Enterprise Architecture Adoption Method for Higher Education Institutions

By

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Declaration

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

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Abstract

During the last few years Enterprise Architecture has received increasing attention among industry and academia. Enterprise Architecture (EA) can be defined as (i) a formal description of the current and future state(s) of an organisation, and (ii) a managed change between these states to meet organisation's stakeholders' goals and to create value to the organisation. By adopting EA, organisations may gain a number of benefits such as better decision making, increased revenues and cost reductions, and alignment of business and IT.

To increase the performance of public sector operations, and to improve public services and their availability, the Finnish Parliament has ratified the Act on Information Management Governance in Public Administration in 2011. The Act mandates public sector organisations to start adopting EA by 2014, including Higher Education Institutions (HEIs). Despite the benefits of EA and the Act, EA adoption level and maturity in Finnish HEIs are low. This is partly caused by the fact that EA adoption has been found to be difficult. Thus there is a need for a solution to help organisations to adopt EA successfully.

This thesis follows Design Science (DS) approach to improve traditional EA adoption method in order to increase the likelihood of successful adoption. First a model is developed to explain the change resistance during EA adoption. To find out problems associated with EA adoption, an EA-pilot conducted in 2010 among 12 Finnish HEIs was analysed using the model. It was found that most of the problems were caused by misunderstood EA concepts, attitudes, and lack of skills. The traditional EA adoption method does not pay attention to these.

To overcome the limitations of the traditional EA adoption method, an improved EA Adoption Method (EAAM) is introduced. By following EAAM, organisations may increase the likelihood of successful EA adoption. EAAM helps in acquiring the mandate for EA adoption from top-management, which has been found to be crucial to success. It also helps in supporting individual and organisational learning, which has also found to be essential in successful adoption.

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Tampere, March 2015

Nestori Syynimaa

“According to Darwin’s Origin of Species, it is not the most intellectual of the species that survives; it is not the strongest that survives; but the species that survives is the one that is able best to adapt and adjust to the changing environment in which it finds itself."

Leon C. Megginson (1963, p. 4)

List of Publications

Syynimaa, N. (2010). HMEF: framework to evaluate merging of Higher Education Institutions – Application of Enterprise Architecture. *NORSA 2010, 3rd Conference of the Nordic Section of the Regional Studies Association.* Seinäjoki, Finland.

Syynimaa, N. (2010). Taxonomy of purpose of Enterprise Architecture *12th International Conference on Informatics and Semiotics in Organisations, ICISO 2010.* Reading, UK.

Riihimaa, J. & Syynimaa, N. (2011). Enterprise Architecture Framework Adoption By Finnish Applied Universities' Network. *EUNIS 2011.* Dublin, Ireland.

Syynimaa, N. (2012). The Art of Shooting the Moving Goal - Explorative Study of EA Pilot. *In:* Nagle, T., ed. 6th European Conference on Information Management and Evaluation, ECIME 2012, September 13-14 2012 Cork, Ireland. Reading, UK: Academic Publishing International Limited, 302-306.

Syynimaa, N. (2012). Enterprise Architecture: The Misunderstood Silver bullet. Widening the Scope of EA.[1]

Syynimaa, N. (2013). Measuring Enterprise Architecture Success: Tentative Model for Measuring EA Implementation Success. *14th International Conference on Informatics and Semiotics in Organisations, ICISO 2013*, Stockholm, Sweden.

Syynimaa, N. (2013). Theoretical Perspectives of Enterprise Architecture. *4th Nordic EA Summer School, EASS 2013.* Helsinki, Finland.

Syynimaa, N. (2015). Modelling the Resistance of Enterprise Architecture Adoption. *17th International Conference on Enterprise Information Systems, ICEIS 2015,* Barcelona, Spain.

[1] Unpublished position paper

Contents

List of Figures

List of Tables

List of Abbreviations

AAPA	The CIO network of Finnish Universities of Applied Sciences
ABS	The Association of Business Schools
ADM	TOGAF Architecture Development Method
AE	Adult Education
AHP	Analytical Hierarchy Process
AR	Action Research
BA	Business Architecture
BPM	Business Process Management
BPMN	Business Process Model and Notation
CAS	Complex Adaptive Systems
CEO	Chief Executive Officer
CIO	Chief Information Officer
CM	Change Management
CRQ	Central Research Question
CSC	Finnish IT Center for Science
DS	Design Science
DSR	Design Science Research
DSRM	Design Science Research Model
DT	Design Theory
DW	Data Warehouse
EA	Enterprise Architecture
EAAM	Enterprise Architecture Adoption Method
EBSE	Evidence-based Software Engineering
EE	Enterprise Engineering
ERA	Excellence in Research for Australia
ERP	Enterprise Resource Planning
FEA	Federal Enterprise Architecture
FINHEEC	Finnish Higher Education Evaluation Council
GEA	Government Enterprise Architecture
GERAM	Generalised Enterprise Reference Architecture and Methodology

GT	Grounded Theory
GTR	Grounded Technological Rule
HEI	Higher Education Institution
IA	Information Architecture
IFEAD	Institute For Enterprise Architecture Developments
IQ	Interviewee Question
ISCED	International Standard Classification of Education
JISC	Joint Information Systems Committee
ICT	Information and Communications Technology
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IM	Information Management
IQ	Interviewer Question
IS	Information System / Information System Science
ISCED	International Standard Classification of Education
ISO	International Organization for Standardization
IT	Information Technology
JISC	Joint Information Systems Committee
KCL	King's College London
KSF	Key Success Factor
LJMU	Liverpool John Moores University
MISQ	MIS Quarterly
MS	Management Sciences
NEAF	National Enterprise Architecture Framework
NHS	National Health Service
OMG	Object Management Group
OSF	Official Statistics of Finland
PE	Performance Expectancy
PEAF	Practical Enterprise Architecture Framework
PM	Project Management / Project Manager
QA	Quality Assurance
QM	Quality Management
REAP	Resistance in Enterprise Architecture Adoption Process
RQ	Research Question

SA	Systems Architecture
SCOR	Supply Chain Operations Reference
SD	System Dynamics
SEAM	Systemic Enterprise Architecture Methodology
SLR	Systematic Literature Review
SME	Small and Medium Enterprise
SMS	Systematic Mapping Study
SOA	Software Oriented Architecture
TA	Technology Architecture
TAM	Technology Acceptance Model
TOGAF	The Open Group Architecture Framework
TQ	Theory Question
TR	Technological Rule
UAS	University of Applied Science, formerly known as Polytechnic
UML	Unified Modelling Language
UTAUT	Unified Theory of Acceptance and Use of Technology
VE	Virtual Enterprise

Chapter 1 Introduction

1.1. Introduction

In the recent years Enterprise Architecture has received a lot of attention by academics and practitioners. This is the case especially in the public sector where, in some countries, Enterprise Architecture is mandatory due legislation. Yet, due to complex nature of public sector, adopting Enterprise Architecture has been found to be challenging (Janssen and Cresswell, 2005; Gregor *et al.*, 2007). The current literature is lacking the solutions for successful adoption, thus there is a need for research focusing on adoption issues and solutions. This thesis contributes to this research gap by presenting the research conducted in Finnish Higher Education sector.

Enterprise Architecture was first introduced as *a framework for information systems architecture* by Zachman (1987). Its purpose was to define and control the interfaces and integration of more and more larger and complex information systems. Since that time, EA has evolved to include also other aspects besides information systems, being more a business issue than IT issue (Ross *et al.*, 2006). Modern EA identifies the main components of the organisation and their relationships, including business processes, staff, information, information systems, and technology (Kaisler *et al.*, 2005). Even Zachman has renamed his *framework for Enterprise Architecture* as the enterprise ontology (Zachman, 2008).

Enterprise Architecture (EA) adoption is an organisational change aiming for realisation of EA benefits, such as increased agility. However, it has been stated that about 70 per cent of organisational change initiatives fail (Hammer and Champy, 1993; Beer and Nohria, 2000b; Kotter, 2008). This thesis aims for increasing the likelihood of success in EA adoption.

This chapter introduces the thesis. First the background and motivation for the research are presented. This is followed by the description of research problem along with the research question and context. Built on this, the research aim and objectives are presented, followed by the key findings and contributions. Finally the structure of the thesis is presented followed by the used notations.

1.2. Background and Motivation

An effective EA is critical to business survival and success (TOGAF, 2009). Indeed, in 21st century EA will be determining factor that separates the successful from the failures, the survivors from the others (Zachman, 1997). EA's purpose is to optimise fragmented legacy processes across the organisation to an integrated environment, enabling responsiveness to changes (TOGAF, 2009). EA has some important strategic outcomes, such as better operational excellence and strategic agility (Ross *et al.*, 2006). Despite these and other benefits to be gained, EA is not widely adopted in organisations (Schekkerman, 2005).

My interest towards EA adoption emerged during my MSc research project from late 2008 to early 2009 (see Syynimaa, 2009). The research was about applying a Government Enterprise Architecture (GEA) to a Finnish Higher Education Institution (HEI). At that time, no EA research on the HEI context were found from the literature.

In early 2010 an EA pilot was started among 12 Finnish HEIs. I participated in the preparation phase of the pilot during 2009 as a consultant, but did not take part in the actual pilot in a consultative role. During the preparation phase, the question was faced: How to adopt EA successfully in Finnish HEIs?

Even though the research question emerged from a practical question, there is also a strong scientific motivation for the research. Preliminary literature review in 2009 revealed no scientific research conducted on EA adoption in HEI context. As the pilot was known to be started in early 2010, a first-hand chance to use the pilot as a source for empirical data was seen scientifically extremely valuable. This meant a unique chance to make novel contribution to the scientific body of knowledge of EA.

A Systematic Literature Review (SLR) conducted on the subject area confirmed that no scientific research on EA adoption in HEI context were found at the beginning of the research project. Also the number of general EA adoption research was low, which calls for a scientific contribution on the subject. The lack of EA adoption research was also motivation for a recently published PhD research by Seppänen (2014) which started back in 2007.

One of the motivating elements for the research was that during 2009 the Finnish Government had plans for making EA mandatory in public sector via legislation. Due to this, the research have had a lot of attention in the Finnish HEI field. The Act was ratified

by the Finnish Parliament in 2011, and it mandates all public sector organisations to adopt EA by 2014 (Finnish Parliament, 2011).

One could question whether there is anything to research in EA adoption in the first place. EA frameworks, such as TOGAF (see TOGAF, 2009), contains methods to be followed to produce EA descriptions, and requirements for EA governance. Moreover, for instance TOGAF has a list of organisational capabilities which are required during EA adoption. However, there are neither instructions nor methods how these capabilities are to be acquired. These aspects are usually out-of-scope of EA frameworks *per se*.

It can be argued that even if there would be de-facto standards to follow and methods to be used, success of EA adoption is not guaranteed. For instance one out of five Enterprise Resource Planning (ERP) implementations have been found to be total failures (Trunick, 1999). One of the latest multi-billion information system failures is the NHS's care record system (Committee of Public Accounts, 2011). Both of these examples are actually instances of information systems. If EA is compared to information system, it can be found being much more complex. Information systems can be regarded as a subset of EA, or a result of its implementation.

In the recent report titled "State of EA work and EA principles in Finnish Higher Education Institutions"[2] (Kella, 2014), some challenges regarding to EA adoption were introduced. According to the report, EA as a concept is vague and has too many interpretations. It is perceived to be too theoretical and without real-life connections. Also, according to the report, co-operation with business and IT should be increased. Even three years after the EA pilot mentioned earlier was ended, the maturity of EA in Finnish HEI sector was low. Thus it can be argued that there is clearly a need for a method to help HEIs to adopt EA. In Finland, the challenges of adopting EA are not limited to the HEIs. According to a survey of a recent PhD research, only 17 % of the respondents (n=49) stated their organisation had completed EA adoption (Seppänen, 2014).

