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# Value of Enterprise Architecture for IT projects

THESIS FOR EXECUTIVE MASTER OF ENTERPRISE IT ARCHITECTURE

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# Value of Enterprise Architecture for IT projects

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# Abstract

As there is still little empirical evidence on the value of Enterprise Architecture (EA), we wanted to find a way to provide it. As the question of the value of EA is a very large question with numerous variables, we scoped our study to the value of Enterprise Architecture on IT projects. As a first time in history we used the project database of The Standish Group International Inc., containing data on more than 120,000 IT projects and associated organizations in order to explore the value of Enterprise Architecture on a large set of projects. We identified 28 organizations, which together had executed 3076 IT projects from 2007 to 2016, and had implemented an EA between 2011 and 2016. We compared the end results of projects done without EA to those done subjected to EA to see if EA has any effect. As the projects were done in the same organizations, this allowed us to get a good before & after picture. In this study, we've found strong indications for the value of Enterprise Architecture on IT projects, as we saw noticeable improvements in projects done after the implementation of EA compared to projects done before EA. This dissertation concludes with a discussion of a number of potential avenues for future research, which could build on the findings of this study.

# Preface

Already in the first year of the programme of Executive Master of Enterprise IT Architecture at the Antwerp Management School I knew I wanted to investigate the value of Enterprise Architecture. This was sparked by the mention of the lack of empirical evidence in the book 'Enterprise Architecture' by Op't Land et al. we received as a one of the handbooks for the programme. By the time we had to start with the Master's thesis I was discouraged by the grand scope of this question and couldn't find a decent approach, at least not for the timespan of a Master's thesis.

At the time I was doing a lot of presales, and thus creating a lot of bids, at the company I worked for (Realdolmen) and thought that some things in the bid management process could be optimized. So my first attempt for a thesis was on the subject of the optimization of bid management at Realdolmen with DEMO. Unfortunately (or maybe fortunately I can say now) during a company reorganization bid management was completely rearranged, and most parts were dissolved. This meant that lots of the work I had done was in vain, and I wasn't able to execute the proposed design changes. While my supervisor at the time, Prof. dr. ir. Jan Hoogervorst, encouraged me to continue on with the work I already done, I was completely discouraged.

From the moment I officially stopped with the subject, a huge weight fell of my shoulders. However instead of giving up, I immediately went back to the subject of the value of Enterprise Architecture and began thinking about several research approaches. When I approached Prof. dr. Steven De Haes with this new subject, he was immediately enthusiastic and asked me to contact Prof. dr. ing. Hans Mulder, as he was one of the subject matter experts on the domain of Enterprise Engineering & Architecture.

It was Hans Mulder who then brought me in contact with Prof. James Johnson, who he works professionally with at The Standish Group. He told me that the Standish Group was opening up their database of IT projects for academic research, and asked if I could combine this with my subject. This was the breakthrough I was searching for, and the result is this dissertation which I am now proud of. Is it perfect? Does this thesis answer the question completely to my content? No, but that wasn't possible either in the available time frame. That said, it provides a good foundation for future research, and Prof. Johnson, together with The Standish Group, is more than willing to take it a step further at a later moment.

## Acknowledgements

I would like to express my gratitude to my thesis supervisor, Prof. dr. ing. Hans Mulder, for always ensuring I was on the right track regarding the content and scientific validation of the thesis, and for being available when needed.

Secondly, I would like to extend my thanks to my other thesis supervisor, Prof. James Johnson of The Standish Group International, who made the time & effort to open up and even modify his database in order to accommodate this research. Without his assistance the thesis would not have the scale & detailed information as it has now.

Thirdly, my thanks also goes out to the management of Realdolmen (Filip Roelandt, David Steppe, Johnny Smets and others) for their support of the whole program.

Last, but surely not the least, I would like to thank my girlfriend and partner, Melissa Haveaux, for her unconditional love and support through some testing times.

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# 1. Management Summary

## 1.1. Problem Statement

As there is still little empirical evidence on the value of Enterprise Architecture (EA), we wanted to find a way to provide it. As the question of the value of EA is a very large question with numerous variables, we scoped our study to the value of Enterprise Architecture on IT projects. Hence the following research question:

*Are IT projects conforming to an Enterprise Architecture more successful than others?*

## 1.2. Research Approach

As a first time in history we used the project database of The Standish Group International Inc., containing data on more than 120,000 IT projects and associated organizations in order to explore the value of Enterprise Architecture on a large set of projects.

We started with a survey to acquire a pool of organizations which have an Enterprise Architecture and asked in what year they implemented & effectuated the EA. We identified 28 organizations, which together had done 3076 IT projects from 2007 to 2016, and had implemented an EA between 2011 and 2016.

We compared the end results of projects done without EA to those done subjected to EA to see if EA has any effect. As the projects were done in the same organizations, this allowed us to get a good before & after picture.

## 1.3. Conclusion

In this study, we've found strong indications for the value of Enterprise Architecture on IT projects, as we saw noticeable improvements in projects done after the implementation of EA compared to projects done before EA. This contributes to the research on the value of Enterprise Architecture by providing explorative empirical indications for the effects of Enterprise Architecture on IT projects. These findings assist an understanding about the various effects of EA. In summation, our study provides strong indications for the value of Enterprise Architecture on IT projects and sets the foundation for further study in the matter.

# 2. Introduction

What is the value proposition of Enterprise Architecture (EA)? This is a question that hasn't been adequately answered yet (Op't Land, Proper, Waage, Cloo, & Steghuis, 2009). Although there are numerous benefit claims in the literature, these are often not explained nor supported by empirical evidence (Tamm, Seddon, Shanks, & Reynolds, 2011).Our research is interested in getting empirical evidence for the value of EA.

The problem of determining the value of EA is actually a multitude of problems. The scope of the question of the value of EA is very large, with numerous variables influencing the outcome. A good strategy to tackle a large question is to split it up in smaller questions, which is what we will do. For this research we will specifically focus on the value of EA on IT projects.

We use the theory of Enterprise Engineering/Enterprise Governance (Hoogervorst, 2009) for the understanding and theoretical background of Enterprise Architecture, which we will elaborate on in chapter 3. Through a partnership of the University of Antwerp Management School and The Standish Group International Inc., which opened up their database of IT projects for the first time for academic research (Mulder & Johnson, 2016), we will investigate if EA has value for IT projects.

As we will discuss later on, Enterprise Architecture guides Enterprise Design. In other words, the value of Enterprise Architecture is to be found in the guidance of Enterprise Design. How can we measure this value then?

In this dissertation we will look at this from the viewpoint of projects. The realization of a system (be it an engine, an ERP system or an organization) usually happens in the format of a project. While EA is not absolutely necessary for the design of a system, it is argued that EA addresses the areas of concern of the whole enterprise (Hoogervorst, 2009), and guides design in the strategic direction of the enterprise. EA thus helps make sure the design fits the enterprise, and does not deviate from that direction. If a design would not adhere to the EA, it thus would not adhere to the enterprise goals and objectives.

So if it is possible to measure a positive effect on project success, it would provide evidence for the value of Enterprise Architecture.

Hence the following research question:

*Are IT projects conforming to an Enterprise Architecture more successful than others?*

We proceed as follows. The next section provides a background on Enterprise Architecture and project success. Next, we describe the research method employed in our empirical study. We then present our data analysis and an examination of the results. The final section presents the implications or our research and discusses the limitations of our work.

# 3. Background

In order to fully understand the research question we will elaborate on the terms used in the following paragraphs.

- What is Architecture?
- What is Enterprise Architecture?
- How can a project conform with Enterprise Architecture?
- What is a successful project?

## 3.1. What is Architecture?

Before we tackle the question of what we mean by Enterprise Architecture, let's first focus on architecture by itself. The definition of architecture alone is already contested. Before presenting what we will use as a definition, we will briefly review some apparently influential (academical and practical) definitions of architecture, and try to identify differences and commonalities between them.

*Table 1 Architecture definitions*

| | |
|---|---|
| Zachman | Architecture is that set of design artifacts, or descriptive representations, that are relevant for describing an object, such that it can be produced to requirements as well as maintained over the period of its useful life. |
| ISO/IEC/IEEE 42010:2011 (ISO/IEC JTC 1/SC 7, 2011) | Fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution. |
| TOGAF 9.1 (The Open Group, 2011) | Architecture has two meanings depending upon its contextual usage:<br>1. A formal description of a system, or a detailed plan of the system at component level to guide its implementation<br>2. The structure of components, their inter-relationships, and the principles and guidelines governing their design and evolution over time |
| The Extensible Architecture Framework (xAF working group, 2004) | Architecture is theoretically defined as the normative restriction of design freedom. Practically, it is a coherent and consistent set of principles that guide the design of a system. |
| Enterprise Engineering Theory (Hoogervorst, 2009) | A coherent and consistent set of principles and standards that guides system design. |
| Integrated Architecture Framework (van't Wout, Waage, Hartman, Stahlecker, & Hofman, 2010) | Architecture links vision, strategy and feasibility, focusing on usability, durability and effectiveness. |

Of all the definitions above, the definition of Zachman is closest to what is generally understood by building architecture, which was the intent of Zachman. However, like in building architecture, architecture is then hardly distinguishable from design.

We can discern two main views on Architecture:

1. Descriptive View: Architecture describes how a design actually is in terms of its functional, operational or material manifestation. This is expressed in models and views.
2. Prescriptive View: Architecture guides how a design must be accomplished: a normative limitation of design freedom. This is expressed in principles and standards.

If we then categorize the architecture definitions by the views above from Table 1, we get:

*Table 2 Categorization of architecture definitions*

| | |
|---|---|
| **Descriptive** | Zachman |
| **Prescriptive** | The Extensible Architecture Framework |
| | Enterprise Engineering Theory |
| **Mixed** | ISO/IEC/IEEE 42010:2011 |
| | TOGAF 9.1 |
| **Other** | Integrated Architecture Framework |

The definition in the Integrated Architecture Framework (IAF) does not fit in either the descriptive or prescriptive view, but doesn't tell us much either.

As we use the EE/ EG Theory as our theoretical framework, we view architecture as normative guidance for the design of a system (where a system is a purposeful, intentional arrangement of elements). But why normative? Well, according to Hoogervorst, the major question in realizing a system, which inherently cannot happen by accident, is **how** it is to be realized. Architecture precedes design and is the answer for this question, which implies it must be prescriptive. It cannot be a design (which is a description of a system) by itself but guides how design must be accomplished. (Hoogervorst, 2009)

Hence we will use the following definition of architecture in this dissertation:

*A coherent and consistent set of principles and standards that guides system design.*

Do note that we're not saying that an *architect*'s only job is to create and maintain the architecture, of course he or she will also create high-level models, blueprints, views…, just like a 'regular' architect who plans and designs buildings, however these descriptive deliverables are already part of the design space, not the architecture space. The difference between design and architecture is explained further in section 3.2.

As stated in our definition of architecture, architecture consists of *principles*.

### 3.1.1. Principles

As with architecture, there is no clear definition of principles. Principles are generally described as constraints on the design space of [enterprise] engineers (Op 't Land & Proper, 2007). According to TOGAF (The Open Group, 2011), principles are general rules and guidelines, intended to be enduring and seldom amended, that inform and support the way in which an organization sets about fulfilling its mission.

They elaborate further: Architecture Principles are based on business principles, business goals, business drivers and provide a firm foundation for making architecture and planning decisions, framing policies, procedures and standards, and supporting resolution of contradictory situations.

Another working definition for a principle is "a general requirement for a class of systems (not for an individual system)".

Like with the definition of architecture, we will use the definition provided by the EE Theory:

*A predefined design action orientation pertinent to one or more design domains.*

The definition of architecture also refers to *standards*. According to the EE Theory, *standards* are a particular set of principles. It is defined as

*A predefined design norm.*

An example of a design norm would be a design pattern which has been based on a previous design, that is being reused.

As we consider standards as being a subset of principles, we will further refer to 'principles and standards' as just 'principles'.

As discussed in (van Bommel, Buitenhuis, Hoppenbrouwers, & Proper, 2007), when considering the many different definitions of principles, three typical perspectives on principles can be discerned:

1. **Inherent laws** – These are essentially properties of (classes of) a system that can be observed and validated. Conceptual parallels are the laws of nature, law of requisite variety, laws of social behavior, etc.

2. **Imposed laws** – Like inherent laws, they are properties of (classes of) a system that can be validated. However, imposed laws also require mechanisms to enforce them. Imposed laws typically address concerns of stakeholders. Some of these concerns may be raised by emergent laws having a negative impact on the system being designed. Examples are: societal laws, policies and regulations within organizations, etc.
3. **Guidelines** – Desired properties that are so concrete that they offer guidelines to make operational behavior fit imposed laws. For example: "use your car's cruise control" is an advisable property to abide by that provides guidance in obeying the law concerning maximum speeds on roads.

In line with the definition of enterprise architecture used in this dissertation, we will mainly use the last two perspectives on principles.

From the perspective of projects, principles need to be interpreted and, if necessary, translated to local requirements.

#### *3.1.1.1. Why Principles?*

Next to operationalizing the strategy by making it explicit, principles are a good tool to combat entropy. Entropy is one of the major issues why the enterprise strategy fails. In science, entropy measures a physical system's degree of disorder, and the second law of thermodynamics states that entropy always *increases* in an isolated physical system. Similarly, weakly managed organizations tend to become less organized and focused. (Rumelt, 2011) This is a force that weakens our unity & integration that we want to achieve.

Possible effects in business are

- Product line grows less focused
- Prices are set low to please the sales department
- Shipping schedules are too long, pleasing only the factory
- Profits are taken home as bonuses to executives whose only accomplishment is outdoing the executive next door in internal competition over the bounty of luck and history

Rumelt proposes the following solution:

> *Leaders must diagnose the causes and effects of entropy […], create a sensible guiding policy for effecting change, and design a set of coherent actions designed to alter routines, culture, and the structure of power and influence.*

While he does not explicitly mention principles as a solution, after the previous chapters we can see how principles can help solve this issue.

Principles must be upheld for each project - now, but also 50 years later. Of course principles can and should be revised and updated, but the strength of principles is the structure in which they are formatted and because they are preserved and stored. The 'rationale' part of a principle always remembers us why it has been put into effect. The 'assurance' parts allows us to measure if the principle is still upheld.

Good examples of entropy can be found in the book Good Strategy/Bad strategy of R. Rumelt, which is recommended reading.

#### *3.1.1.2. Quality of Principles*

It has already been documented (Foorthuis & Brinkkemper, 2008) that principles can also have negative effects. According to their research, prescriptions (including principles) which are ambiguous might not be interpreted as originally intended. A second possible negative effect is additional project complexity, caused by, among other things, the translation effort from generic EA prescriptions to the project level. Thus can be said that there are *good* principles and *bad* principles.

So what qualities do good principles have? Good principles are

- **Understandable**
  The underlying tenets can be quickly grasped and understood by individuals throughout the organization. The intention of the principle is clear and unambiguous, so that violations, whether intentional or not, are minimized.
- **Specific**
  Each principle should be sufficiently precise.
- **Measurable, falsifiable**
  Principles should not contain properties that we can't precisely, reliably and independently measure.
- **Few & high-level**
  Principles must leave room for interpretation.
- **Consistent & coherent**
  Principles should not be contradictory to the point where adhering to one principle would violate the spirit of another.
- **Stable**
  Principles should be enduring, yet able to accommodate changes.

