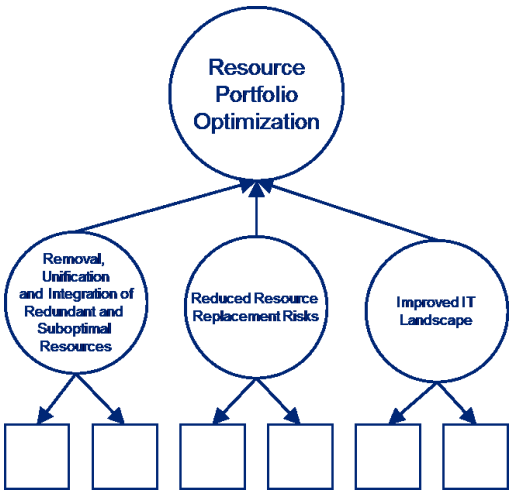


FIGURE 29: MEASUREMENT MODEL OF RESOURCE PORTFOLIO OPTIMIZATION

The Resource Portfolio Optimization construct concerns *"the extent to which an organisation leverages its existing resources, invests in resources that target performance gaps, and minimises unnecessary investments in duplicated resources"* (Tamm et al., 2011). This construct is composed of the following formative dimensions:

- Removal, Unification and Integration of Redundant and Suboptimal Resources
- Reduced Resource Replacement Risks
- Improved IT Landscape

Figure 29 presents the corresponding measurement model.

RESOURCE COMPLEMENTARITY

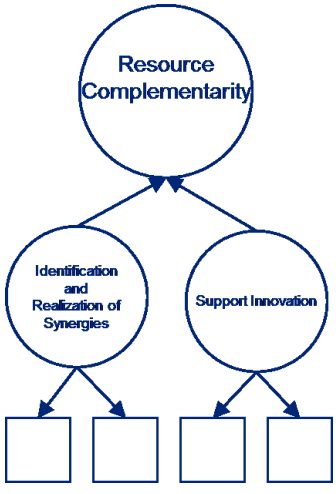


FIGURE 30: MEASUREMENT MODEL OF RESOURCE COMPLEMENTARITY

The Resource Complementarity construct concerns *"the extent to which the organisation's resources synergistically support the pursuit of its strategic goals"* (Tamm et al., 2011). This construct is composed of the following formative dimensions:

- Identification and Realization of Synergies
- Support Innovation

Figure 30 presents the corresponding measurement model.

3.2 Hypotheses and Structural Model

This section discusses how the structural model part of the conceptual model is formed. The structural model concerns the constructs and their relationships. This in contrast to the measurement model as discussed in the previous section, which concerns the constructs and their respective measures (Hair et al., 2011).

3.2.1 Hypotheses

Inter-construct relationships in this conceptual model can be regarded as hypotheses since they have not been confirmed or refuted at the time of model formation. They are merely claimed in literature and oftentimes even in isolation. This thesis contributes by statistically testing the existence and strength of each relationship in one model. This section introduces the hypothesized relationships as extracted from literature in the literature review.

The Benefit Enablers are the dependent variables in the conceptual model of this thesis. The EA Activities serve as the independent variables which are hypothesized to influence the Benefit Enablers. This section is therefore structured by elaborating the hypothesized relationships of each independent variable.

EA ALIGNMENT

As can be seen in the figures of Section 2.3 *EA Contribution to Benefit Enablers*, the only activity of EA Alignment to be reported to contribute to a Benefit Enabler is "Strategy Consultation". This is claimed to contribute to Organizational Alignment, hence the following hypothesis, as visualized in Figure 31:

Hypothesis 1: EA Alignment positively influences Organizational Alignment

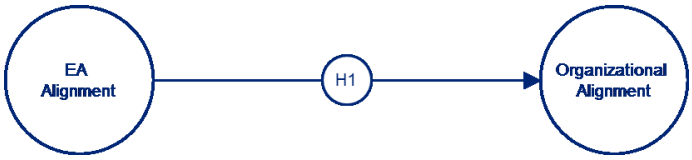


FIGURE 31: VISUAL REPRESENTATION OF HYPOTHESIS 1

EA REALIZATION

As can be seen in the figures of Section 2.3 *EA Contribution to Benefit Enablers*, EA Realization activities contribute to a number of Benefit Enablers. The following relationships are claimed in literature:

- Knowledge Management and Documentation contributes to Organizational Alignment, Information Availability, Resource Portfolio Optimization and Resource Portfolio Complementarity.
- Architecture Project Consultation contributes to Information Availability, Resource Portfolio Optimization and Resource Complementarity.
- Compliancy Verification contributes to Information Availability, Resource Portfolio Optimization and Resource Complementarity.

- Escalation, Exception and Change Management contributes to Information Availability Resource Portfolio Optimization and Resource Complementarity.

This leads to the formulation of the following hypotheses, as visualized in Figure 32:

Hypothesis 2a: EA Realization positively influences Organizational Alignment

Hypothesis 2b: EA Realization positively influences Information Availability

Hypothesis 2c: EA Realization positively influences Resource Portfolio Optimization

Hypothesis 2d: EA Realization positively influences Resource Complementarity

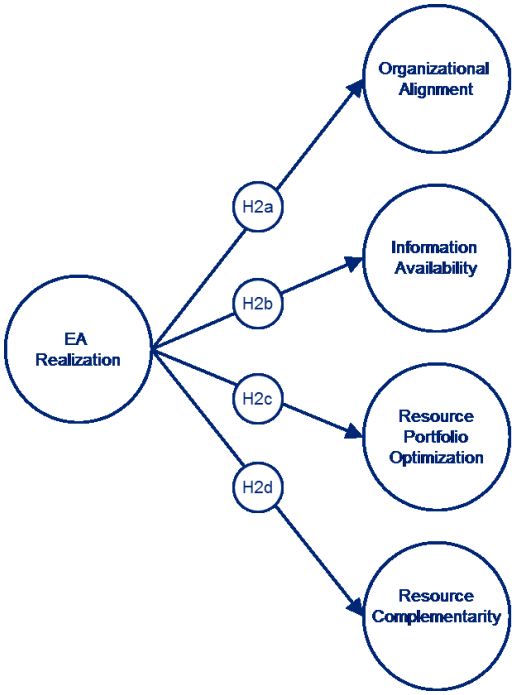


FIGURE 32: VISUAL REPRESENTATION OF HYPOTHESES 2A, 2B, 2C AND 2D

EA DEVELOPMENT

As can be seen in the figures of Section 2.3 *EA Contribution to Benefit Enablers*, EA Development activities contribute to a number of Benefit Enablers. The following relationships are claimed in literature:

- Baseline Architecture Development contributes to Organizational Alignment, Information Availability, Resource Portfolio Optimization and Resource Complementarity.
- Target Architecture Development contributes to Organizational Alignment, Information Availability, Resource Portfolio Optimization and Resource Complementarity.
- Gap Analysis and Migration Planning contributes to Organizational Alignment Information Availability, Resource Portfolio Optimization and Resource Complementarity.
- Definition and Management of Principles, Standards, Rules and Guidelines contributes to Organizational Alignment, Information Availability, Resource Portfolio Optimization and Resource Complementarity.

Hence the following hypotheses are formulated, as visualized in Figure 33:

Hypothesis 3a: EA Development positively influences Organizational Alignment

Hypothesis 3b: *EA Development positively influences Information Availability*

Hypothesis 3c: *EA Development positively influences Resource Portfolio Optimization*

Hypothesis 3d: *EA Development positively influences Resource Complementarity*

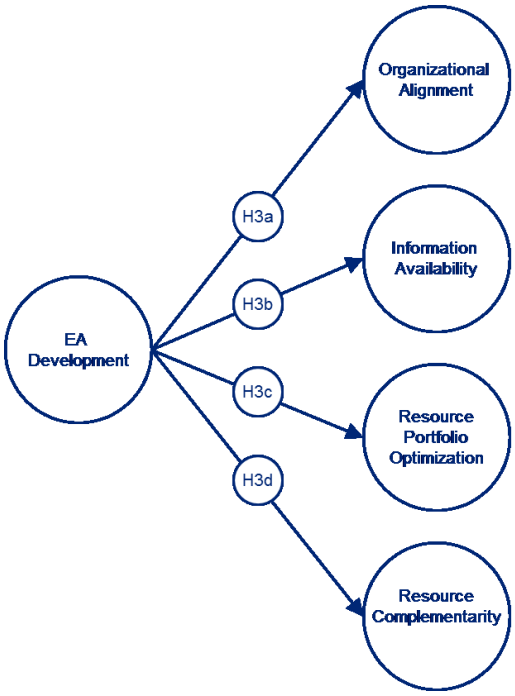


FIGURE 33: VISUAL REPRESENTATION OF HYPOTHESES 3A, 3B, 3C AND 3D

EA FOUNDATION

One missing aspect in the literature is the role of the EA Foundation activities. This concerns all activities which involve keeping the EA organization running. No relationship to benefits has been identified by current research. A direct or mediating relationship seems therefore unlikely. Since it is also unlikely that these activities have no relationship at all, this thesis posits that the EA Foundation activities have a moderating effect on the other EA Activity -> Benefit Enablers relationships. This means that the extent to which Benefit Enablers are influenced as a result of EA Alignment, EA Realization and EA Development activities depends on the level of EA Foundation activities. In other words, organizations must spend time on their EA Foundation otherwise the achievement of benefit enablers from the other activities is reduced. The plausibility of this notion was confirmed by a subject matter expert. This idea leads to the formulation of the following hypotheses, as visualized in Figure 34:

Hypothesis 4: EA Foundation moderates all relationships between EA Activities and Benefit Enablers.

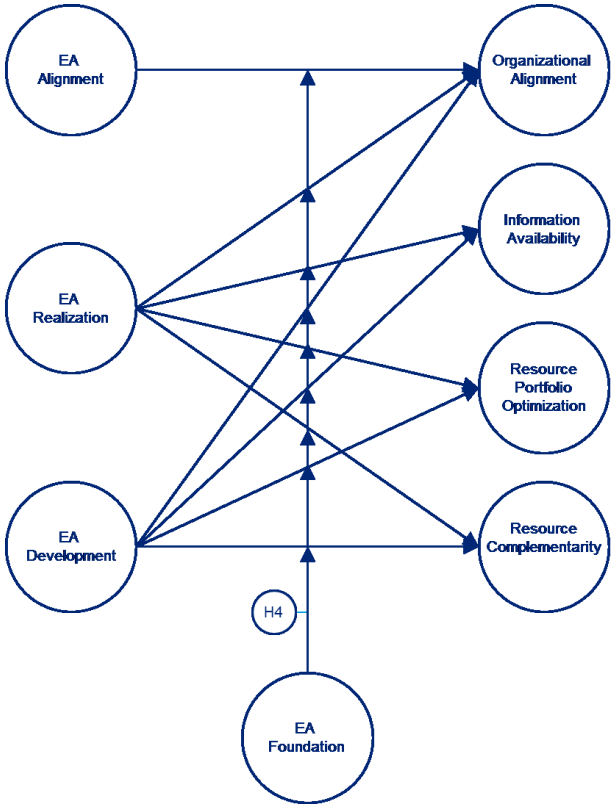


FIGURE 34: VISUAL REPRESENTATION OF HYPOTHESIS 4

3.2.2 **Structural Model**

The hypotheses as described in the previous section result in the structural model in Figure 35.

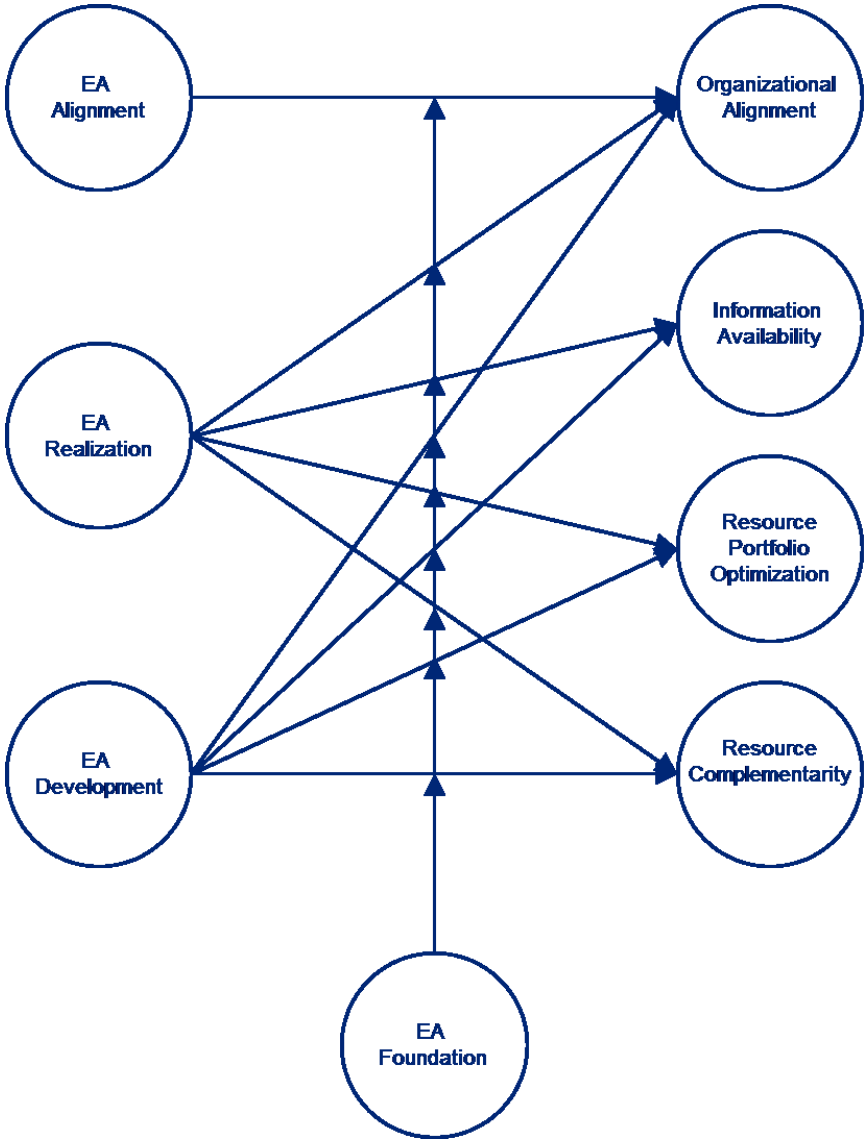


FIGURE 35: STRUCTURAL MODEL

3.3 Complete Conceptual Model

Combining the measurement and structural models results in the complete conceptual model displayed below in Figure 36.

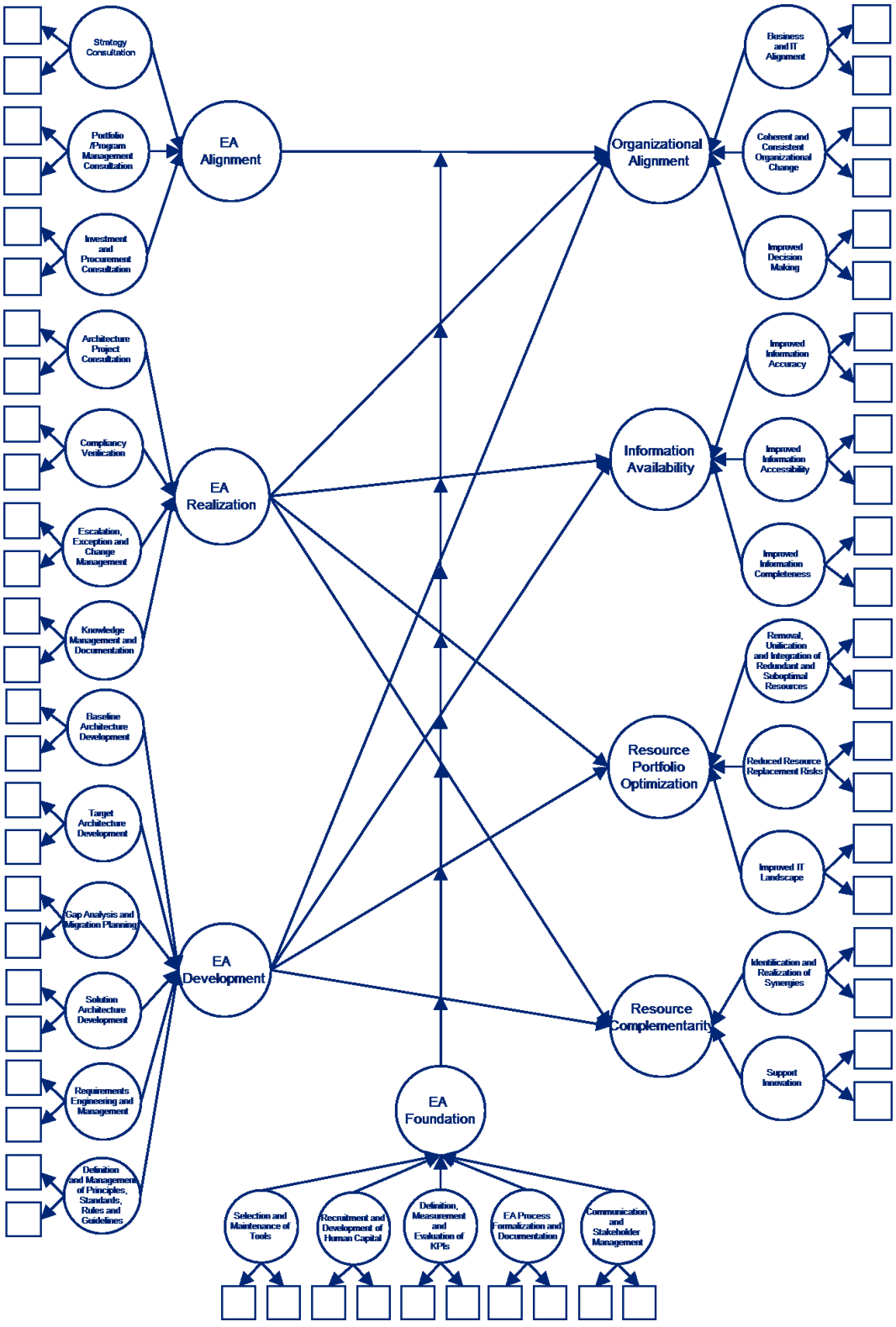


FIGURE 36: COMPLETE CONCEPTUAL MODEL

4 MEASUREMENT INSTRUMENT

This chapter discusses how the conceptual model introduced in the previous section is measured in practice. This research employs a self-administered questionnaire in a survey strategy, which is elaborated in Section 1.3 *Research Design*. The questionnaire used to measure the conceptual model is introduced below. The chapter is concluded with a description of the obtained data.

4.1 Scale Development Overview

Items need to be formulated to measure the conceptual model with a questionnaire. The items need to be verified for validity and reliability. The process of developing the items, verifying their validity and reliability and adjusting them accordingly is described in detail in Appendix C *Scale Development Details*. This section provides a short overview of that scale development process.

The first step involves formulating an item for each of the measures in the conceptual model. Since the measures concern the opinion of the respondent about an EA activity or benefit enabler, a Likert scale is chosen for the items (Saunders, Lewis, & Thornhill, 2009). Likert scales result in ordinal data. Ordinal data is generally regarded as allowing for less powerful statistical analysis techniques than interval or ratio data (Vigderhous, 1977). However, a five-point Likert scale is considered to be detailed enough to be interpreted as interval data (Allen & Seaman, 2007). Therefore all items in this thesis use a five point Likert scale ranging from Strongly Disagree to Strongly Agree. Existing items from previous research are used as much as possible, but wherever necessary new items are formulated.

After having formulated the initial set of questions, the questionnaire was subjected to a strict testing procedure to improve its reliability and validity. It was first distributed among five subject matter experts for initial validation. Based on their feedback a number of items were reformulated and a first pilot test was performed. The results of the pilot test allowed the reliability and validity of all the items to be determined. Content validity was assessed by the subject matter experts. Construct validity was assessed by verifying that all factor loadings of a principal components analysis are significant (>0,5) and reliability was assessed by Cronbach's alpha (Field, 2009) and variance inflation factor values. More details about such assessments can be found in Section 4.3. Based on these tests, seven item pairs were reformulated, one item pair was removed and one new item pair was added. After these adaptations, the new questionnaire was once again assessed by subject matter experts. After incorporating their feedback, a second pilot test was performed. Validity and reliability of the new questionnaire was determined using the same tests as described above, which required the removal of four individual items. That resulted in a questionnaire which was sufficiently valid and reliable. The final version is presented in the next section.

4.2 Final Scale

Table 7 to Table 16 introduce the items of the questionnaire and their respective sources. The sources indicate material on which the formulation of the items is based. Most items could not be taken directly from proven measurement scales due to the lack of quantitative research in these areas. The formulation is therefore loosely based on the most appropriate sources as given in the tables in this section and the resulting questionnaire is thoroughly pre-tested to ensure its reliability and validity as described in Section 4.3 and Appendix C *Scale Development Details*. Items with "None" in the Sources column are formulated without significant input from existing sources.

The literature review reveals that most EA Activities can be performed with varying degrees of organizational scope. Furthermore, the scope in terms of domains which are addressed in an EA

effort differ per organization as explained in Section 1.2 *Background*. Both variations in scope of an EA effort might influence the answers a respondent is inclined to give. Therefore the scope with which the respondent will answer the questionnaire needs to be determined before the actual measurement items are addressed. Items 0.1 and 0.2 in the questionnaire address this issue.

SCOPE

Item #	Items	Answer Options
0.1	What is the scope of the majority of EA activities in your organisation?	• *Enterprise Wide* • *Segment Wide (i.e. a program, a business unit, a department)* • *Project Wide*
0.2	What does your organization consider to be part of EA? Please select all that apply.	• Business (Processes, Products/Services) • Information (Data) • Application • Technical (Technology, Infrastructure, Platforms, Middleware)

TABLE 7: ITEMS IN FINAL QUESTIONNAIRE TO DETERMINE SCOPE

EA ALIGNMENT

Item #	Items	Sources
1	EA staff takes an active role in the development and adjustment of the enterprise strategy.	Lapkin (2008)
2	For strategic decisions input of EA staff is taken into account.	Radeke (2011)
3	Company Program Management Office and Enterprise Architecture Office are working closely together.	Schekkerman (2006)
4	EA staff participates in enterprise portfolio/program management.	None
5	Our IT investments and acquisition strategy is based on the view of our EA staff	Roest (2014)
6	Capital planning and investment control are adjusted based on the feedback received and lessons learned from EA staff.	US GAO (2010)

TABLE 8: ITEMS IN FINAL QUESTIONNAIRE FOR EA ALIGNMENT

EA REALIZATION

Item #	Items	Sources
7	EA staff provides advice in the start-up phase and during the rest of the lifetime of projects.	(van der Raadt & van Vliet, 2008)
8	EA staff offers guidance to projects before and after the start of a project.	None
9	EA staff reviews programs and/or projects on their compliance with the applicable target architectures, current architectures and EA policies.	Van der Raadt and van Vliet (2008)
10	EA staff is involved in assessing the impact of deviations from a specific principle, rule, standard or guideline by programs or projects.	Van der Raadt and van Vliet (2008)
11	EA staff actively participates in a decision making process about how to put architectural plans such as blueprints, standards, rules, principles & guidelines into practice when issues are identified.	Van der Raadt et al. (2008)

12	Artefacts created in the architecture development process are catalogued for future reference.	Deloitte TTL (2013)

TABLE 9: ITEMS IN FINAL QUESTIONNAIRE FOR EA REALIZATION

EA DEVELOPMENT

Item #	Items	Sources
13	Baseline (as-is) architectures are developed and maintained by our EA staff.	Deloitte TTL (2013)
14	EA staff is involved in describing baseline (as-is) architectures.	Deloitte TTL (2013)
15	Target (to-be) architectures is/are developed/maintained by our EA staff.	Deloitte TTL (2013)
16	EA staff is involved in describing target (to-be) architectures.	Deloitte TTL (2013)
17	EA staff addresses how to move from the Baseline to the Target Architectures by creating transition architectures.	The Open Group (2011b)
18	A roadmap for transition from baseline to target is being / has been developed by EA staff.	The Open Group (2011b)
19	EA staff develop architectures (i.e. the blueprint, not the actual implementation), in which various higher level architectures are synthesized into solutions that deliver capabilities to the enterprise.	Lapkin (2008)
20	EA staff creates architectures of future business operations/activities and how IS/IT supports those operations.	The Open Group (2011b)
21	Requirements for Enterprise Architecture and subsequent changes to those requirements are identified, stored, and fed into and out of the EA process.	The Open Group (2011b)
22	EA staff frequently reconsiders requirements for Enterprise Architecture.	Schekkerman (2006)
23	My organization has a clear set of EA principles, rules, standards and guidelines.	Roest (2014)
24	EA staff identifies and establishes architecture principles, rules and guidelines to guide the architecture development and governance.	The Open Group (2011b)

TABLE 10: ITEMS IN FINAL QUESTIONNAIRE FOR EA DEVELOPMENT

EA FOUNDATION

Item #	Items	Sources
25	Sophisticated tools for EA development and documentation are available and are configured for optimal use.	Deloitte TTL (2013)
26	All relevant stakeholders have access to sophisticated, correctly configured tools for EA development and documentation.	Deloitte TTL (2013)
27	EA staff is well trained to execute their tasks.	Deloitte TTL (2013)
28	EA staff have clearly defined roles and are appropriately trained.	Deloitte TTL (2013)
29	Key metrics are defined and are tracked consistently using various tools and manual processes. They are used to optimize the EA function and decision making.	Deloitte TTL (2013)
30	EA processes are formalized and stored in some form of knowledge repository.	Deloitte TTL (2013)

31	Architecture development and governance processes are clearly defined and documented.	Deloitte TTL (2013)
32	A communication plan is consistently updated and followed to drive the flow of the information throughout the organization.	Deloitte TTL (2013)

TABLE 11: ITEMS IN FINAL QUESTIONNAIRE FOR EA FOUNDATION

ORGANIZATIONAL ALIGNMENT

Item #	Items	Sources
33	Our decision making process has been effective in the past.	Roest (2014)
34	Our decision making process is well-established and easy to understand.	Roest (2014)
35	Change initiatives in my organization are effective and in line with each other.	None
36	The changes my organization implements in various parts of our business complement the results of other changes being made.	None
37	Business plans in my organization always state explicitly what is needed from information systems.	Reich & Benbasat (1996)
38	IT plans in my organization are always based on corresponding business plans.	Reich & Benbasat (1996)

TABLE 12: ITEMS IN FINAL QUESTIONNAIRE FOR ORGANIZATIONAL ALIGNMENT

INFORMATION AVAILABILITY

Item #	Items	Sources
39	The information available for decision making contains all the necessary data.	Lee et al. (2002)
40	The information available for decision making is sufficiently complete.	Lee et al. (2002)
41	Key business performance indicators extracted from IT systems are readily available to decision makers who require the information.	Boh & Yellin (2007)
42	Data captured in one part of our organization are immediately available to everyone.	Byrd & Turner (2001)
43	The information available for decision making is always correct.	Lee et al. (2002)
44	The information available for decision making is always reliable.	Lee et al. (2002)

TABLE 13: ITEMS IN FINAL QUESTIONNAIRE FOR INFORMATION AVAILABILITY

RESOURCE PORTFOLIO OPTIMIZATION

Item #	Items	Sources
45	Our organization has proven to be capable to make significant improvements in its IT landscape over the past few years.	None
46	The IT landscape of my organization has been significantly improved recently in a reasonable amount of time.	None
47	It is likely that our business is negatively affected by missing knowledge if someone is fired or replaced.	Weber, Blais & Betz (2002)
48	Our firm has experienced a negative impact in performance due to replacement of personnel.	Wagner & Bode (2008)
49	There are no redundant resources in our organization.	Boh & Yellin (2007)
50	My company has sufficiently identified resources to be shared.	Boh & Yellin (2007)

TABLE 14: ITEMS IN FINAL QUESTIONNAIRE FOR RESOURCE PORTFOLIO OPTIMIZATION

RESOURCE COMPLEMENTARITY

Item #	Items	Sources
51	Resources (human, IT, etc.) in my organization are successfully combined to create new opportunities and/or improvements.	Tamm et al. (2011)
52	In order to pursue strategic goals, resources in my organization are successfully (re)positioned to achieve synergies.	Tamm et al. (2011)

TABLE 15: ITEMS IN FINAL QUESTIONNAIRE FOR RESOURCE COMPLEMENTARITY

GENERAL INFORMATION

Item #	Items	Answer Options
53	Name	
54	Organization Name	
55	Organizational Size	• Small (<50 Employees) • Medium (<250 Employees) • Large (>250 Employees)
56	Industry	• Consumer Business • Financial Services Industry • Manufacturing, Energy & Resources • Public Sector • Technology, Media & Telecommunications • Other: …
57	Job Title	
58	E-Mail	
59	I would like to receive a copy of the final research results	• Yes • No
60	I would like to participate in a round table session to discuss the results and gain more insight into this topic	• Yes • No
61	Remarks	

TABLE 16: ITEMS IN FINAL QUESTIONNAIRE FOR GENERAL INFORMATION

4.3 Reliability and Validity

Credibility of research findings can be assured by assessing the reliability and validity of the research (Saunders et al., 2009). This section elaborates how these concepts are assessed in this thesis and presents the corresponding results.