1.3. Research Problem, Question, and Context

In this thesis, the interest in the process of introducing EA to an organisation for the very first time. This kind of process is a one-time, unique, irreversible process that changes the

[2] Translated from the Finnish title: Kokonaisarkkitehtuurin tila ja periaatteet Suomen korkeakouluissa.

organisation. In this thesis, this process is called *Enterprise Architecture adoption*. Research question has emerged from the fact that EA adoption requires a great amount of resources and commitment from all participants, and that it has been found to be difficult (Kella, 2014). As these difficulties are faced in various settings, much of the research efforts have been taken to identify issues related to EA adoption. However, there is a need for solutions to overcome adoption challenges and problems in order to conduct the adoption successfully.

Context of the research is EA adoption in Higher Education Institutions in Finland (see sub-section 5.3.1). In Finland, higher education field is a part of the public sector. It consists of Universities and Universities of Applied Sciences (UASs). UASs are equivalent to UK's post-92 universities.

Given the research problem and context, this research is trying to find an answer to the following question:

> *How can Enterprise Architecture be adopted successfully in Finnish Higher Education Institutions?*

1.4. Research Aim and Objectives

By addressing the research question this research contributes to improving traditional EA adoption process (see section 2.4) using EA pilot among Finnish HEIs (CSC, 2011c) as a source for empirical data. The purpose of this research, therefore, is to improve the adoption process so that the likelihood of successful EA adoption could be increased. The aim of this research is to develop a method of EA adoption based on thorough understanding of issues surrounding EA adoption.

The Design Science (DS) is used as a research approach of the thesis. Research framework used in the thesis is adapted from March and Smith (1995) and is illustrated in Figure 1.1. The framework consists of four research activities, namely *build*, *evaluate*, *theorise*, and *justify*, and of four research outputs, namely *constructs*, *model*, *method*, and *instantiation*.

As seen in Figure 1.1, an EA adoption method was built during the EA pilot and evaluated by instantiating it in practice. The adoption method, however, was built and evaluated in ad-hoc manner and individually by each participating institution. So there were no common adoption methods used among pilot participants. However, a common EA framework, Kartturi (CSC, 2011b), was developed and used during the pilot.

In this thesis the DS approach is followed to improve the traditional EA adoption method. First the nature of EA is studied based on literature, followed by construction of a model explaining the EA adoption process. Using the model, adoption problems are identified by analysing a real-life EA-pilot. To overcome the identified problems a new artefact, the improved EA adoption method, is constructed. Finally, the method is evaluated by a panel of EA experts using a Delphi method.

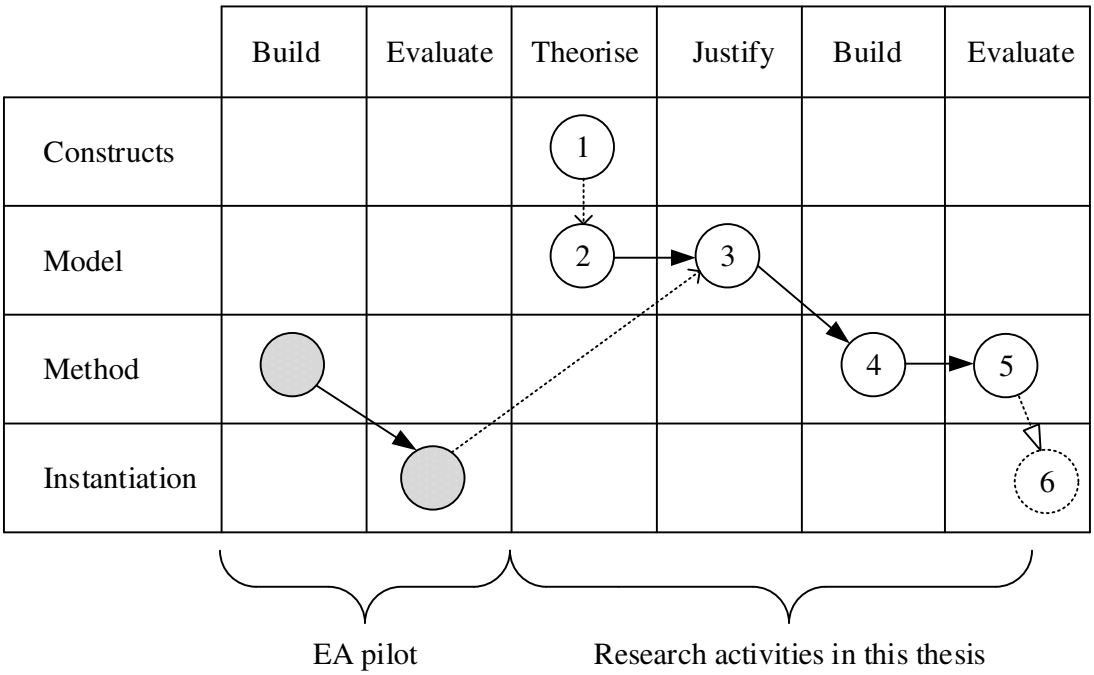


Figure 1.1 Research Framework and Objectives of the Thesis

To accomplish the research aim, following objectives illustrated in Figure 1.1 were set:

Objective 1 To review Enterprise Architecture literature to investigate current body of knowledge of EA and related concepts, and to demonstrate a research gap.

Objective 2 To identify the factors and constructs related to the research gap, and to construct a descriptive model to explain Enterprise Architecture adoption challenges by exploring appropriate theories from literature, informed by outcomes of the 1st objective.

Objective 3 To identify Enterprise Architecture adoption challenges by analysing the empirical data from EA pilot using the constructed model. This objective includes the validation of the model.

Objective 4 To develop a method to overcome Enterprise Architecture adoption challenges identified by the model, by exploring appropriate theories from literature.

Objective 5 To evaluate the method using an appropriate evaluation method.

The 6th step seen in Figure 1.1, instantiation of the method, is out-of-scope of the thesis.

1.5. Key Findings and Contributions

In this section, the key findings or the thesis are presented. First an overall view of the key findings is given, followed by presentation of key contributions in following sub-sections.

Enterprise Architecture (EA) is a concept which can be defined as (i) a formal description of the current state and one or more future states of an organisation, and as (ii) a managed change between these states. One of the activities related to EA is Enterprise Architecture adoption. The strategic level of EA defines what kind of changes the adoption is desired to achieve. These changes, in turn, are causing resistance during the planning and execution phases of the adoption, and thus affecting the actual outcomes.

In the EA pilot among 12 Finnish Higher Education Institutions, most of the resistance during the planning were caused by lack of understanding of EA and related concepts. During the execution phase, resistance were caused by attitudes and lack of EA understanding.

One of the most crucial prerequisite for successful EA adoption is the management buy-in. This can be helped by explaining EA benefits accordingly based on managers' interests and EA knowledge. Organisations' knowledge about EA and related concepts can be increased by training individuals, using a proper leadership style during the training, and by using organisational pressure.

1.5.1. Theoretical Contributions

Van Aken (2004) makes a distinction between description and prescription driven research. The former aims for the explanation resulting to organisation theory, whereas the latter one aims for a solution resulting to management theory. On Gregor's (2006) taxonomy of theory types, the former is of type *explanation* and the latter one of *design and action*.

This thesis contributes to both organisation and management theories of Enterprise Architecture adoption. Resistance during the Enterprise Architecture Adoption Process (REAP) explains the EA adoption from the organisational resistance point-of-view, resulting in an organisation theory. Enterprise Architecture Adoption Method (EAAM) is solution to overcome organisation's change resistance in regards to EA adoption, resulting in a management theory.

This thesis also provides an analysis of EA adoption in Finnish HEIs in 2010. As such, thesis contributes also an *analysis* type of theory on Gregor's taxonomy.

1.5.2. Practical Contribution

The main practical contributions of the thesis are the process descriptions of EAAM. By following the EAAM processes, one may increase the likelihood of successful EA adoption by addressing the resistance caused by the lack of understanding of EA concepts. Also REAP has practical contributions. By utilising REAP, one can identify and prepare for sources of resistance that are not covered by EAAM.

1.6. Structure of the Thesis

Structure of the thesis and objectives are illustrated in Figure 1.2. The contents of chapters are as follows:

Chapter 1. Introduces the thesis, including motivation and background of the research. Main findings and contributions of the thesis are highlighted.

Chapter 2. Introduces key concepts of Enterprise Architecture and theoretical perspectives of it. Purpose of the chapter is give a comprehensive picture of EA and related concepts, and to introduce a theoretical foundation for the thesis.

Chapter 3. Presents a Systematic Literature Review conducted on the subject area. Purpose of the chapter is to demonstrate the current body of knowledge, and a research gap of EA adoption research.

Chapter 4. A discussion about research methodology in general and introduction of methodology applied in this thesis. Purpose of this chapter is to demonstrate the selection process of the research methodology.

Chapter 5. Explains the construction and validation of the *Model of Resistance in EA Adoption Process* (REAP). Also the sources of resistance found from the EA pilot are presented. Purpose of the chapter is to construct a model to explain resistance during the EA adoption. Moreover, by utilising the model, purpose is to reveal sources of resistance from the EA pilot.

Chapter 6. Explains the construction and evaluation of the *EA Adoption Method* (EAAM). Purpose of the chapter is to improve the traditional EA adoption method to minimise the resistance revealed from the EA pilot by REAP.

Chapter 7. Presents the evaluation of the research objectives, methodology, and validity. Presents also the limitations of the thesis.

Chapter 8. Presents the implications to science and practice, suggests future research, and concludes the thesis.

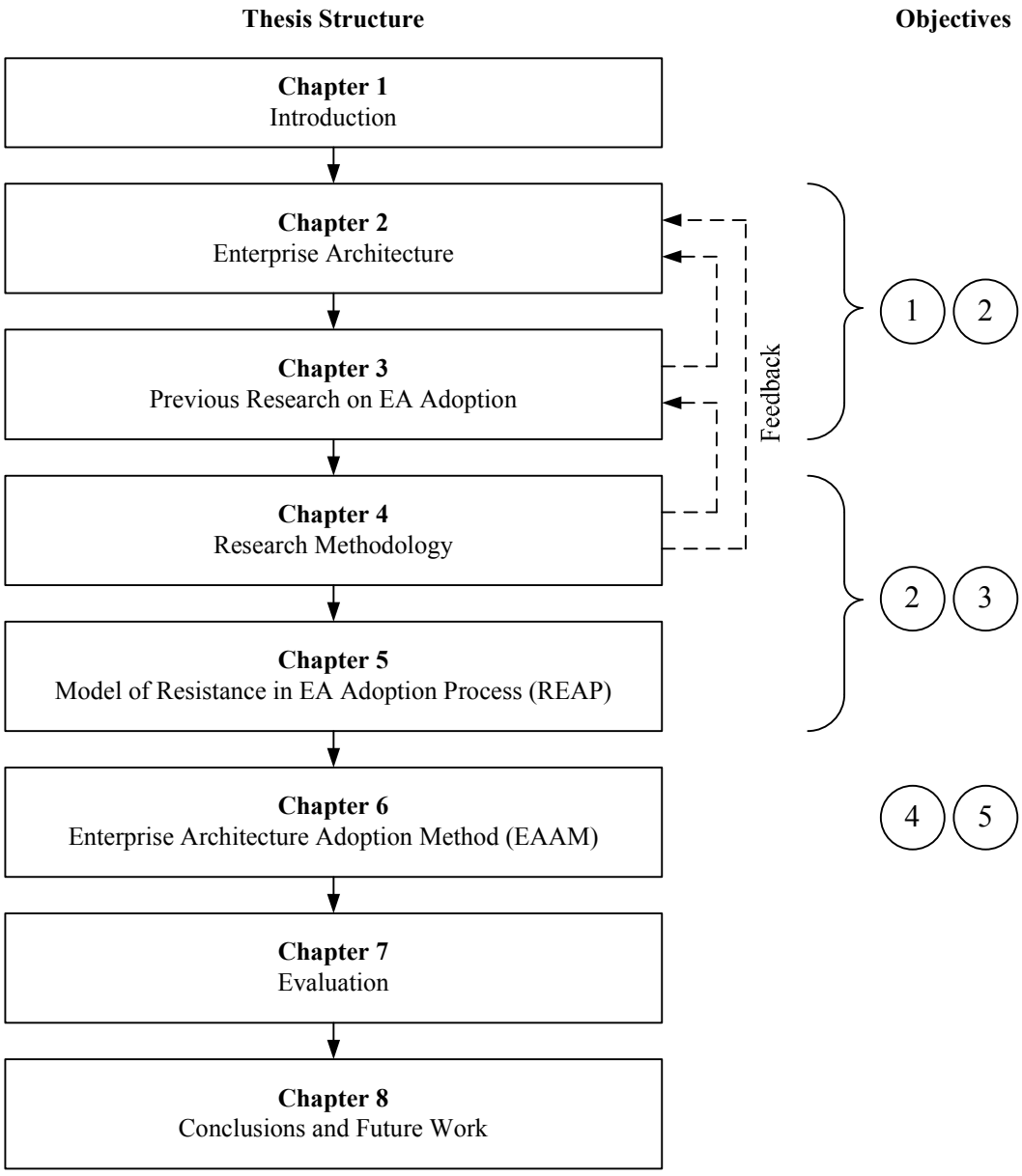


Figure 1.2 Structure and Objectives of the Thesis

1.7. Notations

Most of the text in this thesis is written from a third person's view. Occasionally first person is used. When done so, "I" refers to the author and "we" to the author and reader together.