#### *3.1.1.3. Structure of Principles*

How is a principle formatted? Principles consist at least of

- a Statement (the actual formulation of the architecture principle or standard)
- a Rationale/Motivation (why is the principle necessary, what are the benefits)
- Implications (what is the effect/impact on the current enterprise)

Additionally, the following information can also be included:

- Possible Actions (what has to be done to become compliant with principle, in terms of resources, costs, and activities/tasks)
- Assurance (how to measure compliance)

#### *3.1.1.4. Effectuating principles*

Of course it is not enough to have a repository of principles, they also need to be *adhered to* in the design process. You need 1) management, 2) acceptance and 3) assurance.

Architecture *management* is responsible for

1) the process from initial draft publication, the processing of possible comments and formal approval, up to the definitive publication.
2) maintaining relations with program/project management & IT governance

3) enforcing compliance by assessing, and if necessary, adjusting design, granting (temporal) permission to deviate from the published architecture, and stipulation of the conditions under which the permission is granted.

*Acceptance* is about getting enterprise-wide acceptance of the principles. Principles and standards need to be endorsed and championed by senior management.

Assurance is about measuring compliance. Principles are an excellent basis for metrics (and thus monitoring & control, which are aspects of Governance).

#### *3.1.1.5. Relevance of principles to design*

The relevance of principles to design is thus

- Principles limit design freedom
- Principles create coherence (unity & integration) across different development processes
- Key actions to effectuate a principle might lead to formal projects or programs (Hoogervorst, 2009)

## 3.2. The relationship between Architecture and Design

### 3.2.1. Designing

Designing is the totality of activities from defining system requirements up to implementation (Hoogervorst, 2009). The designing of a system (an organization, a clock, a car, or an ICT application) essentially consists of two things:

1. *Determining the requirements*. The result is a balanced compromise between all stakeholders' requirements.
2. *Devising the specifications*. These specifications should satisfy the resulting requirements and should be feasible. By feasible is meant that the specifications are sufficient for building the system, using the available technology.

It is important to note that the design process consists of two major, logically consecutive phases; 1) the function design phase and 2) the construction design phase. Function design consists of selecting a subset from the functional requirements and transforming them into *functional specifications*. Construction design is devising an implementation to adhere to the functional specifications. This is the real creative design phase, because the constructional designers must bridge the mental gap between function and construction. (Dietz, 2006)

However, for all engineering disciplines, it holds that during a design process, the designer is left with some 'amount' of design freedom after all requirements are satisfied. This 'amount' may be quite substantial for disciplines where the implementation technology is hardly or not at all constrained by physical laws. Among these disciplines are Information Systems Engineering. Consequently, designers of enterprises and information systems are faced with the question how to use this design freedom. (Dietz & Hoogervorst, The BETA Theory, 2015)

### 3.2.2. Architecturing

This is where Architecture comes into play. Architecture is the collective name for functional and constructional principles. The functional principles are an additional 'input' for the function design phase, next to the functional requirements, whereas the constructional principles are an additional 'input' for the construction design phase, next to the constructional requirements. Consequently, principles must be understood as generic requirements, i.e. requirements that are not specific for the object system to be designed, but that apply also to other object systems. Hence we can say that system design requires architecture for design guidance.

Thus, *Architecturing* has to lead to a set of prescriptive functional and constructional principals for the design of a class of systems. (Van Dipten & Mulder, 2011)

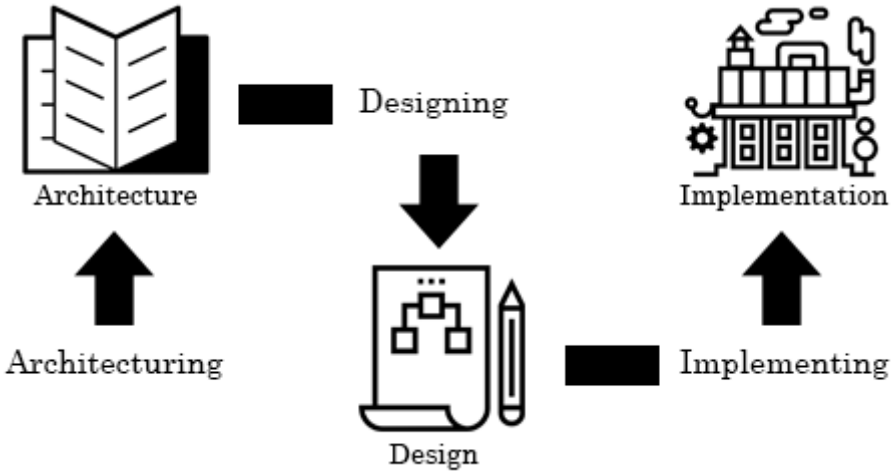



*Figure 1 System realization areas*

In the figure above, *Architecturing* is the process of creating an Architecture (a coherent and consistent set of principles), *Designing* the process of creating a Design (the conceptual realization of a system in a function and construction design, whereby function and construction architecture provides design guidance), *Implementing* the process of building an Implementation (the physical realization of a system).

The realization of a system is further detailed in the GSDP.

### 3.2.3. The GSDP

In Figure 2 the Generic System Development Process (GSDP) is shown. The GSDP is designed as a general framework for understanding the activity or process of design, where an object system is designed (and further developed) for the benefit of a using system. (Dietz & Hoogervorst, 2015)

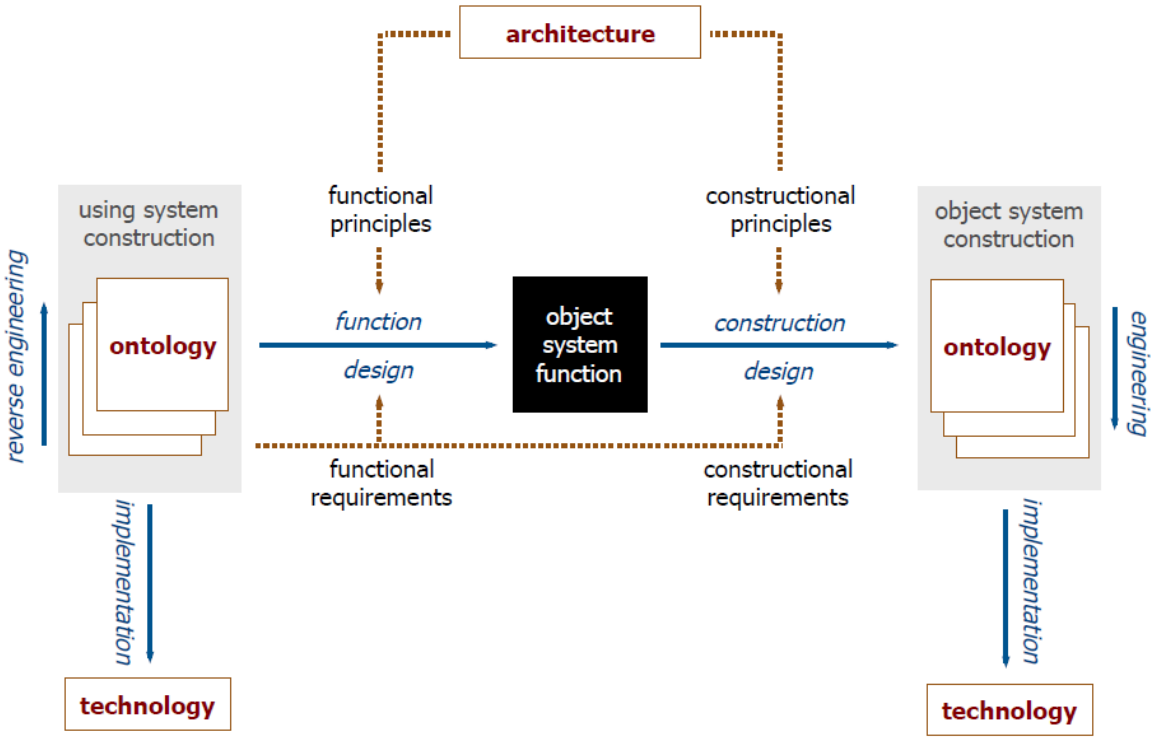



*Figure 2 Generic System Development Process*

On the left side, the construction of the using system is shown. On the right, you see the construction of the object system (the system the using system wants to fulfill its needs). Both systems are shown as a white box because we know, or will know, how these systems are constructed. Between these two systems, the using and the object system, the function of the object system is shown as a black box, consisting of the functional requirements and functional specifications.

The functional requirements for the object system are derived from the using system. The determination of the wanted behavior of the object system is led by the function perspective. The functional requirements are supplemented with the current functional principles from the architecture.

The constructional requirements are also derived from the using system. Together with the determined functional design and the current constructional principles, they provide the input for the constructional design. This way the construction of the object system is determined on the most abstract, and ideally, ontological level, after which the system will be engineered and implemented.

It is also possible to determine the constructional design of an implemented system. This practice is called ‘reverse engineering’ and is shown by the ‘reverse engineering’ arrow.

## 3.3. What is Enterprise Architecture?

As there is no common definition for architecture, it will be no surprise that there isn't a consensus on Enterprise Architecture either. Let's first take a look at a few common definitions of Enterprise Architecture.

*Table 3 Enterprise Architecture definitions*

| | |
|---|---|
| Enterprise Architecture as Strategy (Ross, Weill, & Robertson, 2006) | The enterprise architecture is the organizing logic for business processes and IT infrastructure, reflecting the integration and standardization requirements of the company's operating model. The enterprise architecture provides a long term view of a company's processes, systems, and technologies so that individual projects can build capabilities – not just fulfill immediate needs. |
| Wikipedia (English) | A well-defined practice for conducting enterprise analysis, design, planning, and implementation, using a holistic approach at all times, for the successful development and execution of strategy. |
| Wikipedia (Dutch) | A young field between business, information science and computer science, which aims to ensure that an organization, in all its parts, develops in the desired direction. |
| ArchiMate Foundation (Lankhorst, 2017) | Coherent whole of principles, methods, and models (that are used in the design and realization of an enterprise's organizational structure, business processes, information systems and infrastructure). |
| Enterprise Architecture (Op't Land, Proper, Waage, Cloo, & Steghuis, 2009) | A coherent set of descriptions, covering a regulations-oriented, design-oriented and patterns-oriented perspective on an enterprise, which provides indicators and controls that enable the informed governance of the enterprise's evolution and success. |
| Gartner (Op't Land, Proper, Waage, Cloo, & Steghuis, 2009) | The process of translating business vision and strategy into effective enterprise change by creating, communicating and improving the key principles and models that describe the enterprise's future state and enable its evolution. |
| Gartner (2) (Gartner, 2017) | A discipline for proactively and holistically leading enterprise responses to disruptive forces by identifying and analyzing the execution of change toward desired business vision and outcomes. EA delivers value by presenting business and IT leaders with signature-ready recommendations for adjusting policies and projects to achieve target business outcomes that capitalize on relevant business disruptions. |
| EE theory (Hoogervorst, 2009) | A coherent and consistent set of principles and standards that guide Enterprise Design |

Again we don't find much common ground. According to Maes et al., Enterprise architecture is considered the "missing link" between, on the one hand, strategy and implementation and, on the other hand, business operation and IT operation (Maes, Rijsenbrij, & Truijens, 1999). The business sets out a strategy for the whole or parts of

the enterprise. The strategy consists of high-level goals. To achieve these goals, the strategy has to be operationalized. Enterprise architecture then concerns the function and construction design of that enterprise and its domains as we will discuss later on.

If we look back at the definition of architecture we've chosen (A coherent and consistent set of principles and standards that guides system design) and as we can consider an enterprise as a (albeit complex) system, we can conclude that Enterprise Architecture provides normative guidance for the design of an enterprise.

Hence, throughout this paper we will adhere to the prescriptive view of architecture and use the following definition of Enterprise Architecture:

*A coherent and consistent set of principles and standards that guide Enterprise Design (Hoogervorst, 2009)*

In taking a regulative perspective on enterprise architecture, we are primarily concerned with its ability to steer the over-all enterprise/system development within an enterprise.

What do we mean by over-all development? As we will see in the next section, we can discern 4 main enterprise design domains where development happens: Business, Organization, Information & Technology.

### 3.3.1. Enterprise Design Domains

In the EE/EG Theory (Hoogervorst, 2009) there are 4 main enterprise design domains.

The four main design domains are

1) Business
2) Organization
3) Information
4) Technology

We present these domains as described in the EE/EG Theory:

**Business**. This domain concerns the enterprise function, having to do with topics such as products and services, customers and the interaction/relationship with them, the economic model underlying the business, and the relationships with enterprise (sales channels, market, competitors, milieu, stakeholders).

**Organization**. Having established the enterprise function (its business), many degrees of freedom still exist concerning how the products and services actually brought about, and how the associated activities are actually arranged. The organization domain concerns the internal arrangement of the enterprise, having for example to do with processes, employee behavior, enterprise culture, management/leadership practices, and various structures and systems, such as regarding accounting, purchasing, payment, or employee evaluation. Organization is thus part of the enterprise construction.

**Information**. Information is a crucial factor within both the business and organization design domain. Many informational aspects play a role, such as the structure and quality of information, the management of information (gathering, storage, distribution), and the utilization of information. The information design domain also has to do with the enterprise construction.

**Technology**. Appreciably, technology is essential for business, organizational and informational support, as well as for future enterprise development. Technology is thus an important part of the enterprise construction.