4.3.1 Reliability

The concept of reliability refers to *"the extent to which your data collection techniques or analysis procedures will yield consistent findings"* (Saunders et al., 2009, p. 156). This encompasses the issue of whether the measures will yield similar results if repeated on other occasions or by other observers.

The reliability of reflective measures is commonly assessed by calculating Cronbach's Alpha value of those items that are supposed to measure the same construct (Field, 2009). This implies that in this thesis the Cronbach's Alpha value should be calculated for each item-pair, since these are reflective and are supposed to measure the same dimension. More information about Cronbach's Alpha is included further in this section.

Reliability of formative measures (or dimensions) cannot be assessed by Cronbach's Alpha since that implies correlation between the dimensions. This correlation is not necessary since the formative dimensions each measure different facets of the constructs. Different facets will not necessarily correlate which renders Cronbach's Alpha value useless for formative dimensions. Instead, literature suggests that the Variance Inflation Factor is assessed for formative measures (Petter et al., 2007). More information about the Variance Inflation Factor is included further in this section.

CRONBACH'S ALPHA

As implied above, it is important for reflective measures to possess high internal consistency. Statistically this entails displaying a high degree of correlation. Such correlation can be assessed by calculating Cronbach's Alpha value for those items that are supposed to correlate (i.e. the items intended to measure one construct or dimension). The formula for Cronbach's Alpha value of K measures is as follows (DeVellis, 2011):

$$\alpha = \frac{K}{K-1}\left(1 - \frac{\sum_{i=1}^{K} \sigma_{Y_i}^2}{\sigma_X^2}\right)$$

Where X is the measured construct consisting of K measures with value Y, $(X = Y_1 + Y_2 + Y_3 + \cdots + Y_K)$, σ_X^2 is the variance of the total item scores and $\sigma_{Y_i}^2$and is the variance of item i.

The minimum required value for Cronbach's Alpha for measures to be acceptably reliable is subject to debate. However, generally values below 0,6 are unacceptable, values between 0,6 and 0,7 are acceptable for exploratory research, values between 0,7 and 0,9 are good and values above 0,9 are excellent (Dunn, Baguley, & Brunsden, 2013; George, 2006). Since this research uses newly developed items, values above 0,6 are considered acceptable.

Cronbach's Alpha values are calculated for all item-pairs in the questionnaire and are presented in Table 17 on page 63.

VARIANCE INFLATION FACTOR

Cronbach's Alpha is not a valid reliability indicator for formative measures (Petter et al., 2007). Instead, multicollinearity is proposed by literature as a measure of reliability. To measure multicollinearity the Variance Inflation Factor (VIF) is used. This value is calculated for a set of measures. Such calculations result in a VIF value for each measure. Because the existence of multicollinearity among measures can be harmful for formative measures, the VIF value should be as low as possible (Petter et al., 2007). VIF is calculated for a measure using the following formula (Hair, Black, Babin, & Anderson, 2009):

$$VIF = \frac{1}{1 - R^2}$$

Where R^2 is the coefficient of determination of the regression equation of measure X_i, with X_i as a function of all other measures. These calculations are to be repeated for each measure $X$to obtain a VIF value for all measures in a set.

A VIF value of 5 is generally considered a strong indicator for the presence of multicollinearity. However, because analyses based on formative measures are extremely prone to errors due to multicollinearity, a threshold value of 3,3 is advisable in this case. Any higher value imposes a risk of skewed analysis results (Diamantopoulos & Siguaw, 2006).

The VIF theory above implies that for each construct in this thesis the VIF values of all respective dimensions must be calculated. Note that items with insufficient Cronbach's alpha values were not incorporated in the multicollinearity analysis since they are already determined to be unreliable.

The VIF values for the constructs in this thesis are presented in Table 17 on page 63.

4.3.2 Validity

Validity of research based on questionnaires can be divided into three aspects: content validity, construct validity and criterion validity (Saunders et al., 2009). These are discussed in the following sections.

CONTENT VALIDITY

Content validity of a questionnaire refers to the extent to which the questions cover all necessary aspects of the constructs and the related theory (Saunders et al., 2009). This thesis employs the following techniques to ensure the content validity of the measurement instrument.

1. *Structured Literature Review*
   Chances of missing essential aspects of the underlying theory are minimized by using a structured approach to the literature search. Details are available in Literature Review Methodology.

2. *Subject Matter Expert Reviews*
   Both the literature review as well as the questionnaire items have been extensively reviewed by at least two experienced EA practitioners and two skilled academic EA researchers.

3. *Face Validity Assessment by Peers*
   Face validity of the questionnaire has been assessed by 14 EA practitioners. Their feedback has been included in the questionnaire development process.

CONSTRUCT VALIDITY

Construct validity concerns *"the extent to which your measurement questions actually measure the presence of those constructs you intended them to measure"* (Saunders et al., 2009).

The constructs in this thesis are formative. Assessing the construct validity of formative constructs is done by performing a principal component analysis and verifying whether all factor loadings are significant (Petter et al., 2007). Principal Component Analysis (PCA) is a statistical procedure which converts a set of measurements into a set of uncorrelated variables called principal components. Each component is defined in such a way that it explains as much variance in the original data as possible. The mathematical transformation to accomplish this involves the definition of loadings that map each questionnaire item onto the identified components. In the case of construct validation of formative constructs these so called factor loadings should all be significant. Factor loadings higher than 0,5 are considered significant (Hair et al., 2009). PCA is a relatively complex procedure and the details are considered out of scope for this thesis.

The factor loadings of the items used in the survey of this thesis can be found in Table 17 on page 63.

CRITERION VALIDITY

Criterion validity concerns the *"ability of measures to make accurate predictions"* (Saunders et al., 2009) and/or the ability of measures to make accurate estimates of current values (John & Benet-Martinez, 2000). However, as John & Benet-Martinez (2000) describe, to test for criterion validity,

a measure from a source other than the measurement instrument to be assessed is required. This secondary source of measurement should be used to verify the measurements of the instrument under development. However, as has been pointed out in 1950s methodology literature, there is no guarantee that the measurements from the secondary source are correct (John & Benet-Martinez, 2000). It is therefore not possible to correctly test for criterion validity unless an undisputed source of correct measurements is available. Since such a gold standard is rarely available, it is nowadays generally accepted that construct validity is the central concern in measurement validation (John & Benet-Martinez, 2000).

Criterion validity is not assessed for the reasons described above. Instead, validity assessments in this thesis focus on content and construct validity.

4.4 Data Description

The questionnaire was electronically distributed among 98 relevant contacts of Deloitte Consulting, the graduation committee and the author of this thesis. Additionally, posts on LinkedIn, Yammer and various EA related websites were used to increase the sample size. This has resulted in a total of 152 responses. After removal of incomplete entries the sample size was reduced to 50 useable responses. These **N=50** entries have been used for all analyses described in this thesis and provide the foundation for all results and conclusions.

The sample consists of the answers of a diverse group of respondents. Their functions range from mainly technical to primarily business focussed areas of expertise. The frequency distribution of the various functions is presented in Figure 37. The sample contains data from 45 large (> 250 employees) organizations, 4 medium-sized organizations (<250 employees) and 1 small (<50 employees) organization. These organizations are active in a broad range of industries as is displayed in Figure 38.

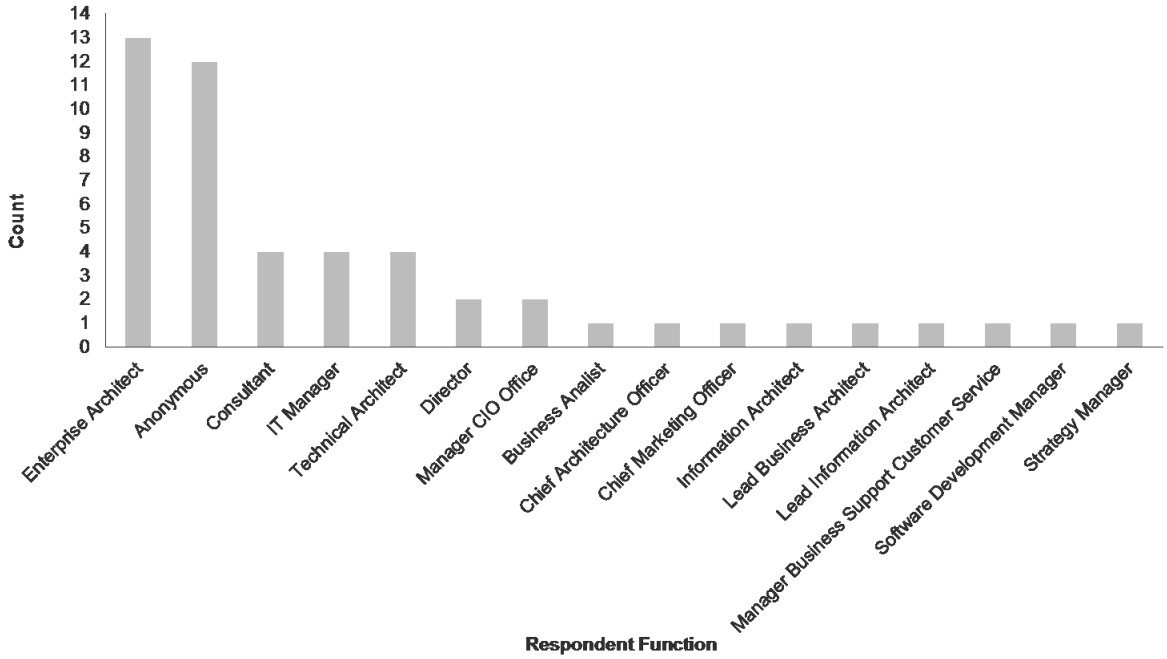


FIGURE 37: FREQUENCY DISTRIBUTION OF SURVEY RESPONDENTS' FUNCTIONS

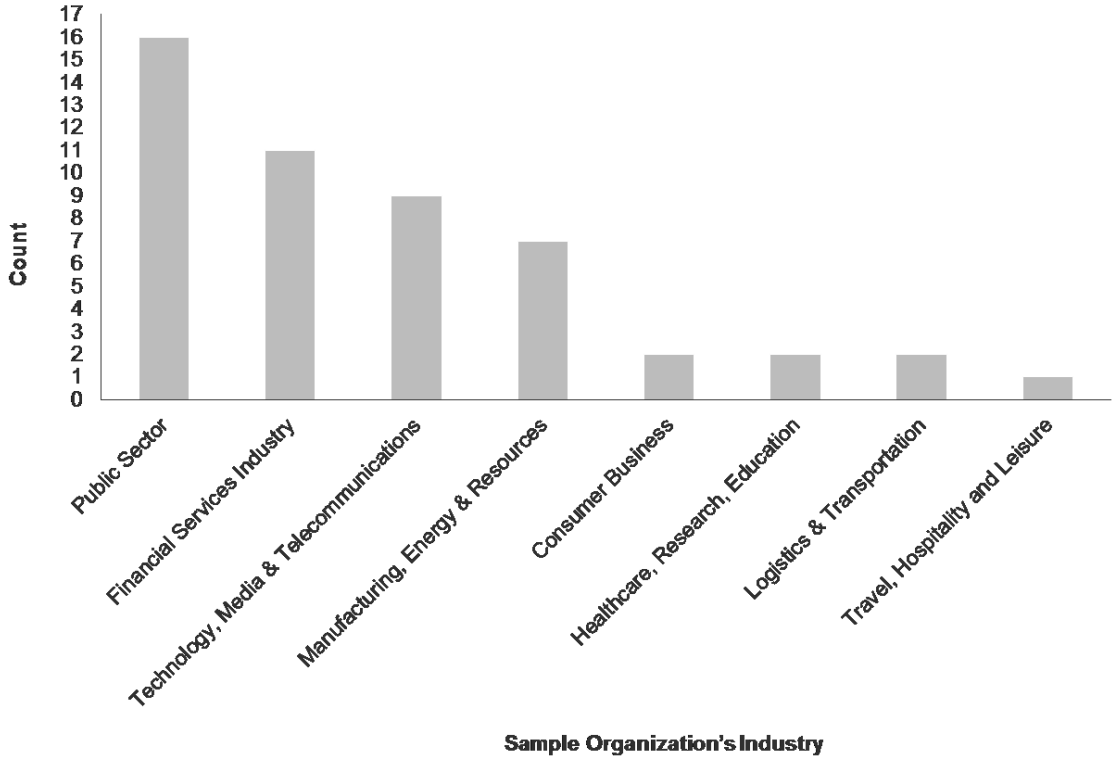


FIGURE 38: FREQUENCY DISTRIBUTION OF SURVEY RESPONDENTS' INDUSTRIES

5 RESULTS

This section presents the results of the survey and the analyses that have been performed to test the hypotheses. First, the analysis procedure is described and second, the analysis results are presented. The analysis results include the acceptance or rejection of the hypotheses.

5.1 Analysis

The data set obtained with the survey is subjected to multiple regression analysis in order to determine whether the hypotheses can be accepted or rejected. Section 5.1.1 shortly introduces the multiple regression analysis technique, followed by Section 5.1.2 which presents the complete analysis procedure used in this thesis.

5.1.1 Multiple Regression

Regression analysis is a statistical technique used to create a model from the data which is able to predict values of the dependent variables from the independent variables. Dependent variables are referred to as *outcome variables* while independent variables are referred to as *predictor variables* in regression analysis. The outcome variables in this thesis are the Benefit Enablers and the predictor variables are the EA Activities. Regression analysis is thus able to take EA Activity values and assess what the impact will be on the Benefit Enablers.

Regression works by deriving a model from the data. That model assumes the relationship between the outcome and predictor variables is linear. A linear relationship can be represented by a straight line in a graph. Such a straight line has two defining characteristics: the slope and the intercept (the point at which the line crosses the y-axis). Regression analysis is used to determine these two characteristics. When this is done for one outcome variable and one predictor variable it is called simple regression, while doing the same for more than one predictor variable is called multiple regression. This thesis has four predictor variables (EA Alignment, EA Realization, EA Development and EA Foundation), therefore multiple regression is used.

The data which is used to derive the linear model is collected by the researcher. In this thesis this is the questionnaire data and in regression this is referred to as the *observed values.* The values which the technique predicts from predictor variable values using the regression model is referred to as *predicted values.* In most regression situations the predicted values will not be identical to the observed values. These deviations between observed values and the values as predicted by the regression model are called *residuals*. When the residual values are high, the model does not fit the data well. Using these residual values, it is possible to calculate how well the regression model fits the data. This is represented by the *R* value (also called *correlation coefficient*) which can range from zero to one, where one indicates the model fits the data perfectly. The squared value of R is an interesting measure. The R^2 value is also a ratio between zero and one and indicates how much variance in the outcome variable can be explained by the regression model. An R^2 value of one indicates that all variance in the outcome variable can be explained using the regression model with the used predictor variables. It is therefore used as a measure of how much influence the predictors have in the outcome variables. Besides these values a regression analysis also provides so called *beta* values. For each predictor in the model one beta value is given. This beta value indicates how many standard deviations the outcome variable changes for an increase of one standard deviation in the predictor variable. This is therefore used to measure the impact of the individual predictors in the model. Finally, for both the entire model as well as for each individual predictor a significance value is given. This represents the probability that the result occurs as a result of chance. In the result tables below this is indicated with stars. One star indicates that the probability of that result occurring due to chance is lower than 0,050, two stars

denote a probability lower than 0,010 and three stars indicate a probability lower than 0,001 (Field, 2009).

5.1.2 Analysis Procedure

This section presents the procedure which is used to perform multiple regression on the data obtained with the questionnaire.

1. **Remove incomplete cases**
   Questionnaires which have not been completed are not incorporated in the data analysis to preserve the validity and reliability of the results. A total of **N=50** complete cases remain after removal of incomplete cases.

2. **Reverse polarity of items 47 and 48**
   Items 47 and 48 are formulated in such a way that the "strongly agree" answer corresponds to a very negative influence in the construct. All other items are formulated inversely. Therefore the polarity of items 47 and 48 must be reversed.

3. **Determine reliability and validity**
   Section 4.3 introduced the concepts of reliability and validity and the techniques used in this thesis to ensure them. The following bullets present the results of applying the techniques mentioned in that section.

   - **Determine reliability with Cronbach's Alpha values**
     Cronbach's Alpha values can be found in Table 17 on page 63. When the Cronbach's Alpha value of an item pair is too low, one of the items needs to be dropped because the two items do not measure the same concept. Content validity is not compromised by removing one of the two items since they were only included as a double check for each other. The item which least represents the dimension to be measured is therefore dropped. The following items were dropped because the Cronbach's Alpha values are too low (<0,600):
     - Business and IT Alignment (0,528)
       Item 37 (least close to Business & IT Alignment definition)
     - Coherent and Consistent Organizational Change (0,583)
       Item 36 (least comprehensible formulation)
     - Improved Decision Making (0,505)
       Item 33 (contains reference to the past)
     - Reduced Resource Replacement Risks (0,415)
       Item 48 (contains reference to the past)
     - Removal, Unification and Integration of Redundant and Suboptimal Resources (-0,057):
       Item 49 (less variance in values, content-wise least interesting)

   - **Calculate composite variables**
     In order to continue with other analyses, the dimension and construct values need to be calculated as a function of the individual item values. They can be calculated by taking either the sum or the mean of the corresponding items. The choice was made as follows:
     - The dimension values are calculated as the mean of the corresponding item values. The mean is chosen because not all dimensions have the same amount of corresponding items. Taking the sum would therefore create unequal scales between the dimensions.
     - The construct values are calculated as the sum of the corresponding dimension values, because taking the sum results in a more accurate measure than taking the mean. Not all constructs have the same amount of

dimensions, consequentially unequal scales are created between the constructs. This is not a problem because the constructs are not related to each other and regression analysis is based on variation of values (not absolute values).

- **Determine reliability with VIF values**
  To determine whether formative dimensions are not correlated, VIF values are calculated. Additionally, VIF values among the predictors are calculated since regression analysis requires uncorrelated predictor variables. The VIF values can be found in Table 17 on page 63. VIF values of formative dimensions should be below 3,3 (the right VIF column) and VIF values of predictor variables should be below 5,0 (the left VIF column) (Diamantopoulos & Siguaw, 2006). As can be seen in the table, all values are below their respective thresholds.

- **Determine validity with PCA Item Loadings**
  In order to determine content validity, PCA item loadings are calculated and can be found in Table 17 on page 63. All loadings should be higher than 0,500 (Hair et al., 2009). As can be seen in the table, all values are above this threshold.

4. **Centre variables**
   Centring variables refers to a procedure where variables are transformed into deviations around a fixed point. Typically, the grand mean is used: the mean of all corresponding values of a variable. Centring on the grand mean thus involves subtracting the mean of a variable from all the variable values. Centred variables have no effect on the residuals and the predicted values of a regression model. In other words: the model will fit the data equally well as with variables which are not centred. However, the centred models result in more stable regression models (Field, 2009). Furthermore, it is recommended to use centred variables when testing for moderating effects. Therefore the predictor variables in this thesis are grand mean centred.

5. **Test regression assumptions**
   To ensure that regression results are generalizable a number of assumptions must be met. The data used in regression must be tested for conformance to these assumptions. This concerns the following assumptions (Field, 2009):
   - *Variable type*: All predictor variables must be quantitative or categorical (with two categories) and the dependent variables must be measured at interval level.
   - *Non-zero variance*: Predictors should have variation in values: no variances of zero.
   - *No perfect multicollinearity:* None of the predictors should be perfectly correlated with any other predictor.
   - *Homoscedasticity*: The variance of the residuals of the predictor variables should be constant.
   - *Independence of errors*: The residuals must be uncorrelated for any two observations in the data.
   - *Normally distributed errors:* It is assumed that the residuals in the model are random, normally distributed and have mean of zero.
   - *Independence*: All values of the outcome variables are independent.
   - *Linearity:* The mean values of dependent variables lie in a straight line for each increment of predictor variables. In other words, it is assumed that the relationship between the predictor and outcome variables is linear.

   Details about the assumption conformance of the data used in this thesis can be found in Appendix D *Regression Assumption*.

6. **Perform Multiple Regression Analysis**
   The final step involves performing several multiple regression analyses. First of all, for each outcome variable (Organizational Alignment, Information Availability, Resource Portfolio Optimization and Resource Complementarity) two regressions were performed: one with only direct relationships of the predictors (EA Alignment, EA Realization, EA Development and EA Foundation) and one which includes moderating relationships between EA Foundation and the other predictors. These two regressions confirm or refute the existence of EA Foundation as a moderator in the model as is hypothesized in Section 3.2. Additionally, for each outcome variable four more regressions were performed. All dimensions of each independent variable were entered as predictors in the model. These four regressions provide insight into the effect of the individual activities on the outcome variable. The results of all these regressions are presented in Table 18 to Table 22.

Table 17 on the next page shows all constructs, dimensions and items with their respective mean, standard deviation, Cronbach's alpha value, VIF values and PCA item loadings.

Construct	Dimension	Items	Mean	Std. Dev.	Cronbach's Alpha	VIF		PCA Item Loadings
EA Alignment	Strategy Consultation (SC)	1, 2	3,070	0,964	0,614	1,335	1,439	0,801
	Portfolio/Program Management Consultation (PMC)	3, 4	3,350	1,026	0,858		1,184	0,676
	Investment and Procurement Consultation (IPC)	5, 6	2,850	0,835	0,601		1,551	0,850
EA Realization	Architecture Project Consultation (APC)	7, 8	3,890	0,810	0,617	3,231	2,170	0,863
	Compliancy Verification (CV)	9	3,800	0,970	N.A.		1,864	0,807
	Escalation, Exception and Change Management (ECM)	10, 11	3,570	0,875	0,634		2,074	0,856
	Knowledge Management and Documentation (KMD)	12	3,040	1,230	N.A.		1,548	0,743
EA Development	Baseline Architecture Development (BAD)	13, 14	3,570	0,904	0,722	3,430	1,530	0,656
	Target Architecture Development (TAD)	15, 16	3,920	0,724	0,818		1,670	0,764
	Gap Analysis and Migration Planning (GMP)	17, 18	3,360	1,035	0,889		2,099	0,811
	Solution Architecture Development (SAD)	19, 20	3,260	0,865	0,612		1,767	0,703
	Requirements Engineering and Management (REM)	21, 22	3,050	0,865	0,608		1,556	0,709
	Definition and Management of Principles, Standards, Rules and Guidelines (SRG)	23, 24	3,480	0,782	0,726		1,508	0,701
EA Foundation	Selection and Maintenance of Tools (SMT)	25, 26	2,570	1,143	0,768	1,745	1,981	0,760
	Recruitment and Development of Human Capital (HC)	27, 28	2,980	0,984	0,722		1,740	0,763
	Definition, Measurement and Evaluation of KPIs (DMK)	29	2,060	0,935	N.A.		1,498	0,737
	EA Process Formalization and Documentation (PFD)	30, 31	2,870	0,978	0,712		2,047	0,802
	Communication and Stakeholder Management (CSM)	32	2,200	0,948	N.A.		1,565	0,669
Organizational Alignment	Business and IT Alignment	37, 38	3,000	1,161	*0,528*		1,080	0,621
	Coherent and Consistent Organizational Change	35, 36	2,640	0,985	*0,583*		1,196	0,784
	Improved Decision Making	33, 34	2,360	0,964	*0,505*		1,155	0,730
Information Availability	Improved Information Accuracy	43, 44	2,580	0,791	0,859		2,120	0,887
	Improved Information Accessibility	41, 42	2,320	0,856	0,711		1,655	0,826
	Improved Information Completeness	39, 40	2,590	0,747	0,762		1,918	0,861
Resource Portfolio Optimization	Removal, Unification and Integration of Redundant and Suboptimal Resources	49, 50	2,820	0,850	*-0,057*		1,203	0,825
	Reduced Resource Replacement Risks	47, 48	2,560	0,993	*0,415*		1,137	0,700
	Improved IT Landscape	45, 46	3,170	0,907	0,738		1,062	0,522
Resource Complementarity	Identification and Realization of Synergies	51, 52	2,860	0,932	0,802		N.A.	N.A.