All figures in the thesis are redrawn, to better understand and learn their content, but also for a common graphical presentation. If any changes are made to the content of figures or tables, the word *adapted* is used on the caption.

Process descriptions presented in the thesis are produced using *Business Process Model and Notation 2.0,* BPMN for short (see OMG, 2011a).

1.8. Summary of Chapter 1

In this chapter, the introduction for the thesis was presented.

Enterprise Architecture has been mandatory for Finnish public sector organisations by legislation since 2011, including Higher Education Institutions. Despite the legislation, the level of EA adoption in Finnish HEIs is still low. EA adoption has been found to be difficult, so there is a need for a solution to help with the adoption. Therefore the research question of this thesis is: *How can Enterprise Architecture be adopted successfully in Finnish Higher Education Institutions?* In order to answer the research question, aim of the research is to develop a method of EA adoption based on thorough understanding of issues surrounding EA adoption.

Design Science approach is followed in achieving the research aim. The thesis provides both theoretical and practical contributions. Main contributions are the REAP model, which explains EA adoption challenges through change resistance, and EAAM method, which helps organisations to minimise resistance during planning and execution of EA adoption.

Chapter 2 Enterprise Architecture

2.1. Introduction

The concept of Enterprise Architecture dates back to late 1980s when John Zachman first introduced it in his article published in IBM Systems Journal (see Zachman, 1987). The purpose of Enterprise Architecture (EA) was originally to solve issues related to complex information systems. Later, it has expanded its scope to include not just the IT, but the whole organisation including strategy and business management. Basic idea of EA is to manage organisation's complexity holistically by analysing the current and planning for the future. In other words, EA aims for organisation level optimisation (Ross *et al.*, 2006).

Adopting EA exposes organisation to number of benefits – if adopted successfully. These benefits includes agility, improved decision making, increased revenues and reduced operational costs. In some countries, these benefits are so highly regarded that EA has been made mandatory in public sector by legislation. This is the case for instance in USA (Office of Management and Budget, 1997) and Finland (Finnish Ministry of Finance, 2011)[3]. Many scholars have researched EA in public sector and found that EA is difficult to adopt (see Chapter 3). This thesis aims to improving the EA adoption method so that the likelihood of successful adoption increases. In order to achieve this, the true nature of Enterprise Architecture needs to be studied.

In this chapter Enterprise Architecture and related concepts are introduced and discussed in detail. First the various definitions of Enterprise Architecture from the literature are presented and discussed, followed by the definitions used in this thesis. Next the nature of EA is explored by examining it from three different theoretical perspectives; EA as a communication media, EA as an activity, and EA as an information technology. After this, the traditional EA adoption process is presented.

[3] For overview of EA in Finnish public sector see: http://vm.fi/en/enterprise-architecture-in-public-sector

2.2. Definitions

Enterprise Architecture has multiple definitions in the current literature. The concept of *Enterprise Architecture* consists of two distinct terms, *enterprise* and *architecture*. In this section, different definitions of these concepts are introduced and discussed. It is acknowledged that the list of definitions presented here is not complete; there are plenty more definitions available. However, definitions presented here are used widely and thus argued to be comprehensive enough to put the research into a context.

2.2.1. Enterprise

Enterprises are social systems with an assumed purpose (Proper, 2013; Dietz *et al.*, 2013). TOGAF (2009, p. 5) defines *enterprise* as "any collection of organizations that has a common set of goals". In ISO/IEC/IEEE 42010:2011 standard, *enterprises* are seen as systems (see Figure 2.1). These systems are "man-made and may be configured with one or more of the following: hardware, software, data, humans, processes (e.g., processes for providing service to users), procedures (e.g. operator instructions), facilities, materials and naturally occurring entities" (ISO/IEC/IEEE, 2011, p. 3). PEAF defines *enterprise* as (2013) follows:

> "The word Enterprise should be interpreted as a general noun - the name of something - to refer to any and all of these types of thing; public and private companies, government agencies, charities, universities etc. This is not an exhaustive list but illustrates the point. In addition the word Enterprise should also be interpreted to mean any name give to any of these types of Enterprises, e.g. a private company may be referred to as a Company, Business, Corporation, Conglomerate, Organisation, SME, Firm, Establishment, Group, Multinational, Venture. The word Enterprise to refers to them all".

In the EA context, the concept of *enterprise* can be generalised to a social system (organisation) having a common set of goals.

2.2.2. Architecture

Zachman (1997) defines *architecture* as "that set of design artifacts, or descriptive representations, that are relevant for describing an object such that it can be produced to requirements (quality) as well as maintained over the period of its useful life (change)". ISO/IEC 42010: 2007 defines *architecture* as ''the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution''. Revised definition in ISO/IEC/IEEE

42010:2011 is "fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution". In TOGAF (2009, p. 9), *architecture* has two meanings depending on the context; (i) "A formal description of a system, or a detailed plan of the system at component level to guide its implementation" and (ii) "The structure of components, their inter-relationships, and the principles and guidelines governing their design and evolution over time".

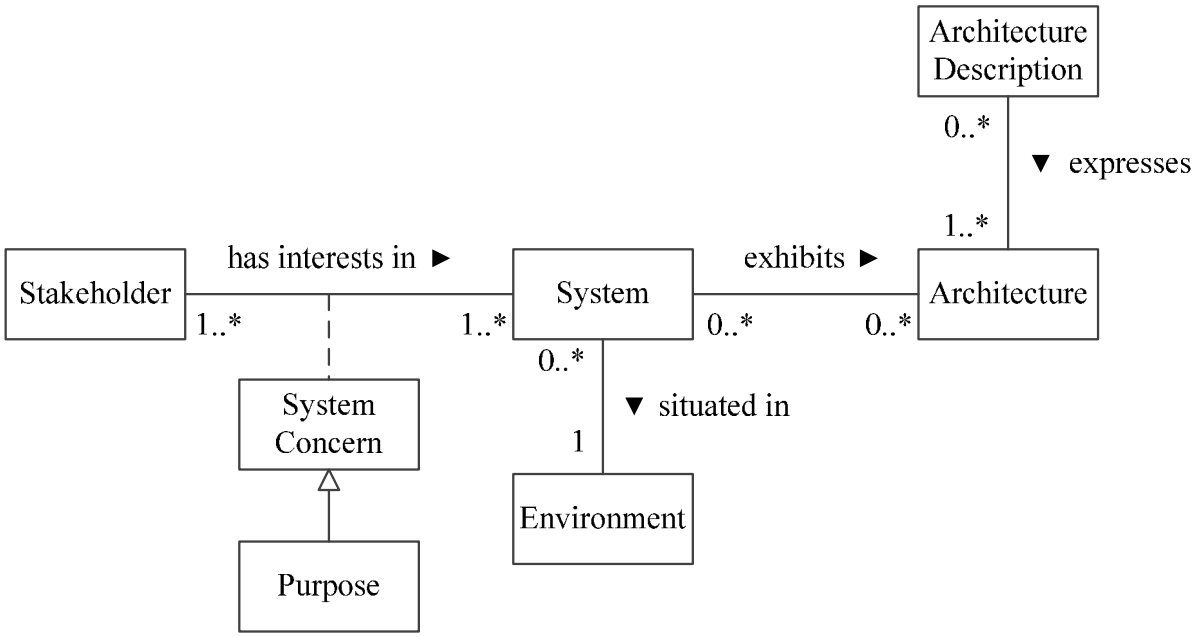


Figure 2.1 Context of Architecture Description (ISO/IEC/IEEE, 2011)

Architecture and its relations to *System* and *Architecture Description*, as stated in ISO/IEC/IEEE 42010:2011, is illustrated in Figure 2.1. The figure is following the UML 2.0 class diagram notation by OMG (2011b). Multiplicity shown on each association end, such as 0..* or 1..*, represents the multiplicity of the particular class in that association. For instance *Architecture* is associated to *Architecture Description* so that there is always at least one *Architecture*, which may have zero to an infinite number of *Architecture Description(s)*. Thus an *Architecture* can exist without any *Architecture Descriptions*.

In the EA context, *architecture* can be generalised to a structure of the enterprise and *architecture description* to its representation.

2.2.3. Enterprise Architecture

As noted earlier, Enterprise Architecture consists of two distinct terms, which together form the concept of Enterprise Architecture. Now that its components are defined, let's put

them together. Federal Chief Information Officer Council of United States (CIO Council, 2001, p. 5) defines *Enterprise Architecture* as

> "a strategic information asset base, which defines the mission, the information necessary to perform the mission and the technologies necessary to perform the mission, and the transitional processes for implementing new technologies in response to the changing mission needs. An enterprise architecture includes a baseline architecture, target architecture, and a sequencing plan".

CIO Council sees EA as a *description* of current and future states of an *architecture*. Moreover, EA is seen as a *process* between these two states of the architecture. Similarly, Gartner (2013) defines *Enterprise Architecture* as

> "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. EA is used to steer decision making toward the evolution of the future state architecture".

Gartner sees EA as a *discipline*, which purpose is to *lead* organisations' towards the future state of the *architecture*. This is achieved by providing *descriptions* to help the decision making. Thus, Gartner's view to EA is a systematic planning and execution, which can also be seen as an *Enterprise Engineering* (EE). EE is a holistic and systematic approach to address enterprise changes (Dietz *et al.*, 2013). GERAM (1999) defines EE as "the collection of those tools and methods which one can use to design and continually maintain an integrated state of the enterprise". As such, GERAM sees EE as a *set of tools* and *methods* to *design* the *architecture*. In Pulkkinen's PhD thesis, *Enterprise Architecture* (2008, p. 46) is summarised as

- The management of the ICT assets as enterprise resources
- Planning developments of these assets and developments enabled with them, like business models, services or processes
- Collaboration of different groups; first and foremost the business and the ICT managers in the enterprise
- Managerial activity, meaning decision making, Recording and describing the ICT resources and evaluating them for the decisions to be made
- Scanning for new technology enablers as part of the environment information the enterprise is collecting for its strategic management
- Planning development steps both for the business and the supporting ICT, according to the strategies of the enterprise.

Pulkkinen's view to EA is a summary of the previous views with one addition: EA is also seen as an *activity* of scanning new technology enablers.