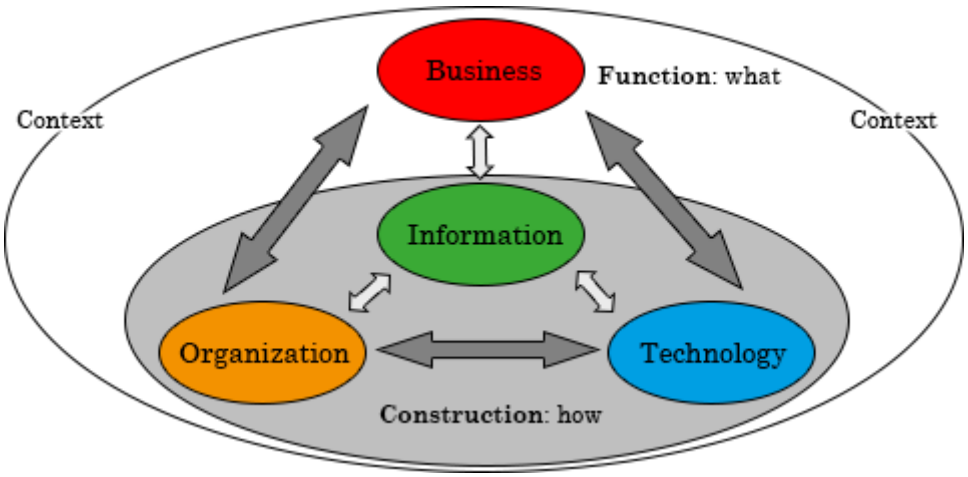



*Figure 3 Main enterprise design domains*

Associated with these domains are thus four architectures. Together, they comprise the Enterprise Architecture. These four architectures are:

1) Business architecture
2) Organization architecture
3) Information architecture
4) Technology architecture

The **business architecture** guides the way the business domain is to be exploited and explored. We might consider principles concerning the provisioning of products and services to customers, the market position relative to competitors of the relationship with stakeholders. The business architecture is the functional architecture of the enterprise. Formally, we can define business architecture as a coherent and consistent set of principles and standards that guide how a chosen area of goal-oriented and gainful (commercial) endeavor must be exploited and explored. An example of a business principle could be:

| Business principle | |
|---|---|
| **Statement** | Car line should be integral, each car in the line should properly be conceived in its relationship to the line as a whole. |
| **Rationale** | There is too much intracompany competition and product clutter. Intracompany competition leads to lower prices and partial waste in investments in advertising and development. The intent of this principle is to reduce the fuzziness or confusion about the difference between the car brands. This should lead to increased sales and reduced costs. |
| **Implications** | • Internal competition must be reduced. |

| | |
|---|---|
| | • Brands with models with no distinction in either style or price must be sold or dissolved.<br>• This, in turn, has consequences for effected dealers and customers. |
| **Actions** | • Define a unique range of prices for each brand to work within<br>• Investigate which brands to sell or dissolve<br>• Investigate the consequences for current dealers & customers |
| **Assurance** | No or little (less than 10%) overlap in price range between brands |

The **organization architecture** guides the organizational arrangement through principles and standards pertinent to topics mentioned in the organization domain. Notably, the traditional vertical, hierarchical, and functional organizational orientation, as compared with the horizontal, process orientation, manifests two essentially different organization architectures. Organizational architecture is a main part of the enterprise's constructional architecture. Formally, we can define organization architecture as a coherent and consistent set of principles and standards guiding how the enterprise must be designed internally for providing the enterprise products and services. An example of an organization principle could be:

| Organization principle | |
|---|---|
| **Statement** | Quality control must take place at the point of production (by production employees themselves). |
| **Rationale** | In view of our quality strategy, separate quality inspectors are not conducive to employee involvement with, and commitment to quality. Dedication to quality must be an inherent part of production employees behavior. Hence, separate quality inspectors rather reduce than enhance this dedication. |
| **Implications** | • Task enhancement of production staff.<br>• Possible wage increase.<br>• Discontinuation of the quality inspector functions |
| **Actions** | • Define and arrange production staff training.<br>• Investigate remuneration aspects.<br>• Investigate and arrange new employment possibilities for the current quality inspectors. |
| **Assurance** | • No separate quality inspectors |

The **information architecture** guides the way information (or better, 'data') must be used and handled. So principles might concern the handling of customer and supplier data, or the way operational systems update informational systems. Notably, information architecture differs from IT architecture. The latter architecture has its focus on technology. Formally, we can define information architecture as a coherent and

consistent set of principles and standards that guide how information must be used and handled. An example of an information principle could be:

| Information principle | |
|---|---|
| **Statement** | Data is defined with a consistent vocabulary throughout the enterprise, and the definitions are understandable and available to all users. |
| **Rationale** | The data that will be used in the development of applications must have a common definition throughout the Headquarters to enable sharing of data. A common vocabulary will facilitate communications and enable dialogue to be effective. In addition, it is required to interface systems and exchange data |
| **Implications** | • We are lulled into thinking that this issue is adequately addressed because there are people with "data administration" job titles and forums with charters implying responsibility. Significant additional energy and resources must be committed to this task. It is key to the success of efforts to improve the information environment. This is separate from but related to the issue of data element definition, which is addressed by a broad community - this is more like a common vocabulary and definition.<br>• The enterprise must establish the initial common vocabulary for the business. The definitions will be used uniformly throughout the enterprise.<br>• Whenever a new data definition is required, the definition effort will be coordinated and reconciled with the corporate "glossary" of data descriptions. The enterprise data administrator will provide this coordination.<br>• Ambiguities resulting from multiple parochial definitions of data must give way to accepted enterprise-wide definitions and understanding.<br>• Multiple data standardization initiatives need to be coordinated.<br>• Functional data administration responsibilities must be assigned. |
| **Actions** | • Define initial common vocabulary for the business<br>• Study the effective way to store the data definitions<br>• Investigate location of ambiguities<br>• Study the effective way to coordinate the data standardization initiatives<br>• Define & arrange staff training |
| **Assurance** | • There is a published glossary with common vocabulary<br>• There is a published glossary with data definitions<br>• No definition ambiguities<br>• Functional data administration responsibilities are assigned |

Every technology therefore has an associated architecture, guiding its design. In view of the dominant position of information technology (IT), the associated IT architecture, guiding IT system design, is often the only architecture addressed formally within the **technology architecture** perspective. Formally, we can define IT architecture as a coherent and consistent set of principles and standards that guides how IT systems must be designed. An example of an IT principle could be:

| IT principle | |
|---|---|
| **Statement** | Remote access must be based on two-factor authentication. |
| **Rationale** | Flexibility and speed are crucial enterprise areas of concern. For that, easy and quick access to our network – any place, any time – is essential our employees. At the same time, such access should be secure in order to avoid security risks. |
| **Implications** | • Current access methods must be discontinued.<br>• Different user groups must comply with more stringent access arrangements. |
| **Actions** | • Investigate employee roles for which remote access is required.<br>• Investigate possible methods for two-factor authentication.<br>• Study migration of current instances not compliant with this principle towards the compliant<br>• access method.<br>• Develop access services.<br>• Create overall security policies and awareness about remote access. |
| **Assurance** | • Remote access is secured by two-factor authentication |

If we are thus talking about Enterprise Architecture, we are talking about the whole of these 4 main architectures.

## 3.4. How can projects conform to Enterprise Architecture?

As we already discussed in section 3.1.1.4, the result of architecturing (the architecture) is only effective if the architecture (consisting of principles) is used during the design process.

Each design should formally be declared compliant with the published architecture.

A project conforms to the Enterprise Architecture when it doesn't violate any principle OR has explicit permission of the EA board for violating one or more principles, when necessary.

## 3.5. What defines project success?

The Standish Group, located in Boston and founded by Jim Johnson, has, over the years, acquired a large database of over 120 000 ICT projects, of which 50 000 projects are actively used today, which have been successful, challenged or failed. This database grows each year with around 5000 projects, while projects older than 11 years are purged.

The Standish Group also releases yearly CHAOS reports, based on this database, which proposes critical success factors for project success.

### 3.5.1. Measuring project success

What is the measure of project success? The Standish Group defines project success by 6 indicators, divided in Traditional indicators (indicators used traditionally in project management) and Additional indicators (indicators proposed by The Standish Group, which, according to them, are better indicators for the project success rate):

#### *3.5.1.1. Traditional indicators:*

1) **On Time**: the project was resolved within a reasonable estimated time
2) **On Budget**: the project stayed within budget
3) **On Target**: the project contained a good number of the specified features and functions

#### *3.5.1.2. Additional indicators:*

4) **On Goal**: the business objectives for the project are clear
5) **Value**: the project was considered valuable
6) **Satisfaction**: the project delivered customer and user satisfaction regardless of the original scope

The 'On Goal' indicator is a curious one, at least by the findings of The Standish Group: The Standish Group has stated for many years that clear goals are achieved when all the stakeholders are focused on and understand the core values of the project. The Standish Group used to believe that goal clarity and focus were essential to a successful project. However, measuring success by both the Traditional and Modern metrics, The Standish Group found the opposite to be true. The Standish Group coded the database with a 5-point scale, from precise to distant, in order to measure the effect on success rates. It is clear from the research that **goals closer to the organization's strategy/goal have the opposite effect on higher satisfaction and success rates.**

The Standish Group is now suggesting that organizations take action over trying to achieve goal clarity. Many of the most satisfying projects start out with vague goals. The business objectives are dynamic as the project progresses. Project teams should reduce or give up control of the business objectives to encourage and promote innovation. (The Standish Group International, Inc., 2014)

As part of the Enterprise Architecture is to operationalize the enterprise strategy, it is to be seen what effect this has on the 'On Goal' indicator.

### 3.5.2. Resolution

Not to be mixed with the indicators, resolution uses a combination of certain indicators to determine the end state of the project (successful, challenged or failed). Today, The Standish Group discerns two methods of resolution.

#### *3.5.2.1. Traditional resolution*

Traditional resolution measures projects against the CHAOS database for on time, on budget, and on target (scope). This means the project was resolved within a reasonable estimated time, stayed within budget, and contained a good number of the specified features and functions.

Using traditional resolution:

- **Successful projects** are projects completed on time and on budget, with all features and functions as initially specified.
- **Challenged projects** are projects that were completed but late, over budget, and did not meet the target specifications.
- **Failed projects** are projects that were cancelled at some point during the development cycle or not used after implementation.

#### *3.5.2.2. Modern resolution*

Modern resolution measures projects against the CHAOS database for on time, on budget, and satisfaction. This definition encompasses both a success rate for the project management of a project and for the project itself. The Traditional resolution of On Time, On Budget, and On Target clearly supports the goals of project management, but not the customer or user of the product or project. The reason The Standish Group considers Modern Resolution to be the best definition is that it combines the project management process and the end results of a project. The Standish Group reports to have seen many projects that met the triple constraints of On Time, On Budget, and On Target, but where the customers were not satisfied with the outcome.

In changing from the On Target constraint to satisfactory, penalizing a project for having an evolving target, which all projects have - even the very small ones, is avoided. Customers have a clear opinion on the satisfaction level whether or not all the features and functions that they asked for in the beginning of the project are realized. Research done by The Standish Group found that both satisfaction and value are greater when the features and functions delivered are much less than originally specified and only meet obvious needs.

In other research The Standish Group found that most features and functions of software are not used. These additional features increase cost, risk, and quality, but do not necessarily provide value.

Using Modern resolution:

- **Successful projects** are projects completed on time and on budget, with a satisfactory result.
- **Challenged projects** are projects that were completed but late, over budget, with unsatisfactory results.
- **Failed projects** are projects that were cancelled at some point during the development cycle or not used after implementation.

### 3.5.3. Critical Success Factors for projects

The critical success factors noted in the 2016 CHAOS report, in order of influence, are

1) **Small project size**. The project size must be small (maximum of 6 project members and a time box of 6 months or less)
2) **Agile process**. The process must be agile, i.e. iterative development. It provides for a constant cycle of design, development, test, and user acceptance. Stakeholders get to see the system in small stepping-stones before it is fully built, thereby allowing changes to occur without having a major impact on the project cost and schedule.
3) **Talented staff**. The project members must be highly skilled in the agile process and technology.
4) **Skilled project sponsor**. The product owner/sponsor must be highly skilled. A good executive sponsor should be able to inspire the team and take responsibility for gaining value for the project. The executive should encourage risk taking and take the heat if the project is canceled. The executive provides the project's vision. The executive should encourage and assist in gaining value from the project, and ensure that needed resources are made available. Executive Sponsorship also includes negotiation and resolution of high-level conflicts.
5) **Emotional maturity**. The organization must show a high emotional maturity. According to the Standish Group, emotional maturity is the collection of basic behaviors of how people work together (being self-aware, socially aware, self-managed, and able to manage relationships, among other skills). In any group, organization, or company it is both the sum of their skills and the weakest link that determine the level of emotional maturity. The Standish group measures 50 emotional maturity skills.

According to the 2016 CHAOS report, adherence to these five critical success factors will lead to a project delivered on time, within budget and with satisfied customers.

> *If you do these five things and do them well you have an 81% chance that a project will come in on time and on budget, with satisfied customers. You have only a 1% chance the project will fail and only an 18% chance it will be challenged in some way or other. More importantly, the project will have a 64% chance of returning very high to high value and only a 15% chance of returning no to low value. If you do not do these five things well, however, the chances of a failed, challenged, or low-value result increase. On the other hand, everything else you do (outside of these five things) is most likely a waste of time and money or has very low to negative impact. - (The Standish Group International, Inc., 2016)*

Other, less significant, identified success factors are

6) **User Involvement**. Takes place when users are involved in the project decision-making and information-gathering process. This also includes user feedback, requirements review, basic research, prototyping, and other consensus-building tools

7) **Optimization.** A structured means of improving business effectiveness and optimizing a collection of many small projects or major requirements. Optimization starts with managing scope based on relative business value.
8) **Standard Architectural Management Environment** (SAME). A consistent group of integrated practices, services, and products for developing, implementing, and operating software applications. SAME applies architecture principles to guide organizations through software technology transformations. The reason SAME provides value to projects is because there is reduction in cost and time to deliver product to the users and stakeholders. There is little to no learning curve for the project team or teams for new products and services. SAME narrows the technology choices, improves skill levels, and reduces the number of decisions. SAME promotes communications through a standard feedback system.
9) **Modest Execution**. Having a process with few moving parts, and those parts are automated and streamlined. Modest execution also means using project management tools sparingly and only a very few features.
10) **Project Management Process Expertise**. The application of knowledge, skills, and techniques to project activities in order to meet or exceed stakeholder expectations and produce value for the organization.
11) **Clear Business Objectives**. Is the understanding of all stakeholders and participants in the business purpose for executing the project. Clear Business Objectives could also mean the project is aligning to the organization's goals and strategy.

# 4. Research Model

The goal of this research to gather empirical evidence for the value of Enterprise Architecture. In a lot of literature around Enterprise Architecture benefits are mentioned backed either by theoretical deduction, a limited amount of case studies or even not backed at all.

The goal of this research is to measure the influence of Enterprise Architecture on IT projects in order to establish (or not) the value of Enterprise Architecture for IT projects.

## 4.1. Hypothesis

Our hypothesis is that there is a positive correlation between adherence to the EA and the success of IT projects.

The first angle is that architecture has an important effect, by delivering normative guidance, on the functional and constructional design of the system to be realized. We would expect that the value of the project would go up.

This hypothesis is backed by research done by Dr. Raymond Slot (Slot, 2010) on the value of architecture on software development projects. He found the following results, showing the value of EA on these projects:

1. 19% decrease in project budget overrun
2. 40% decrease in project time overrun
3. Increased customer satisfaction, with 0.5 to 1 point – on a scale of 1 to 5
4. 10% increase of results delivered
5. Increased technical fit of the project results

The research is a success if indication for advantages or disadvantages of Enterprise Architecture for a majority of projects have been found. If we find a majority of advantages we can answer the research question positively, if not this means we could not find any value (maybe even on the contrary) of EA for projects. Both results would set a base for further research.

## 4.2. Theoretical framework

### 4.2.1. Why Enterprise Engineering / Enterprise Governance theory?

A plethora of literature indicates that a core reason for strategic failures is the lack of coherence and consistency among the various components of an enterprise, which precludes it operating as a unified and integrated whole.

Coherence and consistency does not happen by itself. Without deliberate design the forces of inertia (resistance to change) and entropy will overtake.