TABLE 17: OVERVIEW OF RELIABILITY AND VALIDITY INDICATORS OF SURVEY DATA

NOTE: VALUES IN ITALICS ARE INSUFFICIENT AND. "N.A." INDICATES THAT THE ANALYSIS IS NOT APPLICAPLE.

5.2 Results

This section presents all regression results organised in four tables: one table for each of the four dependent variables with all regression results pertaining to that variable.

Each table is structured as follows. The left part of the table presents regression results of a regression model with the four EA Activity categories as predictors without any moderating effects. The right part of the table presents the results of a regression model with the same four predictors however this time with moderating effects of the EA Foundation construct. The middle part of the table presents four separate regressions: the activities of each EA Activity category have been entered as direct predictors in a regression model without any interaction effects. All values in the table are *beta* values except the cells which are indicated to be R^2 values.

*Regression results of model **without moderating effects** of EA Foundation.*

*Regression results of model **with moderating effects** of EA Foundation.*

5.2.1 Dependent Variable: Organizational Alignment

Direct Effects					Direct & Interaction Effects
Main Constructs		Dimensions			Main Constructs
	R^2	,292**	R^2	-,210*	,342**
EAA		,128	**SC**	,373*	,192
			PMC	-,145	
			IPC	,173	
EAR		,339	R^2	,290**	,498
			APC	,438*	
			CV	,075	
			ECM	-,207	
			KMD	,258	
EAD		-,172	R^2	,230	-,246
			BAD	-,063	
			TAD	-,166	
			GMP	,312	
			SAD	,189	
			REM	-,011	
			SRG	,227	
EAF		,331	R^2	,345**	,277
			SMT	-,250	
			HC	,443**	
			DMK	,102	
			PFD	,241	
			CSM	,107	
EAA * EAF					-,076
EAR * EAF					,222
EAD * EAF					,059

NOTE: *P < .050; **P < .010; ***P < .001.

TABLE 18: OVERVIEW OF REGRESSION RESULTS FOR ORGANIZATIONAL ALIGNMENT

*Regression results of one model with only the main **constructs** as predictors.*

*Regression results of several models with the **dimensions** of constructs as predictors. Each set of dimensions is a separate model.*

The results in Table 18 show that the regression model with the four main constructs as direct predictors explains the variance in Organizational Alignment significantly. However, in that model none of the constructs have a significant individual relationship with Organizational Alignment. The regression models of the individual activities do show significant individual relationships. Strategy Consultation (SC), Architecture Project Consultation (APC) and Recruitment and Development of Human Capital (HC) have significant and positive relationships with Organizational Alignment. The table also shows that the moderating effects of EA Foundation are not significant. The regression model which includes the interaction effects is therefore ignored.

These results have the following consequences for the hypotheses:

Hypothesis 1:	*EA Alignment positively influences Organizational Alignment*	**Partially Accepted**
Hypothesis 2a:	*EA Realization positively influences Organizational Alignment*	**Partially Accepted**
Hypothesis 3a:	*EA Development positively influences Organizational Alignment*	**Rejected**
Hypothesis 4:	*EA Foundation moderates all relationships between EA Activities and Benefit Enablers.*	**Rejected**

5.2.2 Dependent Variable: Information Availability

Direct Effects				**Direct & Interaction Effects**
Main Constructs		**Dimensions**		**Main Constructs**
R^2	,207*	R^2	,257**	,234
EAA	,143	**SC**	,409*	,194
		PMC	-,271	
		IPC	,187	
EAR	-,009	R^2	,098	,128
		APC	,304	
		CV	,027	
		ECM	-,117	
		KMD	,095	
EAD	-,085	R^2	,164	-,168
		BAD	,111	
		TAD	-,210	
		GMP	,199	
		SAD	,101	
		REM	,310	
		SRG	-,178	
EAF	,440*	R^2	,330**	,403
		SMT	-,336	
		HC	,219	
		DMK	,147	
		PFD	,365*	
		CSM	,198	
EAA * EAF				-,095
EAR * EAF				,241
EAD * EAF				-,040

NOTE: *P < .050; **P < .010; ***P < .001.

TABLE 19: OVERVIEW OF REGRESSION RESULTS FOR INFORMATION AVAILABILITY

The results in Table 19 show that the regression model with the four main constructs as direct predictors explains the variance in Information Availability significantly. EA Foundation has a significantly positive effect on Information Availability. The four regression models on activity level show that Strategy Consultation (SC) and Process Formalization and Documentation (PFD) have a significant positive effect on Information Availability. The table also shows that the moderating effects of EA Foundation are not significant. The regression model which includes the interaction effects is therefore ignored.

These results have the following consequences for the hypotheses:

Hypothesis 2b:	*EA Realization positively influences Information Availability*	**Rejected**
Hypothesis 3b:	*EA Development positively influences Information Availability*	**Rejected**
Hypothesis 4:	*EA Foundation moderates all relationships between EA Activities and Benefit Enablers.*	**Rejected**

5.2.3 Dependent Variable: Resource Portfolio Optimization

Direct Effects				**Direct & Interaction Effects**
Main Constructs		**Dimensions**		**Main Constructs**
R^2	,327**	R^2	,211*	,356**
EAA	,306*	**SC**	,274	,404*
		PMC	,036	
		IPC	,231	
EAR	,449*	R^2	,341**	,445
		APC	,625**	
		CV	,022	
		ECM	-,246	
		KMD	,137	
EAD	-,369	R^2	,163	-,450
		BAD	-,016	
		TAD	-,211	
		GMP	,207	
		SAD	,166	
		REM	,074	
		SRG	,200	
EAF	,263	R^2	,289**	,272
		SMT	-,169	
		HC	,423*	
		DMK	-,018	
		PFD	,162	
		CSM	,179	
EAA * EAF				-,168
EAR * EAF				-,085
EAD * EAF				,195

NOTE: *P < .050; **P < .010; ***P < .001.

TABLE 20: OVERVIEW OF REGRESSION RESULTS FOR RESOURCE PORTFOLIO OPTIMIZATION

The results in Table 20 show that the regression model with the four main constructs as direct predictors explains the variance in Resource Portfolio Optimization significantly. EA Alignment and EA Realization have a significant and positive effect on Resource Portfolio Optimization. The regression models on activity level show that Architecture Project Consultation (APC), and

Recruitment and Development of Human Capital (HC) both have a significant positive relationship with Resource Portfolio Optimization. The table also shows that the moderating effects of EA Foundation are not significant. The regression model which includes the interaction effects is therefore ignored.

These results have the following consequences for the hypotheses:

Hypothesis 2c:	*EA Realization positively influences Resource Portfolio Optimization*	**Accepted**
Hypothesis 3c:	*EA Development positively influences Resource Portfolio Optimization*	**Rejected**
Hypothesis 4:	*EA Foundation moderates all relationships between EA Activities and Benefit Enablers.*	**Rejected**

5.2.4 Dependent Variable: Resource Complementarity

Direct Effects				Direct & Interaction Effects
Main Constructs		**Dimensions**		**Main Constructs**
R^2	,469***	R^2	,183*	,524***
EAA	,263*	**SC**	,309	,395**
		PMC	-,062	
		IPC	,195	
EAR	,314	R^2	,181	,380
		APC	,442*	
		CV	,019	
		ECM	-,213	
		KMD	,140	
EAD	-,639**	R^2	,099	-771**
		BAD	-,241	
		TAD	-,047	
		GMP	,183	
		SAD	,081	
		REM	,041	
		SRG	,180	
EAF	,671***	R^2	,397***	,662***
		SMT	,062	
		HC	,179	
		DMK	,034	
		PFD	,101	
		CSM	,415**	
EAA * EAF				-,233
EAR * EAF				,032
EAD * EAF				,190

NOTE: *P < .050; **P < .010; ***P < .001.

TABLE 21: OVERVIEW OF REGRESSION RESULTS FOR RESOURCE COMPLEMENTARITY

The results in Table 21 show that the regression model with the four main constructs as direct predictors explains the variance in Resource Complementarity significantly. EA Alignment and EA Foundation have a significant positive relationship with Resource Complementarity, while EA Development has a significant negative relationship. The regression models at activity levels show that Communication and Stakeholder Management (CSM) has a significant positive relationship

with Resource Complementarity. The table also shows that the moderating effects of EA Foundation are not significant. The regression model which includes the interaction effects is therefore ignored.

These results have the following consequences for the hypotheses:

Hypothesis 2d:	*EA Realization positively influences Resource Complementarity*	**Rejected**
Hypothesis 3d:	*EA Development positively influences Resource Complementarity*	**Rejected**
Hypothesis 4:	*EA Foundation moderates all relationships between EA Activities and Benefit Enablers.*	**Rejected**

5.3 Additional Analyses

Besides the regression analyses needed to accept or reject the hypotheses, a number of additional analyses are performed. These regressions provide a different impression of the effects of EA than the individual relationships between activities and benefits do.

5.3.1 Effects of Different EA Roles on Benefit Enablers

The EA activities are categorized according to similarity in their goals. EA Alignment activities aim to align the organization with the EA effort, EA Realization activities aim to realise EA plans etc. However, the complete set of activities can also be categorized differently: according to their role in the organization. When the activities are inspected closely, three different roles can be identified:

- **Advisory Activities**
  These activities provide projects and management bodies with advice and insights of the EA staff. These include: SC, PMC, IPC, APC, CSM, GMP and HC.

- **Compliancy Assurance Activities**
  These activities assure that the organization complies with the plans and agreements of the EA staff. These include: CV and ECM

- **Artefact Development and Planning Activities**
  These activities observe and document the as-is and to-be states in various artefacts such as architecture blueprints, principles and requirements. These include: KMD, BAD, TAD, SAD, REM, SRG, PFD, DMK and SMT.

To calculate a score for these new categories, the mean was taken from the corresponding activities. The results of a regression analysis with these new categories as predictors is shown in Table 22. Significant relationships are printed in bold: only advisory activities have significant relationships. This category has a significant positive relationship with each benefit enabler.

	Organizational Alignment	Information Availability	Resource Portfolio Optimization	Resource Complementarity
R^2	,316**	,203*	,328***	,311**
Advisory Activities	**,576****	**,492***	**,743*****	**,694****
Compliancy Assurance Activities	-,085	-,208	-,064	-,222
Artefact Development and Planning	,054	,101	-,148	-,025

NOTE: *P < .050; **P < .010; ***P < .001.

TABLE 22: REGRESSION RESULTS OF EA ACTIVITIES CATEGORIZED BY OBJECTIVE

5.3.2 Current EA Focus of Organizations

To determine how much effort the organizations in the sample put in the various EA activities, the mean of the activity values is used as an indicator. The means of the various categories are presented in Table 23.

Organizations seem to put most effort in EA Realization with EA Development a close second. Third in this list is EA Alignment and significantly lower and on the priority list is EA Foundation.

The role of the EA efforts in the sample is focussed on Compliancy Assurance while Advisory and Artefact Development both come second.

	All Organizations (N=50)
EA Alignment	3,09
EA Realization	3,58
EA Development	3,44
EA Foundation	2,54
Advisory Activities	3,10
Compliancy Assurance Activities	3,69
Artefact Development and Planning	3,10

TABLE 23: MEAN OF EA ACTIVITY CATEGORIES

5.4 Overview of Hypotheses

This section presents an overview of all findings. First a visual representation of the acceptance and rejection of all hypotheses is given, along with a table which outlines the same information. This is followed by two more tables which provide the statistical information on which the acceptance and rejection of the hypotheses is based.

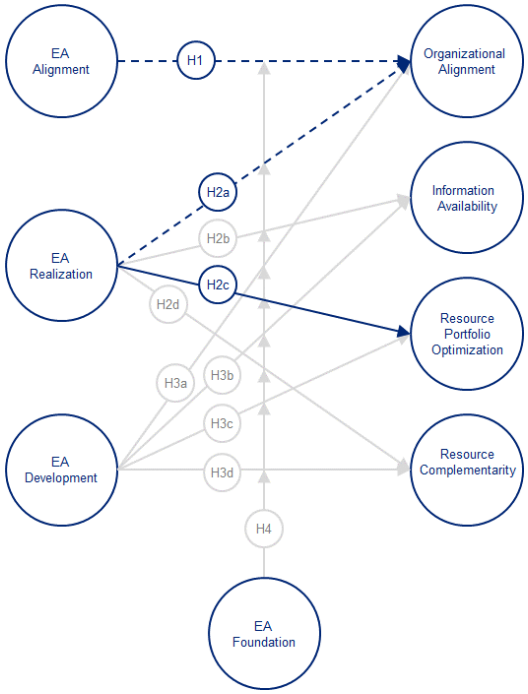


FIGURE 39: VISUAL REPRESENTATION OF ACCEPTED AND REJECTED HYPOTHESES

Table 24 contains an overview of all hypotheses and whether they have been rejected or accepted. Figure 39 visualizes this information.

H	Independent Variable	Dependent Variable	Moderator	Result
1	EA Alignment	Organizational Alignment	None	**Partially Accepted**
2a	EA Realization	Organizational Alignment	None	**Partially Accepted**
2b	EA Realization	Information Availability	None	Rejected
2c	EA Realization	Resource Portfolio Optimization	None	**Accepted**
2d	EA Realization	Resource Complementarity	None	Rejected
3a	EA Development	Organizational Alignment	None	Rejected
3b	EA Development	Information Availability	None	Rejected
3c	EA Development	Resource Portfolio Optimization	None	Rejected
3d	EA Development	Resource Complementarity	None	Rejected
4	EA Alignment, EA Realization, EA Development	Organizational Alignment, Information Availability, Resource Portfolio Optimization, Resource Complementarity	EA Foundation	Rejected

TABLE 24: OVERVIEW OF ACCEPTANCE AND REJECTION OF HYPOTHESES

Table 25 contains an overview of all regression results of significant relationships between individual activities and Benefit Enablers.

Independent Variable		Dependent Variable	Beta	R^2
EA Alignment	Strategy Consultation	Organizational Alignment	,373*	-,210*
		Information Availability	,409*	,257**
EA Realization	Architecture Project Consultation	Organizational Alignment	,438*	,290**
		Resource Portfolio Optimization	,625**	,341**
EA Foundation	Recruitment and Development of Human Capital	Organizational Alignment	,443**	,345**
		Resource Portfolio Optimization	,423*	,289**
	Process Formalization and Documentation	Information Availability	,365*	,330**
	Communication and Stakeholder Management	Resource Complementarity	,415**	,397***

TABLE 25: OVERVIEW OF SIGNIFICANT RELATIONSHIPS BETWEEN ACTIVITIES AND BENEFIT ENABLERS

Table 26 presents an overview of the regression results of all relationships between EA Activity Categories and Benefit Enablers.

Dependent Variable	R^2	Beta	Independent Variable
Organizational Alignment	,292**	,128	EA Alignment
		,339	EA Realization
		-,172	EA Development
		,331	EA Foundation
Information Availability	,207*	,143	EA Alignment
		-,009	EA Realization
		-,085	EA Development
		,440*	EA Foundation
Resource Portfolio Optimization	,327**	,306*	EA Alignment
		,449*	EA Realization
		-,369	EA Development
		,263	EA Foundation
Resource Complementarity	,469***	,263*	EA Alignment
		,314	EA Realization
		-,639**	EA Development
		,671***	EA Foundation

TABLE 26: OVERVIEW OF SIGNIFICANT RELATIONSHIPS BETWEEN EA ACTIVITY CATEGORIES AND BENEFIT ENABLERS

6 DISCUSSION

This section elaborates the results. All hypotheses are presented along with a discussion about expected and unexpected outcomes. The insights obtained in the roundtable session with EA experts are incorporated in these sections to provide more explanation of the results. This section concludes with an important observation about the current state of EA in organizations and a direction for a more effective EA effort.

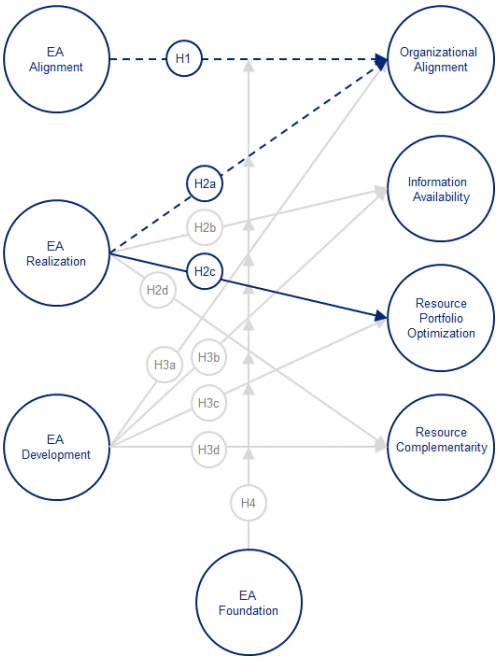


FIGURE 40: CONFIRMED AND REJECTED HYPOTHESES

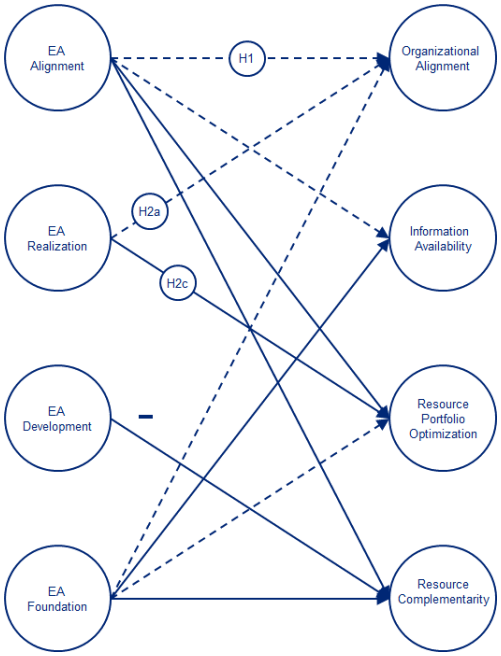


FIGURE 41: UPDATED RESEARCH MODEL

Visualizing the results of the previous chapter, Figure 40 shows the accepted hypothesis with a dark straight line. The hypotheses which are partially accepted are shown in dark dashed lines and the rejected hypotheses are shown in light grey lines. Figure 41 shows the same research model, but this time with the relationships which have been confirmed by regression analysis. The dashed lines in both models represent relationships which concern one of the sub dimensions of the respective EA Activity construct instead of the entire construct itself. The solid lines represent relationships which do concern the entire construct. This difference is a result of the different regression analyses used to identify these relationships. The solid lines have been confirmed by a regression analysis using the four EA Activity constructs as predictors in the model. Hence relationships of entire EA constructs are identified. The dashed lines on the other hand are confirmed by entering all sub dimensions of one EA Activity category as predictors in a regression analysis. This can only reveal relationships of individual dimensions of an EA Activity category. Relationships which are a result of the former type of regression are solid lines, while the relationships resulting from the latter regression analyses are presented as dashed lines.

Evidently, there are quite a few differences between the hypothesized relationships and the relationships found with regression analysis. This section elaborates these dissimilarities.

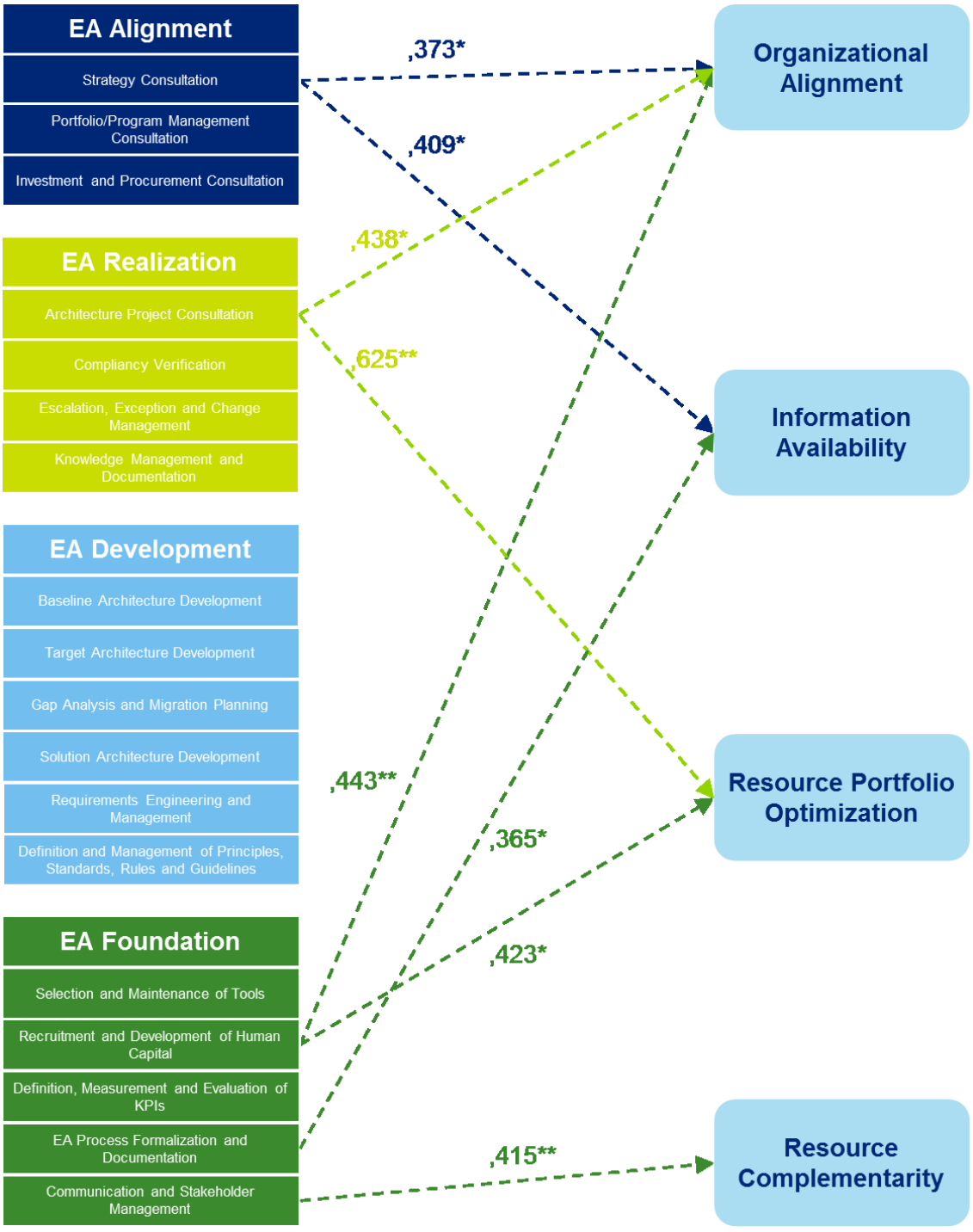


FIGURE 42: SIGNIFICANT EFFECTS AT ACTIVITY LEVEL

6.1 EA Alignment

The literature review provided evidence for one hypothesis involving EA Alignment:

Hypothesis 1: EA Alignment positively influences Organizational Alignment

However, this relationship is only partially accepted. It is not completely accepted because regression analysis revealed no direct relationship between EA Alignment and Organizational

Alignment. However, regression analysis did reveal a significant relationship between “Strategy Consultation” (which is a dimension of EA Alignment) and Organizational Alignment as can be seen in Figure 42. Hence the partial acceptance of this hypothesis.

Besides Organizational Alignment, “Strategy Consultation” also has a significant positive relationship with Information Availability. That this activity does not directly contribute to the resource related benefit enablers may be explained by the fact that strategy decisions only impact resources in the long run. Consulting the enterprise strategy process will impact resources in the (far) future but these effects are too indirect to be measured, hence no effect is present in Resource Portfolio Optimization and Resource Complementarity.

The other activities do not have a significant effect on any of the Benefit Enablers. This does not mean these activities are of no use to an organization. They may have impact on aspects of an organization which are not measured in this research. The effects of these activities cannot be explained by the setup in this thesis. However, the lack of effects of the other categories is in line with the literature review. “Strategy Consultation” is the only category in the literature review which is linked to benefits. This empirical research has confirmed the notion that the other activities lack identifiable benefits.

EA Alignment as a construct has a significant positive effect on both Resource Portfolio Optimization and Resource Complementarity, as can be seen in Figure 43. Literature did not provide enough evidence for these relationships: this is therefore a new finding.

Why EA Alignment only has effects on “Resource Portfolio Optimization” and “Resource Complementarity” is unclear. The roundtable discussions with subject matter experts also did not provide any satisfactory explanation. More research is required to determine the (lack of) effects of EA Alignment as a construct.

EA Alignment can be concluded to be more important than previous research suggested. Instead of having a significant effect on Organizational Alignment only, it has significant positive effects on all Benefit Enablers. The effect of EA Alignment is not only underestimated in literature, but also in practice. The data in Table 23 on page 69 suggests that organizations have EA Alignment as a third priority after EA Realization and EA Development. The results of this research suggest that more focus of organizations on EA Alignment might be beneficial, since it is linked to more benefits than expected.