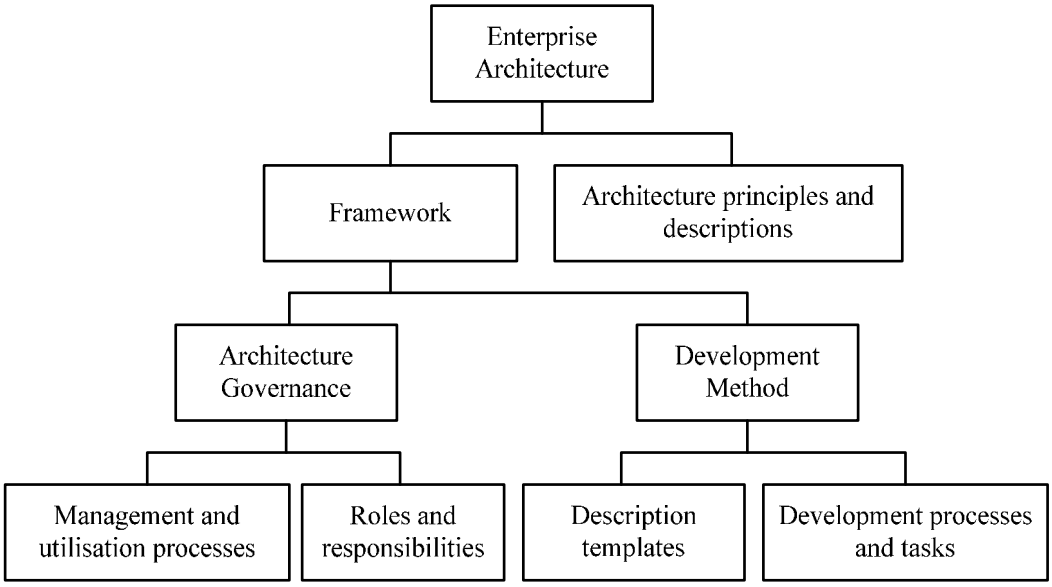


Figure 2.2 Taxonomy of Enterprise Architecture (traslated from ValtIT, 2007)

Finnish Ministry of Finance has compiled a taxonomy of Enterprise Architecture (ValtIT, 2007) which can be seen in Figure 2.2. This taxonomy can be seen as a summary of previous definitions. However, not all concepts mentioned in the definitions are included, such as Gartner's statement about value delivery and Pulkkinen's scanning of new technology. As in any activity, EA does not provide value *per se*, but utilising EA makes it possible. Similarly, scanning of new technology can be seen as a special case of planning a future architecture, which purpose is to utilise new technology enablers. Thus, both can be better categorised as an examples of a *purpose* of Enterprise Architecture (see Figure 2.3).

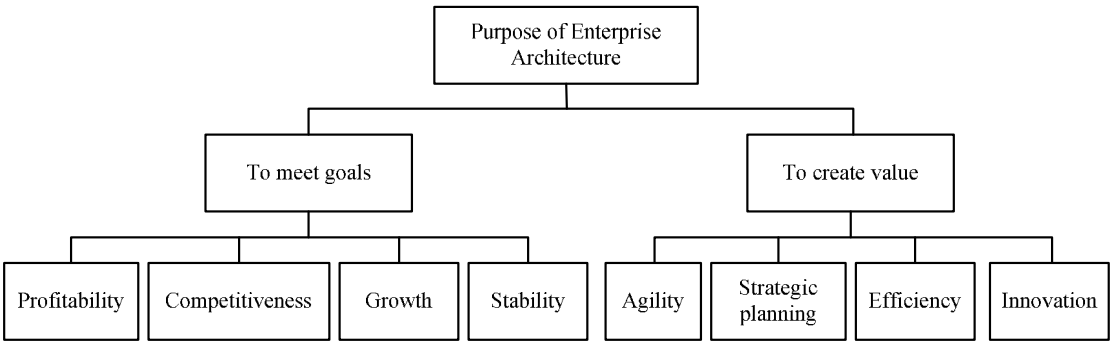


Figure 2.3 Classification of the Purpose of Enterprise Architecture (Syynimaa, 2010b)

The classification seen in Figure 2.3 is a result of author's qualitative research (Syynimaa, 2010b). The classification were formed by analysing 155 answers from 125 individuals to the question asking to describe the purpose of EA in 160 characters. Purpose of the EA was

classified to two main categories, *To meet goals* (of stakeholders) and *To create value* (to organisation). The former category includes concepts that stakeholder's are considering being organisation's goals. The latter category includes properties or capabilities that are adding or creating value to organisation. In this context value refers to "The regard that something is held to deserve; the importance, worth, or usefulness of something" (Oxford Dictionaries, 2010). These valuable capabilities, in turn, are helping organisations to meet the aforementioned goals.

Now that the several definitions of *enterprise, architecture,* and *Enterprise Architecture* are introduced, they can be discussed and summarised and the definition used in this thesis can be presented.

2.2.4. Definitions Used in the Thesis

Definition of *enterprise* seems to be quite constant. In the context of Enterprise Architecture, enterprise can be anything from a team to a multi-level organisation of a global corporation (TOGAF, 2009; ISO/IEC/IEEE, 2011; PEAF, 2013; Dietz *et al.*, 2013). Enterprises are social systems having a common set of goals.

Similarly, definitions of *architecture* and *architecture description* are more or less constant. Architecture is a structure of the enterprise and an architecture description its representation. To be more specific, it is seen as a *formal description* of an *enterprise* at a certain time (Zachman, 1997; ISO/IEC/IEEE, 2011; TOGAF, 2009), either from the current state or from one or more future states (CIO Council, 2001; Gartner, 2013).

Definitions of *Enterprise Architecture* are more diverse, but they have similarities. If looked at the taxonomy of EA in Figure 2.2, it can be seen having two main categories, *Framework* and *Architecture principles and descriptions*. The latter does not bring anything new to the definition of *architecture*, but the former is what makes the difference. Enterprise Architecture *framework* is what brings in concepts of *Architecture Governance* and *Development Method*. These are depending on, and related to, the used framework such as TOGAF or PEAF, and thus are not part of the definition of EA *per se*. However, what is shared among most of the definitions is the concept of *managed change* of the *enterprise* between the current and future states for a purpose (CIO Council, 2001; Gartner, 2013; GERAM, 1999; Pulkkinen, 2008). According to EA specialists, this purpose is *to meet goals* of stakeholders and *to create value* to the enterprise (Syynimaa, 2010b; see also PEAF, 2010). As the term *enterprise* is usually used as a synonym of a business or

company, later in the thesis the term *organisation* is used instead of it. *Organisation* covers both businesses and public sector and thus suits better to be used in the thesis.

The definitions of Enterprise Architecture and its components introduced in previous sections revealed that the definitions are indeed unambigous. Thus there is a need for a precise definition of Enterprise Architecture. Aforementioned definitions can be summarised to the definition of Enterprise Architecture used in this thesis. This definition is as follows (see also illustration in Figure 2.4):

> *Enterprise Architecture is; (i) a formal description of the current and future state(s) of an organisation, and (ii) a managed change between these states to meet organisation's stakeholders' goals and to create value to the organisation.*

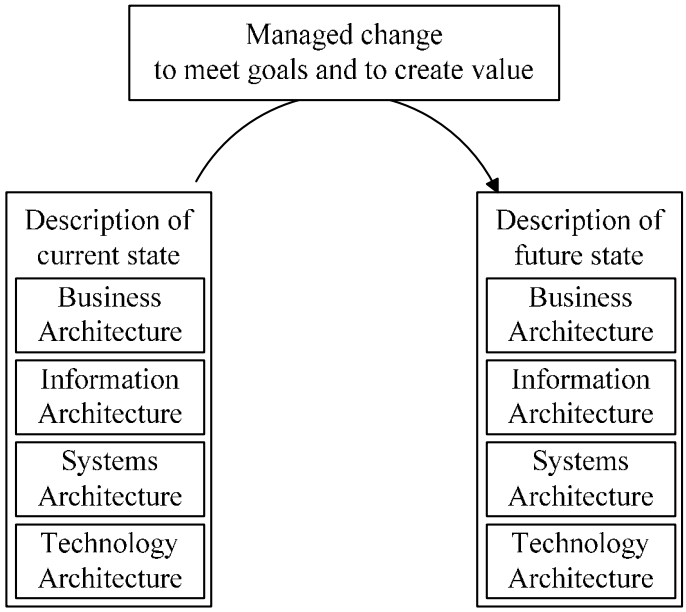


Figure 2.4 Definition of Enterprise Architecture (Syynimaa, 2012)

As a formal description, widely used and accepted way to describe the organisation is to use so called the four-layer model. These layers are *Business Architecture* (BA), *Information Architecture* (IA), *Systems Architecture* (SA), and *Technology Architecture* (TA) (Pulkkinen, 2006). There are also other ways to model and describe organisations, for instance Zachman uses a 6 by 6 matrix (see Figure 2.5). The four-layer model was selected due to its popularity, but also for its "simplicity" to demonstrate the complexity of organisations.

2.3. Theoretical Perspectives of Enterprise Architecture

In the previous section, various Enterprise Architecture definitions were introduced, including the definition used in this thesis. As previously stated, EA is a formal description of an organisation (Zachman, 1997). Moreover, it is a discipline of planning or engineering to produce these descriptions (Pulkkinen, 2008; Gartner, 2013) and the managed change between them (CIO Council, 2001; Gartner, 2013; GERAM, 1999; Pulkkinen, 2008). Therefore, as EA is a formal description of an organisation and a managed change, it restrains the organisation's activities. In order to better understand these different aspects of EA, in this section, EA is examined from three theoretical perspectives. First EA was viewed as a communication media using theoretical lenses of ontology and semiotics. Next EA was examined and analysed using Activity Theory. Lastly EA was viewed as an information technology with discussion on technology acceptance models.

2.3.1. Enterprise Architecture as a Communication Media

In this section, it is first argued that Enterprise Architecture, or EA descriptions to be specific, are ontologies of organisations.

The term ontology used here does not refer to a concept used in philosophy as discussed in sub-section 4.2.2. Instead, according to Uschold and Gruninger (1996, p. 4) *ontology* "is the term used to refer to the shared understanding of some domain of interest". This is also what Enterprise Architecture is; at least according to Zachman (2008, p. 1), where he defines his famous Zachman Framework as:

> "an ontology - a theory of the existence of a structured set of essential components of an object for which explicit expressions is necessary and perhaps even mandatory for creating, operating, and changing the object (the object being an Enterprise, a department, a value chain, a "sliver," a solution, a project, an airplane, a building, a product, a profession or whatever or whatever)."

Therefore it can be argued that EA frameworks, such as Zachman (see Figure 2.5) and TOGAF (2009) are *meta-models* of an organisation. This means that every organisation can be described in a standard, formal way using any particular EA framework. Examples of how and where to use ontologies are *Communications*, *Inter-Operability*, and *Systems engineering*: *specification*, *reliability* and *reusability* (Uschold and Gruninger, 1996).

	DATA *What*	FUNCTION *How*	NETWORK *Where*	PEOPLE *Who*	TIME *When*	MOTIVATION *Why*
OBJECTIVES/ SCOPE (contextual) *Planner*	List of Things Important to the Business	List of Processes the Business Performs	List of Locations in Which the Business Operates	List of Organizations Important to the Business	List of Events Significant to the Business	List of Business Goals/Strat.
ENTERPRISE MODEL (conceptual) *Owner*	e.g. Semantic Model	e.g. Business Process Model	e.g. Business Logistics System	e.g. Workflow Model	e.g. Master Schedule	e.g. Business Plan
OBJECTIVES/ SCOPE (contextual) *Planner*	e.g. Logical Data Model	e.g. Application Architecture	e.g. Distributed System Architecture	e.g. Human Interface Architecture	e.g. Processing Structure	e.g. Business Rule Model
TECHNOLOGY MODEL (physical) *Builder*	e.g. Physical Data Model	e.g. System Design	e.g. Technology Architecture	e.g. Presentation Architecture	e.g. Control Structure	e.g. Rule Design
DETAILED REPREN-TATIONS (out-of-context) *Sub-Contractor*	e.g. Data Definition	e.g. Program	e.g. Network Architecture	e.g. Security Architecture	e.g. Timing Definition	e.g. Rule Specification
FUNCTIONING ENTERPRISE	e.g. DATA	e.g. FUNCTION	e.g. NETWORK	e.g. ORGANIZATION	e.g. SCHEDULE	e.g. STRATEGY

Figure 2.5 Framework for Enterprise Architecture (adapted from Zachman, 1997)

To better understand EA as a communication media, EA is next examined with theoretical lenses of *semiotics*. Semiotics is about information science, or to be more specific, the study of signs and their meanings. Eco (1976, p. 7) defines it to be ”concerned with everything that can be taken as a sign”. Similarly, Oxford Dictionaries (2010) defines semiotics as “the study of signs and symbols and their use or interpretation”. In the context of semiotics, a sign can be anything used for communication; a word, a picture, a blueprint, a gesture, or an Enterprise Architecture description. Semiotics has been studied at least since 1878, when Peirce’s article was published (as cited in Peirce, 1974). Famous semiotics framework by Stamper can be seen in Figure 2.6. Many of today’s organisational semiotics literature is based on Stamper’s framework (see for example Liu *et al.*, 2001; Beynon-Davies, 2009a).