Enterprise Engineering is underpinned by two important concepts: enterprise ontology and enterprise architecture. While enterprise ontology focuses on the essence of an enterprise (fully independent of its actual or possible implantation), enterprise architecture provides normative guidance for design, in order for the enterprise to operate as a unified and integrated whole, whereby various enterprise objectives must be satisfied.

EE/EG Theory provides an academically sound theory on EA, which is precise, falsifiable and measurable.

## 4.3. Related Work

### 4.3.1. Thesis Raymond Slot

A related study has been executed by Dr. Slot in his doctoral research where he did a statistical analysis on a survey of 49 software development projects where solution architecture has been applied. He discerned 6 effects on project success:

1. 19% decrease in project budget overrun
2. Increased predictability of project budget planning, which decreases the percentage of with large budget overruns
3. 40% decrease in project time overrun
4. Increased customer satisfaction, with 0.5 to 1 point – on a scale of 1 to 5
5. 10% increase of results delivered
6. Increased technical fit of the project results

He concludes:

> *These results demonstrate that the use of solution architecture is correlated with substantial, positive effects on project success variables. We can conclude that there are convincing indications that the use of solution architecture is correlated with a substantial improvement of several key success variables.*

#### *4.3.1.1. Similarities*

##### 4.3.1.1.1. Software development projects

In the study of Dr. Slot and in our study, we are looking at the value of EA on software development projects.

#### *4.3.1.2. Differences*

##### 4.3.1.2.1. Theoretical framework

However his definition of Enterprise Architecture differs, he sees it as a practice:

> *Enterprise Architecture is the practice of applying a standard approach for and describing in a standard way the current and/or future structure and behavior for an organization's processes, personnel and organizational sub-units, information systems and technical infrastructure.*

The use of this definition alone is expected to bear other results.

##### 4.3.1.2.2. Sample size

While Dr. Slot's research looked into 49 software development projects, we're looking into 3076 software development projects.

##### 4.3.1.2.3. Size of the investigated projects

Very large (> 10 million euro) and very small (< 100 000 euro) projects were excluded from his research. The largest project is his research was 2,5 million euro.

# 5. Research Method

## 5.1. Possible Research Methods

### 5.1.1. Quantative Research

1) **Independent Survey**
   A survey would be a good method to look into historical data. The general idea would be to question project / program managers (by title or by role) if their project(s) were influenced by EA principles and if this influence was positive or not, and if positive, to which project success factors they contribute.

   One of the possible issues with this method is the (assumed) rather small amount of organizations with an EA practice. Another thing to note that while such a survey would be targeted to experts in their field, it can never be considered completely objective.
2) **Data collection**
   This method would mean digging into the Standish Group database (a database of over 50,000 IT projects) finding and then comparing projects conforming to EA against those, of similar size and scope, where there is no EA. Then to analyze if there is a link between EA and project success.

   The Standish Group database doesn't include information on EA, so this would mean this method would need to be enhanced with a survey to gather this additional information.

   A major risk is if there are not enough projects in the database where the design has been influenced by EA principles. And if projects are found, there should be projects of similar size and scope, without any EA influence, to compare them with.

### 5.1.2. Qualitative Research

1) **Case Study**
   Looking into one or several well-documented cases where projects were executed in organizations with an Enterprise Architecture.

   The first risk with this method is not finding these well-documented cases and the second that, by nature of case study research, we will not have enough individual cases to statistically prove the (positive, neutral or negative) influence by EA in general.
2) **Interviews**
   Interviews would provide in-depth information, which is very difficult to achieve with other methods. It is possible to ask more open questions then with a survey, thus would allow other insights.

   A risk with this method is that interviews aren't possible for a large number of subjects in the timespan of this research.

## 5.2. Choice of method

We have chosen a explorative quantative approach to collect the required information. First by means of a survey, because this method provides a way to receive feedback from a large number of respondents in an acceptable timespan. However since we cannot assume the respondents will and/or can be completely objective, we will follow these responses up by data collection on these organizations & projects in the CHAOS database of The Standish Group.

As this is the first time ever that the CHAOS database of The Standish Group has been opened for academic research, and access to it is, at the time of writing, still limited, we first present a hypothetical approach (how such research would hypothetical be done without the availability of the CHAOS database) and then an empirical approach, the approach we used.

### 5.2.1. Hypothetical approach

#### *5.2.1.1. Phase 1*

Step 1. Start from a large repository of IT projects, with enough metadata concerning the end state of the projects (success/challenged/failed), indicators of project success (see section 3.5), and which factors contributing to that success or failure. The projects must be linked to the organizations responsible for executing the project & project management.

Step 2. Create a survey asking if the organization has an Enterprise Architecture, and when the Enterprise Architecture has been effectuated.

Step 3. Send the survey to the experts (CIOs, VPs, directors, and PMO project/program managers) of the organizations from Step 1.

Step 4. Keep the surveys from respondents that say yes to having an Enterprise Architecture, discard the others.

Step 5. Of the remaining organizations, find a time where there are enough projects 'before' and 'after' the introduction of EA. This will give a nice picture since the targets will be the same organizations before and after EA.

Step 6. Discard organizations which have an EA before the set date (which don't have enough data before the introduction of EA).

#### *5.2.1.2. Phase 2*

Step 7. Find the projects linked to these organizations in the IT project repository from step 1.

Step 8. Split the projects up in 'before EA' and 'after EA'

Step 9. Compare the 'before' and 'after EA' projects on indicators of project success (see point 3.5)

### 5.2.2. Empirical approach

#### *5.2.2.1. Phase 1*

Step 1. Work with the CHAOS database of The Standish Group International Inc., which provides metadata on more than 50 000 IT projects and a 1000 organizations.

Step 2. Create a survey asking if the organization has an Enterprise Architecture, and when the Enterprise Architecture has been effectuated.

Step 3. Send the survey to the experts (CIOs, VPs, directors, and PMO project/program managers) of the organizations from Step 1.

Step 4. Keep the surveys from respondents that say yes to having an Enterprise Architecture, discard the others.

Step 5. Of the remaining organizations, find a time where there are enough projects 'before' and 'after' the introduction of EA. This will give us a nice picture since the targets will be the same companies before and after EA.

Step 6. Discard organizations which have an EA before the set date (which don't have enough data before the introduction of EA).

#### *5.2.2.2. Phase 2*

Step 7. Find the projects linked to these organizations in the CHAOS database from step 1.

Step 8. Split the projects up in 'before EA' and 'after EA'

Step 9. Compare the 'before' and 'after EA' projects on indicators of project success (see point 3.5)

### 5.2.3. Argumentation

We want to approach our research question by observation in order to gain further understanding of the value of Enterprise Architecture for IT projects. While some effort has been made (Slot, 2010)

The Standish Group International has been has been formally researching the causes of software project success and failure since 1994. Working with members to fill up their project database, it currently exceeds 50,000 registered projects. This provides a wealth of information and contacts in the field of project management.

This database, the CHAOS Database, has two parts: organizational profiles and project profiles. There are about 50,000 current projects from more than 1,000 organizations. The Standish Group collects, adjudicates, and approves about 5,000 new projects per year or an average of five projects per organization. Each organizational profile has 24 data points and each project profile has over 80 data points. (Johnson, 2016)

During the last 23 years The Standish Group held the data private and no outside access was permitted. However on March 8, 2016, at the Antwerp Management School, The Standish Group presented a view into the working of the CHAOS Database.

This research, on the value of EA on IT projects, would be the first joint effort by the Antwerp Management School and The Standish Group. The enormous amount of

information on projects and associated organizations would provide us enough data for true empirical research.

Working with the Standish Group on this research, would allow us to send a survey to all their participating organizations and look into the database to gather the information we need to, at least, provide an adequate answer the research question.

## 5.3. Measurement

### 5.3.1. Survey

Question 1
**Do you have an Enterprise Architecture?**

Definition: An Enterprise Architecture is a coherent and consistent set of principles and standards that guide Enterprise Design (the design and realization of an enterprise's organizational structure, business processes, information systems and infrastructure)

- Yes
- No

---

Question 2
**How often do your IT projects conform to your Enterprise Architecture?**

We define conformance to Enterprise Architecture as: no violations against the principles, or with violations but sanctioned by the EA Board.

Select one choice from the options below and click submit to record your response.

- All new projects conform
- Mostly on new large projects
- Rarely now, but moving in that direction
- We don't consult the principles or don't know if they exist

---

Question 3
**In your opinion, which aspects of projects does Enterprise Architecture improve?** (check all the apply)

Select up to 4 choices from the options below and click submit to record your response.

- On-budget & On-time delivery
- On-target (scope) & on-goal (strategy)
- Great customer satisfaction
- Higher value/return on investment
- None of the above

Question 4
**How often do projects violate Enterprise Architecture principles?**

Select **one choice** from the options below and click submit to record your response.

- Never
- Rarely
- Few
- Many

Question 5
**From what year were your projects subjected to the Enterprise Architecture?**

Select one choice from the options below and click submit to record your response.

- After 2014
- 2013-2014
- 2011-2012
- Before 2011
- Never

### 5.3.2. CHAOS Database

From the 62 responses on the survey 28 (45%) organizations were qualified having an Enterprise Architecture (question 1 of the survey) and had introduced the Enterprise Architecture in 2011 or later, allowing a good before & after picture since all the organizations had projects from 2007 to 2016.

These 28 organizations together have **3076 projects** registered in the CHAOS database. The qualification was they implemented EA between 2011 and 2016. So, projects completed prior to 2011 are coded as "No". Of the 3076 IT projects, 1828 were resolved prior to the implementation of EA and 1248 were resolved after the implementation of EA.

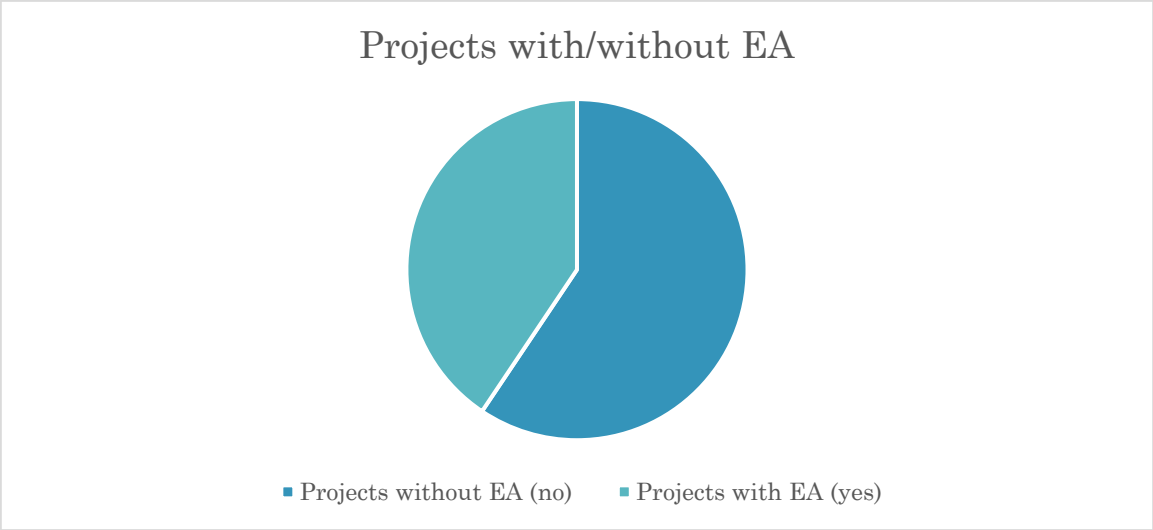



*Table 4 Projects with and without EA*

| Has Enterprise Architecture | Amount of projects | Percentage |
|---|---|---|
| **No** | 1828 | 59,4% |
| **Yes** | 1248 | 40,6% |

### 5.3.3. Variables

#### *5.3.3.1. Project size/cost*

The project cost scales from Small to Grand. In the CHAOS database, the sizes are determined as follows:

| Size | Cost | Team members | Length |
|---|---|---|---|
| **Small** | Under $1 million labor | 6 or less | 6 or less months |
| **Moderate** | $1 million to $3 million | 7 to 12 | 7 months to 1 year |
| **Medium** | $3 million to $6 million | 13 to 24 | 1 to 2 years |
| **Large** | $6 million to $10 million | 25 to 50 | 2 to 4 years |
| **Grand** | Over $10 million | Over 50 | More than 4 years |

In the following table the amount of projects by cost size used in our research is shown.

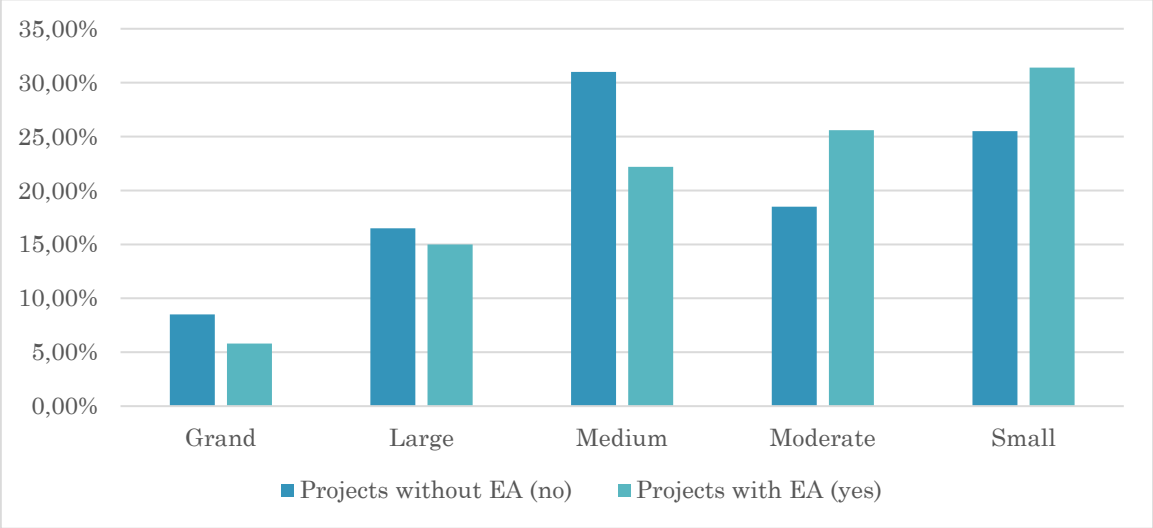



*Table 5 Project size/cost*

| Has Enterprise Architecture | Grand | Large | Medium | Moderate | Small |
|---|---|---|---|---|---|
| **No** | 155 (8,5%) | 301 (16,5%) | 567 (31%) | 338 (18,5%) | 467 (25,5%) |
| **Yes** | 73 (5,8%) | 187 (15,0%) | 277 (22,2%) | 319 (25,6%) | 392 (31,4%) |
| **Difference** | 2,7 pp | 1,5 pp | 8,8 pp | 7,1 pp | 5,9 pp |
| **Change** | -31,76% | -9,09% | -28,39% | +38,38% | +23,14% |

#### *5.3.3.2. Region*

The following table depicts the region where the projects used in this research were executed.