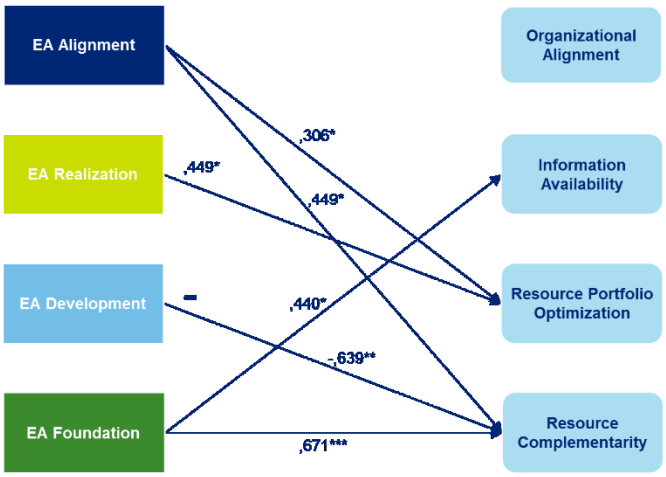


FIGURE 43: SIGNIFICANT EFFECTS AT EA ACTIVITY CATEGORY LEVEL

6.2 EA Realization

The literature review provided evidence for four hypotheses involving EA Realization:

Hypothesis 2a: EA Realization positively influences Organizational Alignment

Hypothesis 2b: EA Realization positively influences Information Availability

Hypothesis 2c: EA Realization positively influences Resource Portfolio Optimization

Hypothesis 2d: EA Realization positively influences Resource Complementarity

One of these hypotheses is confirmed by this research: the positive effect of EA Realization on Resource Portfolio Optimization (hypothesis 2c). Another hypothesis is partially accepted: the effect of EA Realization on Organizational Alignment (2a). The partial acceptance is a result of the positive effect of "Architecture Project Consultation" (a dimension of EA Realization) on Organizational Alignment.

The positive effect of Architecture Project Consultation on Organizational Alignment makes sense because the purpose of this activity is among other things to ensure a project aligns with the rest of the organization. By consulting a project, an architect can steer a project in the right direction resulting in a project which aligns with the organization.

Besides Organizational Alignment, "Architecture Project Consultation" also has a significant positive effect on Resource Portfolio Optimization. This might be caused because EA staff is involved in many projects and has knowledge about multiple aspects of the organization. In the activity of project consultation the staff may help projects collaborate or integrate with other projects the architects know about to create various resource optimizations for the organization. This might cause the positive effect of Architecture Project Consultation on Resource Portfolio Optimization. The lack of effects towards Resource Complementarity may be explained by the out of the box type of vision which is required to identify the synergy possibilities that underpin this Benefit Enabler. The nature of the work which architects do may result in a tunnel vision towards existing resources and optimizations. Identifying entirely new synergies may require such a different vision that this does not occur in the Architecture Project Consultation activity.

The lack of effects of the Knowledge Management and Documentation activity might be caused by the internal EA focussed nature of this activity. Documenting and managing EA and project knowledge has benefits primarily for EA and project staff (less re-work, quick overview etc.). These benefits may result in more efficiency in the end, however this effect may be too indirect to be measurable in the Benefit Enablers.

The results in this research provide a nuance to what is indicated in literature. The literature review showed many effects from other EA Realization activities. However, this thesis suggests that these effects may be overestimated since none of the other activities have confirmed effects on Resource Portfolio Optimization or any other Benefit Enabler. "Architecture Project Consultation" is the only EA Realization activity with any confirmed effects at all.

This overestimation of EA Realization effects is also visible in the focus which organizations show in their EA activities. EA Realization displays the highest mean value of all activity categories in Table 23 on page 69. This may indicate that organizations spend quite some time on this category. The confirmed effects of this are relatively small, so a shift in focus could improve the effectivity of EA in these organizations.

6.3 EA Development

The literature review provided evidence for four hypotheses involving EA Development:

Hypothesis 3a: EA Development positively influences Organizational Alignment

Hypothesis 3b: EA Development positively influences Information Availability

Hypothesis 3c: EA Development positively influences Resource Portfolio Optimization

Hypothesis 3d: EA Development positively influences Resource Complementarity

All of these hypotheses are rejected based on the regression results. This is remarkable considering the amount of relationships which are claimed in literature. EA Development is claimed to contribute to all Benefit Enablers, but none of these claims can be confirmed. On the contrary, the only effect which is significant is a negative relationship with Resource Complementarity.

Experts in the roundtable discussion pointed out that documentation in itself has no use. It is an instrument used to communicate and support the work of architects. It is obligatory homework which needs to be in order for architects to be able to convey their message to other parties in the organization. Documentation needs to be part of a larger process and it needs a corresponding 'story' of an architect for it to have any use. Documentation on its own is of no use: this might explain the lack of any positive effect of EA Development activities.

The negative effect on Resource Complementarity is quite strong with a multiple R^2 of 0,469 on a 0,000 significance level and a beta of -0,639 on a 0,010 significance level. This negative relationship implies that the combined effect of all EA Development activities has a negative influence on the capability of an organization to identify and realize synergies with its resources. An explanation could lie in the betas of the EA Development activities. Though none of these activities has a significant effect, "Baseline Architecture Development" and "Target Architecture Development" have negative betas almost consistently. This is an indication that the negative effect of EA Development can be attributed primarily to the negative effects of these two activities. This can be explained by the nature of these two activities. Determining the "as-is" situation does not imply a search for resource synergies. It is an activity which in its purpose is not innovative in any way, it simply aims to establish what the current situation is. Hence the lack of any positive effect. Determining the "to-be" situation on the other hand might imply that some degree of establishing synergies is an integral part of the "Target Architecture Development" activity. However, it must be noted that merely establishing the architecture on paper does not help the organization to achieve resource synergies in practice: it is a paper exercise. Experts in the roundtable discussion also noted that architects may not be inclined to think outside the lines of what is already known, hence they will not discover new synergy possibilities. This might explain the lack of positive effects of Baseline Architecture Development and Target Architecture Development on Resource Complementarity. Though it must be stressed that these are hypothetical explanations. Further research is required to confirm the validity of these arguments. The negative effects are assumed to result from the time and effort put in these activities. This time and effort does not have significant positive benefits, while EA staff and people in the organization do spend time into establishing these architecture artefacts. Spending time (which, as the well-known saying tells us, means spending money) on something which does not result in positive effects inherently has a negative effect on performance. This notion was also pointed out by experts in the roundtable session.

However, notice that the multiple R^2 is positive which means that the net effect of all four EA Activity categories on Resource Complementarity is positive. The negative effects of EA Development are counterbalanced by the positive effects of EA Alignment and EA Foundation. Organizations can

thus improve their resource synergies by focussing their EA effort away from EA Development activities and more onto EA Alignment and EA Foundation activities.

EA Development receives a lot of attention of organizations in their EA efforts and results in this thesis might seem to imply this is counterproductive. As can be seen in Table 23 on page 69, it has the second highest mean of the four EA categories while no direct positive effect is identified and instead even a negative effect on Resource Complementarity is present. Although this might give the impression that organizations should stop performing EA Development activities altogether, this is unlikely. A more likely explanation is obtained by investigating the use of EA Development artefacts. The development activities focus primarily on creating and updating various architecture blueprints, principles, requirements etc. These are then used in other processes such as those in EA Alignment and EA Realization. Such activities which take the EA Development artefacts as input in turn do have a positive effect on Benefit Enablers. This means that EA Development activities in itself do not have benefits for an organization: as mentioned they constitute paper exercises. However, they are used to create input for activities which do have positive effects. This notion nuances the ideas in the literature review which attribute benefits to developing architecture blueprints and maintaining principles in itself.

6.4 EA Foundation

The literature review did not provide any evidence for hypothetical relationships between EA Foundation and the Benefit Enablers. Together with subject matter experts it was decided that this is unlikely and that a moderating effect of EA Foundation on the relationships between all other EA activity categories and the Benefit Enablers was the most likely scenario. Therefore, the following hypothesis was formulated:

> *Hypothesis 4: EA Foundation moderates all relationships between EA Activities and Benefit Enablers.*

However, one of the most evident results of the regression analysis is the lack of any moderation effect of EA Foundation; hence the rejection of this hypothesis. Instead, the results indicate that EA Foundation has a direct positive relationship with Information Availability and Resource Complementarity. Additionally, three of its dimensions have relationships with Benefit Enablers. All together this means that EA Foundation has direct relationships with all Benefit Enablers instead of any moderating relationships. The three dimensions with direct relationships to Benefit Enablers are “Recruitment and Development of Human Capital”, “EA Process Formalization and Documentation” and “Communication and Stakeholder Management”.

Recruitment and Development of Human Capital has direct positive relationships with both Organizational Alignment and Resource Portfolio Optimization. This suggests that having the right staff in the right places with the right training can improve the effectivity of EA primarily in the alignment of the organization and in the identification and realization of resource optimizations. Experts in the roundtable discussion agreed that proper training is essential for architects. They stated that a well-trained architect can prevent many issues by properly conveying the intended message to its recipients in the organization. The fact that this activity does not have a relationship with resource complementarity may be explained by the tunnel vision effect as mentioned in Section 6.2: architecture staff are focussed on the existing set of resources and its optimizations instead of opening up to new possibilities and synergies. This would also explain why the Communication and Stakeholder Management activity does have a positive relationship with Resource Complementarity. This activity involves talking to people in the business organizations who do have the proper position to identify synergies. When these people talk to EA staff, the synergy ideas they convey may be picked up by the EA staff, resulting in the implementation of these ideas. Hence the positive relationship of Communication and Stakeholder Management with Resource Complementarity.

EA Process Formalization and Documentation has a direct relationship with Information Availability. This implies that a well-structured and formalized EA process improves architects' abilities to provide useful and high quality information to decisions makers. This makes sense because when EA processes are formalized and its documentation is made available, Information Availability (about EA processes in this case) has actually increased.

Communication and Stakeholder Management has a direct relationship with Resource Complementarity. This suggests that strong communication capabilities of the EA team improve the identification and realization of resource synergies of the organization. This seems logical, since the people with whom the architects talk in this activity may possess ideas of how synergies can be accomplished, as was mentioned earlier. When properly executed, the EA team can obtain a "spider in the web" position in the organization; bringing people and opportunities together. Therefore communication is an important aspect in order to obtain a positive effect on Resource Complementarity.

The experts in the roundtable discussion supported the importance of good communication of EA staff. They stated that awareness in practice is increasing for this notion, however that too often such soft-skills are not at the desired level yet.

Table 23 on page 69 and the literature review reveal that there is little attention for EA Foundation activities, both in practice as well as in literature. The mean of EA Foundation is the lowest of all four EA Activity categories and no hypothetical relationships were identified in the literature review. The results in this thesis imply that EA Foundation has impact in all Benefit Enablers and is therefore an important aspect of EA. More attention to EA Foundation related activities may increase the effectivity of the EA effort and eventually increase the extent to which benefits are experienced.

6.5 EA Scope

The questionnaire contains an item to determine the scope of the EA effort of the respondent's organization (item 0.1), yet there are no results that incorporate these differences. This is due to the sample size of N=50. In order to compare whether the results would be different for the various scope differences, a larger sample would be required. The scope data is therefore only used to determine whether the results are not biased. For example, when too many respondents with an EA effort limited to "project scope" would be present in the sample, the results would be too biased since the scope of this thesis is based on an "Enterprise Wide" EA scope. This would make the results less generalizable.

This is not the case however: 32 respondents indicated to have an Enterprise Wide scope, 15 respondents indicated to have a Segment Wide scope and 3 respondents indicated to have a Project Wide scope. Analysis revealed that the latter three do not present outliers which affect the results. The 15 segment wide EA efforts do not represent a problem, because, as TOGAF also describes (The Open Group, 2011b), an EA effort can be tailored to a specific part of an organization without any issues. All activities as identified in this thesis can still take place at a segment scope, since there is no activity which only takes place at an Enterprise Wide scope. Unsurprisingly, outlier problems with these 15 entries were not detected.

The same argument can be made for the item about the EA domains (item 0.2). The sample size is too small to use this data for comparison purposes. It was used to determine bias or outlier problems: these were not found.

6.6 Improving EA Effectivity

This section synthesizes the discussions of the previous sections.

First, an interesting result of the analyses is the lack of relationships to benefits from EA Development. The literature review provided indications that many relationships were to be expected. For example, Tamm et al. (2011) state that *"it seems likely that EA's impact on benefits that are contingent on implementation is somewhat weaker than on benefits that can be derived from the EA plans directly*". This turns out not to be entirely accurate. Benefits which can be derived from EA plans directly have not been identified. Instead, it seems that these plans provide input for advisory-type activities which do have significant relationships to benefits.

Second, judging from the results there is an interesting mismatch between the focus of EA efforts and the amount of benefits resulting from that focus. As is visible in Table 23 on page 69, organizations focus their EA efforts primarily on EA Realization and EA Development activities. Interestingly, these are the two activity categories with the least amount of relationships to Benefit Enablers as can be seen in Figure 44. EA Alignment and EA Foundation have more significant relationships and are therefore considered important for delivering the benefits which an EA effort may bring. Organizations seem to focus on EA Development and EA realization while EA Alignment and EA Foundation seem to yield more direct benefits. Experts in the roundtable session pointed out that they recognize this in practice: *"The development and support of an EA department does not receive enough attention in practice"*. This implies that EA Foundation indeed is underappreciated in practice. They also recognized that a lot of value can be achieved with EA Alignment activities. The experts nuanced this by stating that any discipline in an organization would like to provide input at board level and that EA cannot exist without EA Realization and EA Development activities. Finally, they mentioned that the difference in attention may be explained by the amount of time these activities take: EA Alignment and EA Foundation activities take less time than EA Development and EA Realization activities.

When the focus of EA efforts is characterized by the role of the activities in the organization a similar mismatch as identified above is visible. In the additional analyses of this research, the activities are categorized by the role each activity has in the business processes of the organization. This results in three roles: an advisory role, a compliancy assurance role and an observing/documenting role. Each identified EA activity was categorized as one of these three. For more details refer to Section 5.3.1. The regression results indicate that only the advisory activities have a significant positive effect on the Benefit Enablers. Interestingly, both the compliancy assurance and the documenting roles have no significant effect at all. Comparing these effects on the Benefit Enablers with the focus of EA efforts of organizations yields a similar mismatch as previously mentioned. The organizations in the sample focus their EA efforts around the compliancy assurance activities while these do not have a significant effect. The advisory and documenting activities are secondary in focus while the former constitutes the only category with a significant impact on the Benefit Enablers.

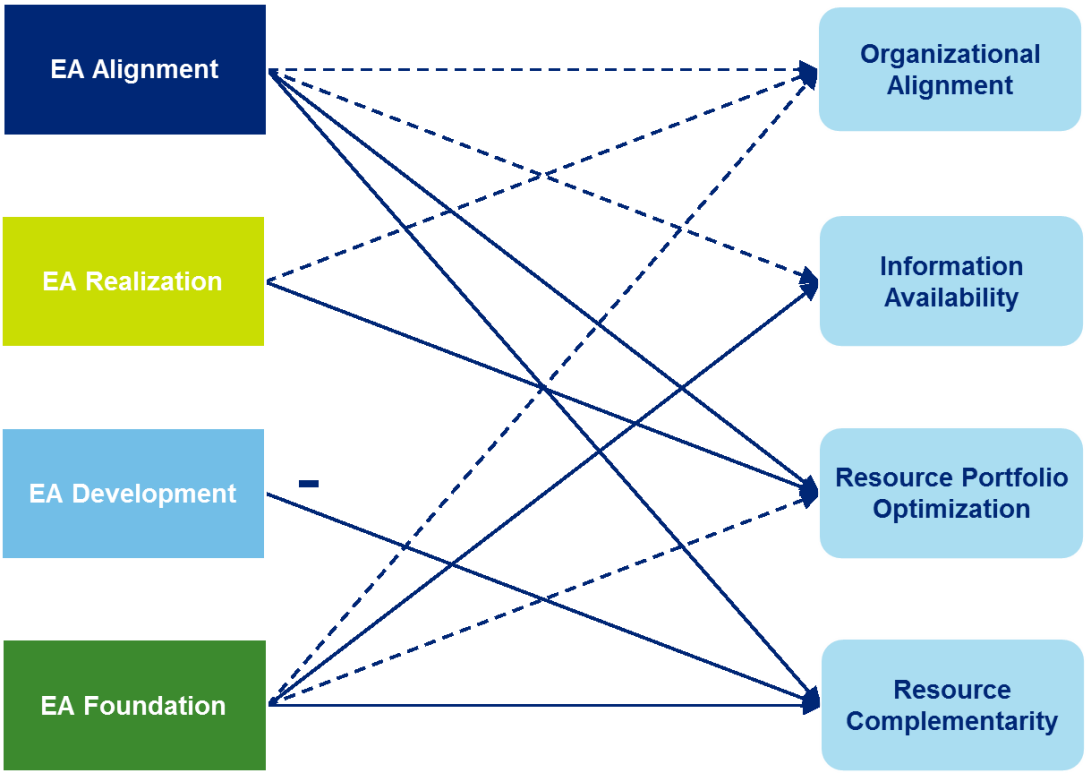


FIGURE 44: FINAL MODEL AFTER ANALYSIS

The two mismatches mentioned above suggest that organizations may improve the effectiveness of their entire EA effort by a shift in focus. Instead of concentrating on creating artefacts in isolation and enforcing compliancy of the organization, more attention should be directed towards providing advice to projects or management bodies and joint development of the architecture work. Activities which focus on the development of various architecture related artefacts cannot be omitted from an EA effort. However, it seems that more positive effects could be obtained by jointly developing the architecture documents with the people in the organization itself. Moreover, organizations may benefit more from their EA investments if they evaluate the amount of effort put in those activities in comparison to the provision of insights and advice for which the artefacts were created in the first place. The results in this thesis thus provide indications that an EA team which functions as an internal enterprise consultancy organization will be more effective than an EA team which functions as an internal compliancy assurer.

However, it must be noted that this does *not* mean that the EA Development and EA Realization activities are *unimportant*. The roundtable discussions with enterprise architects of various large organizations yielded the conclusion that these are still important activities. They serve as a basis for the communication and advice activities. This thesis merely posits the notion that the amount of attention for these activities may be too large at the moment, not that they should be omitted from an EA effort altogether.

6.7 External Validity

The sample on which the results of this research are based consists primarily of large organizations and the majority are multinational organizations active in The Netherlands. Nearly all employ dedicated architects. The results are therefore considered to be relevant for any large organization with dedicated EA staff.

6.8 Implications for Practice

This section elaborates what the results of this research imply for organizations engaged in EA practices. The first four sections elaborate what EA can do to improve business performance through its effects on the Benefit Enablers. The last section provides a direction for both current and future EA efforts.

6.8.1 Aligning the Organization

A well aligned organization uses its resources during execution in a way which supports the pursuit of the enterprise strategy. As can be seen in Figure 45, this contributes to the financial and learning & growth perspectives of the BSC according to literature. EA has a positive influence on this primarily by the effects of the advisory services of an EA team. The regression results in this thesis show that EA can improve Organizational Alignment by providing advice in two areas: first of all in the strategy formulation of the enterprise and secondly in the execution of projects. This makes sense because it is these two components which are of key importance to alignment: first of all ensuring that the strategy aligns well with the organization and secondly the other way around; helping projects in the right direction according to that strategy. Important to note here is that regression resulted in one more important activity for Organizational Alignment: Recruitment and Development of Human Capital. Having the right people properly trained has a significant positive effect on alignment. Concluding, EA can contribute to Organizational Alignment by providing advice to strategy formulation and project execution as well as ensuring proper personnel is hired and training is provided to the EA staff.

6.8.2 Exposing High Quality Information

Providing decision makers with high quality information has a positive effect on three out of four BSC elements according to literature: customer, internal and learning & growth. However, the effects of EA on improving the availability of high quality information is not as strong as the other benefit enablers. As displayed in Figure 45, only two EA activity categories have a significant impact: EA Foundation and EA Alignment. Two activities are of primary importance regarding this aspect: a formalized EA process and the provision of strategy advice. Ensuring these two activities are well executed has a positive effect on the Information Availability according to the regression results.

6.8.3 Optimizing the Resource Portfolio

The only Benefit Enabler with an impact in all aspects of business performance is Resource Portfolio Optimization (see Figure 45). Optimizing the resource portfolio by removing redundancies and integrating compatible resources is considered an important element of EA by literature. In order to improve this aspect, EA Realization activities are proven to be key by this thesis. Regression results show that it is especially important for EA staff to provide advice to projects dealing with these resource portfolio optimizations. Besides the advice to specific resource optimization projects it is also important for EA staff to advise the strategy formulation of the enterprise. This ensures that the pursued strategy of the organization is in line with the possibilities and opportunities of the existing resource portfolio. Finally, having the right staff and providing them with proper training has a significant impact on the capability of EA to optimize the resource portfolio.

6.8.4 Innovation

Organizations with a focus on innovation (a key aspect of Resource Complementarity) should focus on the EA Foundation activities. Results show that EA can contribute to the identification and realization of resource synergies if there is enough communication between EA and the organization. Companies where innovation takes a key priority should also ensure not too much focus is placed on the development of architecture documents such as blueprints, principles and requirements. The results indicate that such paper based documentation activities can be harmful to the Resource Complementarity benefit enabler, which is of great importance for innovation.

Innovative organizations should therefore organize their EA efforts around a 'spider in the web' type of role in the business; a lot of emphasis on communication and less focus on architecture development and planning.

6.8.5 Improving EA Effectiveness

Besides the way EA can improve business performance, this thesis also provides a direction for current and future EA efforts. The results give a clear indication as to which activities have more effects on Benefit Enablers and thus on business performance than other activities. Comparing this to the focus of current EA efforts yields a worrying mismatch. The sample of organizations in this research show a strong bias towards the development of EA documents/plans and the assurance of compliancy to those plans. However the regression results show that these are not the activities which contribute to business performance. Instead, providing advice to both projects as well as various management bodies is significantly more effective. This result along with the fact that activities such as recruitment and communication also have a direct positive effect on several benefit enablers provide a clear direction for the field of EA. These results paint a picture of EA as a 'spider in the web' where key people in the organization know how to find EA staff and EA staff know how to find key people. Connecting people to opportunities and vice versa is more important than previously thought. This is of course impossible without a proper view of the as-is and to-be architecture of the organization. However, the results provide indications that developing such artefacts in close collaboration between architects and the business organization is more effective than an ivory tower type of approach. According to the results of this thesis the future of EA thus lies in an approach focussed on close collaboration and advisory services instead of isolated development and compliancy assurance.

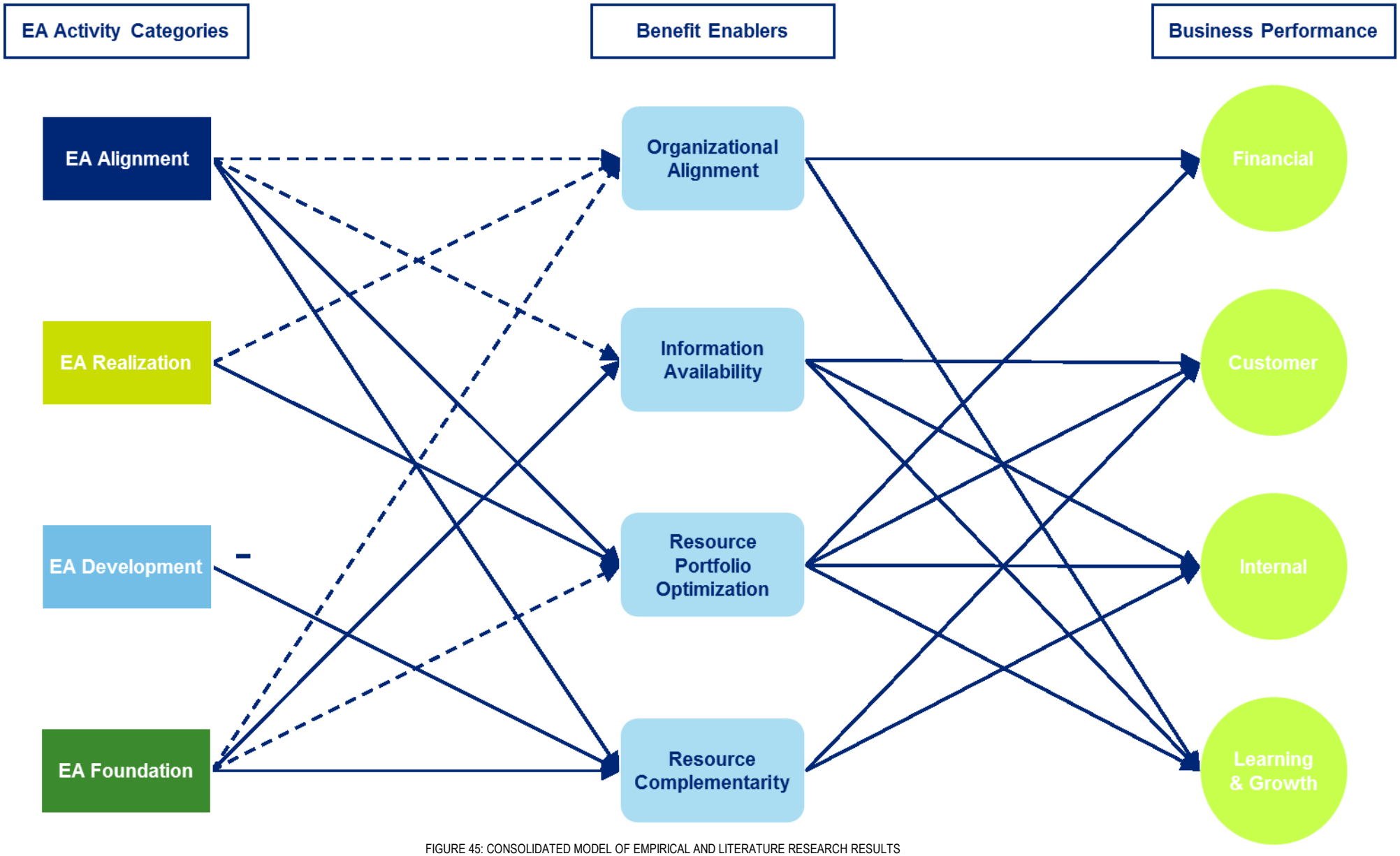


FIGURE 45: CONSOLIDATED MODEL OF EMPIRICAL AND LITERATURE RESEARCH RESULTS

7 CONCLUSION

This section presents the conclusions of this research. The research questions are answered in Section 7.1 and the contribution of this thesis to both literature and practice is presented in Section 7.2. The section is concluded with opportunities for future research in Section 7.3.