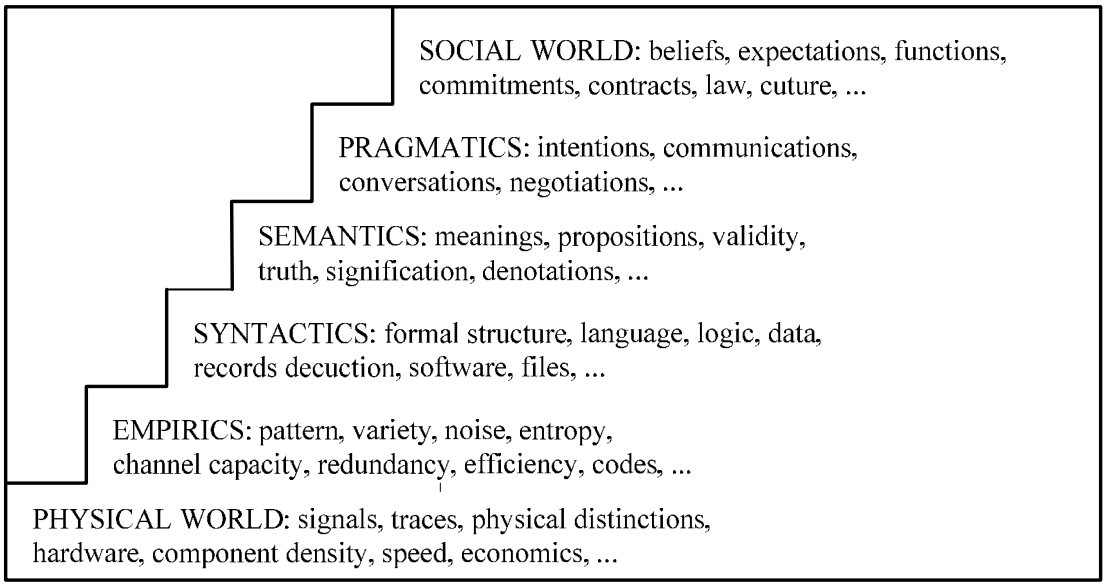


Figure 2.6 Stamper's (1973) Semiotic Ladder (cited by Liu, 2000)

Key concepts in semiotics and their relations can be seen in Figure 2.6 and are defined as follows (Barron *et al.*, 1999; Beynon-Davies, 2009a; Liu, 2000, pp 26-35). *Pragmatics* is about the purpose of communication; why we are communicating, what we are trying to achieve and so on. Pragmatics gives an answer to a question: Why? *Semantics* is about meaning of things; definitions. It gives an answer to a question: What? *Syntactics* is about the structure of communication, such as grammar of a spoken language, or a XML schema of HTML 5.0. Syntactics gives answer to a question: How? *Empirics* is about the medium used for communication, such as a letter, email, air pressure, and so on. These four "layers", e.g. pragmatics, semantics, syntactics, and empirics bound together the *social* and *physical worlds* we're living in. Social world refers for example to organisations, whereas physical world refers for instance to a paper with writing or to a hard drive of a computer.

With this view to Enterprise Architecture, it can be mapped to the semiotic ladders as seen in Figure 2.7 (idea originally presented by Dr. Riihimaa, 2009). Every organisation exists in an *environment*, having one or more *stakeholders* having interests to it as seen in Figure 2.1. This can be mapped to *Social World*. The purpose of EA is to meet goals of *stakeholders,* and to create value for organisations as seen in Figure 2.3. As this is the commitment for "doing" EA, it can also be mapped to *Social World* layer.

Business Architecture layer contains descriptions of the organisation's "business". The word business is in quotes because also organisations that are not doing business *per se*, such as public sector organisations, have similar activities. This layer tells us what the

organisation actually does, why it exists in the first place. In this layer, also processes of the organisation are described, so it also tells us how the business is done. Business Architecture can thus be mapped to *Pragmatics* layer.

Information Architecture layer contains descriptions of the information itself, for example its meaning and denotations. *Information Architecture* can thus be mapped to *Semantics* layer.

Systems Architecture contains descriptions about information systems and their relations. It tells us where the information is located and how it is communicated. Thus *Systems Architecture* can be mapped to *Syntactics* ladder.

Technology Architecture contains decisions related to the actual physical technology to be used, such as the used paper type or the make and model of server hardware. Thus *Technology Architecture* can be mapped to both *Empirics* and *Physical World* layers.

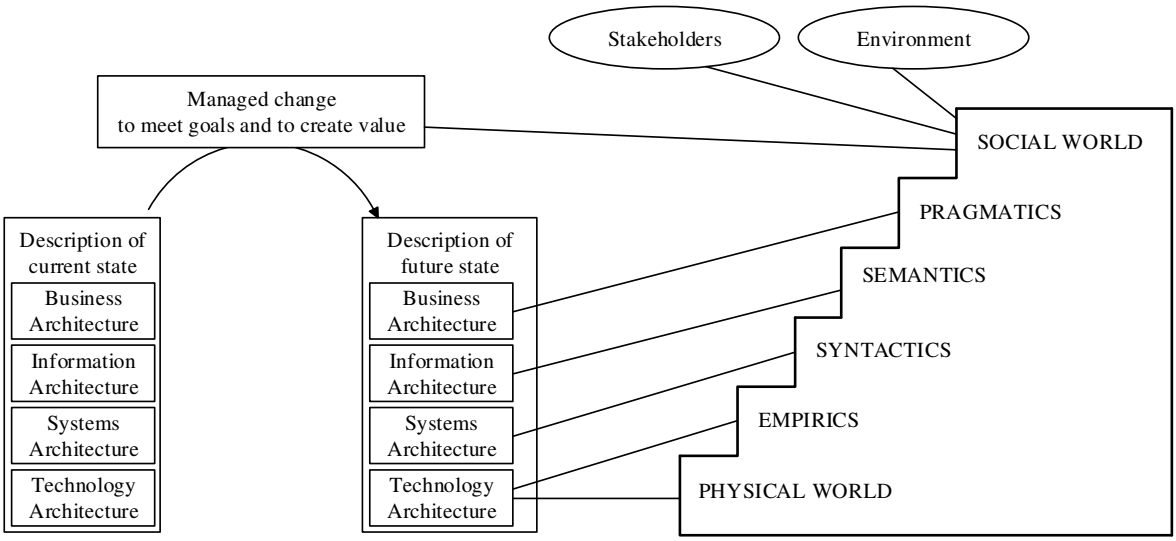


Figure 2.7 Mapping Enterprise Architecture with Semiotics

Now that EA is mapped to semiotics as a whole, to better understand it as a formal description of an organisation, it is next studied using Peirce's *trichotomy*. It consists of three ontological categories, namely *firstness*, *secondness*, and *thirdness* (as cited in Peirce and Houser, 1998). These can also be called to *a sign*, *an object*, and *an interpretant*, respectively. A well-known representation of this is seen in Figure 2.8. This is usually called to Peirce's triangle, but also to a semiotic triangle (Odgen and Richards, 1923) and a meaning triangle (Sowa, 2000). The triangle consists of the three aforementioned

components and their relationships. Peirce explains the components and their relations as follows:

> "A sign, or representamen, is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the interpretant of the first sign. The sign stands for something, its object [or referent]. It stands for that object, not in all respects, but in reference to a sort of idea, which I have sometimes called the ground of the representamen." (Peirce, 1934, p. 2.228)

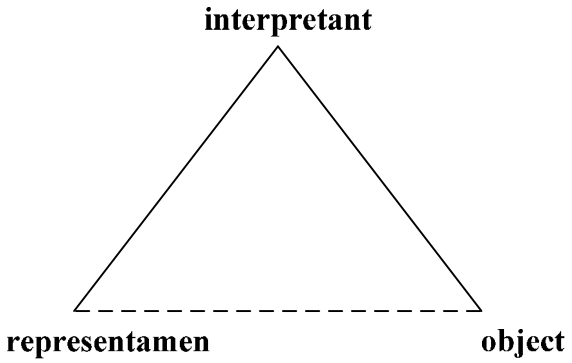


Figure 2.8 Peirce's Triangle

If looked at Figure 2.1 in more detail and analyse it with the triangle, the following can be found. First category of any ontology is the one that exist independently, a sign. Second category is which the first one is relative to, and third one is a mediation which brings the first two in to a relation. To put this into the context of Enterprise Architecture, let's use an example illustrated in Figure 2.9. *Architecture description* (representamen) is an example of a sign: it exist independently. Even though it expresses the *architecture* (object), it would exist even if there would not be such an architecture. That is, it can express a previous, a current, or a future (planned) architecture. As such, it is "just a piece of paper". When a cognitive agent, such as an employee, interprets the architecture description, he or she makes a relation (interpretant) between the architecture and its description. In the example, it tells to the employee how things are currently done in the particular process.

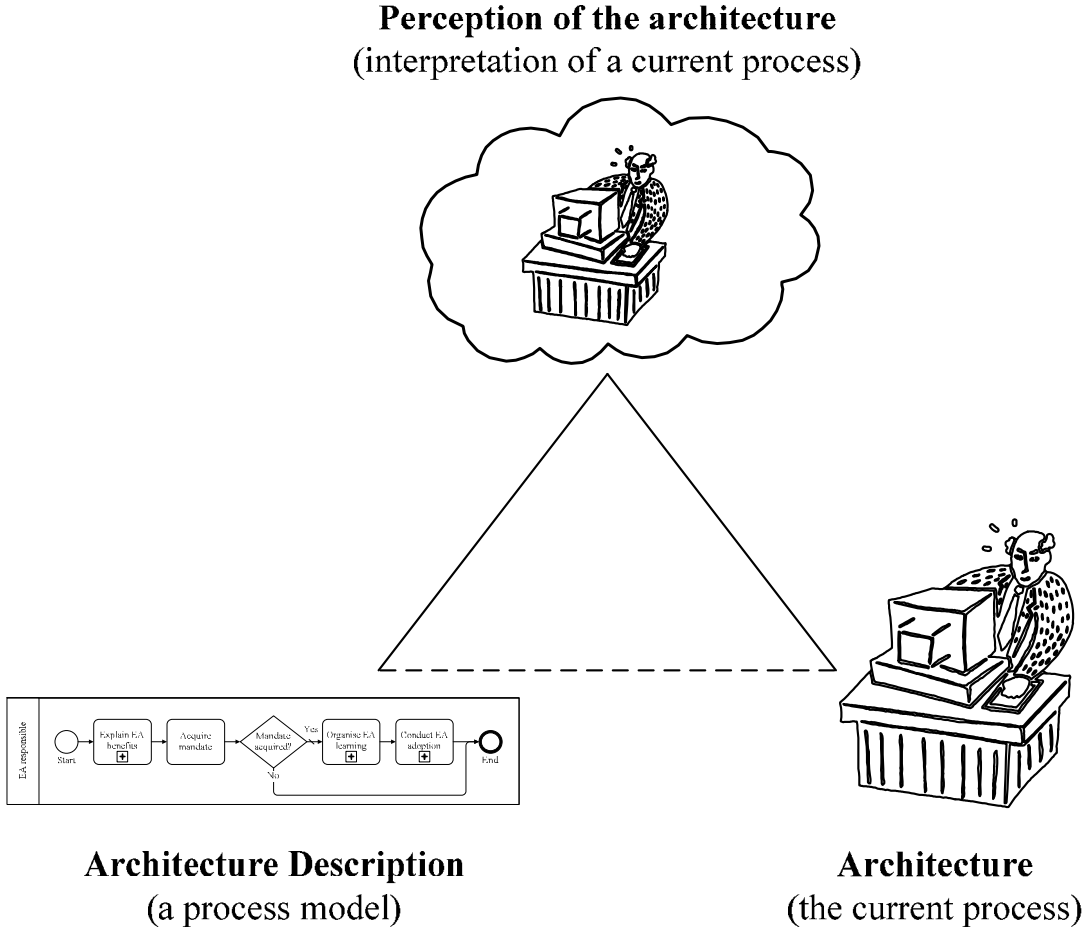


Figure 2.9 The Meaning of a Process Model

In this sub-section, by mapping EA to the semiotic ladder, it has been demonstrated that EA can be used to holistically describe and communicate the ontology of an organisation. Moreover, by analysing EA as a formal description, it has been demonstrated that EA descriptions can be used as a media to communicate different parts of the architecture. Unlike with the informal communication, formal descriptions makes it possible for employees to interpret for instance the descriptions of current processes similarly. Thus it demonstrates that EA can be used as a communication media.