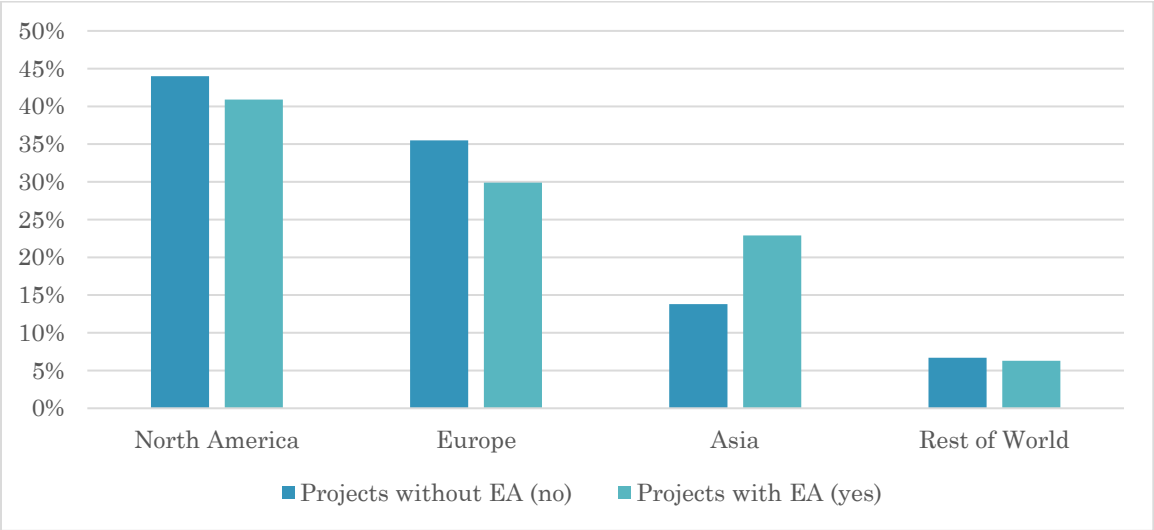



*Table 6 Region of project execution*

| Has Enterprise Architecture | North America | Europe | Asia | Rest of World |
|---|---|---|---|---|
| **No** | 804 (44,0%) | 649 (35,5%) | 252 (13,8%) | 123 (6,7%) |
| **Yes** | 511 (40,9%) | 373 (29,9%) | 286 (22,9%) | 78 (6,3%) |
| **Difference** | 3,1 pp | 5,6 pp | 9,1 pp | 0,4 pp |
| **Change** | -7,05% | -15,77% | +65,92% | -5.97% |

#### *5.3.3.3. Industry*

The following table depicts the projects used in this research sorted by industry.

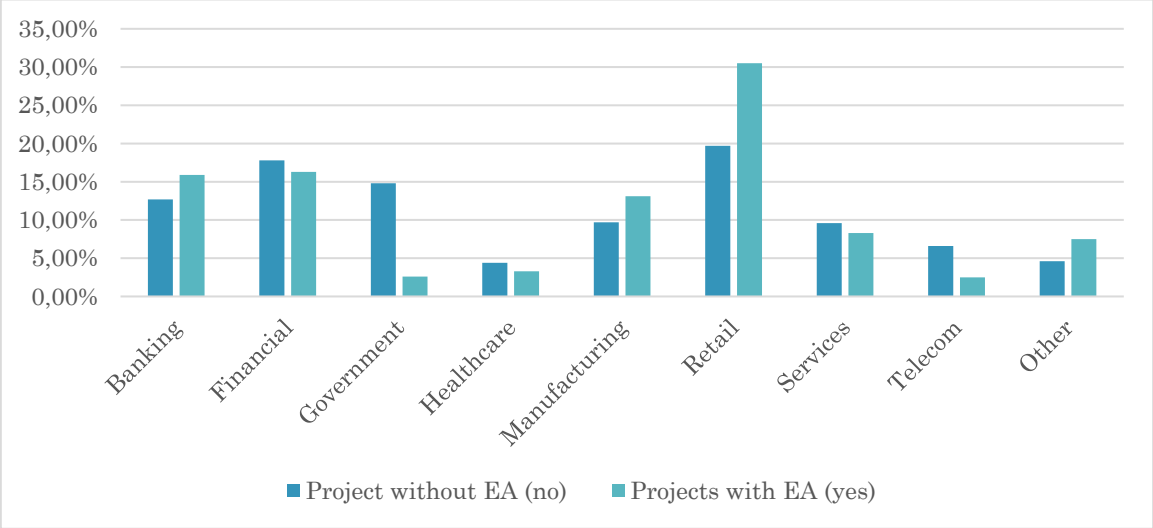



*Table 7 Industry where the project was executed*

| Has Enterprise Architecture | Banking | Financial | Government | Healthcare |
|---|---|---|---|---|
| **No** | 232 (12,7%) | 326 (17,8%) | 271 (14,8%) | 81 (4,4%) |
| **Yes** | 199 (15,9%) | 203 (16,3%) | 33 (2,6%) | 41 (3,3%) |
| **Difference** | 3,2 pp | 1,5 pp | 12,2 pp | 1,1 pp |
| **Change** | +25,20% | -8,43% | -82,43% | -25% |

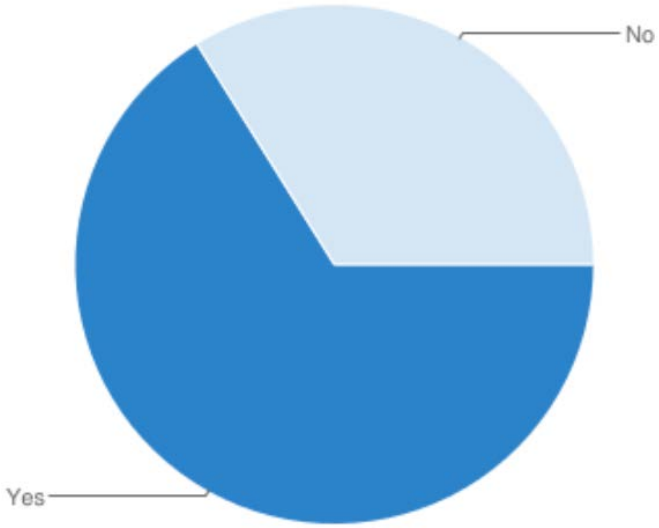
| Has Enterprise Architecture | Manufacturing | Retail | Services | Telecom | Other |
|---|---|---|---|---|---|
| **No** | 178 (9,7%) | 361 (19,7%) | 175 (9,6%) | 120 (6,6%) | 84 (4,6%) |
| **Yes** | 163 (13,1%) | 381 (30,5%) | 103 (8,3%) | 31 (2,5%) | 94 (7,5%) |
| **Difference** | 3,4 pp | 10,8 pp | 1,3 pp | 4,1 pp | 2,9 pp |
| **Change** | +35,05% | +54,82% | -13,54% | -62,2% | +63,04% |

# 6. Results

## 6.1. Survey

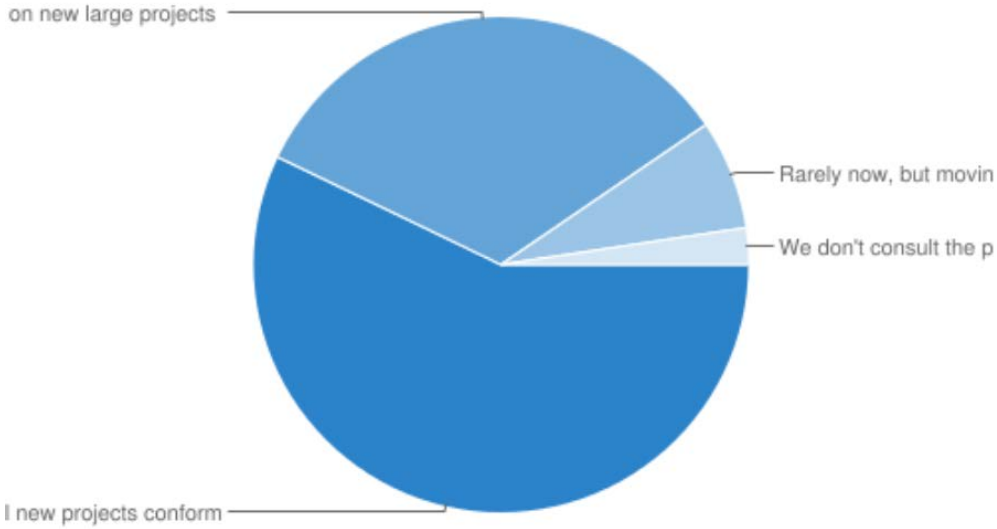
The survey has been set up using Dezider, a survey tool of The Standish Group International, and has been sent to project/program managers of a 1,000 organizations. Of these 1,000 we got 62 responses (6,2%). The result of the survey is as follows:

### 6.1.1. Question 1. Do you have an Enterprise Architecture?



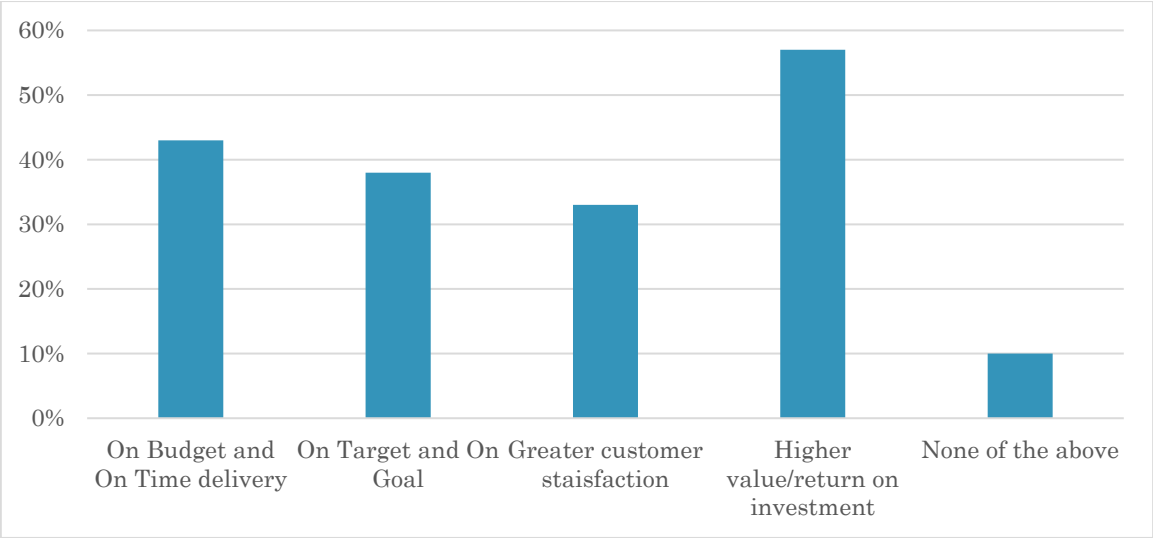

| | |
|---|---|
| Yes | 66% |
| No | 34% |

### 6.1.2. Question 2. How often do your IT projects conform to your Enterprise Architecture?




| | |
|---|---|
| All new projects conform | 57% |
| Mostly on new large projects | 33% |
| Rarely now, but moving in that direction | 7% |
| We don't consult the principles | 2% |

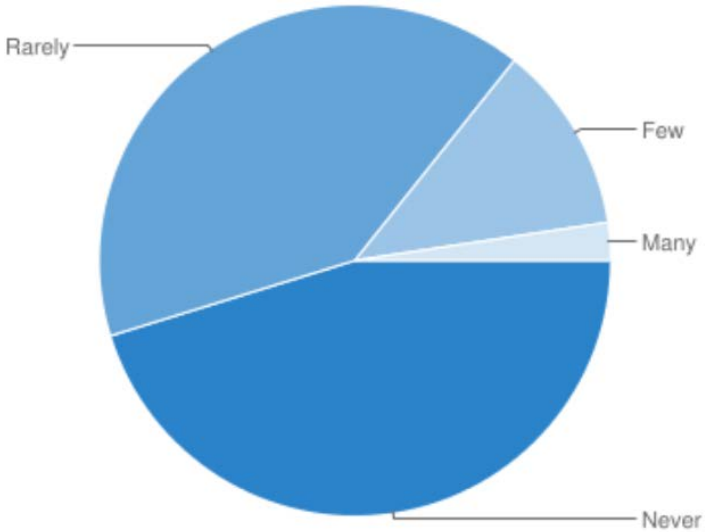
### 6.1.3. Question 3. In your opinion, which aspects of projects does Enterprise Architecture improve?




| | |
|---|---|
| On Budget and On Time delivery | 43% |
| On-Target (scope) and On Goal (strategy) | 38% |
| Greater customer satisfaction | 33% |
| Higher value/return in investment | 57% |
| None of the above | 10% |

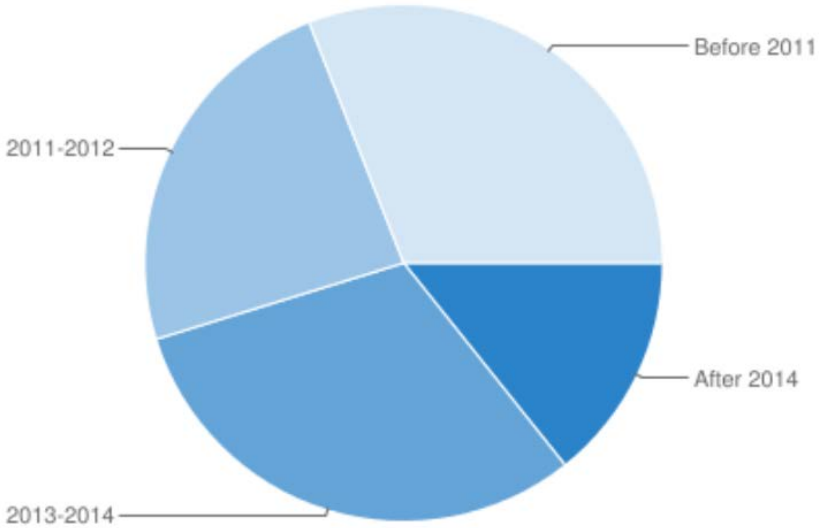
While just 10% of the respondents thought that EA has totally no positive effect on projects, we can find that only "Higher value/return in investment" is selected by more than 50% of the respondents.

### 6.1.4. Question 4. How often do projects violate Enterprise Architecture principles?




| | |
|---|---|
| Never | 45% |
| Rarely | 40% |
| Few | 12% |
| Many | 2% |

### 6.1.5. Question 5. From what year were your project subjected to the Enterprise Architecture?




| | |
|---|---|
| After 2014 | 14% |
| 2013-2014 | 31% |
| 2011-2012 | 24% |
| Before 2011 | 31% |

## 6.2. CHAOS Database

### 6.2.1. Influence of EA with modern resolution of projects

In the following table we're looking at the modern resolution of project success (On Time, On Budget, a satisfied customer), which we discussed in point 3.5.2.2.