7.1 Conclusions

This thesis presents an answer to the main research question stated below. This question is answered by dividing the problem into four sub-questions which are answered in this section.

How does Enterprise Architecture impact Business Performance?

The first part of the answer to the main question consists of determining what constitutes EA. In order to be able to answer the main question on a granularity level which is useful for both literature as well as practice, the first research question is as follows:

1. *Which EA Activities can be distinguished?*
    a. *What does EA staff do in each activity?*
    b. *What is the organizational scope of each activity?*

An overview of all EA activities is presented in Figure 46 below. Identification of these activities is based on a structured literature review and feedback from subject matter experts. The activities have been grouped into four categories, each with a common goal:

EA Alignment
EA Alignment activities aim to align the organization with the EA plans and effort. This is done by providing advice in three key areas: strategy formulation, portfolio/program management and investment/procurement. The knowledge and understanding of EA staff about an organization's business, information and technical architecture can provide different perspectives for various strategic options. Additionally, the solid understanding of project and program interdependencies can bring transparency and helps prioritizing the portfolio. Finally, the diverse view of the enterprise which EA staff possesses can aid the assessment of various investment or procurement options. Together, these activities aim to align the organization's architecture with its intended future state and vice versa.

EA Realization
EA Realization activities aim to realize the EA plans and architectures in the organization. Architecture plans such as blueprints, principles and requirements are implemented in the organization through the execution of projects. The execution of projects is not considered to be part of EA, however providing advice to those projects and assuring their compliancy with the aforementioned plans is. Assuring compliancy is done by structurally verifying whether the execution of the project is in line with the plans and providing a formalized escalation decision process when discrepancies are found. Furthermore, giving additional advice may help projects overcome issues and can realize possible synergies with other projects. Finally, an important part of realizing plans is storing and retrieving architecture related knowledge and documentation. This aims to prevent work being done twice and can provide insights without new investigations. All these activities together ensure that the architecture artefacts, which are developed in the EA Development activities, are properly implemented in the organization.

EA Development
EA Development activities aim to develop and formalize an understanding of the current and future architecture of the organization. This is done by developing various architecture plans such as blueprints and artefacts. These describe the baseline, the target and different transition architectures. The baseline architecture describes the current situation of the business, information and/or technical domain. The target architecture describes the intended future state of one or more of these domains. The gap analysis activity assesses which gaps exist between the current and target states, which can then be used to plan how to these gaps should be filled. In order to ensure all these different architecture aspects are in line with each other and with what the organization needs, requirements are constantly updated and principles are instated and guarded. Finally, the gap analysis and target architectures are synthesized into solution architectures which are implemented to provide new capabilities or optimize current resources. All these activities together develop and formalize an understanding of the current and future state of the organization.

EA Foundation
EA Foundation activities enable the EA staff to do their work. In order to perform all activities mentioned above, certain aspects need to be taken care of. This includes recruiting the right staff, providing the proper training and ensuring availability of the right tools. Furthermore, the process of performing all activities needs to be formalized and documented. The measurement and evaluation of KPIs is also an activity of the EA Foundation category. Finally, EA staff need to communicate consistently with the organization, this requires planning and stakeholder management, which constitutes the last activity of EA Foundation. These activities together ensure that all EA staff can do what they are required to do without any impediments.

More details about the activities can be found in Section 2.2 on page 10.

	Activity	Scope
EA Alignment	Strategy Consultation	Enterprise Level
		Segment Level
	Portfolio/Program Management Consultation	Enterprise Level
		Segment Level
	Investment and Procurement Consultation	Enterprise Level
		Segment Level

	Activity	Scope
EA Realization	Architecture Project Consultation	Project Level
	Compliancy Verification	Project Level
	Escalation, Exception and Change Management	Enterprise Level
		Segment Level
	Knowledge Management and Documentation	Enterprise Level
		Segment Level
		Project Level

	Activity	Scope
EA Development	Baseline Architecture Development	Enterprise Level
		Segment Level
	Target Architecture Development	Enterprise Level
		Segment Level
	Gap Analysis and Migration Planning	Enterprise Level
		Segment Level
	Solution Architecture Development	Project Level
	Requirements Engineering and Management	Enterprise Level
		Segment Level
		Project Level
	Definition and Management of Principles, Standards, Rules and Guidelines	Enterprise Level
		Segment Level
		Project Level

	Activity	Scope
EA Foundation	Selection and Maintenance of Tools	EA Level
	Recruitment and Development of Human Capital	EA Level
	Definition, Measurement and Evaluation of KPIs	EA Level
	EA Process Formalization and Documentation	EA Level
	Communication and Stakeholder Management	EA Level

FIGURE 46: OVERVIEW OF EA ACTIVITIES AND SCOPE

The next part of the main question concerns determining how the activities identified in question one impact business performance. Previous research has already determined that the effects of EA on business performance are indirect. EA is claimed to influence so called 'benefit enablers' which in turn influence business performance. The second question therefore aims to determine which Benefit Enablers can be identified:

2. *Which Benefit Enablers can be identified?*

FIGURE 47: OVERVIEW OF BENEFIT ENABLERS

Figure 47 provides an overview of all Benefit Enablers. These have been identified with a literature review. The four main Benefit Enabler categories are explained below:

Organizational Alignment
Organizational Alignment concerns *"the extent to which an organisation's subunits share a common understanding of its strategic goals, and contribute towards achieving these goals"* (Tamm et al., 2011). The literature review identified three elements which represent this concept: these are shortly described here. First is business and IT alignment. This refers to the extent to which IT supports the business and vice versa. Second is coherent and consistent organizational change. Organizations change frequently and to a great extent. Without proper management these changes may have opposing effects, which is undesirable. Last is the extent to which decision makers are able to make the correct decisions. These three benefits together constitute the concept of organizational alignment.

Information Availability
Information Availability concerns *"the extent of useful, high-quality information accessible to organisational decision makers"* (Tamm et al., 2011). Literature provides three aspects which EA is claimed to influence. The accuracy, accessibility and completeness of the information which decision makers can use to make decisions. These concepts are considered self-explanatory.

Resource Portfolio Optimization
Resource Portfolio Optimization concerns *"the extent to which an organisation leverages its existing resources, invests in resources that target performance gaps, and minimises unnecessary investments in duplicated resources"* (Tamm et al., 2011). Three aspects are identified in literature which constitute Resource Portfolio Optimization in organizations. First is the optimization of redundant and suboptimal resources. These can be removed, unified and/or integrated in order to increase overall enterprise efficiency. Second is the reduction of risks associated with the replacement of resources. When resources in an organization are replaced, risks such as loss of information or access to key resources may be present. Reducing such risks optimizes the resource portfolio of the organization. Finally, the IT landscape of an organization is considered to be significantly impacted by EA. Optimizations in this area are considered large enough to mention this as a separate part of the resource portfolio optimization benefit enabler, despite its similarities with the aspect mentioned first. These benefits all optimize the resource portfolio of an organization and are considered to be a result of EA.

Resource Complementarity
Resource Complementarity concerns *"the extent to which the organisation's resources synergistically support the pursuit of its strategic goals"* (Tamm et al., 2011). Literature indicated two important aspects which EA is claimed to support. First is the identification and realization of the mentioned synergies. Organizations may possess various resources (such as processes, IT systems or personnel) which are currently operating independently, but could benefit from working together. EA is claimed to help identify and realize such opportunities. Second is the support of innovation. Realizing these synergy opportunities can eventually support the invention and

development of new ideas, which in the end enables innovation. These two aspects concern the benefits of Resource Complementarity which EA is claimed to support.

More details about Benefit Enablers can be found in Section 2.3.1.

In order to be able to indicate how EA impacts business performance, the relationship between the aforementioned activities and Benefit Enablers must be clarified first. Hence research question three:

3. *What is the relationship between EA Activities and Benefit Enablers?*
    a. *Which activities have influence on which Benefit Enablers?*

Figure 48 displays the relationships between EA Activity categories on the left and Benefit Enablers on the right. These relationships are determined using multiple regression analysis on data obtained with a questionnaire. More details about the used questionnaire can be found in Chapter 4. The regression results can be found in Chapter 5. A summary of the findings is presented below.

The dashed lines in Figure 48 indicate a relationship between a benefit enabler and one specific activity of the activity category to which the line is connected. The other lines indicate relationships between a benefit enabler and the complete activity category.

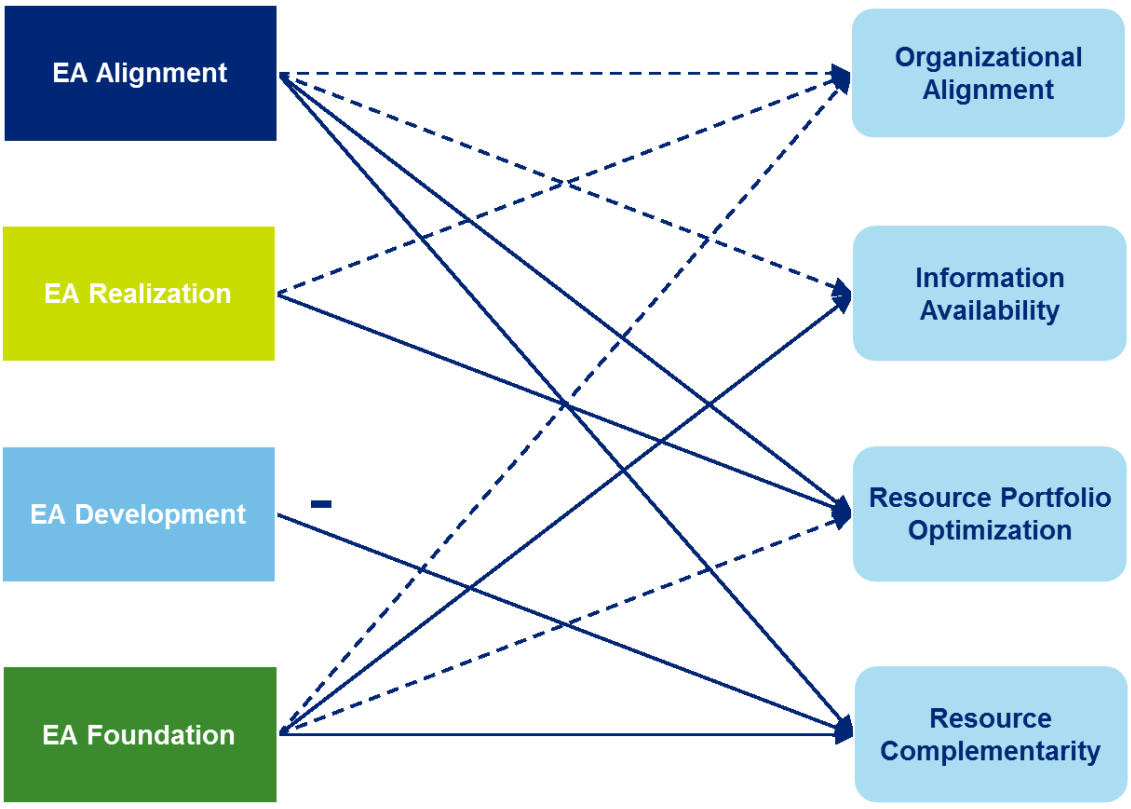


FIGURE 48: CONSOLIDATED MODEL OF EA IMPACT ON BENEFIT ENABLERS

As can be seen in the model above, EA Alignment and EA Foundation have positive relationships with all Benefit Enablers. EA Realization has positive relationships with Organizational Alignment and Resource Portfolio Optimization, while EA Development has only one relationship: a negative relationship with Resource Complementarity.

The negative relationship of EA Development is interesting, because the literature review provided indications that many positive relationships were to be expected from this category. This turns out not to be entirely accurate. Benefits which can be derived from EA plans directly have not been identified. Instead, it seems that these plans provide input for advisory-type activities which do have significant relationships to benefits, as will be elaborated below.

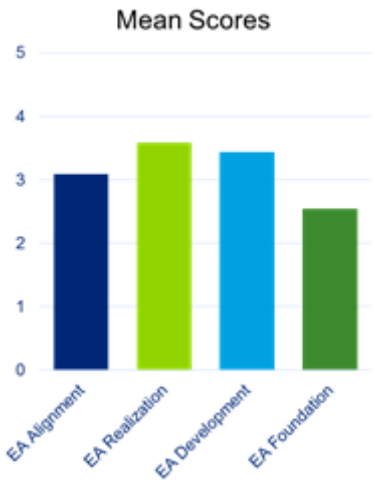


FIGURE 49: MEAN SCORES OF EA ACTIVITY CATEGORIES

An interesting mismatch is found when the results of the regression analysis are compared to the focus of the EA efforts of the sample organizations. Figure 49 displays the mean scores of each EA Activity category as obtained with the questionnaire. These means can be used as an indication of how much effort organizations put in each category. EA Foundation and EA Alignment have the lowest means of the four, so these receive the least attention in the EA practices of the sample organizations. However, as is explained above, these are also the two categories with most significant relationships to Benefit Enablers. There is a clear mismatch between activity categories which yield most benefits for an organization and the focus of current EA practitioners.

Closer inspection of the regression results reveals this mismatch more clearly. In Figure 42 on page 74 it becomes clear that most significant relationships are the result of activities in which EA provides advice and/or interacts with the rest of the organization. This gives reason to believe that advisory and communication related activities are more important than other activities. This notion is confirmed when the activities are categorized according to their role in the organization. The complete set of EA activities contains different activities in which the EA team has various roles in the business processes and projects of an organization. Three different roles are identified:

- **Advisory Activities:** activities in which EA staff provides advice to projects, processes or management bodies.
- **Compliancy Assurance Activities**: activities in which EA staff assure that execution of projects, processes and decisions are compliant with EA plans.
- **Artefact Development and Planning Activities**: activities in which EA staff observes and documents the baseline and target state of the organization in various artefacts such as blueprints, principles and requirements.

Figure 51 presents the mean scores for this alternative categorization. Figure 50 presents the significant relationships between these categories and the Benefit Enablers. Evidently, the same mismatch is present: advisory activities receive the least attention (along with artefact development), yet it is the only category with significant relationships. Advisory activities even have a positive relationship with each Benefit Enabler.

The negative effects of EA Development can be explained by the lack of any advisory component. Time (and money) is spent on developing architecture artefacts which in itself have no benefit: they are merely plans on paper. They are used in other activities which in turn do result in benefits. The net effect is therefore positive, however the individual effect of developing the artefacts is negative.

The answer to research question three is therefore as follows: the benefits which are identified in the form of Benefit Enablers are realized when EA staff provide advice to the organization. In order to provide accurate advice it seems that the artefact development and planning activities and the compliancy assurance activities deliver important input.

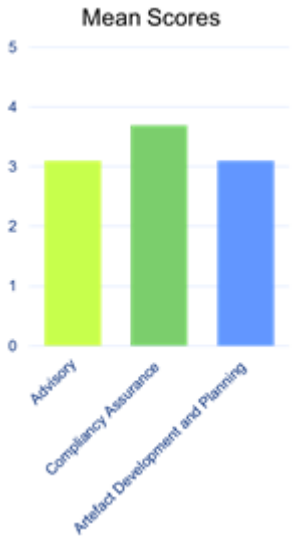


FIGURE 51: MEAN SCORES FOR ALTERNATIVE EA ACTIVITY CATEGORIES

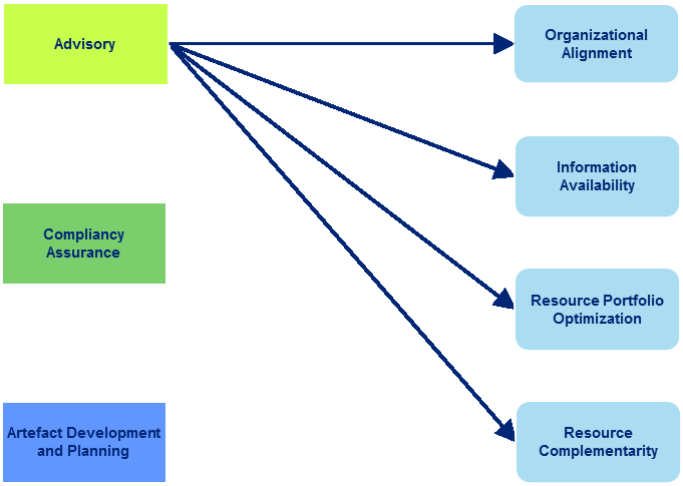


FIGURE 50: SIGNIFICANT RELATIONSHIPS OF ALTERNATIVE EA ACTIVITY CATEGORIES

Finally, to complete the chain of causality from EA activities through Benefit Enablers to business performance, research question four is answered:

4. *What is the relationship between Benefit Enablers and Business Performance?*

Business performance is defined in this thesis by the four perspectives of the BSC approach of Kaplan & Norton (1996): financial, customer, internal and learning & growth business performance factors.

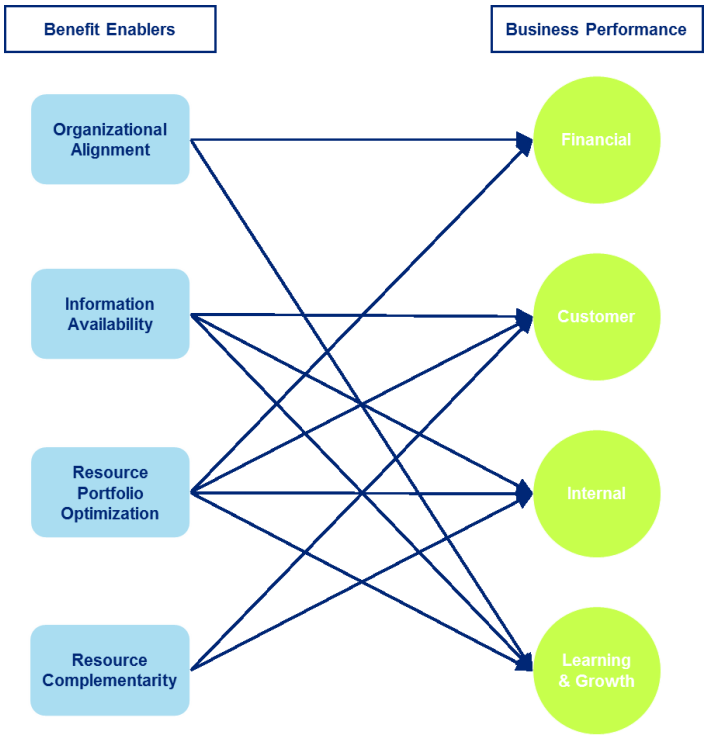


FIGURE 52: RELATIONSHIPS BETWEEN BENEFIT ENABLERS AND BUSINESS PERFORMANCE

Figure 52 displays the relationships between Benefit Enablers and Business Performance as found in literature. The timeframe of this research was too short to test these empirically too, these are therefore only desk research results.

Organizational Alignment has a positive influence on both financial and learning & growth related business performance factors. Information Availability is claimed to improve customer, internal and learning & growth related business performance factors. Resource Portfolio Optimization positively influences all four perspectives of the BSC. Finally, Resource Complementarity has a positive influence on both customer and internal business performance factors.

The previous sub-questions together answer the main research question: EA improves business performance by enabling benefits for the organization through the provision of advice. Activities which focus on the development of architecture plans to describe the current, future and intermediate state of the enterprise only provide the necessary input for the advisory activities of EA. They do not yield benefits directly; they are merely a precedent to activities which do deliver benefits.

The results of this thesis are visualized in Figure 53.

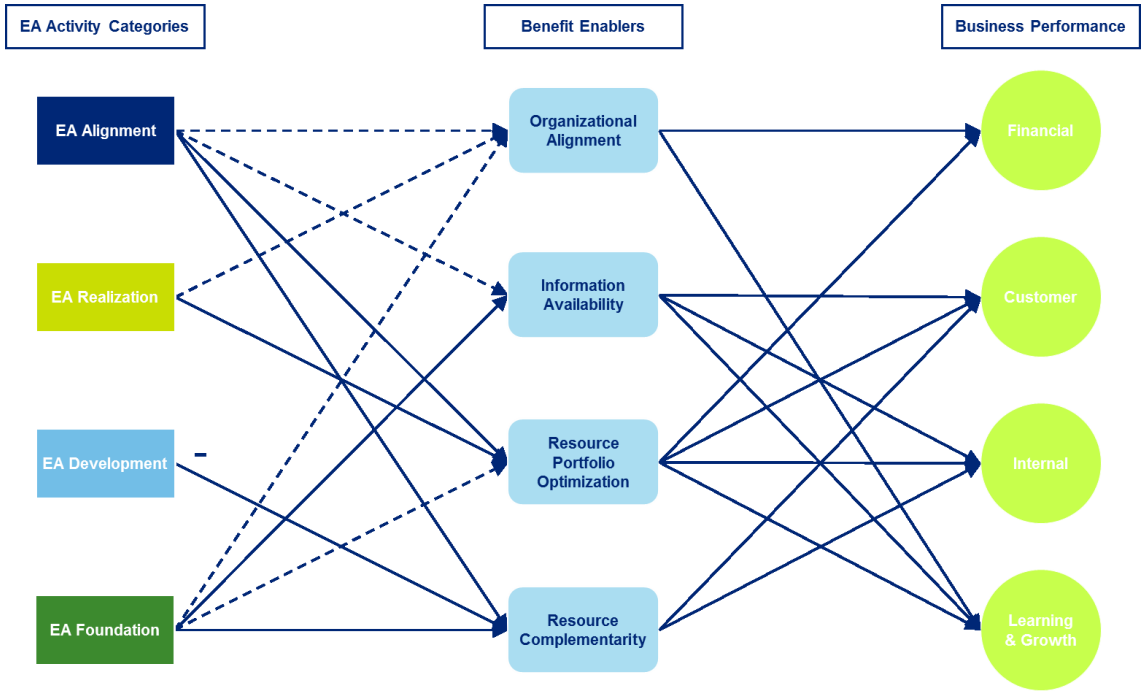


FIGURE 53: VISUAL REPRESENTATION OF THE ANSWER TO THE MAIN RESEARCH QUESTION

7.2 Contributions

This section indicates how this research contributes to EA practice and theory.

7.2.1 Contribution to Practice

This research contributes to EA practice by validating presumed benefits, providing a direction for future EA efforts and giving a foundation for planning and prioritizing EA investments.

First and foremost this research provides evidence confirming and refuting various claims about benefits supposedly resulting from EA efforts. Both academic and practitioner literature contains

an abundance of qualitative claims, as is clear from the literature review. By using these qualitative claims as a basis for this quantitative research the validity of these claims is assessed. This provides executives with an idea of what is true about EA and what is likely to be false.

Second, by evaluating the relationships between EA activities and benefits the effectivity of an EA effort can be determined. This research provides an indication that the EA practices of the sample organizations could benefit from a shift in focus. Most benefits result from EA Alignment and EA Foundation and yet their current focus is on EA Development and EA Realization. Such an effectivity assessment is possible with the insights in this thesis.

Third, the relationships between EA activities and benefits provide a basis for planning and prioritizing investments in EA. The combination of literature and empirical results give an indication of which activities have an effect on what aspects of business performance. When organizations engage in planning or prioritizing their EA effort, an idea of the effects of the various EA subcomponents or activities is useful to target specific aspects of business performance. This research provides the link between EA activities and the impact they may have on these business performance factors. This allows management to tailor their EA efforts to their needs by providing focus and eliminating waste.

7.2.2 Contribution to Theory

This research provides a contribution to current theory by shedding light on the role of EA Foundation activities, testing relationships between EA activities and alleged benefits, and quantifying those relationships.

As indicated in Section 3.2 the role of EA Foundation was unclear in literature. This research provides a first insight into what the role of support activities is for EA staff. Regression results indicate that a direct relationship to various benefits is present which confirms the notion that current literature was missing an important aspect of EA.

The incorporation of all benefit claims and EA activities into a single model is another important aspect which previous research lacked. Current literature presents various individual aspects of architecture and their alleged benefits. This thesis synthesizes these individual components into a single model in order to create a more explanatory whole.

This thesis presents a first indication of what the benefits of EA are on an activity granularity level. No prior research has investigated effects of EA on business performance on the level of individual activities. This granularity level gives a first indication of how EA delivers benefits to an organization through its various aspects.

Finally, the literature review revealed that most EA benefit claims are of a qualitative nature. This thesis has incorporated all these claims into one model and tested their validity. Not only allows this to confirm or refute various claims, it also provides a quantification of the strength of various EA and business performance relationships.

7.3 Limitations and Suggestions for Future Work

This section outlines the limitations of this research and the possibilities for future research.

7.3.1 Limitations

A number of limitations of this research are present.

The most important limitation is the small sample size. While 50 independent observations is enough to provide statistically significant regression results, more research is necessary to further generalize the results in this thesis.

Another limitation is the scope of this thesis. External factors such as those mentioned in Section 2.5 are expected to influence the EA activity to Benefit Enabler relationships identified in this research, but could not be incorporated in this study. Further research should investigate the impact of such factors. Additionally, the relationship between EA and other factors which impact business performance is also considered outside of scope of this study. Future research should investigate how EA and other factors influence each other to increase the understanding of EA's effect on business performance.

Because this research incorporated all EA activities and all identified benefits, the number of questions per construct was limited to preserve the length of the questionnaire. Additional research with more measures per construct is required to provide a more precise measurement of the relationships identified here.

7.3.2 Future Work

This thesis provides a number of interesting opportunities for future research. First of all new studies can focus on overcoming the limitations as previously mentioned. Besides this, other thought-provoking possibilities are identified below.

A number of activities are unrelated to any benefits according to the results of this study. This contradicts previous research. More research is required to determine what the role and effect of these activities is.

The relationship to benefits of all activities in this thesis are considered without regard for any temporal or process aspects. For example, some activities may exist purely to provide input for another activity. The former might therefore have no benefits in itself, but it still is of critical importance. Future research could investigate the effects of such input-output relationships among activities.

Though this research investigates the effects of EA's different roles in the organization on a high level, more research in this area could clarify what the effects are of various levels of responsibility of EA staff. It is expected that varying levels of involvement of EA in different parts of the enterprise have different effects on business performance. More research is required to shed light on the effects of different responsibility levels (such as those in a RACI matrix[2]).