2.3.2. Enterprise Architecture as an Activity

There are many activities related to Enterprise Architecture (GERAM, 1999; CIO Council, 2001; Pulkkinen, 2008; Gartner, 2013; Dietz *et al.*, 2013). In the previous sub-section, Enterprise Architecture was examined as a communication media. In this sub-section, EA related activities are examined. If the definition of Enterprise Architecture used in thesis is studied, at least three processes can recognised. The process of *describing the current state* of the organisation, the process of *describing one or more future states* of the organisation,

and the *managed change* between these states. There is also a process of initial adoption of Enterprise Architecture tools, methods, etc., which is later called simply *adoption*.

Human activities can be studied using various approaches, such as *Activity Theory* (AT), *situated action models*, and *distributed cognition*. Situated action approach studies person's activity in a setting (Lave, 1988). Thus the unit of analysis is the relation between the individual and the environment. AT approach studies the activity system itself, where the research context is composed of object, actions, and operation. To be more specific, the context is the activity involving people and artefacts. The mediation by artefacts is the key idea of AT (Kuutti, 1996). Distributed cognition approach studies the cognitive system composed of individuals and the artefacts they are using (Flor and Hutchins, 1991). Its emphasis is on understanding how individuals align and share within a distributed process. From these approaches, AT is the richest and the most comprehensive (Nardi, 1996). Therefore, in this sub-section, EA related activities are analysed using AT.

Oxford Dictionaries (2010) defines *process* as "a series of actions or steps taken in order to achieve a particular end". Moreover, *activity* is defined as "a thing that a person or group does or has done" (Oxford Dictionaries, 2010). In Activity Theory these definitions are more complex and under debate. Engeström (1999) introduces six dichotomies related to Activity Theory; (i) *Psychic process* versus *object-related activity*, (ii) *Goal-oriented* action versus *object-related* activity, (iii) *Instrumental tool-mediated production* versus *expressive sign-mediated communication*, (iv) *Relativism* versus *historicity*, (v) *Internalisation* versus *creation and externalisation*, and (vi) *Principle of explanation* versus *object of study*. Engeström summarised these dichotomies into three critical questions (1999, p. 28):

> "First, how can we depict the cell of activity theory or, more specifically, what would be a viable way of modelling the structure and dynamic relations of an activity system?
>
> Second, how can we incorporate historicity and developmental judgment into activity-theoretical analyses, yet take fully into account the diversity and multiplicity inherent in human activities?
>
> And third, what kind of methodology is appropriate for activity-theoretical research – one that could bridge the gaps between the basic and applied, between conceptualization and intervention?"

As a solution to these aforementioned dichotomies and questions, Engeström has presented a model of activity system seen in Figure 2.10.

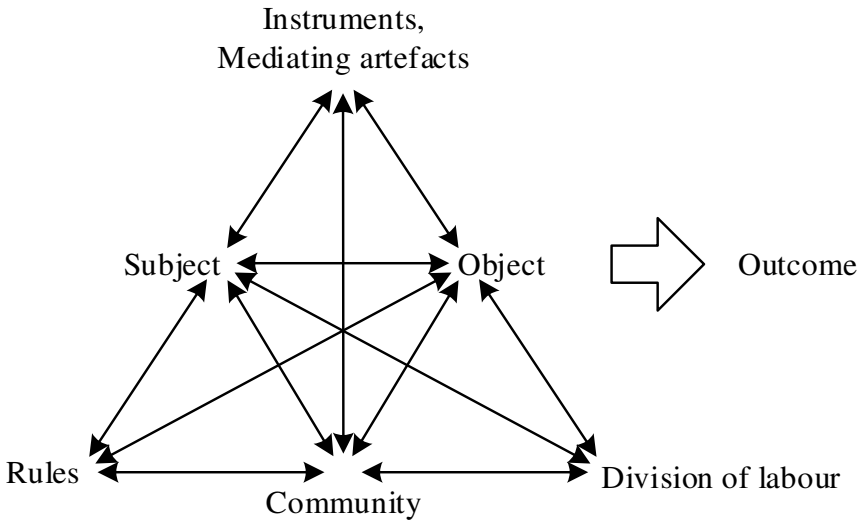


Figure 2.10 A Complex Model of an Activity System (adapted from Engeström, 1987; 1999; 2000)

Basic idea of the model is that every activity has three main components; *Subject, Object,* and *Community*. These are in a relation to each other directly and through mediation. Subject-object relation is mediated by *Instruments* (or "tools" as in Kuutti, 1996), object-community by *Division of labour*, and community-subject by *Rules*. These mediating elements should be regarded in a broad sense:

> "A "tool" can be anything which is used in the transformation process, including both material tools and tools for thinking; "rules" cover both explicit and implicit norms, conventions and social relations within a community; "division of labour" refers to the explicit and implicit organization of a community as related to the transformation process of the object into the outcome" (Kuutti, 1996, p. 6).

Engeström's model has been used for example to analyse Human-Computer Interaction (Kuutti, 1996), and to analyse and redesign work (Engeström, 2000). Next the processes related to Enterprise Architecture are analysed using Activity Theory and Engeström's model.

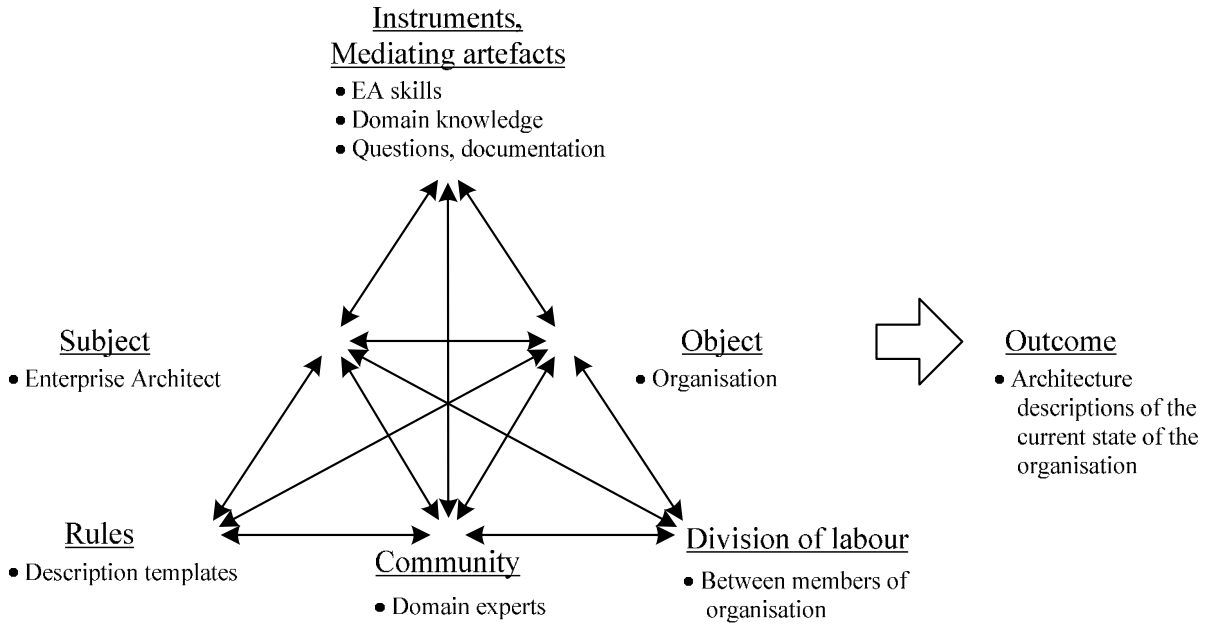


Figure 2.11 Activity 1: Describing the Current State of the Organisation

In Figure 2.11, the process of describing the current state of the organisation as an activity system can be seen. Subject, the one who is creating descriptions, is called *Enterprise Architect*. This should be understood as role, not a single person in the organisation (although that can be the case too). Object of the activity is the *Organisation* being described. Instruments of the activity are *Enterprise Architecture skills*, *domain knowledge*, and *questions and documentation*. Documentation refers to all available documentation used in the activity, such as web-pages, quality assurance handbook, income statement, etc. The community, where the activity takes place, are *Domain experts.* Domain expert is a role of a person having knowledge of a particular domain, such as business, information, or technology. Rules that apply in this activity are *Description templates* of the used Enterprise Architecture framework, because they define for instance which notation is used. There are division of labour between the members of the organisation, including domain experts. Members of the organisation takes part to the activity related to his/hers own domain. Outcome of the activity is architecture description(s) of the current state of the organisation.

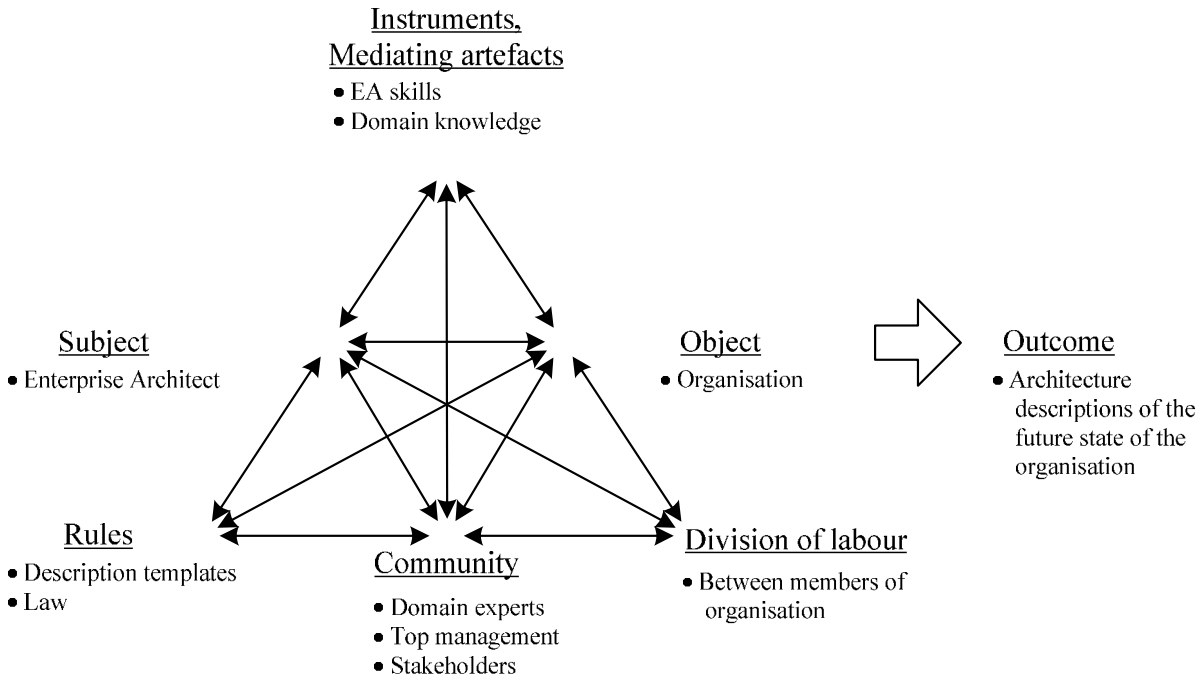


Figure 2.12 Activity 2: Describing the Future State of the Organisation

Activity model of the process of describing the future state of the organisation seen in Figure 2.12 has a number of common elements with the previous one. However, there are some fundamental differences. As this activity is describing future, the element of planning exists in the activity. The community contains also *Top management* and *Stakeholders*, as these are the parties that have interests in (and are responsible for) the future of the organisation. Domain experts are still part of the community too, because they have knowledge about what is possible, for instance in the technology domain. There is a division of labour between the members of the organisation, including the management, stakeholders, and domain experts. If for instance there are changes in organisation structure, domain expert are not necessarily involved in the planning as they might have conflicting interests with the management. Also the rules are a bit different, as the future is involved, laws and regulations may restrict future changes. Outcome is an architecture description of the future state of the organisation.