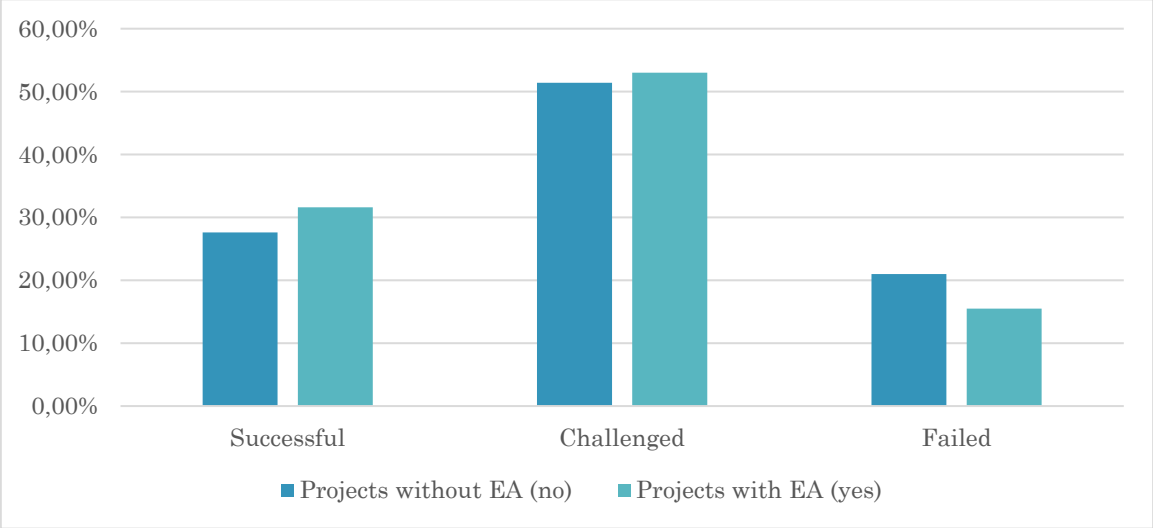



*Table 8 Project end state using alternate resolution*

| Has Enterprise Architecture | Successful | Challenged | Failed |
|---|---|---|---|
| **No** | 505 (27,6%) | 939 (51,4%) | 384 (21,0%) |
| **Yes** | 394 (31,6%) | 661 (53,0%) | 193 (15,5%) |
| **Difference** | 4 pp | 1,6 pp | 5,5 pp |
| **Change** | +14,5% | +3,1% | -26,2% |

We see an increase of 14,5% of successful projects, and a decrease of 26,2% of failed projects when the organization has an Enterprise Architecture.

### 6.2.2. Influence of EA with traditional resolution of projects

In the following table we are scoring projects using traditional resolution of project success (On Time, On Budget and On Target), which we discussed in point 3.5.2.1.

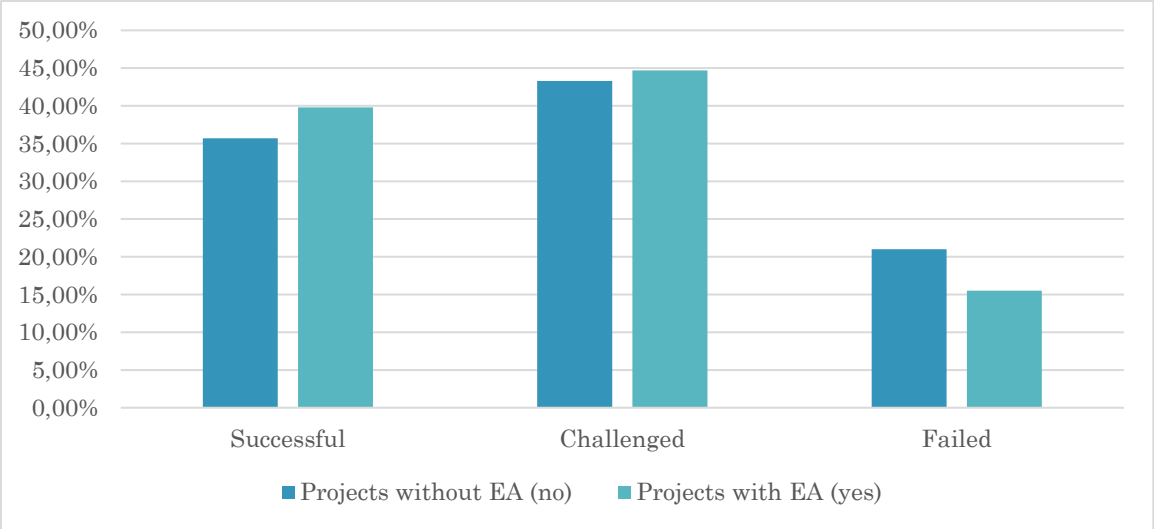



*Table 9 Project end state using traditional resolution*

| Has Enterprise Architecture | Successful | Challenged | Failed |
|---|---|---|---|
| **No** | 653 (35,7%) | 791 (43,3%) | 384 (21,0%) |
| **Yes** | 497 (39,8%) | 558 (44,7%) | 193 (15,5%) |
| **Difference** | 4,1 pp | 1,4 pp | 5,5 pp |
| **Change** | +11,5% | +3,2% | -26,2% |

We can discern an increase of 11,48% of successful projects, and a decrease of 26,19% of failed projects for the organizations with an Enterprise Architecture.

### 6.2.3. The value of the projects

The table below shows the range in value on a five-point scale from very high value to very low value.

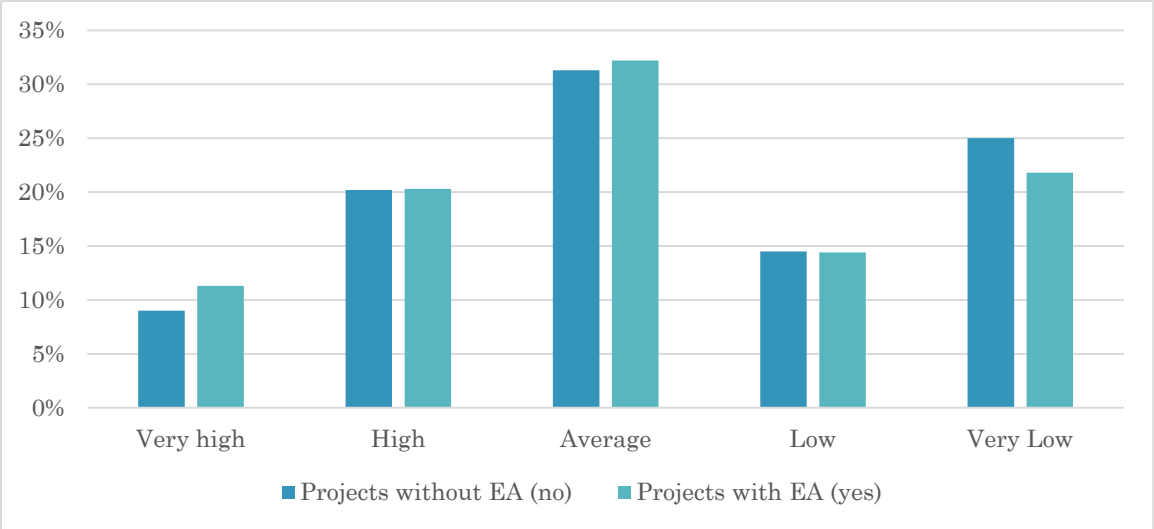



*Table 10 Value of projects*

| Has Enterprise Architecture | Very high | High | Average | Low | Very Low |
|---|---|---|---|---|---|
| **No** | 164 (9,0%) | 369 (20,2%) | 573 (31,3%) | 265 (14,5%) | 457 (25,0%) |
| **Yes** | 141 (11,3%) | 253 (20,3%) | 402 (32,2%) | 180 (14,4%) | 272 (21,8%) |
| **Difference** | 2,3 pp | 0,1 pp | 0,9 pp | 0,1 pp | 3,2 pp |
| **Change** | +25,6% | +0,5% | +2,9% | -0,7% | -12,8% |

We can see an increase in the amount of projects with very high value by 25,56% and a decrease of projects with very low value by 12,8% for the organizations with an Enterprise Architecture.

### 6.2.4. Satisfaction of users/customers with the project

The table below shows the range in satisfaction on a five-point scale from very satisfied to not satisfied.

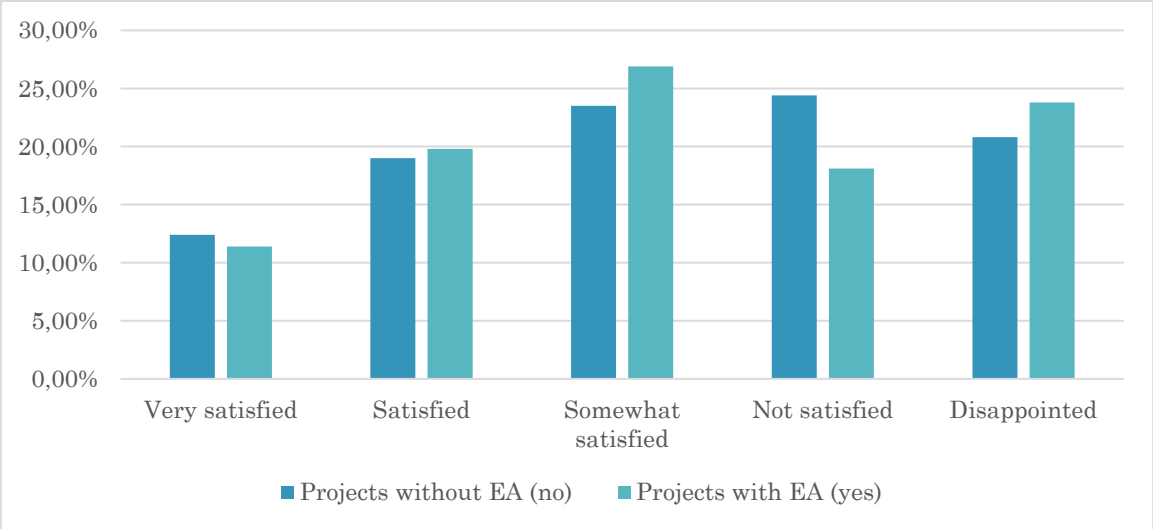



*Table 11 Satisfaction of customers with project*

| Has Enterprise Architecture | Very satisfied | Satisfied | Somewhat satisfied | Not satisfied | Disappointed |
|---|---|---|---|---|---|
| **No** | 226 (12,4%) | 347 (19,0%) | 429 (23,5%) | 446 (24,4%) | 380 (20,8%) |
| **Yes** | 142 (11,4%) | 247 (19,8%) | 336 (26,9%) | 226 (18,1%) | 297 (23,8%) |
| **Difference** | 1 pp | 0,8 pp | 3,4 pp | 6,3 pp | 3 pp |
| **Change** | -8,1% | +4,2% | +14,5% | -25,8% | +14,4% |

Interestingly, we see a decrease of projects scored as 'very satisfied' with 8%, and an increase in projects scored as 'disappointed' with 14,4%.

However if we put 'very satisfied' and 'satisfied' together, and do the same with 'not satisfied' and 'disappointed', as visualized with the table below, we can merely discern a difference in the positive ranges, but see a decrease of 7,3% in the negative ranges.

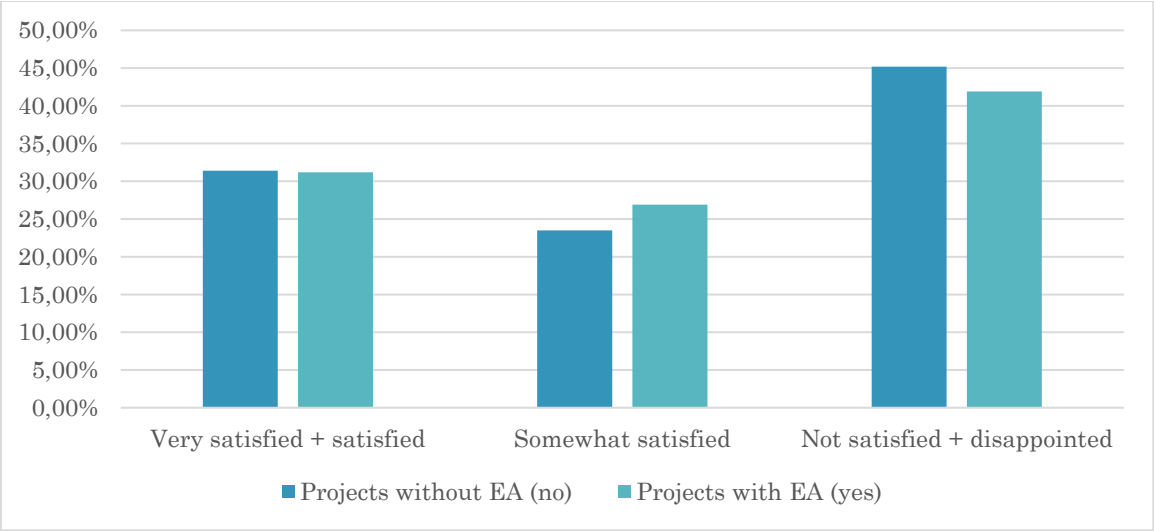



*Table 12 Satisfaction of customers with project (merged)*

| Has Enterprise Architecture | Very satisfied + satisfied | Somewhat satisfied | Not satisfied + disappointed |
|---|---|---|---|
| **No** | 573 (31,4%) | 429 (23,5%) | 826 (45,2%) |
| **Yes** | 389 (31,2%) | 336 (26,9%) | 523 (41,9%) |
| **Difference** | 0,2 pp | 3,4 pp | 3,3 pp |
| **Change** | -0,6% | +14,5% | -7,3% |

So while we see an general move of projects going from 'disappointed' and 'not satisfied' to 'somewhat satisfied', which is a slight improvement, there is a 14,4% increase in projects being scored as 'disappointed'.

### 6.2.5. Projects on goal

Goal is measured on a five-point scale. See point 3.5.1.2 for the definition of 'on goal'.

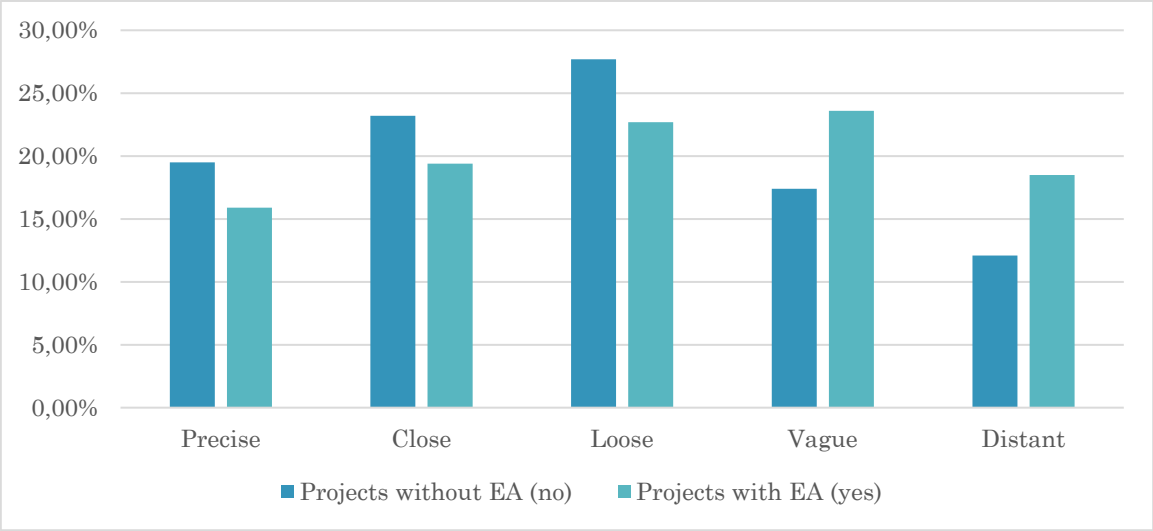



*Table 13 Projects on goal*

| Has Enterprise Architecture | Precise | Close | Loose | Vague | Distant |
|---|---|---|---|---|---|
| **No** | 357 (19,5%) | 425 (23,2%) | 506 (27,7%) | 318 (17,4%) | 222 (12,1%) |
| **Yes** | 198 (15,9%) | 242 (19,4%) | 283 (22,7%) | 294 (23,6%) | 231 (18,5%) |
| **Difference** | 3,6 pp | 3,8 pp | 5 pp | 6,2 pp | 6,4 pp |
| **Change** | -18,5% | -16,4% | -18,1% | +35,6% | +35,6 |

### 6.2.6. Projects on budget

This is a yes or no binary question. See point 3.5.1.1 for the definition of 'on budget'.