[2] A RACI matrix describes the involvement of various stakeholders and roles in completing a task or deliverable in a project or business process. The different levels of involvement are Responsible, Accountable, Consulted, and Informed.

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Van der Raadt, B., & van Vliet, H. (2008). Designing the Enterprise Architecture Function. In *Quality of Software Architectures. Models and Architectures* (pp. 103–118). Springer.

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Venkatesh, V., Bala, H., Venkatraman, S., & Bates, J. (2007). Enterprise Architecture Maturity: The Story of the Veterans Health Administration. *MIS Quarterly Executive*, *6*(2), 79–90.

Vigderhous, G. (1977). The Level of Measurement and "Permissible" Statistical Analysis in Social Research. *The Pacific Sociological Review*, *20*(1), 61–72. doi:10.2307/1388904

Wagter, R., Van Den Berg, M., Luijpers, J., & Van Steenbergen, M. (2005). *Dynamic Enterprise Architecture: How to Make it Work*. John Wiley & Sons.

Wang, R. Y., & Strong, D. M. (1996). Beyond Accuracy: What Data Quality Means to Data Consumers. *Journal of Management Information Systems*, *12*(4), 5–33.

Webster, J., & Watson, R. T. (2002). Analyzing the Past to Prepare for the Future: Writing a Literature Review. *MIS Quarterly*, *26*(2), 13–23.

Winter, R., & Aier, S. (2011). How are Enterprise Architecture Design Principles Used? In *Enterprise Distributed Object Computing Conference Workshops (EDOCW), 2011 15th IEEE International* (pp. 314–321). IEEE.

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APPENDIX A LITERATURE REVIEW METHODOLOGY

A.1 Literature Review Methodology

In order to ensure that all relevant literature is included in this thesis, a structured literature review approach was used as described in Webster & Watson (2002) and in Wolfswinkel et al. (2013). This section describes this approach and elaborates on the way it was used to construct the literature review section.

A.1.1 Review Structure

Webster and Watson describe two approaches to structure a literature review: the author-centric and the concept-centric approach (Webster & Watson, 2002). The former describes a structure in which all materials are sorted according to author. This results in a review consisting of sections which describe all contributions of one or more authors. Such an approach fails to synthesize the works of different authors into a coherent whole. The concept-centric approach overcomes this issue by describing the work of various authors concerning a certain concept together and synthesizing the contributions wherever possible. This approach has been used to construct and structure this literature review; each section discusses an important concept in this thesis.

A.1.2 Search Process Overview

In order to identify all relevant literature for this thesis, the DEFINE, SEARCH & SELECT stages of the process as described in Wolfswinkel et al. (2013) were used. The process as executed is depicted in Figure 54. It was repeated until the last step did not result in identification of new literature.

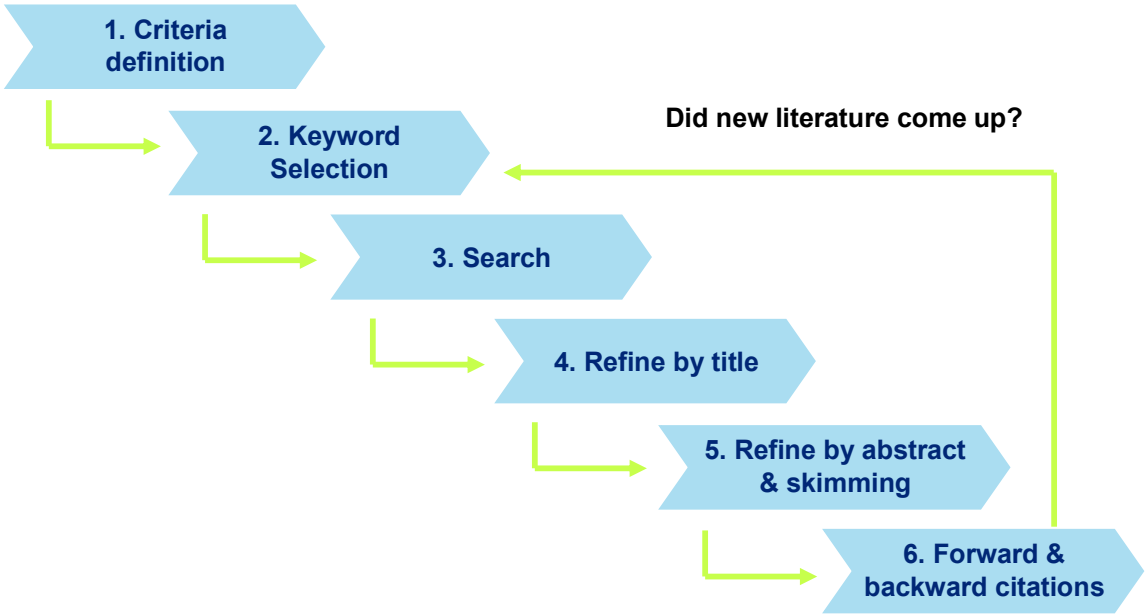


FIGURE 54: LITERATURE SEARCH PROCESS

CRITERIA DEFINITION

In order to limit the amount of papers to include, a set of criteria needed to be defined. To accommodate for the difference in nature of the search engines the criteria were different for Google Scholar and Scopus. Google Scholar incorporates more sources and therefore generates more results. On the other hand Scopus only incorporates peer-reviewed literature, which ensures a certain quality of the results. Additionally, Scopus offers more advanced search refinement options. These differences were taken into account when the following criteria where formulated:
General Criteria:

- The material is from 2004 and later

Google Scholar specific criteria:

- Sorted by relevance
- Within first 30 results

Scopus specific criteria:

- Scope is "Title, Abstract & Keywords"
- Sorted by Citation Count
- Limited to exact keyword: "Enterprise Architecture"
- Within first 50 results

KEYWORDS

The identification of keywords for the search started with the central concepts of this thesis. These are derived from the research framework as discussed in Section 2.1. The following concepts are identified: "Contribution of enterprise architecture to organizations" and "activities of enterprise architecture". A thesaurus was used to generate an initial set of keywords to search for. The set of keywords was then expanded with each iteration by reviewing the keywords as used by the literature found so far. This resulted in the set of keywords presented in Table 27 (where the asterisk and question marks denote wildcards):

EA Contribution	EA Activities
"Enterprise Architecture" AND	**"Enterprise Architecture" AND**
contribution	*activit**
addition	*action?*
Improvement	*component?*
Increase	*factor*
value	*element*
worth	*part*
benefits	*function?*
Advantages	*operation?*
Gains	*task?*
Profits	*Process**
perks	*procedure?*
Concern?	*Step?*
Enabler?	*Management*
goal?	
Performance	
valuation	
effectiveness	
success	

TABLE 27: KEYWORDS AS USED IN LITERATURE SEARCH

RESULTS

The resulting set of literature that was found using the keywords above and which satisfied all criteria consists of 780 unique items of which 137 were considered relevant for inclusion in the review.

A.2 Activity Definitions

The literature review process as described in the previous section resulted in the sources in Table 28 to have been included in the definition of EA Activities.

Deloitte TTL, 2013	Deloitte TTL. (2013, May). Deloitte Enterprise Architecture Maturity Model (DEAMM) User Guide. Deloitte Touche Tohmatsu Limited.
Lapkin, 2008	Lapkin, A. (2008, April 15). Gartner Updates the Enterprise Architecture Activity Cycle. Gartner, Inc.
Luftman & Kempaiah, 2007	Luftman, J., & Kempaiah, R. (2007). An Update on Business-IT Alignment:“ A Line” Has Been Drawn (SAMM). MIS Quarterly Executive, 6(3).
NASCIO, 2003	NASCIO. (2003, December). NASCIO Enterprise Architecture Maturity Model (EAMM). National Association of State Chief Information Officers. Retrieved from http://www.nascio.org/publications/documents/NASCIO-EAMM.pdf
Nikpay et al., 2013	Nikpay, F., Selamat, H., Rouhani, B. D., & Nikfard, P. (2013). A Review of Critical Success Factors of Enterprise Architecture Implementation. In 2013 International Conference on Informatics and Creative Multimedia (ICICM) (pp. 38–42). Doi:10.1109/ICICM.2013.16
Radeke, 2011	Radeke, F. (2011). Toward Understanding Enterprise Architecture Management’s Role in Strategic Change: Antecedents, Processes, Outcomes. Wirtschaftsinformatik, 2011, 16.
Ross et al., 2006	Ross, J. W., Weill, P., & Robertson, D. C. (2006). Enterprise architecture as strategy: Creating a foundation for business execution. Harvard Business Press.
Schekkerman, 2006	Schekkerman, J. (2006). Extended Enterprise Architecture Maturity Model (E2AMM) Support Guide. Institute For Enterprise Architecture Developments.
Spewak & Hill, 1993	Spewak, S. H., & Hill, S. C. (1993). Enterprise architecture planning: developing a blueprint for data, applications and technology. QED Information Sciences, Inc.
The Open Group, 2011b	The Open Group. (2011b). TOGAF Version 9.1. U.S.: The Open Group.
US DoC, 2007	US DoC. (2007, December 10). ACMM Enterprise Architecture Capability Maturity Model (EACMM). United States Department of Commerce. Retrieved from http://ocio.os.doc.gov/ITPolicyandPrograms/Enterprise_Architecture/PROD01_004935

US GAO, 2010	US GAO. (2010, August). Organizational Transformation: A Framework for Assessing and Improving Enterprise Architecture Management (Version 2.0) (EAMMF). US Government Accountability Office. Retrieved from http://www.gao.gov/products/GAO-10-846G
van der Raadt & van Vliet, 2008	Van der Raadt, B., & van Vliet, H. (2008). Designing the enterprise architecture function. In Quality of Software Architectures. Models and Architectures (pp. 103–118).

TABLE 28: ACTIVITY DEFINITION SOURCE LIST

These sources were used to form the final list of activities as presented in this thesis in Section 2.2. The process to transform the various sources into a coherent set of activities is outlined below.

1. **Activity Description Extraction**
   The first step involved extracting activity descriptions from the literature identified in the literature review. This involved carefully reading the sources and evaluating whether the sources described aspects which could be classified as activities according to the definition as given in Section 2.2.1. This step resulted in a large set of individual activity descriptions.

2. **Compare and Contrast**
   The activity descriptions were compared and contrasted with each other to identify descriptions which essentially described the same activity. This resulted in a grouped version of the long list of activities.

3. **Synthesize into Initial List**
   The third step involved comparing and contrasting the identified groups in order to ensure that overlap was minimized. Whenever too much overlap was identified, the respective groups were split up and/or joined together. Finally, the groups were given names and definitions which represented the activity to which all group members essentially referred. This list of names and definitions represented the initial version of the activity definition list.

4. **Subject Matter Expert Validation**
   The initial list was discussed with an experienced EA expert at Deloitte Consulting. This resulted in the identification of points at which the initial list did not stroke with the experience of the subject matter expert. These points were addressed to create a second version of the activity definitions.

5. **Expert Group Validation**
   The second version was then validated by seven other EA experts at Deloitte. This resulted in minor modifications which were included to form the final list as presented in this thesis.

APPENDIX B EA ACTIVITY OVERVIEW

This appendix gives an overview of all activity categories along with their respective activities and scope levels. For more details about these activities refer to Section 2.2.2.

	Activity	Scope
EA Alignment	*Strategy Consultation*	Enterprise Level
		Segment Level
	Portfolio/Program Management Consultation	Enterprise Level
		Segment Level
	Investment and Procurement Consultation	Enterprise Level
		Segment Level

	Activity	Scope
EA Realization	*Architecture Project Consultation*	Project Level
	Compliancy Verification	Project Level
	Escalation, Exception and Change Management	Enterprise Level
		Segment Level
	Knowledge Management and Documentation	Enterprise Level
		Segment Level
		Project Level

	Activity	Scope
EA Development	*Baseline Architecture Development*	Enterprise Level
		Segment Level
	Target Architecture Development	Enterprise Level
		Segment Level
	Gap Analysis and Migration Planning	Enterprise Level
		Segment Level
	Solution Architecture Development	Project Level
	Requirements Engineering and Management	Enterprise Level
		Segment Level
		Project Level
	Definition and Management of Principles, Standards, Rules and Guidelines	Enterprise Level
		Segment Level
		Project Level

	Activity	Scope
EA Foundation	*Selection and Maintenance of Tools*	EA Level
	Recruitment and Development of Human Capital	EA Level
	Definition, Measurement and Evaluation of KPIs	EA Level
	EA Process Formalization and Documentation	EA Level
	Communication and Stakeholder Management	EA Level

APPENDIX C SCALE DEVELOPMENT DETAILS

This appendix describes in detail how the final measurement scale was developed and tested.

C.1 Process Overview

In order to ensure the final measurement scale is reliable and valid, the following steps were taken:

1. **Item Formulation (adoption, adaptation, self-formulation)**
   The measures for each construct had been previously identified in the measurement model. In order to achieve higher validity, two items were formulated for each of these measures. The items were adopted from existing scales wherever possible. If an item could not be adopted entirely, it was adapted to suit this scale. If that was not possible either, items were formulated based as much as possible on existing literature, in order to achieve formulation of items as close as possible to existing use of language and jargon.

2. **Subject Matter Expert Reviews**
   The first complete version of the scale was handed to five subject matter experts for review.

3. **Reformulation of Items**
   The feedback of the subject matter experts was incorporated to obtain a pilot-ready version of the scale. The scale can be found in Section C.2.1 of this appendix.

4. **Pilot Test #1**
   In order to assess the reliability and validity of the newly developed scale a pilot test was executed among EA experts at Deloitte Consulting. The results and assessments are elaborated in Section C.2 of this appendix.

5. **Reformulation of Items**
   The reliability and validity assessments of the first pilot test results provided evidence that not all measures were up to standard. This led to the reformulation, removal and addition of several items. These adaptations are presented in Section C.3 of this appendix.

6. **Subject Matter Expert Review**
   The revised items were handed to a subject matter expert for review.

7. **Reformulation of Items**
   Before a second pilot test was deployed, the feedback of the subject matter expert was incorporated in the items. The items marked with “new” in Section C.3 already contain the improvements based on the feedback of the subject matter expert.

8. **Pilot test #2**
   The second pilot test was also executed among EA experts of Deloitte Consulting. The results and assessments of this pilot test are elaborated in Section C.4 of this appendix.

9. **Final Questionnaire**
   All the steps above resulted in the final version of the questionnaire. This final version can be found in Section 4.2 in the main part of the thesis and for reasons of completeness also Section C.6 of this appendix.

C.2 Pilot Test #1

The first pilot test was held among EA experts of Deloitte Consulting. The pilot survey resulted in 14 responses. All responses were complete questionnaires: no data was missing.

The complete first questionnaire is included in the next section.

Before the questionnaire was tested for reliability and validity the polarity of the following items was reversed because of their formulation:

- 5.5
- 6.2
- 6.3
- 6.5

C.2.1 Reliability

The questionnaire was first tested for reliability. Details about reliability assessment are included in Section 4.3.1.

CRONBACH'S ALPHA

Cronbach's alpha values lower than 0,6 are considered insufficient and printed in italics.

EA Alignment

Item #	Question	Cronbach's Alpha
1.1	EA staff takes an active part in the development of the enterprise strategy.	*0.547*
1.4	There is active participation of EA staff in evaluating strategic business options.	

1.2	Company Program Management Office and Enterprise Architecture Office are working closely together.	0,619
1.5	EA staff participates in enterprise portfolio/program management.	

1.3	Our IT investments and acquisition strategy is based on the view of our EA staff	0,798
1.6	Capital planning and investment control are adjusted based on the feedback received and lessons learned from EA staff.	

EA Realization

2.1	EA staff guards the conformity of projects to relevant EA policies	0,665
2.4	EA staff reviews programs and/or projects on their compliance with the applicable target architectures, current architectures and EA policies.	

2.2	EA staff is involved in assessing the implications of allowing programs and projects that file the requests to deviate from a specific principle, rule, standard or guideline.	0,798
2.5	EA staff actively participates in a decision making process about how to put architectural plans such as blueprints, standards, rules, principles & guidelines into practice when issues are identified.	

2.3	Artefacts created in the architecture development process are catalogued and leveraged for governance meetings, updates, planning, strategy and budgeting process.	*0,544*
2.6	Efforts are ongoing to define a knowledge repository and to store architecture artefacts in that repository for re-use.	

EA Development

3.1	Baseline (as-is) architectures are developed and maintained by our EA staff.	0,778
3.7	EA staff is involved in describing baseline (as-is) architectures.	

3.2	Target (to-be) architectures is/are developed/maintained by our EA staff.	0,748
3.8	EA staff is involved in describing target (to-be) architectures.	

3.3	EA staff addresses how to move from the Baseline to the Target Architectures by creating transition architectures.	0,928
3.9	A roadmap for transition from baseline to target is being / has been developed by EA staff.	

3.4	EA staff develop architectures (i.e. the blueprint, not the actual implementation), in which various higher level architectures are synthesized into solutions that deliver capabilities to the enterprise.	0,739
3.10	EA staff creates architectures of future business operations/activities and how IS/IT supports those operations.	

3.5	Requirements for Enterprise Architecture and subsequent changes to those requirements are identified, stored, and fed into and out of the EA process.	0,970
3.11	EA staff frequently reconsiders requirements for Enterprise Architecture.	

3.6	My organization has a clear set of EA principles, rules, standards and guidelines.	0,967
3.12	EA staff identifies and establishes architecture principles, rules and guidelines to guide the architecture development and governance.	

EA Foundation

4.1	Sophisticated tools for EA development and documentation are available and are configured for optimal use.	0,728
4.6	All relevant stakeholders have access to sophisticated, correctly configured tools for EA development and documentation.	

4.2	EA staff is well trained to execute their tasks.	0,866
4.7	EA staff have clearly defined roles and are appropriately trained.	

4.3	Key metrics are defined and are tracked consistently using various tools and manual processes. They are used to optimize the EA function and decision making.	0,905
4.8	Metrics are used to measure the effectiveness of the EA function in the organization.	

4.4	EA processes and governance processes are well-established and in use throughout the organization.	*0,547*

4.9	Architecture development and governance processes are clearly defined and documented.	

4.5	A formal communication plan that encompasses different processes for managing communications exists and is used to distribute information, including EA architecture artefacts to the stakeholders	0,629
4.10	A communication plan is consistently updated and followed to drive the flow of the information throughout the organization.	

Organizational Alignment

5.1	Our decision making process has been effective in the past.	0,728
5.4	Our decision making process is well-established and easy to understand.	

5.2	Change initiatives in my organization are effective and in line with each other	*0,355*
5.5	The changes my organization implements in various parts of our business contradict the results of previous changes.	

5.3	Business plans in my organization always state explicitly what is needed from information systems.	0,738
5.6	IT plans in my organization always are based on corresponding business plans.	

Information Availability

5.7	The information available for decision making has sufficient breadth and depth.	0,824
5.10	The information available for decision making is sufficiently complete.	

5.8	Key business performance indicators extracted from IT systems are readily available to decision makers who require the information.	0,659
5.11	Data captured in one part of our organization are immediately available to everyone	

5.9	The information available for decision making is always correct.	0,932
5.12	The information available for decision making is always reliable.	

Resource Portfolio Optimization

6.1	Our organization has proven to be capable to make significant improvements in its IT landscape over the past few years	0,911
6.4	The IT landscape of my organization has been significantly improved recently in a reasonable amount of time	

6.2	It is likely that our business is negatively affected by missing knowledge if someone is fired or replaced.	0,654
6.5	Our firm has experienced a negative impact in performance due to replacement of personnel.	

6.3	Multiple groups in different lines of business are providing similar resources in our organization.	*-0,565**
6.6	My company has formally and sufficiently identified resources to be shared across lines of business.	

Resource Complementarity

6.7	My organization introduced product/service, process, organizational or marketing innovations by combining resources from different departments in the past few years.	0,866
6.10	My organization realized a better profit margin from realizing innovations by combining resources in new ways.	

6.8	Resources (human, IT, etc.) in my organization are successfully combined to create new opportunities and/or improvements.	0,787
6.11	In order to pursue strategic goals, resources in my organization are successfully (re)positioned to achieve synergies.	

*: Cronbach's alpha is negative due to negative average covariance. Investigation of the responses leads to the conclusion that either of the two questions is not interpreted as intended.

The Cronbach's alpha value of the following item pairs is considered insufficient (<0,6) and will be reformulated:

- 1.1 & 1.4
- 2.3 & 2.6
- 4.4 & 4.9
- 5.2 & 5.5
- 6.3 & 6.6

The reformulated items can be found in Section C.3 of this appendix.

VIF AND PCA

EA Alignment

	VIF	PCA Factor Loading
Portfolio/Program Management Consultation (PMC)	2,432	0,940
Investment and Procurement Consultation (IPC)	2,432	0,940

EA Realization

	VIF	PCA Factor Loading
Architecture Project Consultation (APC)	2,523	0,943
Escalation, Exception and Change Management (ECM)	2,523	0,943

EA Development

	VIF	PCA Factor Loading
Baseline Architecture Development (BAD)	1,803	0,674
Target Architecture Development (TAD)	1,888	0,626
Gap Analysis and Migration Planning (GMP)	2,579	0,744
Solution Architecture Development (SAD)	2,384	0,732
Requirements Engineering and Management (REM)	*3,322*	0,835
Definition and Management of Principles, Standards, Rules and Guidelines (SRG)	*3,858*	0,910

EA Foundation

	VIF	PCA Factor Loading
Selection and Maintenance of Tools (SMT)	1,798	0,797
Recruitment and Development of Human Capital (HC)	1,515	0,742
Definition, Measurement and Evaluation of KPIs (DMK)	2,110	0,805
Communication and Stakeholder Management (CSM)	2,667	0,881

Organizational Alignment

	VIF	PCA Factor Loading
Business and IT Alignment	1,611	0,899
Improved Decision Making	1,611	0,899

Information Availability

	VIF	PCA Factor Loading
Improved Information Accuracy	3,202	0,909
Improved Information Accessibility	1,260	0,684
Improved Information Completeness	*3,357*	0,924

Resource Portfolio Optimization

	VIF	PCA Factor Loading
Reduced Resource Replacement Risks	1,015	0,748
Improved IT Landscape	1,015	0,748

Resource Complementarity

	VIF	PCA Factor Loading
Support Innovation	*4,753*	0,972
Identification and Realization of Synergies	*4,753*	0,972

As is described in Petter, Straub, & Rai (2007), when VIF values are higher than or equivalent to 3,3 it is up for the researcher to decide between the following options:

> *" 1) Model construct as having both formative and reflective measurement items*
> *2) Remove correlated items if content validity is not affected*
> *3) Collapse correlated items into a composite index*
> *4) Convert into a multidimensional construct*
> *"* (Petter et al., 2007)

The following sections will discuss each case which concerns measures with a VIF value higher than or equivalent to 3,3.

EA Development

- Requirements Engineering and Management (VIF: 3,322)
- Definition and Management of Principles, Standards, Rules and Guidelines (VIF: 3,858)

The multicollinearity of these items with the other items of EA Development can be explained using theory. Most other activities of this construct (such as "Baseline Architecture Development", "Target Architecture Development" etc.) require the formation of principles and the management of requirements. It is therefore likely that when respondents agree on statements relating to the development of architecture prints they also agree on statements regarding the measures above. This is possible to have caused the multicollinearity in the measures.

The first option of Petter, Straub, & Rai (2007) as described above is not applicable since the causality of reflective measures is the inverse of the case presented here. This does not allow us

to model the above two measures as reflective measures. The second option is also not applicable since content validity would be compromised too severely. Removing these two measures would result in ignoring two aspects which are mentioned in various sources as being an integral part of EA (refer to Section 2.2.2 of the literature review for details). The third option is not applicable since the measures concern conceptually different aspects of EA. The fourth option is not applicable since these two are already dimensions of a multidimensional construct. Splitting them up into multidimensional constructs would create a third order model and would thereby compromise the parsimony severely.

The previous two sections led to the conclusion that none of the options as mentioned in Petter et al. (2007) is applicable. Since the VIF values are still far below 5, which is generally considered as the threshold for multicollinearity (Petter et al., 2007), and only slightly above 3,3, which is considered the threshold for multicollinearity in case of formative items, combined with the fact that the multicollinearity can be explained theoretically, the items are kept as they are.

Information Availability

- Improved Information Completeness (VIF: 3,357)

The multicollinearity of this measure with the other measures of Information Availability is likely to be caused by the similarly formulated items for Information Completeness and those of Information Accuracy. Therefore a variant of option 2 is chosen: the item is removed and a reformulated version is added and retested in the second pilot study.

Resource Complementarity

- Support Innovation (4,753)
- Identification and Realization of Synergies (4,753)

The multicollinearity of these two items combined with the fact that "Identifying & Realizing Synergies" is listed as an indirect antecedent of "Support Innovation" in the underlying model of Resource Complementarity in Figure 15 on page 25, have led to the choice for option 2: remove the Support Innovation measure.

C.2.2 Validity

Details about validity assessment techniques used in this thesis can be found in Section 4.3.2.

Content validity of the questionnaire is assessed by five subject matter experts. Their feedback resulted in the addition of one new item pair. This item pair is presented in Section C.3 of this appendix.

Construct validity is assessed by verifying that factor loadings of the principal components analysis of each construct are significant (>0,5). The tables in the previous section indicate that no factor loading was insignificant.

C.3 Adaptations after Pilot Test #1

The reliability and validity assessments as described above have resulted in the following adaptations. Motivation for these adaptations is included in the mentioned assessments in the previous sections.

C.3.1 Reformulated

Old 1.1 & 1.4: Cronbach's alpha too low (0,547)

Item Number	Question
1.1	EA staff takes an active part in the development of the enterprise strategy.

1.4	There is active participation of EA staff in evaluating strategic business options.

New 1.1 & 1.4:

1.1	EA staff takes an active role in the development and adjustment of the enterprise strategy.
1.4	For strategic decisions input of EA staff is taken into account.

Old 2.2: Sentence is too complex

2.2	EA staff is involved in assessing the implications of allowing programs and projects that file the requests to deviate from a specific principle, rule, standard or guideline.

New 2.2

2.2	EA staff is involved in assessing the impact of deviations from a specific principle, rule, standard or guideline by programs or projects.