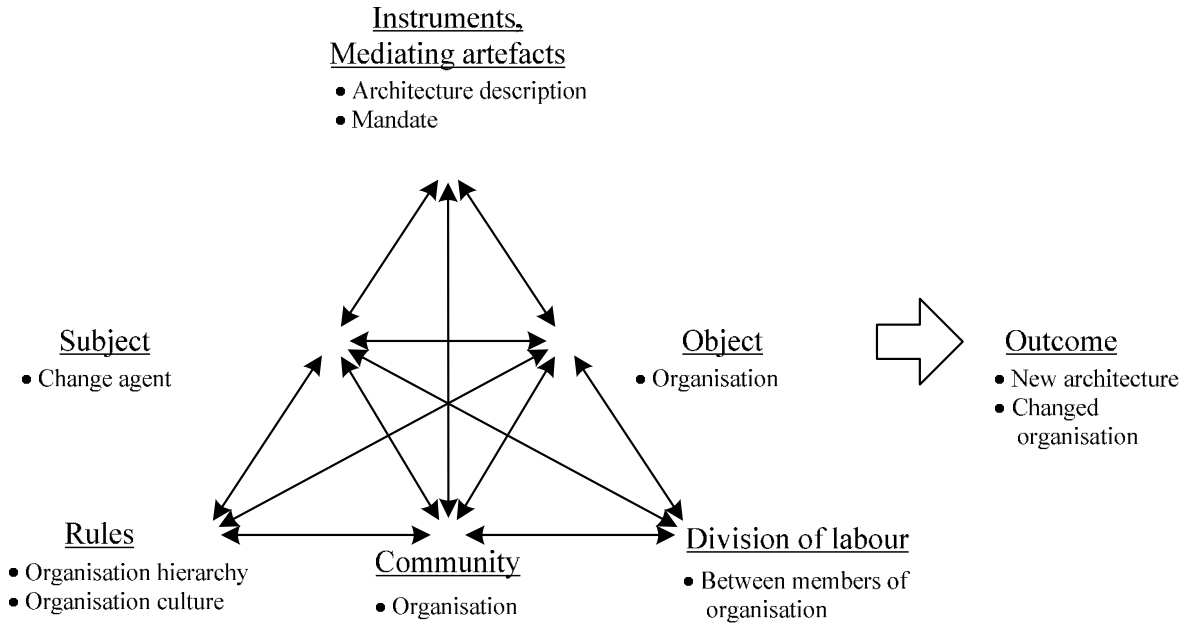


Figure 2.13 Activity 3: Managed Change Between Current and Future States

Figure 2.13 shows us an activity system of the third EA process, the process of managed change. Subject of the activity is *Change agent* and object *Organisation*. Organisation in a sense that it depends on the "target" architecture, what is to be changed. So object can be any part of the organisation, its processes, technology, and so on. Instruments of the change are *Architecture description(s)* and *Mandate* to conduct the change. As in previous activities, community is *Organisation* itself. Rules are *Organisation hierarchy* and *Organisation culture*. Hierarchy in a sense that division of power is usually embodied to the hierarchy or structure of the organisation. Outcome of this activity system is a new architecture which should be similar to the architecture description(s), and a changed organisation.

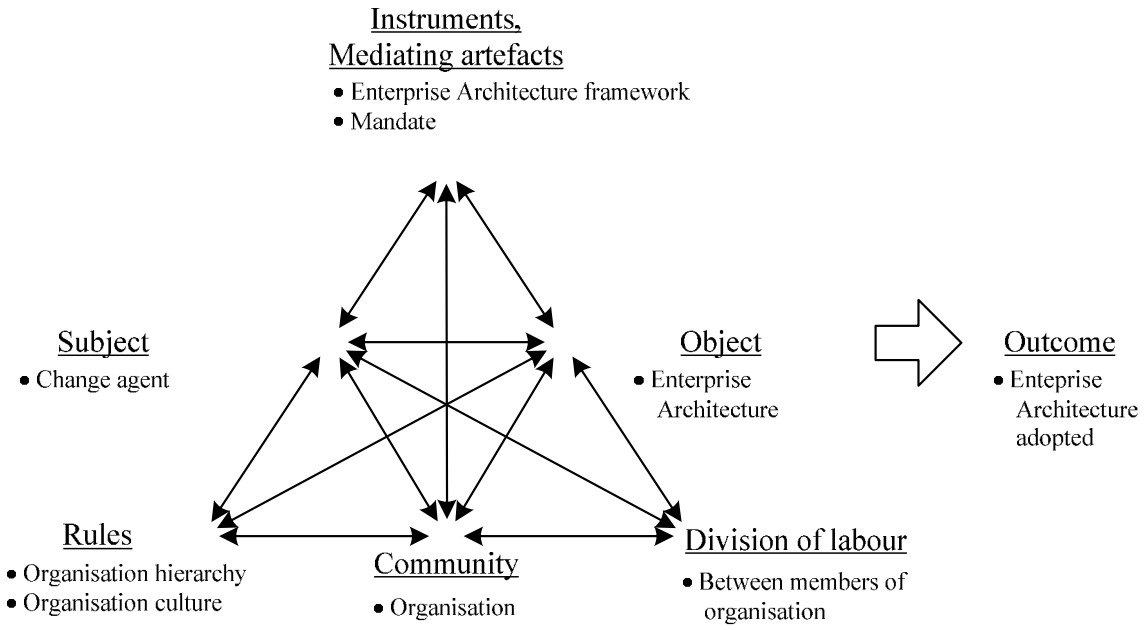


Figure 2.14 Activity 4: Enterprise Architecture Adoption

Activity system of Enterprise Architecture adoption seen in Figure 2.14 shares a lot of elements with the previous one. This is actually quite natural, because Enterprise Architecture adoption can be seen as an instance of managed change. Adoption starts in a situation where organisation has not adopted EA (e.g. the current state) and aims to the situation where EA is adopted (e.g. the target state). Instruments used in the activity are *Mandate* and an *Enterprise Architecture framework*. The object of the activity is *Enterprise Architecture* to be adopted. Outcome of the adoption activity is *an organisation with Enterprise Architecture adopted* in some degree.

It should be noted that activities presented here are not comprehensive; there are for instance activities which are related to the selected Enterprise Architecture framework. However, these activities give a comprehensive picture about general activities related to Enterprise Architecture and its adoption.

In the next sub-section EA is studied as an Information Technology System and discussion is provided about using Technology Acceptance Models to explain EA adoption issues.

2.3.3. Enterprise Architecture as an Information Technology System

In previous sub-section, Enterprise Architecture related activities were studied as activity systems. In this sub-section, Enterprise Architecture is studied from another perspective: as an Information Technology System.

In Oxford Dictionaries (2010), *system* is defined as "a set of things working together as parts of a mechanism or an interconnecting network; a complex whole" and "a set of principles or procedures according to which something is done; an organized scheme or method". According to organisational semiotics, "an organisation, and therefore an information system, is essentially a system of social norms." (Stamper *et al.*, 2000, p. 2). On Aulin's (1989) classification, these definitions can be regarded as self-steering systems. As such, by definition, organisations cannot be steered outside. However, the rules and policies organisations are following may be internal (i.e. company policy) or external (i.e. law). Thus, social systems such as organisations are both self-steering and steerable from outside (Baumgartner, 1986).

Typically Enterprise Architecture is planned and described by using a top-down approach. In this approach a higher level output is an input for level below it (TOGAF, 2009; Pulkkinen, 2006). Some Enterprise Architecture frameworks, such as TOGAF and PEAF, have methods and processes for describing and maintaining architecture descriptions. The development cycle of TOGAF's Architecture Development Method (ADM) can be seen in Figure 2.15. As it can be seen, phases from A through H follow each other. Each phase has a defined set of minimum inputs and outputs. For instance some required inputs of phase B, *Business Architecture*, can be seen in Box 2.1 and outputs in Box 2.2.

- Organizational Model for Enterprise Architecture
- Tailored Architecture Framework
- Approved Statement of Architecture Work
- Architecture Vision
- Draft Architecture Definition Document, including (when in scope)
    - Baseline Business Architecture, Version 0.1
    - Baseline Technology Architecture, Version 0.1
    - Baseline Data Architecture, Version 0.1
    - Baseline Application Architecture, Version 0.1
    - Target Business Architecture, Version 0.1
    - Target Technology Architecture, Version 0.1
    - Target Data Architecture, Version 0.1
    - Target Application Architecture, Version 0.1

Box 2.1 TOGAF ADM Phase B Input Requirements (TOGAF, 2009)

- Draft Architecture Definition Document, including:
  - Baseline Business Architecture, Version 1.0 (detailed), if appropriate
  - Target Business Architecture, Version 1.0 (detailed), including:
    - Organization structure - identifying business locations and relating them to organizational units
    - Business goals and objectives - for the enterprise and each organizational unit
    - Business functions - a detailed, recursive step involving successive decomposition of major functional areas into sub-functions
    - Business services - the services that the enterprise and each enterprise unit provides to its customers, both internally and externally
    - Business processes, including measures and deliverables
    - Business roles, including development and modification of skills requirements
    - Business data model
    - Correlation of organization and functions - relate business functions to organizational units in the form of a matrix report

Box 2.2 TOGAF ADM Phase B Outputs (TOGAF, 2009)

Each phase takes these input requirements, builds more information on top of them accordingly, and thus contributes to the subsequent phases. For instance the phase C, *Information Systems Architecture*, has a set of input requirements. Some of these requirements can be seen in Box 2.3 (outputs of phase B in boldface). As it can be seen Box 2.3, phase B added version 1.0 of *Baseline Business Architecture* and *Target Business Architecture*, which are passed to phase C.

- Draft Architecture Definition Document, including:
  - **Baseline Business Architecture, Version 1.0 (detailed), if appropriate**
  - **Target Business Architecture, Version 1.0 (detailed)**
  - Baseline Data Architecture, Version 0.1
  - Target Data Architecture, Version 0.1
  - Baseline Application Architecture, Version 0.1
  - Target Application Architecture, Version 0.1

Box 2.3 TOGAF ADM Phase C Input Requirements (TOGAF, 2009)

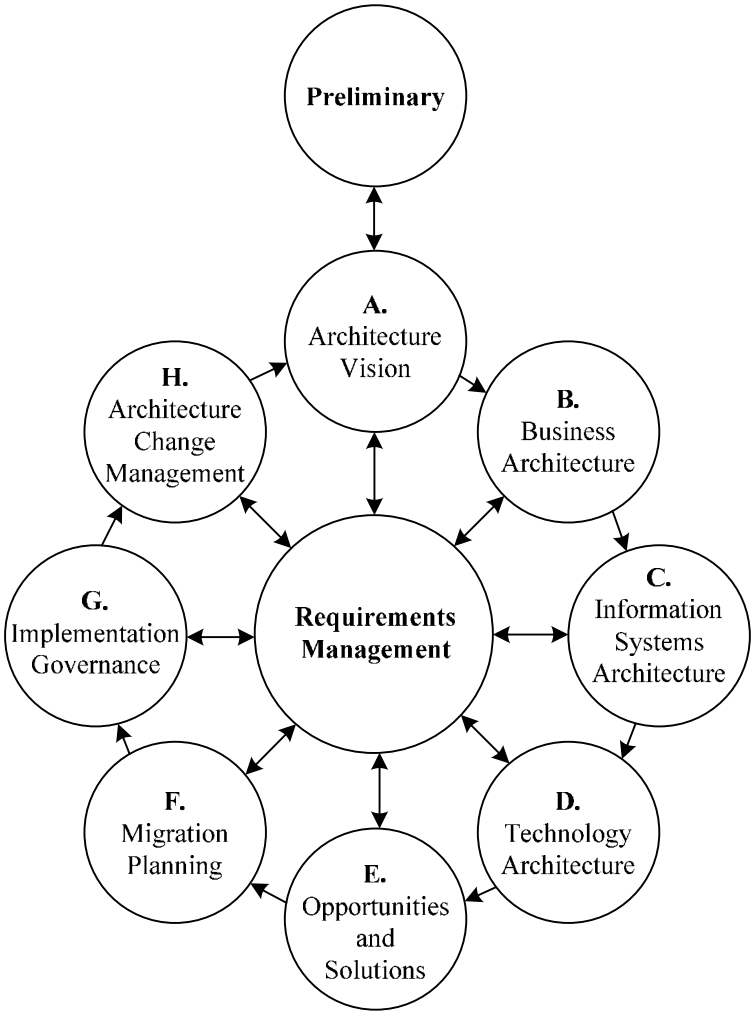


Figure 2.15 Architecture Development Cycle (TOGAF, 2009)

Organisations can be seen as systems. Similarly, so can Enterprise Architecture. Both have a set of defined rules and processes to be followed. At the same time, information systems are systems that consist of information and communication technology (ICT) and of people utilising ICT (Beynon-Davies, 2009b). In this sense, ICT can be defined as any physical artefact used for storing or for communicating information (Beynon-Davies, 2009a). Thus also Enterprise Architecture can be regarded as an *information and communication technology*. As discussed in previous sub-sections, it stores information about the organisation and it can be used to communicate this information.