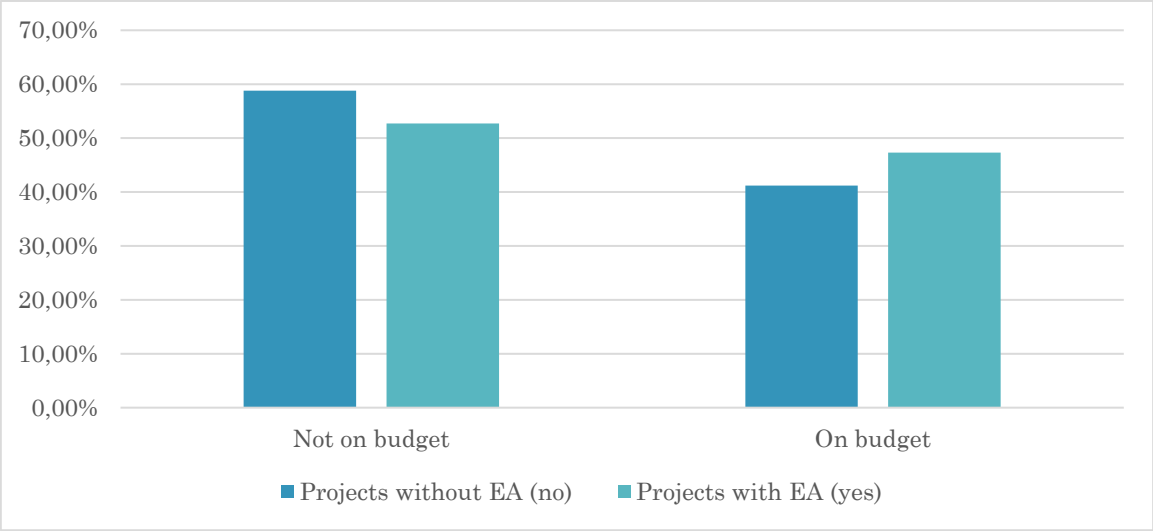



*Table 14 Projects on budget*

| Has Enterprise Architecture | Not on budget | On budget |
|---|---|---|
| **No** | 1057 (58,8%) | 753 (41,2%) |
| **Yes** | 658 (52,7%) | 590 (47,3%) |
| **Difference** | 6,1 pp | 6,1 pp |
| **Change** | -10,4% | +14,8% |

### 6.2.7. Projects on time

This is a yes or no binary question. See point 3.5.1.1 for the definition of 'on time'.

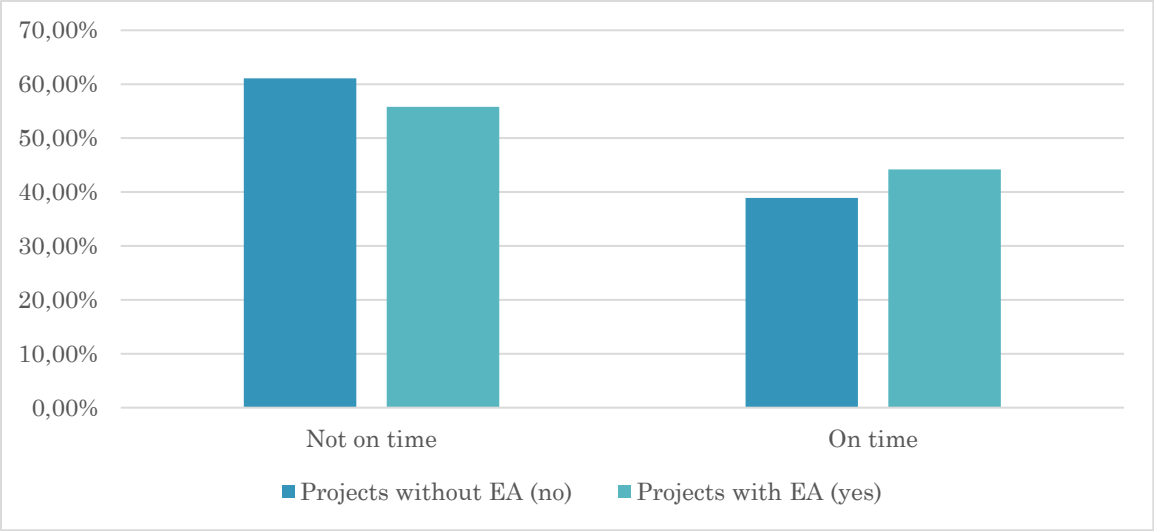



*Table 15 Projects on time*

| Has Enterprise Architecture | Not on time | On Time |
|---|---|---|
| **No** | 1117 (61,1%) | 711 (38,9%) |
| **Yes** | 658 (55,8%) | 552 (44,2%) |
| **Difference** | 5,3 pp | 5,3 pp |
| **Change** | -8.7% | +13.6% |

### 6.2.8. Projects on target

This is a yes or no binary question. See point 3.5.1.1 for the definition of 'on target'.

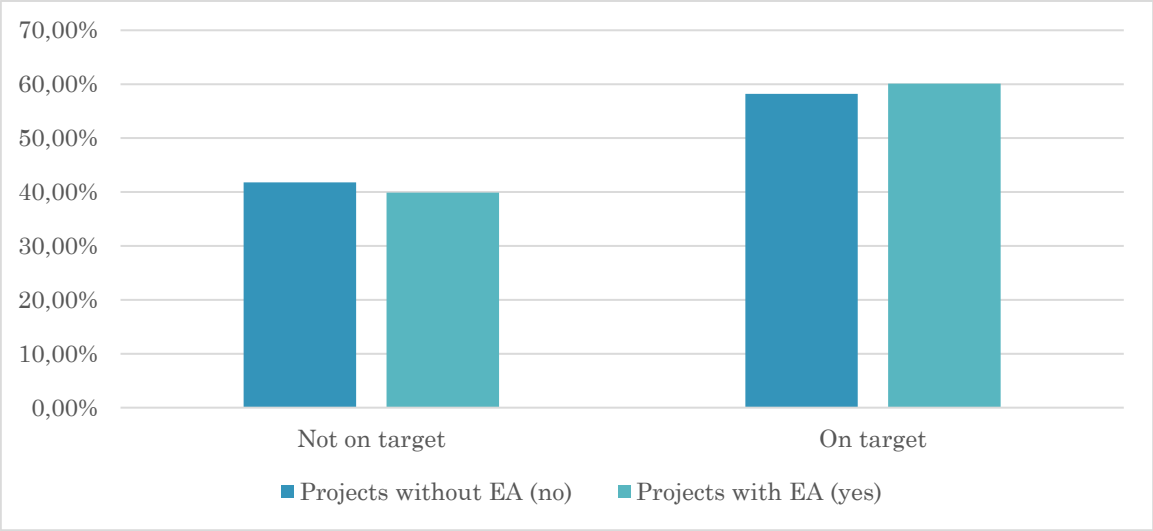



*Table 16 Projects on target*

| Has Enterprise Architecture | Not on target | On target |
|---|---|---|
| **No** | 765 (41,8%) | 1063 (58,2%) |
| **Yes** | 498 (39,9%) | 750 (60,1%) |
| **Difference** | 1,9 pp | 1,9 pp |
| **Change** | -4,5% | +3,3% |

### 6.2.9. Success rate of small projects with modern resolution

A total of 859 projects qualify as small projects. Of these, 467 projects where executed without EA and 392 projects with EA.

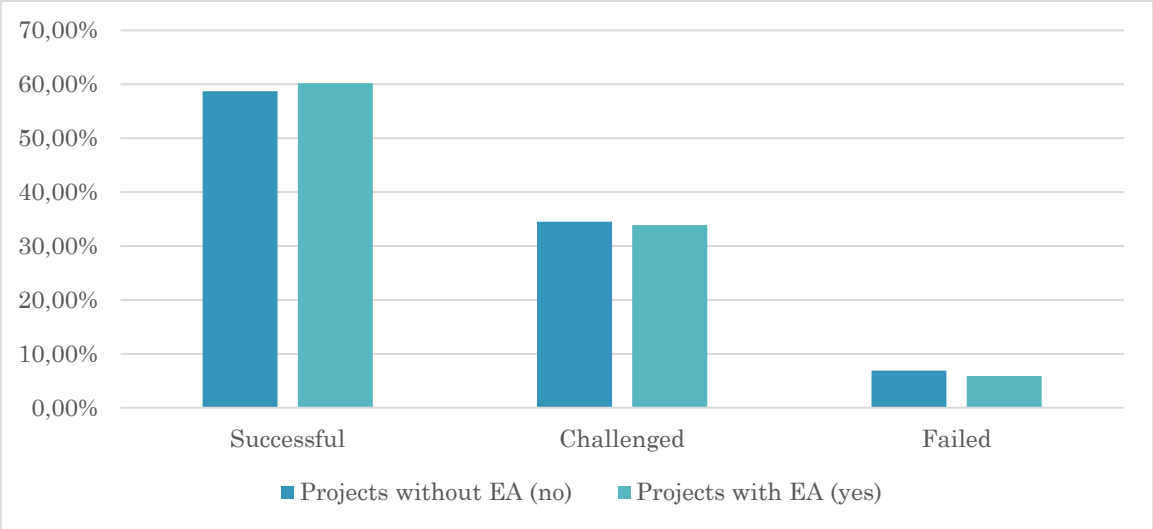



*Table 17 Project end state of small projects*

| Has Enterprise Architecture | Successful | Challenged | Failed |
|---|---|---|---|
| **No** | 274 (58,7%) | 161 (34,5%) | 32 (6,9%) |
| **Yes** | 236 (60,2%) | 133 (33,9%) | 23 (5,9%) |
| **Difference** | 1,5 pp | 0,6 pp | 1 pp |
| **Change** | +2,6% | -1,7% | -14,5% |

### 6.2.10. Success rate of medium & moderate sized projects with modern resolution

A total of 1501 projects qualify as medium or moderate sized projects. Of these, 905 projects where executed without EA and 596 projects with EA.

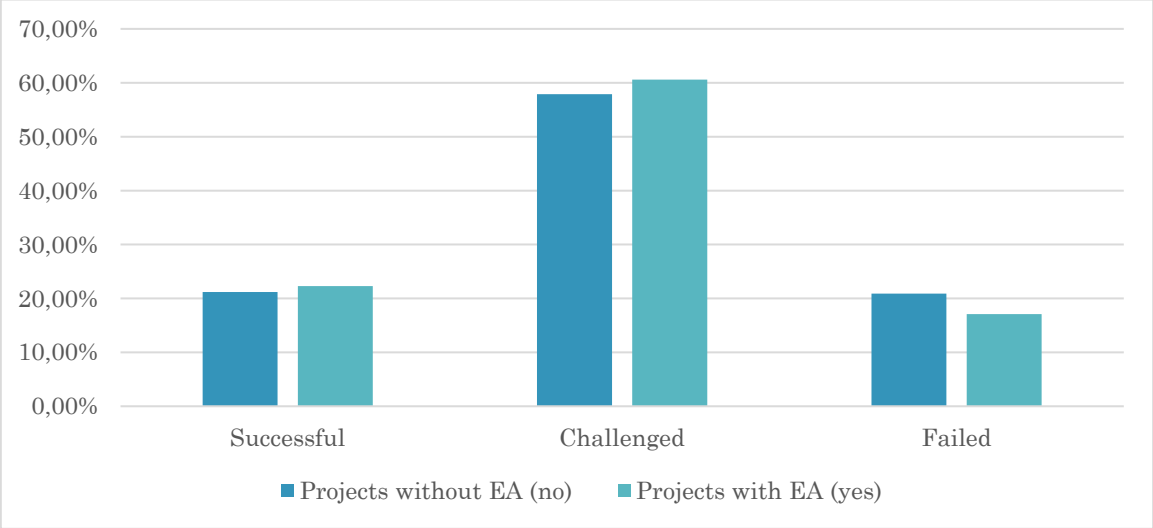



*Table 18 Project end state of medium or moderate sized projects*

| Has Enterprise Architecture | Successful | Challenged | Failed |
|---|---|---|---|
| **No** | 192 (21,2%) | 524 (57,9%) | 189 (20,9%) |
| **Yes** | 133 (22,3%) | 361 (60,6%) | 102 (17,1%) |
| **Difference** | 1,1 pp | 2,7 pp | 3,8 pp |
| **Change** | +5,2% | +4,7% | -18,2% |

### 6.2.11. Success rate of large and grand projects with modern resolution

A total of 716 projects qualify as large and grand projects. Of these, 456 projects where executed without EA and 260 projects with EA.

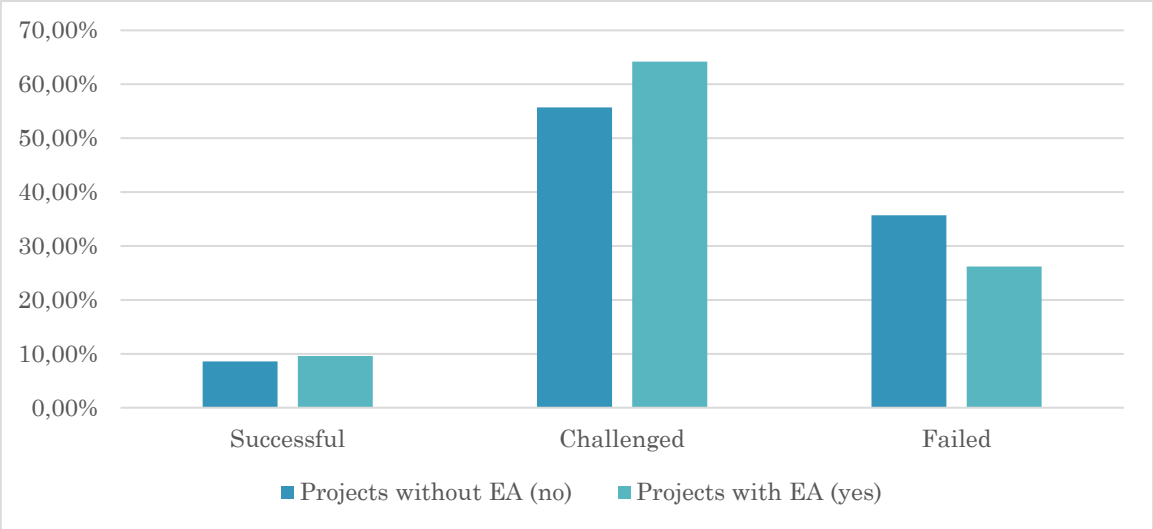



*Table 19 Project end state of large and grand projects*

| Has Enterprise Architecture | Successful | Challenged | Failed |
|---|---|---|---|
| **No** | 39 (8,6%) | 254 (55,7%) | 163 (35,7%) |
| **Yes** | 25 (9,6%) | 167 (64,2%) | 68 (26,2%) |
| **Difference** | 1 pp | 8,5 pp | 9,5 pp |
| **Change** | +11,6% | +15,3% | -26,6% |

### 6.2.12. Success rate of only grand projects with modern resolution

A total of 228 projects qualify as large and grand projects. Of these, 155 projects where executed without EA and 73 projects with EA.