Old 2.3 & 2.6: Cronbach's alpha too low (0,544)

2.3	Artefacts created in the architecture development process are catalogued and leveraged for governance meetings, updates, planning, strategy and budgeting process.
2.6	Efforts are ongoing to define a knowledge repository and to store architecture artefacts in that repository for re-use.

New 2.3 & 2.6

2.3	Artefacts created in the architecture development process are catalogued for future reference.
2.6	Architecture artefacts are stored in a knowledge repository for re-use.

Old 4.4 & 4.9: Cronbach's alpha too low (0,547)

4.4	EA processes and governance processes are well-established and in use throughout the organization.
4.9	Architecture development and governance processes are clearly defined and documented.

New 4.4 & 4.9:

4.4	EA processes are formalized and stored in some form of knowledge repository.
4.9	Architecture development and governance processes are clearly defined and documented.

Old 5.2 & 5.5: Cronbach's alpha too low (0,355)

5.2	Change initiatives in my organization are effective and in line with each other
5.5	The changes my organization implements in various parts of our business contradict the results of previous changes.

New 5.2 & 5.5:

5.2	Change initiatives in my organization are effective and in line with each other.
5.5	The changes my organization implements in various parts of our business complement the results of other changes being made.

Old 5.7 & 5.10: VIF value too high (3,357)

5.7	The information available for decision making has sufficient breadth and depth.
5.10	The information available for decision making is sufficiently complete.

New 5.7 & 5.10, based on (Lee et al., 2002):

5.7	The information available for decision making contains all the necessary data.
5.10	The information available for decision making is sufficiently complete.

Old 6.3 & 6.6: Negative Cronbach's alpha (-0,565)

6.3	Multiple groups in different lines of business are providing similar resources in our organization.
6.6	My company has formally and sufficiently identified resources to be shared across lines of business.

New 6.3 & 6.6:

6.3	There are no redundant resources in our organization.
6.6	My company has sufficiently identified resources to be shared.

H.1.1 **Removed**

6.7 & 6.10: VIF value too high (4,753)

6.7	My organization introduced product/service, process, organizational or marketing innovations by combining resources from different departments in the past few years.
6.10	My organization realized a better profit margin from realizing innovations by combining resources in new ways.

H.1.2 **Added**

These two items are added as a result of feedback received on content validity. They belong to the "Architecture Project Consultation" measure of "EA Realization". A subject matter expert noticed this measure was missing.

2.X	EA staff provides advice in the start-up phase and during the rest of the lifetime of projects.	(van der Raadt & van Vliet, 2008)
2.X	EA staff offers guidance to projects before and after the start of a project.	

C.4 Pilot Test #2

The second pilot test was also held among EA experts of Deloitte Consulting. The pilot survey resulted in 11 responses. All responses were complete questionnaires: no data was missing.

The complete second pilot questionnaire is included in the next section.

C.4.1 Reliability

The questionnaire was first tested for reliability. Details about reliability assessment are included in Section 4.3.1.

CRONBACH'S ALPHA

Cronbach's alpha values lower than 0,6 are considered insufficient and printed in italics.

Item Number	Question	Cronbach's Alpha
1.1	EA staff takes an active role in the development and adjustment of the enterprise strategy.	0,769
1.4	For strategic decisions input of EA staff is taken into account.	
2.2	EA staff is involved in assessing the impact of deviations from a specific principle, rule, standard or guideline by programs or projects.	0,826
2.5	EA staff actively participates in a decision making process about how to put architectural plans such as blueprints, standards, rules, principles & guidelines into practice when issues are identified.	
2.3	Artefacts created in the architecture development process are catalogued for future reference.	*0,426*
2.6	Architecture artefacts are stored in a knowledge repository for re-use.	
4.4	EA processes are formalized and stored in some form of knowledge repository.	0,823
4.9	Architecture development and governance processes are clearly defined and documented.	
5.2	Change initiatives in my organization are effective and in line with each other.	0,716
5.5	The changes my organization implements in various parts of our business complement the results of other changes being made.	
5.7	The information available for decision making contains all the necessary data.	0,873
5.10	The information available for decision making is sufficiently complete.	
6.3	There are no redundant resources in our organization.	0,707
6.6	My company has sufficiently identified resources to be shared.	
2.X	EA staff provides advice in the start-up phase and during the rest of the lifetime of projects.	0,932

2.XX	EA staff offers guidance to projects before and after the start of a project.	

All Cronbach's Alpha values are above 0,6 except items 2.3 & 2.6. The answers to those questions were investigated with a subject matter expert in order to explain why respondents interpreted these two items differently. Analysis revealed that respondents tended to give item 2.3 higher scores than item 2.6. Together with the subject matter expert it was decided to remove item 2.6 as it is probable that the formulation of that item is more specific than intended. The word "re-use" may imply that the organization actively finds new uses for existing knowledge. While the formulation of item 2.3 is more generic by using the words "for future reference". This does not necessarily entail that existing knowledge is used repeatedly; existing knowledge is merely being "referred to". Such more generic formulation may explain why respondents tend to score item 2.3 higher than the more strictly formulated item 2.6. On the basis of this analysis it was decided to keep item 2.3, as this comes closer to the intended construct of "Knowledge Management & Documentation".

VIF AND PCA

EA Alignment

	Items	VIF	PCA Factor Loadings
Strategy Consultation (SC)	1.1 & 1.4	1,507	0,982
Portfolio/Program Management Consultation (PMC)	1.2 & 1.5	2,333	0,906
Investment and Procurement Consultation (IPC)	1.3 & 1.6	2,318	0,898

EA Realization

	Items	VIF	PCA Factor Loadings
Architecture Project Consultation (APC)	2.X & 2.XX	2,698	0,882
Compliancy Verification	2.1 & 2.4	*9,216*	0,958
Escalation, Exception and Change Management (ECM)	2.2 & 2.5	*5,919*	0,880
Knowledge Management & Documentation (KMD)	2.3	*3,470*	0,818

EA Development

	Items	VIF	PCA Factor Loadings
Baseline Architecture Development (BAD)	3.1 & 3.7	1,803	0,674
Target Architecture Development (TAD)	3.2 & 3.8	1,888	0,626
Gap Analysis and Migration Planning (GMP)	3.3 & 3.9	2,579	0,744
Solution Architecture Development (SAD)	3.4 & 3.10	2,384	0,732
Requirements Engineering and Management (REM)	3.5 & 3.11	*3,322*	0,835
Definition and Management of Principles, Standards, Rules and Guidelines (SRG)	3.6 & 3.12	*3,858*	0,910

EA Foundation

	Items	VIF	PCA Factor Loadings
Selection and Maintenance of Tools (SMT)	4.1 & 4.6	1,942	0,705
Recruitment and Development of Human Capital (HC)	4.2 & 4.7	2,666	0,860
Definition, Measurement and Evaluation of KPIs (DMK)	4.3 & 4.8	2,549	0,848
EA Process Formalization and Documentation (PFD)	4.4 & 4.9	1,400	0,504
Communication and Stakeholder Management (CSM)	4.5 & 4.10	*4,545*	0,905

Organizational Alignment

	Items	VIF	PCA Factor Loadings
Business and IT Alignment	5.3 & 5.6	2,065	0,926
Coherent and Consistent Organizational Change	5.2 & 5.5	1,003	0,097
Improved Decision Making	5.1 & 5.4	2,062	0,924

Information Availability

	Items	VIF	PCA Factor Loadings
Improved Information Accessibility	5.8 & 5.11	1,747	0,875
Improved Information Accuracy	5.9 & 5.12	1,726	0,866
Improved Information Completeness	5.7 & 5.10	1,073	0,520

Resource Portfolio Optimization

	Items	VIF	PCA Factor Loadings
Removal, Unification and Integration of Redundant and Suboptimal Resources	6.3 & 6.6	1,076	0,853
Reduced Resource Replacement Risks	6.2 & 6.5	1,146	0,691
Improved IT Landscape	6.1 & 6.4	1,202	0,855

Resource Complementarity

	Items	VIF	PCA Factor Loadings
Identification and Realization of Synergies	6.8 & 6.11	1,00	N.A.*

* PCA is not possible on a single measure

All cases where VIF values are higher than 3,3 will be discussed below.

EA Realization

The VIF values of EA Realization are far above the generally accepted threshold of 3,3. As described in Petter et al. (2007), in such a scenario the researcher can decide to remove an item if content validity is not harmed. Further investigation of the data revealed that item 2.1 caused the high VIF values. Removing item 2.1 gives the following VIF values and item weights:

	Items	VIF	PCA Item Weights
Architecture Project Consultation (APC)	2.X & 2.XX	2,727	0,862
Compliancy Verification (CV)	2.4	*2,387*	0,840

Escalation, Exception and Change Management (ECM)	2.2 & 2.5	*2,707*	0,827
Knowledge Management and Documentation (KMD)	2.3	*2,460*	0,854

Content validity is not compromised by removing item 2.1 since this item was only included as a double check for item 2.4 (and vice-versa). Item 2.4 still measures the Compliancy Checks component of the EA Realization construct. All components of EA Realization are therefore still accounted for in the remaining items. Item 2.1 can therefore be safely removed.

EA Development
The EA Development items have not changed after Pilot Test #1. The reasons why the VIF values are higher than 3,3 and yet the items remain unchanged are stated in Section C.2 *Pilot Test #1*. In short:

1. theory can explain why multicollinearity of these items is to be expected
2. the values are only slightly above 3,3 and still well below 5
3. content validity dictates that both constructs are addressed

The items are kept as they are after Pilot Test #2 for the same reasons.

EA Foundation
The VIF values of the *Communication and Stakeholder Management* items are unacceptably high: 4,545. Further investigation of the EA Foundation items reveals that this inflation is caused by items 4.8 and 4.5. This can be seen in the table below, where these two items have been removed and VIF values are re-calculated. As mentioned before, if content validity is not harmed items can be safely removed. In this case the same argument holds as for item 2.1 of EA Realization. Both item 4.8 and item 4.5 are mere doubles of other items. Removing them does not result in an unmeasured construct. Hence these items are removed after this pilot test.

	Items	VIF	PCA Item Weights
Selection and Maintenance of Tools (SMT)	4.1 & 4.6	1,675	0,662
Recruitment and Development of Human Capital (HC)	4.2 & 4.7	2,166	0,848
Definition, Measurement and Evaluation of KPIs (DMK)	4.3	1,646	0,865
EA Process Formalization and Documentation (PFD)	4.4 & 4.9	2,914	0,698
Communication and Stakeholder Management (CSM)	4.10	*2,684*	0,822

C.4.2 Validity

Content validity assessments of subject matter experts did not result in any changes in the questionnaire.

Construct validity was again assessed by verifying that all factor loadings of a principal component analysis were significant (>0,5). The factor loadings can be found in the tables of the previous section. All measures are significant except *Coherent and Consistent Organizational Change* (items 5.2 & 5.5). As Petter et al. (2007) describe, a researcher has two options when factor loadings are insignificant. Remove the item or keep the item to preserve content validity. In this case the latter option is chosen. *Coherent and Consistent Organizational Change* is an essential part of the Organizational Alignment Benefit Enabler and can therefore not be removed.

C.5 Adaptations after Pilot Test #2

The reliability and validity assessments as described above have resulted in the following adaptations. Motivation for these adaptations is included in the mentioned assessments in the previous sections.

C.5.1 Removed

Item 2.6: Cronbach's Alpha too low (0,426)

2.3	Artefacts created in the architecture development process are catalogued for future reference.
2.6	Architecture artefacts are stored in a knowledge repository for re-use.

Item 2.1: VIF value too high (9,216)

2.1	EA staff guards the conformity of projects to relevant EA policies

Item 4.5: VIF value too high (4,545)

4.5	A formal communication plan that encompasses different processes for managing communications exists and is used to distribute information, including EA architecture artefacts to the stakeholders

Item 4.8: Strongly inflates multicollinearity among other EA Foundation measures.

4.8	Metrics are used to measure the effectiveness of the EA function in the organization.

C.6 Final Questionnaire

This section presents the complete final version of the questionnaire in Table 29 to Table 38. This version is identical to the version in Section 4.2 of the main part of this thesis. It has been included in this appendix to provide a complete overview of the scale development process: from initial to final version.

SCOPE

Item #	Items	Answer Options
0.1	What is the scope of the majority of EA activities in your organisation?	• *Enterprise Wide* • *Segment Wide (i.e. a program, a business unit, a department)* • *Project Wide*
0.2	What does your organization consider to be part of EA? Please select all that apply.	• Business (Processes, Products/Services) • Information (Data) • Application • Technical (Technology, Infrastructure, Platforms, Middleware)

TABLE 29: ITEMS IN FINAL QUESTIONNAIRE TO DETERMINE SCOPE

EA ALIGNMENT

Item #	Items	Sources
1	EA staff takes an active role in the development and adjustment of the enterprise strategy.	Lapkin (2008)
2	For strategic decisions input of EA staff is taken into account.	Radeke (2011)
3	Company Program Management Office and Enterprise Architecture Office are working closely together.	Schekkerman (2006)
4	EA staff participates in enterprise portfolio/program management.	None
5	Our IT investments and acquisition strategy is based on the view of our EA staff	Roest (2014)
6	Capital planning and investment control are adjusted based on the feedback received and lessons learned from EA staff.	US GAO (2010)

TABLE 30: ITEMS IN FINAL QUESTIONNAIRE FOR EA ALIGNMENT

EA REALIZATION

Item #	Items	Sources
7	EA staff provides advice in the start-up phase and during the rest of the lifetime of projects.	(van der Raadt & van Vliet, 2008)
8	EA staff offers guidance to projects before and after the start of a project.	None
9	EA staff reviews programs and/or projects on their compliance with the applicable target architectures, current architectures and EA policies.	Van der Raadt and van Vliet (2008)
10	EA staff is involved in assessing the impact of deviations from a specific principle, rule, standard or guideline by programs or projects.	Van der Raadt and van Vliet (2008)
11	EA staff actively participates in a decision making process about how to put architectural plans such as blueprints, standards, rules, principles & guidelines into practice when issues are identified.	Van der Raadt et al. (2008)
12	Artefacts created in the architecture development process are catalogued for future reference.	Deloitte TTL (2013)

TABLE 31: ITEMS IN FINAL QUESTIONNAIRE FOR EA REALIZATION

EA DEVELOPMENT

Item #	Items	Sources
13	Baseline (as-is) architectures are developed and maintained by our EA staff.	Deloitte TTL (2013)
14	EA staff is involved in describing baseline (as-is) architectures.	Deloitte TTL (2013)
15	Target (to-be) architectures is/are developed/maintained by our EA staff.	Deloitte TTL (2013)
16	EA staff is involved in describing target (to-be) architectures.	Deloitte TTL (2013)
17	EA staff addresses how to move from the Baseline to the Target Architectures by creating transition architectures.	The Open Group (2011b)
18	A roadmap for transition from baseline to target is being / has been developed by EA staff.	The Open Group (2011b)
19	EA staff develop architectures (i.e. the blueprint, not the actual implementation), in which various higher level architectures are	Lapkin (2008)

	synthesized into solutions that deliver capabilities to the enterprise.	
20	EA staff creates architectures of future business operations/activities and how IS/IT supports those operations.	The Open Group (2011b)
21	Requirements for Enterprise Architecture and subsequent changes to those requirements are identified, stored, and fed into and out of the EA process.	The Open Group (2011b)
22	EA staff frequently reconsiders requirements for Enterprise Architecture.	Schekkerman (2006)
23	My organization has a clear set of EA principles, rules, standards and guidelines.	Roest (2014)
24	EA staff identifies and establishes architecture principles, rules and guidelines to guide the architecture development and governance.	The Open Group (2011b)

TABLE 32: ITEMS IN FINAL QUESTIONNAIRE FOR EA DEVELOPMENT

EA FOUNDATION

Item #	Items	Sources
25	Sophisticated tools for EA development and documentation are available and are configured for optimal use.	Deloitte TTL (2013)
26	All relevant stakeholders have access to sophisticated, correctly configured tools for EA development and documentation.	Deloitte TTL (2013)
27	EA staff is well trained to execute their tasks.	Deloitte TTL (2013)
28	EA staff have clearly defined roles and are appropriately trained.	Deloitte TTL (2013)
29	Key metrics are defined and are tracked consistently using various tools and manual processes. They are used to optimize the EA function and decision making.	Deloitte TTL (2013)
30	EA processes are formalized and stored in some form of knowledge repository.	Deloitte TTL (2013)
31	Architecture development and governance processes are clearly defined and documented.	Deloitte TTL (2013)
32	A communication plan is consistently updated and followed to drive the flow of the information throughout the organization.	Deloitte TTL (2013)

TABLE 33: ITEMS IN FINAL QUESTIONNAIRE FOR EA FOUNDATION

ORGANIZATIONAL ALIGNMENT

Item #	Items	Sources
33	Our decision making process has been effective in the past.	Roest (2014)
34	Our decision making process is well-established and easy to understand.	Roest (2014)
35	Change initiatives in my organization are effective and in line with each other.	None
36	The changes my organization implements in various parts of our business complement the results of other changes being made.	None
37	Business plans in my organization always state explicitly what is needed from information systems.	Reich & Benbasat (1996)
38	IT plans in my organization are always based on corresponding business plans.	Reich & Benbasat (1996)

TABLE 34: ITEMS IN FINAL QUESTIONNAIRE FOR ORGANIZATIONAL ALIGNMENT

INFORMATION AVAILABILITY

Item #	Items	Sources
39	The information available for decision making contains all the necessary data.	Lee et al. (2002)
40	The information available for decision making is sufficiently complete.	Lee et al. (2002)
41	Key business performance indicators extracted from IT systems are readily available to decision makers who require the information.	Boh & Yellin (2007)
42	Data captured in one part of our organization are immediately available to everyone.	Byrd & Turner (2001)
43	The information available for decision making is always correct.	Lee et al. (2002)
44	The information available for decision making is always reliable.	Lee et al. (2002)

TABLE 35: ITEMS IN FINAL QUESTIONNAIRE FOR INFORMATION AVAILABILITY

RESOURCE PORTFOLIO OPTIMIZATION

Item #	Items	Sources
45	Our organization has proven to be capable to make significant improvements in its IT landscape over the past few years.	None
46	The IT landscape of my organization has been significantly improved recently in a reasonable amount of time.	None
47	It is likely that our business is negatively affected by missing knowledge if someone is fired or replaced.	Weber, Blais & Betz (2002)
48	Our firm has experienced a negative impact in performance due to replacement of personnel.	Wagner & Bode (2008)
49	There are no redundant resources in our organization.	Boh & Yellin (2007)
50	My company has sufficiently identified resources to be shared.	Boh & Yellin (2007)

TABLE 36: ITEMS IN FINAL QUESTIONNAIRE FOR RESOURCE PORTFOLIO OPTIMIZATION

RESOURCE COMPLEMENTARITY

Item #	Items	Sources
51	Resources (human, IT, etc.) in my organization are successfully combined to create new opportunities and/or improvements.	Tamm et al. (2011)
52	In order to pursue strategic goals, resources in my organization are successfully (re)positioned to achieve synergies.	Tamm et al. (2011)

TABLE 37: ITEMS IN FINAL QUESTIONNAIRE FOR RESOURCE COMPLEMENTARITY

GENERAL INFORMATION

Item #	Items	Answer Options
53	Name	
54	Organization Name	
55	Organizational Size	• Small (<50 Employees) • Medium (<250 Employees) • Large (>250 Employees)
56	Industry	• Consumer Business • Financial Services Industry • Manufacturing, Energy & Resources • Public Sector • Technology, Media & Telecommunications • Other: …
57	Job Title	
58	E-Mail	
59	I would like to receive a copy of the final research results	• Yes • No
60	I would like to participate in a round table session to discuss the results and gain more insight into this topic	• Yes • No
61	Remarks	

TABLE 38: ITEMS IN FINAL QUESTIONNAIRE FOR GENERAL INFORMATION

APPENDIX D REGRESSION ASSUMPTIONS

This appendix describes the assumptions which underpin the regression analyses used in this thesis. The assumptions are presented along with the tests used to assess assumption conformance and the corresponding results.

D.1 Assumptions Overview

This section presents an overview of all assumptions and the conformance of the data in this thesis. The assumptions presented in Table 39 must be checked when performing multiple regressions (Field, 2009).

Assumption	Description	Conformance
Variable types	All predictor variables must be quantitative or categorical (with two categories) and the dependent variables must be measured at interval level.	Yes. As explained in Chapter 4 *Measurement Instrument*, all variables are of the interval type.
Non-zero variance	Predictors should have variation in values: no variances of zero.	Yes. As can be seen in Table 17 in the standard deviation column: no values of zero are present.
No perfect multicollinearity	None of the predictors should be perfectly correlated with any other predictor	Yes. As can be seen in Table 17 in the left of the two VIF columns, no value is above five.[3]
Homoscedasticity	The variance of the residuals of the predictor variables should be constant. Residuals are the deviations between the observed values and the values as predicted by the regression model.	Yes. As can be seen in the tables of the sections below, all scatterplots are evenly distributed around zero.
Independent errors	The residuals must be uncorrelated for any two observations in the data.	Yes. As can be seen in the tables of the sections below, all Durbin-Watson values are between one and three.
Normally distributed errors	It is assumed that the residuals in the model are random, normally distributed and have mean of zero.	Yes. As can be seen in the tables of the sections below, all histograms are nearly normally distributed. There is also not too much deviation from the straight line in the P-P Plots.
Independence	All values of the outcome variables are independent.	Yes. All values are taken from different, unrelated respondents.

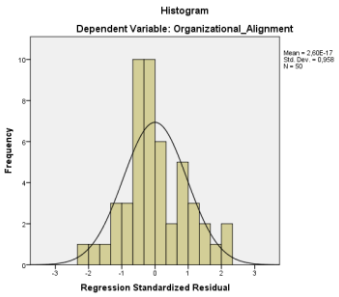
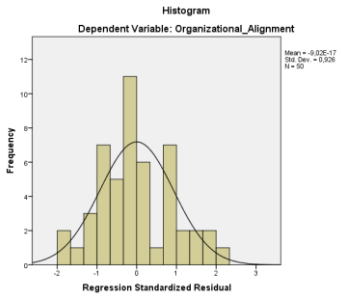
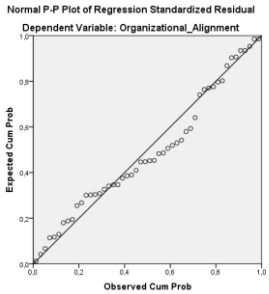
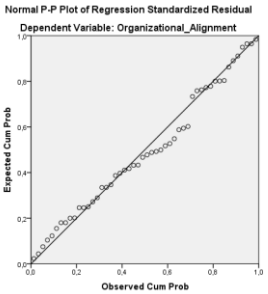
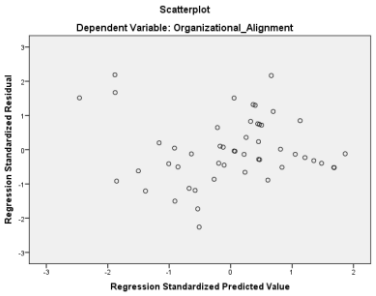
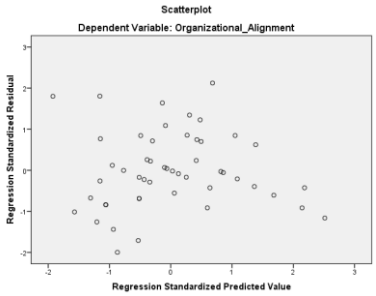
[3] Multicollinearity is likely to be present among variables if VIF values are above 5 (Diamantopoulos & Siguaw, 2006).

Linearity	The mean values of dependent variables lie in a straight line for each increment of predictor variables. In other words, it is assumed that the relationship between the predictor and outcome variables is linear.	Yes. As can be seen in the tables of the sections below, all scatterplots show points evenly distributed around zero, without having an obvious curved shape.

TABLE 39: REGRESSION ASSUMPTIONS OVERVIEW

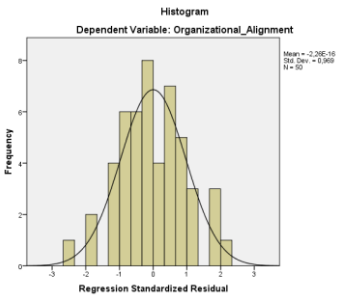
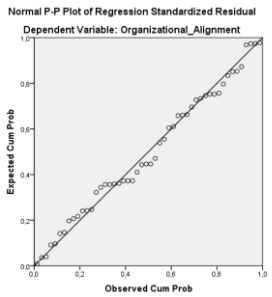
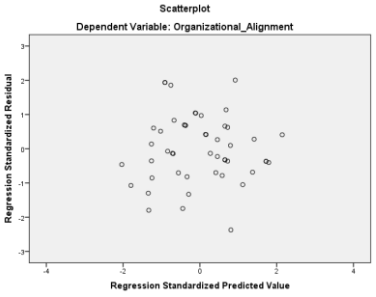
D.2 Dependent Variable: Organizational Alignment

Predictor variables: EA Alignment, EA Realization, EA Development and EA Foundation.