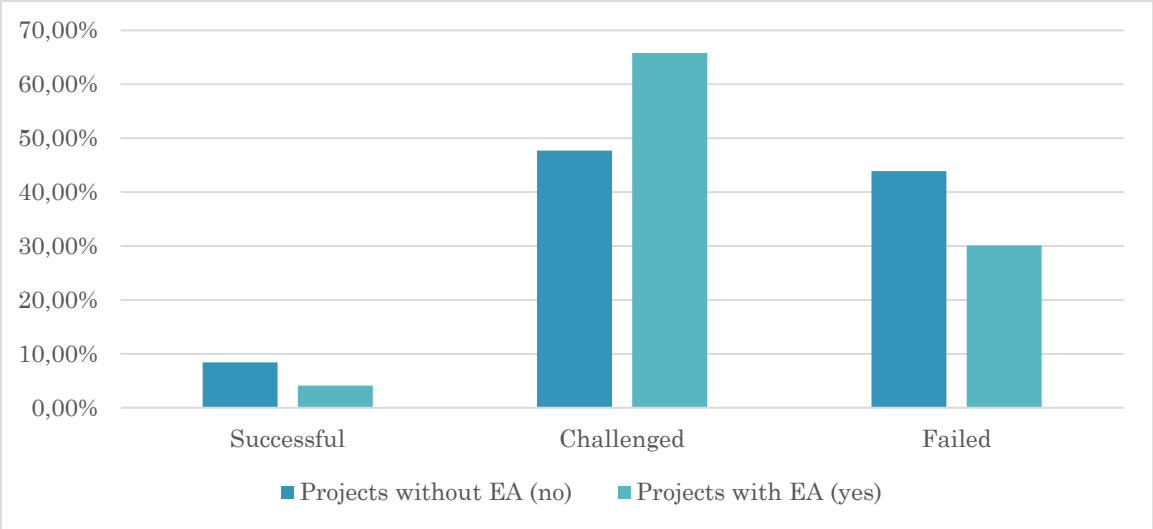



*Table 20 Project end state of grand projects*

| Has Enterprise Architecture | Successful | Challenged | Failed |
|---|---|---|---|
| **No** | 13 (8,4%) | 74 (47,7%) | 68 (43,9%) |
| **Yes** | 3 (4,1%) | 48 (65,8%) | 22 (30,1%) |
| **Difference** | 4,3 pp | 18,1 pp | 13,8 pp |
| **Change** | -51,2% | +37,9% | -31,4% |

# 7. Discussion

The first results from the survey looked promising. Of the respondents who had an Enterprise Architecture only 10% of the respondents thought that EA would bring no value at all, which means that 90% of the respondents thought EA would bring value to the table for projects. These results were in line with our hypothesis.

When investigating the 3076 projects executed by these 28 organizations, we also saw indications of advantages. When looking at the project end state, using the Modern Resolution (see section 3.5.2) we see an increase of 14,5% of successful projects, and a decrease of 26,2% of failed projects when the organization has an Enterprise Architecture. These results also came back using the traditional resolution: we could discern an increase of 11,48% of successful projects, and a decrease of 26,19% of failed projects for the organizations with an Enterprise Architecture. The slight difference between these resolutions is explained by the use of a different indicator. The traditional resolution measures the 'On Target' indicator, whereas the Modern Resolution measures the customer satisfaction.

## 7.1. Tentative indications

### 7.1.1. Less failed projects after the introduction of EA

Over the whole line we can see a decrease in the amount of failed projects after the introduction of EA, with an average decrease of 5,5 percent points or 26,2%.

### 7.1.2. More successful projects after the introduction of EA

We also see an increase in the amount of successful projects, with an average increase of 4 percent points or 14,5%.

There is an exception for grand projects where we see a decrease of successful projects by 4,3 percent points or 51,2%. We will touch this further in point 7.1.6.2.

### 7.1.3. Influence on traditional indicators

We see an increase of 1,9 pp or 3,9% of projects which are on target, a 5,3 pp or 13,6% increase of projects delivered on time, and a 6,1 pp or 14,8% increase of projects on budget.

These observations seem to (partly) support the findings of Dr. Slot (point 4.3.1), so were not unexpected.

### 7.1.4. Influence on modern indicators

#### *7.1.4.1. Less on goal*

We were rather surprised with the results of the On Goal indicator (see Table 13). As principles add to the requirements of the projects, we would expect the project goals to become more clear. We see an opposite effect after the introduction of EA; project goals become more vague & distant and less precise & clear.

While The Standish Group sees this as a positive thing (elaborated in point 3.5.3), it is hard to imagine that EA is the cause of this. There might be other variables at play here like the development process (agile versus waterfall), which we didn't investigate. We don't know either how much this variable or variables effect the rest of our research. Of course there could be principles which guide software development projects to more agile

methods, but this is just speculation. Is this an effect or a cause? In any case, further research is necessary.

#### *7.1.4.2. Satisfaction*

We don't observe more projects with a satisfactory result, but do observe less projects with unsatisfactory results. However, the amount of projects with a truly disappointing result did increase.

#### *7.1.4.3. More value*

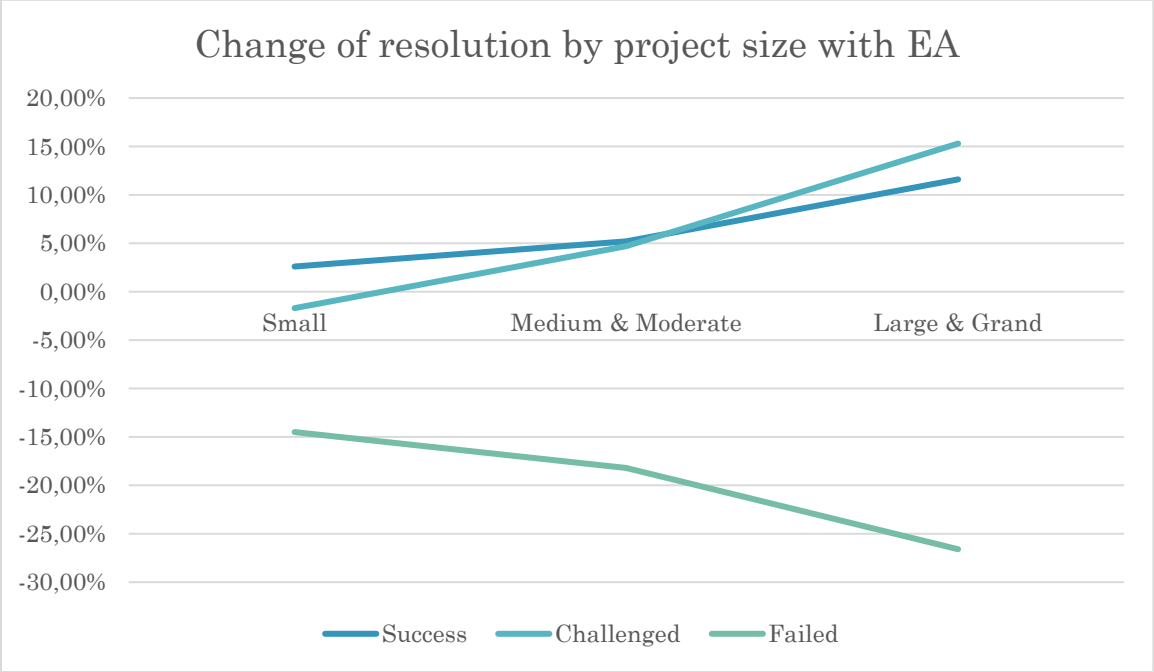
We can see an increase in the amount of projects with very high value by 2,3 pp or 25,56% and a decrease of projects with very low value by 3,2 pp or 12,8% for the projects subjected to Enterprise Architecture.

### 7.1.5. The larger the projects get, the less successful they become

The relative amount of successful projects decreases the larger the projects get, which is on par with the observations of The Standish Group (The Standish Group International, Inc., 2016).

### 7.1.6. The larger the project size, the more value EA has (until a certain point)

Although the success of projects drops the larger they get, apparently, the larger the projects gets, the more value EA has (with grand projects as an exception).




We observe that with the introduction of EA the percent change of successful and challenged projects positively increases going from small up to large & grand projects.

At the same time, we see a decrease in failed projects going from small to large & grand projects.

#### *7.1.6.1. Possible explanation*

We can assume that the larger the project gets, the more requirements and the bigger designs get. We speculate that with a larger design, the value of EA becomes more

apparent, because the larger a design gets it will be subjected to more principles that guide the design.

The Enterprise Architecture most likely has more effect on the design of the system to be developed, then on the project process to realize the system. This is shown in the GSDP model, as discussed in section 3.2.3, where architecture touches the function and constructional design, but not the engineering & implementation.

#### *7.1.6.2. Exception for Grand projects*

As you can see in Table 20, if we look at grand projects alone, we see a more than 50% decrease in successful projects. Research by The Standish Group already indicate that only 5% of the Grand projects are successful (The Standish Group International, Inc., 2016). Maybe this size of projects might not even be helped by EA because of the sheer amount of requirements which might conflict with existing principles. Have we passed some critical border? In any case, this requires more research into the matter.

## 7.2. Comparison with Thesis Dr. Slot

We also compare our preliminary findings with the findings of Dr. Slot:

*Table 21 Findings comparison with Thesis Dr. Slot*

| Indicator | Thesis Dr. Slot | Our research |
|---|---|---|
| **On Budget** | 19% decrease in project budget overrun | 4,5% decrease in projects with budget overrun |
| **On Time** | 40% decrease in project time overrun | 8,7% decrease in projects with time overrun |
| **Satisfaction** | Increased customer satisfaction, with 0.5 to 1 point – on a scale of 1 to 5 | 7,3% reduction in unsatisfied customers & no increase is satisfied customers |
| **On Target** | 10% increase of results delivered | 3,3% increase of projects on target |

The difference in results could be explained by the amount of investigated projects (3076 vs 29 software development projects) and the size of the projects included in the study. Our study includes a much larger amount of large projects, which inherently are less successful than small projects.

That said, as our findings are only indicative and not conclusive, we refrain ourselves of reviewing & validating his results.

## 7.3. Critical reflections

While the findings in this research are most interesting, they only provides indicative and tentative answers for the research question. For a more conclusive & definitive answer much more research has to be done, which would transcend a Master thesis. We make the following critical observations and reflections for our research:

### 7.3.1. Control group

As we don't have a control group (organizations which didn't implement an EA) we cannot make any definitive conclusions. While we are looking at exactly the same organizations before & after the introduction of EA, which allows us to say something with some significance, however we cannot be sure that the improvements we see can completely be attributed to EA. As the projects with an EA have been executed at a later time then the projects without an EA (implicitly by this research), other factors (like improved organizational emotional maturity, better project management, improved staff skills,…) could also play a role. This must be further researched.

### 7.3.2. Agreement on definitions

As there is no major agreement on the quiddity of Enterprise Architecture by practitioners and academics alike, we had to make a stance on what we would use as a definition in this research (we used the EE theory). In the survey we asked if the organization had an EA, and we gave our definition of EA with that question. However it is still possible that a respondent could have answered positively on that question while having another idea on EA and ignoring our definition. We didn't validate this afterwards.

### 7.3.3. Quality of principles

In section 3.1.1.2, we've written about the quality of principles, and stated what we understand with good principles. We did not investigate the quality of the principles of the 28 organizations, as this was not the intent of this study. However, an organization with (a lot of) bad principles could influence the results.

### 7.3.4. Reliability of the used data

While The Standish Group International is a professional organization and its adjudicators are scrupulous in examining the projects sent in by members, the CHAOS database is not an academic database and hasn't been scientifically validated yet.

### 7.3.5. Validity

We are not yet certain if we managed to identify the influence of all other variables in order to isolate the influence of Enterprise Architecture.

Project Size, being one of the largest influences on project success, is fairly well managed. We observed a large change in project size when comparing projects before and after the introduction of EA (more small projects and less large and grand projects). As discussed in section 3.5.3, on critical success factors for projects, we discerned that the project size has a very large influence on project success. To rule out this variable, we looked at the Modern Resolution of each project size. The results can be found in Table 17, Table 18, Table 19 and Table 20.

That said, we cannot explain the effect on the 'On Goal' indicator to our satisfaction. Are there other, second order, effects at play? Further research is necessary.

## 7.4. Opportunities for research

This research has provided significant indications of the value of Enterprise Architecture, however we don't have conclusive evidence yet.

A first follow-up study could scientifically validate the CHAOS database of the Standish Group. Are the processes used scientifically sound? Is the data completely reliable and valid?

A necessary addition to this study would be to introduce a control group, in order to further isolate the influence of EA and to enhance and validate the quality. This could be done by finding similar organizations which don't have an Enterprise Architecture, and to compare the result of the projects.

While we used the definition and practice concerning Enterprise Architecture of the EE/EG theory, there are many other definitions and practices in use in the world. It would be great to be able to compare different approaches to EA to each other, and see if this has an influence on the results.

The agile software development process has interactions with EA during the whole project, while in waterfall projects the design happens mostly up front, so the interactions with EA as well. Does this influence the end result?

In our study we concentrated on IT (software development projects), while IT is just one of the enterprise design domains. It would be interesting to see the influence on Business, Organizational and Information projects as well.

# 8. Implications

## 8.1. Implications for practice

While the findings hint that there might be (significant) value in EA for IT projects, this is still explorative research. This means we cannot make any conclusive recommendations yet.

## 8.2. Implications for research

As this research gives significant indications for value of Enterprise Architecture on IT projects, it is imperative that this should be further investigated in order to provide a definitive and conclusive answer.

# 9. Conclusions

In this study, we contribute to the research on the value of Enterprise Architecture by providing explorative empirical indications for the effects of Enterprise Architecture on IT projects. These findings assist an understanding about the various effects of EA. In summation, our study provides strong indications for the value of Enterprise Architecture on IT projects and sets the foundation for further study in the matter.

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