	Direct effects	Direct and Interaction effects
Durbin-Watson value	1,796	1,838
Histogram of Regression Standardized Residuals		
Normal P-P Plot of Regression Standardized Residuals		
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values		
Conformant	**Yes**	**Yes**

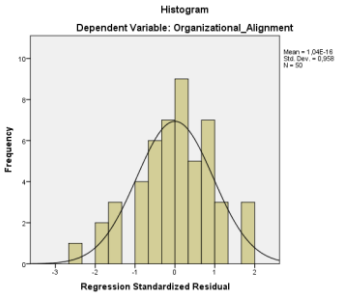
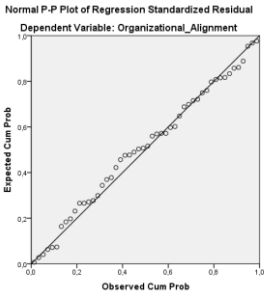
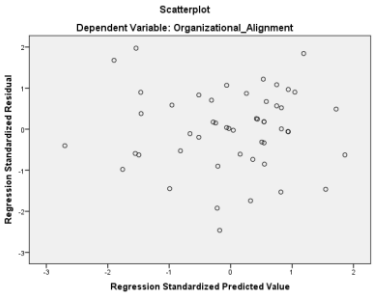
D.2.1 EA Alignment Predictors

Predictor variables: Strategy Consultation (SC), Portfolio/Program Management Consultation (PMC), Investment and Procurement Consultation (IPC)

	Direct effects
Durbin-Watson value	2,070
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

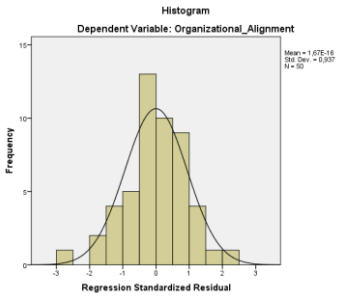
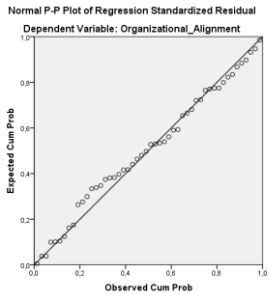
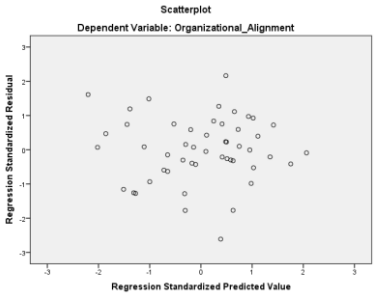
D.2.2 EA Realization Predictors

Predictor variables: Architecture Project Consultation (APC), Compliancy Verification (CV), Escalation, Exception and Change Management (ECM), Knowledge Management and Documentation (KMD)

	Direct effects
Durbin-Watson value	1,811
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

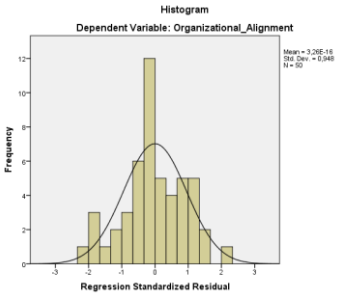
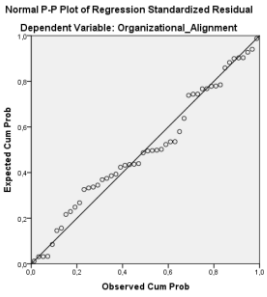
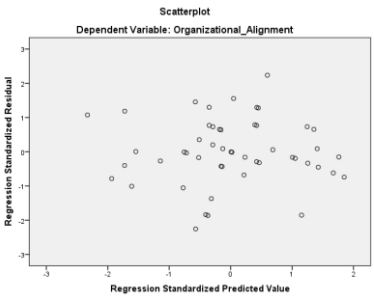
D.2.3 EA Development Predictors

Predictor variables: Baseline Architecture Development (BAD), Target Architecture Development (TAD), Gap Analysis and Migration Planning (GMP), Solution Architecture Development (SAD), Requirements Engineering and Management (REM), Definition and Management of Principles, Standards, Rules and Guidelines (SRG)

	Direct effects
Durbin-Watson value	2,055
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

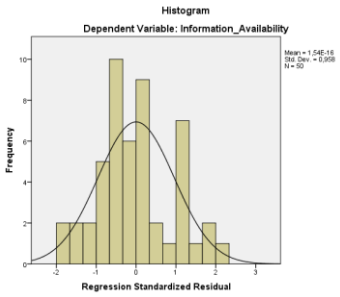
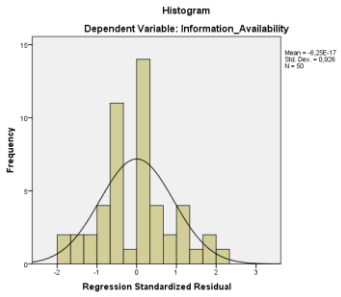
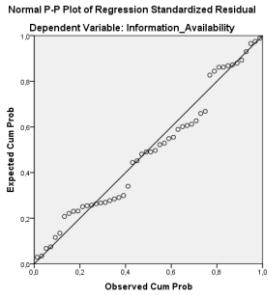
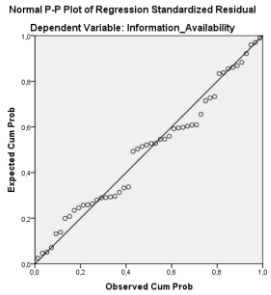
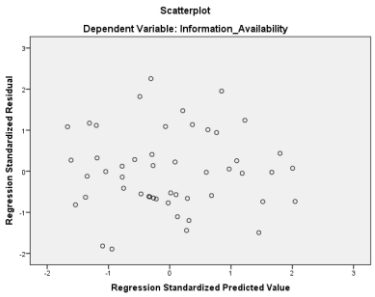
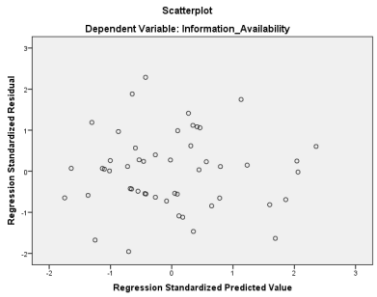
D.2.4 EA Foundation Predictors

Predictor variables: Selection and Maintenance of Tools (SMT), Recruitment and Development of Human Capital (HC), Definition, Measurement and Evaluation of KPIs (DMK), EA Process Formalization and Documentation (PFD), Communication and Stakeholder Management (CSM)

	Direct effects
Durbin-Watson value	2,011
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

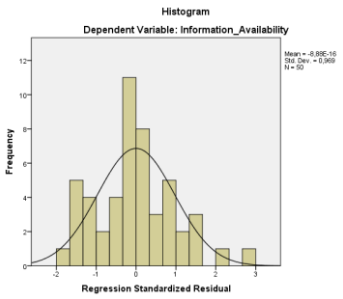
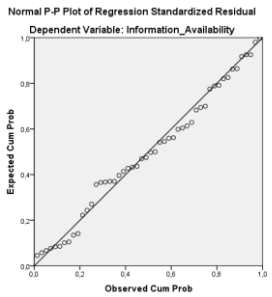
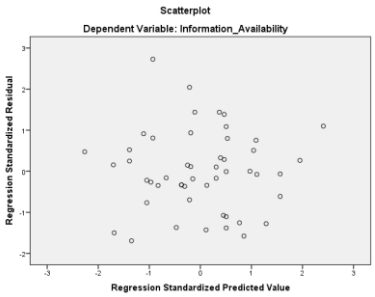
D.3 Dependent Variable: Information Availability

Predictor variables: EA Alignment, EA Realization, EA Development and EA Foundation.

	Direct effects	Direct and Interaction effects
Durbin-Watson value	1,641	1,804
Histogram of Regression Standardized Residuals		
Normal P-P Plot of Regression Standardized Residuals		
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values		
Conformant	**Yes**	**Yes**

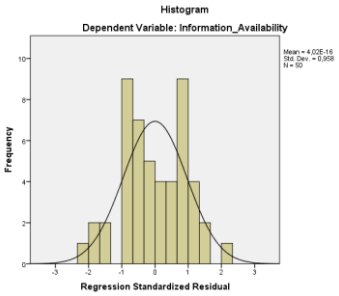
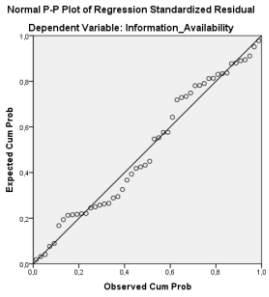
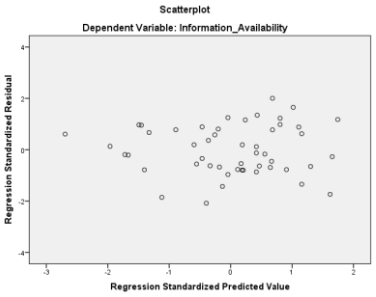
D.3.1 EA Alignment Predictors

Predictor variables: Strategy Consultation (SC), Portfolio/Program Management Consultation (PMC), Investment and Procurement Consultation (IPC)

	Direct effects
Durbin-Watson value	1,820
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

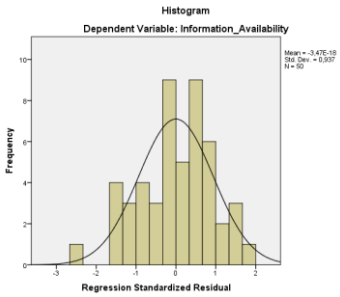
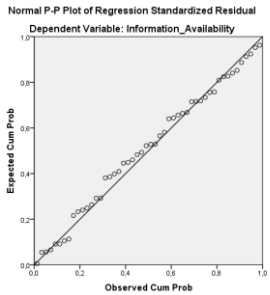
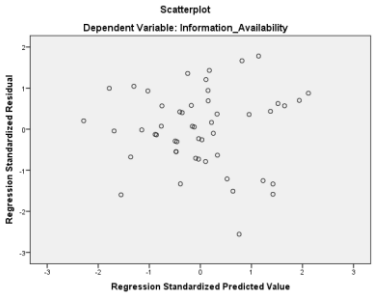
D.3.2 EA Realization Predictors

Predictor variables: Architecture Project Consultation (APC), Compliancy Verification (CV), Escalation, Exception and Change Management (ECM), Knowledge Management and Documentation (KMD)

	Direct effects
Durbin-Watson value	1,814
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

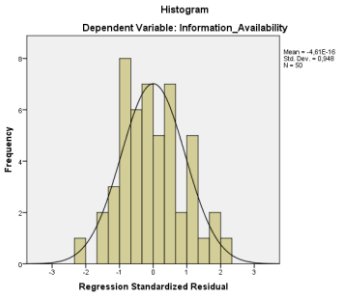
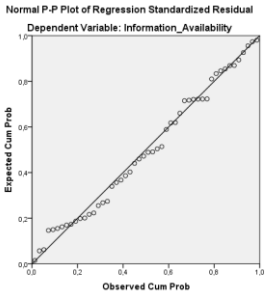
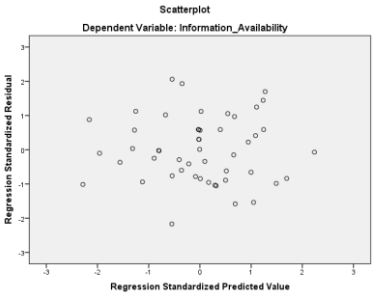
D.3.3 EA Development Predictors

Predictor variables: Baseline Architecture Development (BAD), Target Architecture Development (TAD), Gap Analysis and Migration Planning (GMP), Solution Architecture Development (SAD), Requirements Engineering and Management (REM), Definition and Management of Principles, Standards, Rules and Guidelines (SRG)

	Direct effects
Durbin-Watson value	1,948
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

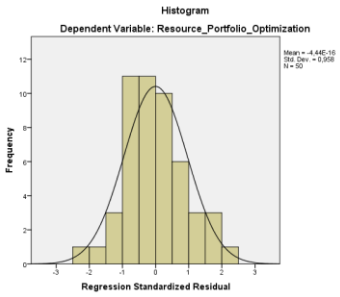
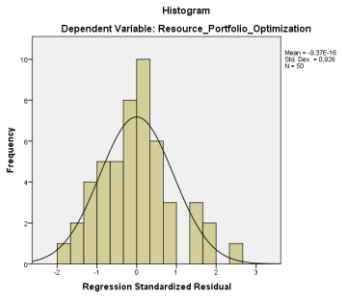
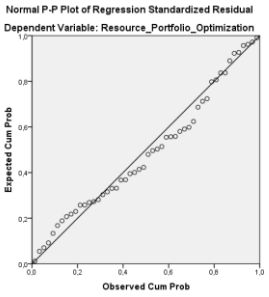
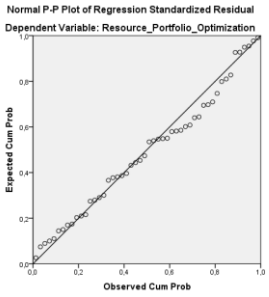
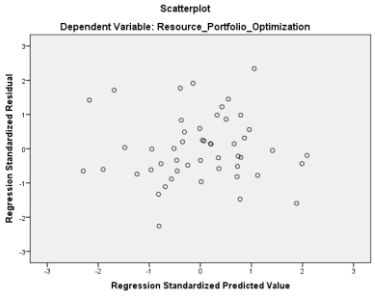
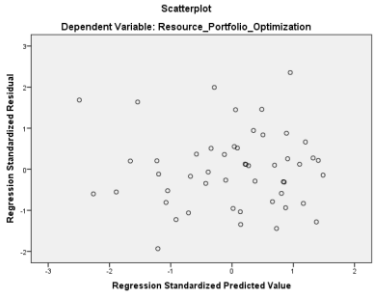
D.3.4 EA Foundation Predictors

Predictor variables: Selection and Maintenance of Tools (SMT), Recruitment and Development of Human Capital (HC), Definition, Measurement and Evaluation of KPIs (DMK), EA Process Formalization and Documentation (PFD), Communication and Stakeholder Management (CSM)

	Direct effects
Durbin-Watson value	1,995
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

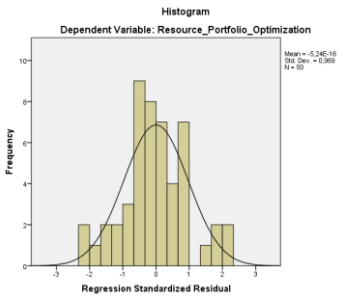
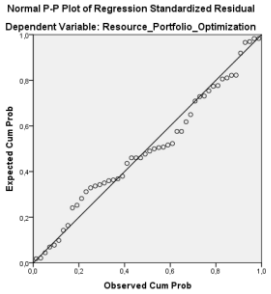
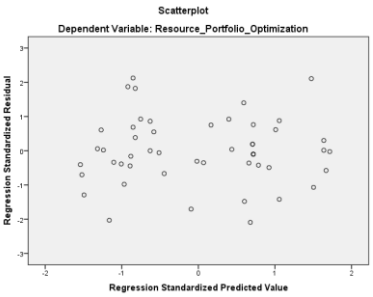
D.4 Dependent Variable: Resource Portfolio Optimization

Predictor variables: EA Alignment, EA Realization, EA Development and EA Foundation.

	Direct effects	Direct and Interaction effects
Durbin-Watson value	1,932	2,389
Histogram of Regression Standardized Residuals		
Normal P-P Plot of Regression Standardized Residuals		
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values		
Conformant	**Yes**	**Yes**

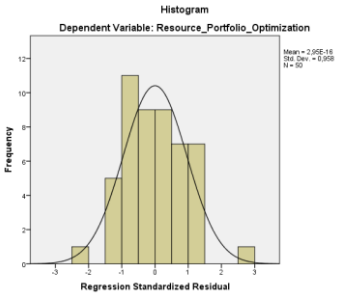
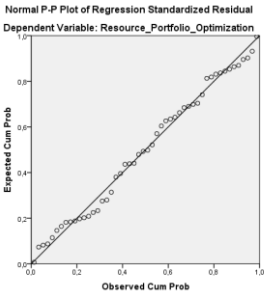
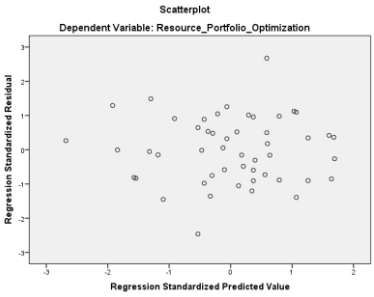
D.4.1 EA Alignment Predictors

Predictor variables: Strategy Consultation (SC), Portfolio/Program Management Consultation (PMC), Investment and Procurement Consultation (IPC)

	Direct effects
Durbin-Watson value	2,467
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

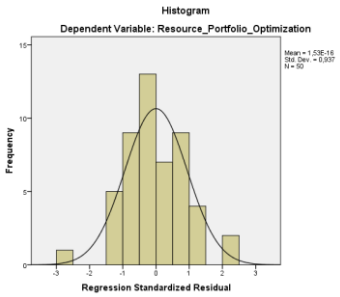
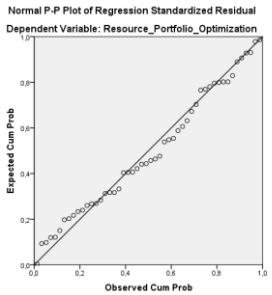
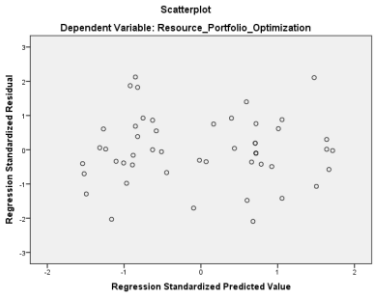
D.4.2 EA Realization Predictors

Predictor variables: Architecture Project Consultation (APC), Compliancy Verification (CV), Escalation, Exception and Change Management (ECM), Knowledge Management and Documentation (KMD)

	Direct effects
Durbin-Watson value	2,456
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

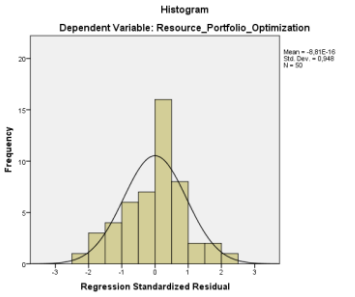
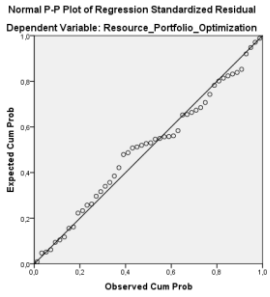
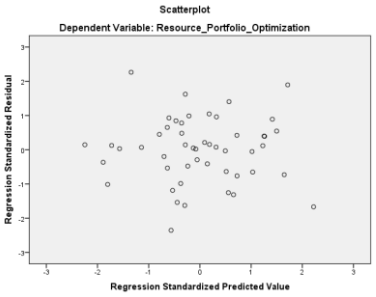
D.4.3 EA Development Predictors

Predictor variables: Baseline Architecture Development (BAD), Target Architecture Development (TAD), Gap Analysis and Migration Planning (GMP), Solution Architecture Development (SAD), Requirements Engineering and Management (REM), Definition and Management of Principles, Standards, Rules and Guidelines (SRG)

	Direct effects
Durbin-Watson value	2,540
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

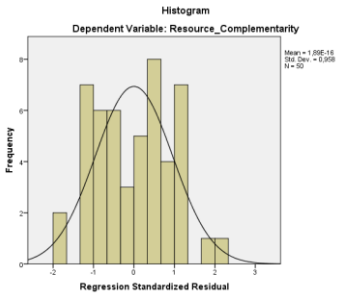
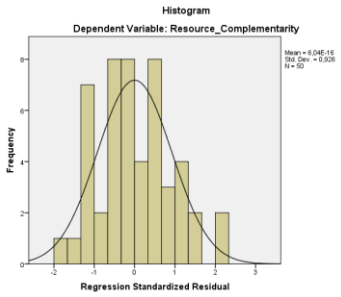
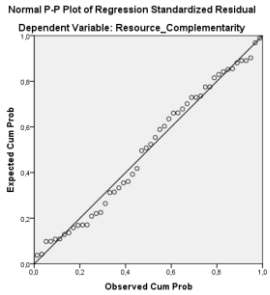
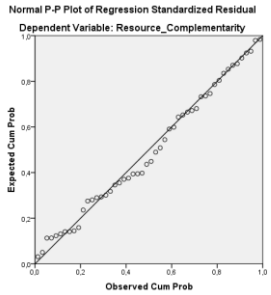
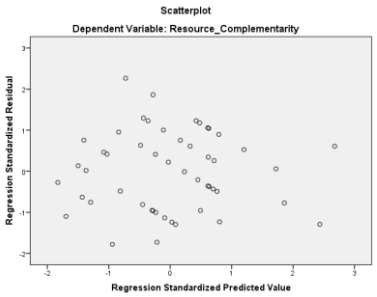
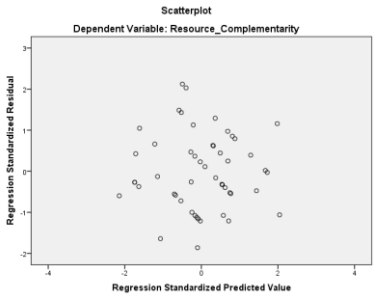
D.4.4 EA Foundation Predictors

Predictor variables: Selection and Maintenance of Tools (SMT), Recruitment and Development of Human Capital (HC), Definition, Measurement and Evaluation of KPIs (DMK), EA Process Formalization and Documentation (PFD), Communication and Stakeholder Management (CSM)

	Direct effects
Durbin-Watson value	2,658
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

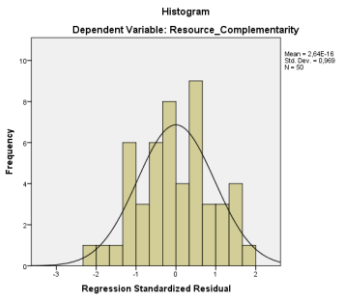
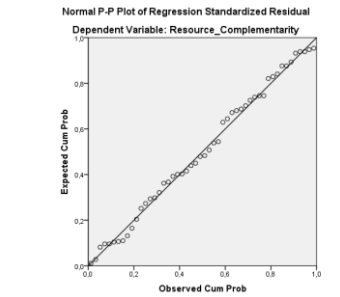
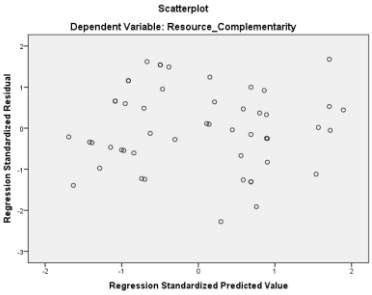
D.5 Dependent Variable: Resource Complementarity

Predictor variables: EA Alignment, EA Realization, EA Development and EA Foundation.

	Direct effects	Direct and Interaction effects
Durbin-Watson value	1,661	1,692
Histogram of Regression Standardized Residuals		
Normal P-P Plot of Regression Standardized Residuals		
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values		
Conformant	**Yes**	**Yes**

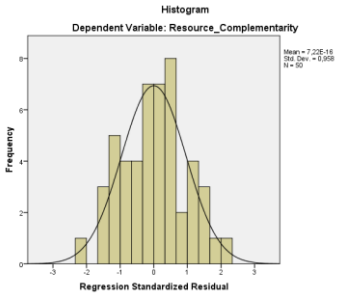
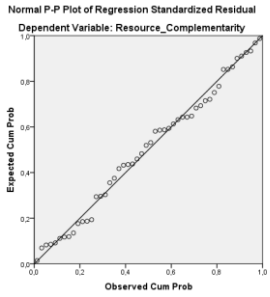
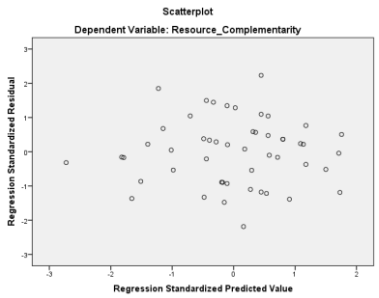
D.5.1 EA Alignment Predictors

Predictor variables: Strategy Consultation (SC), Portfolio/Program Management Consultation (PMC), Investment and Procurement Consultation (IPC)

	Direct effects
Durbin-Watson value	1,650
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

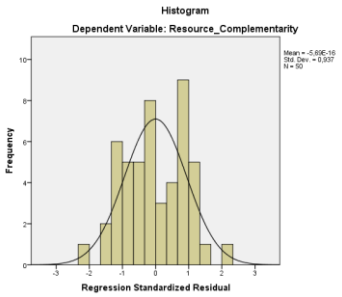
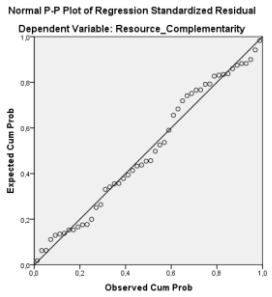
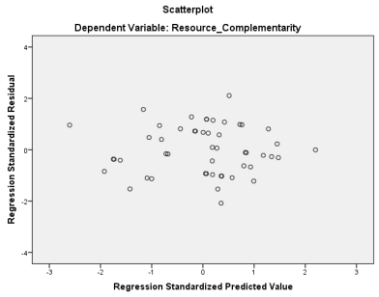
D.5.2 EA Realization Predictors

Predictor variables: Architecture Project Consultation (APC), Compliancy Verification (CV), Escalation, Exception and Change Management (ECM), Knowledge Management and Documentation (KMD)

	Direct effects
Durbin-Watson value	1,928
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

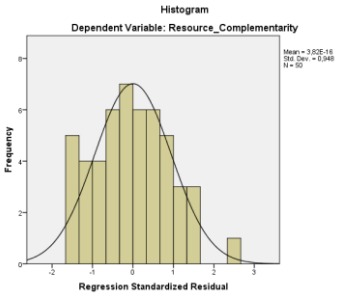
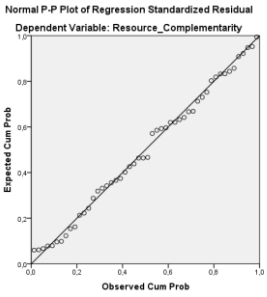
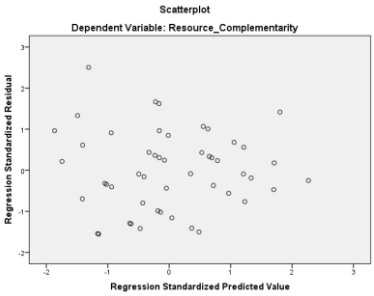
D.5.3 EA Development Predictors

Predictor variables: Baseline Architecture Development (BAD), Target Architecture Development (TAD), Gap Analysis and Migration Planning (GMP), Solution Architecture Development (SAD), Requirements Engineering and Management (REM), Definition and Management of Principles, Standards, Rules and Guidelines (SRG)

	Direct effects
Durbin-Watson value	1,818
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**

D.5.4 EA Foundation Predictors

Predictor variables: Selection and Maintenance of Tools (SMT), Recruitment and Development of Human Capital (HC), Definition, Measurement and Evaluation of KPIs (DMK), EA Process Formalization and Documentation (PFD), Communication and Stakeholder Management (CSM)

	Direct effects
Durbin-Watson value	1,912
Histogram of Regression Standardized Residuals	
Normal P-P Plot of Regression Standardized Residuals	
Scatterplot of Regression Standardized Residuals vs. Regression Standardized Predicted Values	
Conformant	**Yes**