All organisations are already managed in some way. They are providing services using certain business processes. They are developing or acquiring information systems to support these processes and utilising some technology. In Enterprise Architecture adoption, as described earlier, an organisation adopts Enterprise Architecture rules, processes, tools, etc. If these "things" to be adopted are different from those currently used in the organisation, challenges may be faced. This phenomenon is very common when for

instance new information system is developed; sometimes end-users are not willing to use the new information system or a piece of software. In the study of Information Systems this issue is known as technology acceptance (see for example Davis, 1986; 1993; Venkatesh and Davis, 2000). Since its introduction (Davis, 1986), Technology Acceptance Model (TAM) has been used in many published researches (see for example Lee *et al.*, 2003). An enhanced version of acceptance model by Venkatesh *et al.* (2003) is called the *Unified Theory of Acceptance and Use of Technology*, or UTAUT for short. It is based on various acceptance models, and its illustration can be seen in Figure 2.16. In UTAUT, there are three constructs influencing *Behavioural Intention*, and two constructs influencing *Use Behaviour*. The mentioned three former constructs influences *Use Behaviour* indirectly via *Behavioural Intention.*

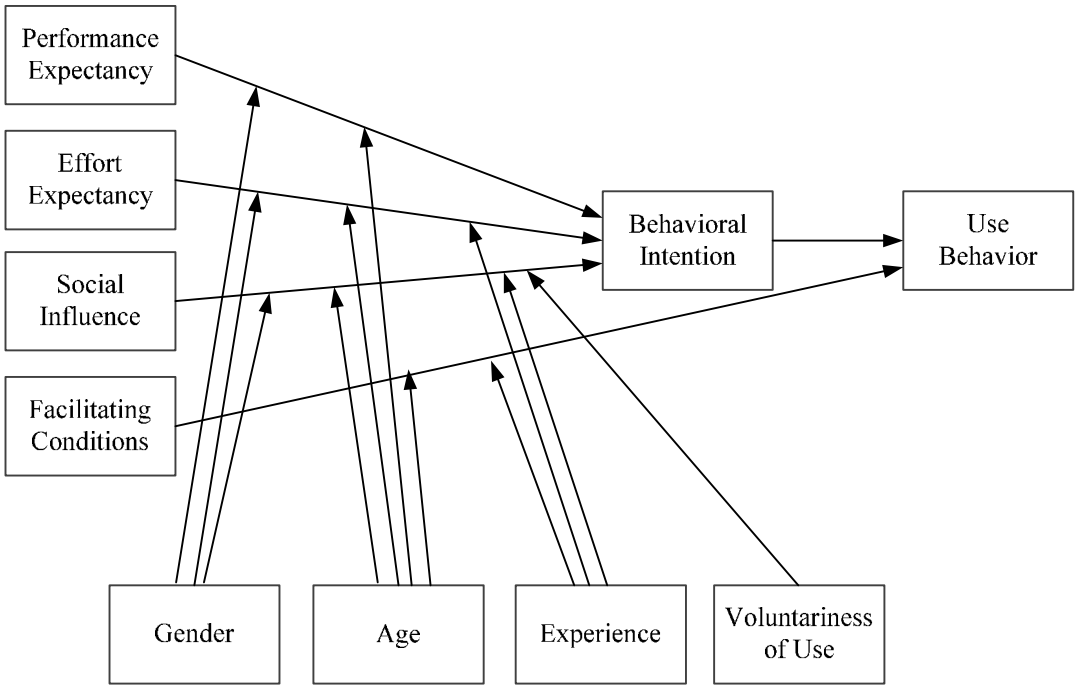


Figure 2.16 UTAUT, Unified Theory of Acceptance and Use of Technology (Venkatesh *et al.*, 2003)

Performance Expectancy is defined as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance." (Venkatesh *et al.*, 2003, p. 447). *Effort Expectancy* is defined as "the degree of ease associated with the use of the system." (Venkatesh *et al.*, 2003, p. 450). *Social Influence* is defined as "the degree to which an individual perceives that important others believe he or she should use the new system" (Venkatesh *et al.*, 2003, p. 451). *Facilitating Conditions* is defined as “the degree to which an individual believes that an organizational and technical infrastructure exists to

support use of the system." (Venkatesh *et al.*, 2003, p. 453). These influences are moderated by *Gender*, *Age*, *Experience*, and *Voluntariness of Use*, as seen in Figure 2.16.

In the context of Enterprise Architecture adoption, *Performance Expectancy* can be defined as the degree how individual feels EA would help he or she to perform in his/her job. In the same way *Effort Expectancy* can be defined as the degree of efforts an individual feels EA would require to take. *Social Influence* can be defined as the perceived degree of importance of using EA to others is, and *Facilitating Condition* as the degree on to which individual feels organisation being ready to support usage of EA.

In this sub-section, Enterprise Architecture is studied as an information technology system. As such, Enterprise Architecture adoption can be seen as an instance of *technology adoption*. Therefore one theoretical perspective to explain its adoption challenges might be the UTAUT model.

2.3.4. Summary of Theoretical Perspectives of Enterprise Architecture

In this section EA was examined from three different theoretical perspectives. EA can be seen as a communication media, as an activity system, and as an information technology system. As a communication media, EA can be seen as an ontology of the organisation. As an activity system EA consists of four high-level activities; (i) describing the current state of the organisation, (ii) describing the future state(s) of the organisation, (iii) managed change between the current and future states, and (iv) the EA adoption. EA can also be seen as an information technology system. As such, technology acceptance theories may be used as theoretical view while studying EA adoption issues.

In the next section the latter of the EA activities, namely EA adoption, is presented and discussed in detail.

2.4. Enterprise Architecture Adoption

The interest of this thesis is the Enterprise Architecture adoption. In this section, the traditional Enterprise Architecture adoption method is presented and discussed. The detailed definition of the concept of EA adoption is presented in Section 5.2 on page 84.

The traditional EA adoption process is illustrated in Figure 2.17 using BPMN 2.0 notation. It is a high level process description, having only two tasks. The first task is to *acquire a mandate* for EA adoption. The mandate, or support from the top-management, is seen

crucial by both researchers and practitioners (Carrillo *et al.*, 2010; Gregor *et al.*, 2007; Iyamu, 2009a; 2011b; Kaisler *et al.*, 2005; Liu and Li, 2009; Mezzanotte *et al.*, 2010; North *et al.*, 2004; Shupe and Behling, 2006; Struijs *et al.*, 2013; Vasilescu, 2012). The mandate is usually defined as an "official order or commission to do something" (Oxford Dictionaries, 2010). In TOGAF the mandate is a formal document called to *Statement of Architecture Work* and defined as "the document against which successful execution of the architecture project will be measured and may form the basis for a contractual agreement between the supplier and consumer of architecture services" (TOGAF, 2009, p. 495). During the EA adoption, mandate is used as a "tool" as seen in the activity illustrated in Figure 2.14. If the mandate is not given, the process of EA adoption ends. By default, for instance if the mandate existence is not assessed, the process continues to next tasks. Naturally, this is also the case if the mandate was given.

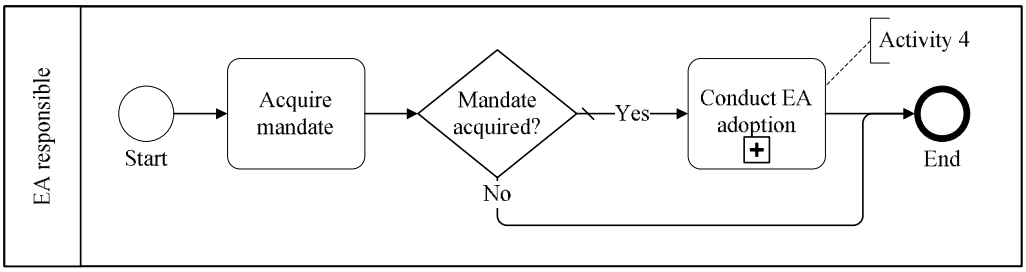


Figure 2.17 Traditional EA Adoption Process

As seen in Figure 2.2, EA frameworks consists of architecture governance and a development method. Thus the activities of the next task, *Conduct EA adoption,* depends on the selected EA framework. If, for instance TOGAF ADM (Figure 2.15) is used, this includes all ADM phases (e.g. from A to H). *Acquire mandate* task is included in the preliminary phase, even though the actual mandate, in the form of approved *Statement of Architecture Work*, is acquired in phase A. This is because the sponsoring stakeholders are identified in the preliminary phase, and their approval to continue is required to continue.

A general process of conducting EA adoption is illustrated in Figure 2.18. This is general in a sense that each task is included in EA frameworks, such as TOGAF's ADM, but not necessarily in similar way. Regarding the EA related activities, the process maps to activity 4 (Figure 2.14). First task of the process is the *selection of EA framework.* Various frameworks, such as TOGAF and Kartturi, may have been evaluated beforehand, but the selection needs to be done before starting describing. The second task, *describe current state*, maps to EA activity 1 (Figure 2.11) and the third task, *describe future state*, maps to

EA activity 2 (Figure 2.12). The order of these two tasks depends on the framework. For instance in Kartturi, the future state of the organisation is recommended to be described before the current state (CSC, 2013). The last task, *execute the change*, maps to EA activity 3 (Figure 2.13).

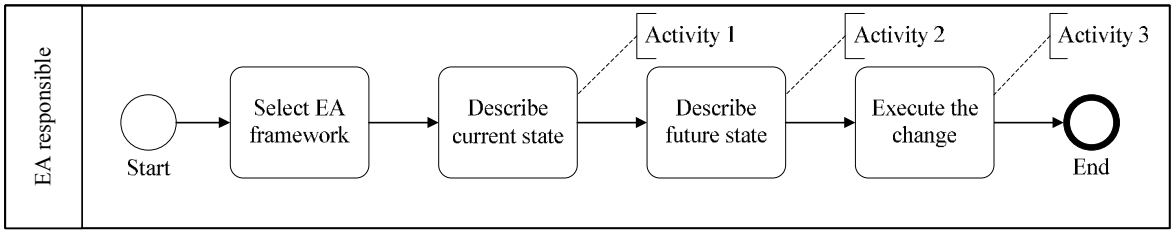


Figure 2.18 Process of Conducting EA Adoption

In the previous sub-section, EA has been studied from various theoretical perspectives to increase the understanding of the phenomenon. The interest of this thesis is in the process of EA adoption in organisations. The theoretical perspective to EA is thus the activity of EA adoption (see Figure 2.14). When EA is introduced to the organisation for the very first time, the organisation is changed somehow. The organisation is adopting a new way to communicate (to describe) its current and future states, and a new formal way to develop the organisation to achieve its stakeholders' goals. Thus, this thesis adopts *organisational change* as the underpinning theory to explain EA adoption.

As noted earlier, organisations can be categorised as systems. Lee (2010) states that systems may evolve from one state to another deliberately by design, or in a natural uninformed way (the default). Van de Ven and Poole (1995) have recognised four ideal-types organisational development theories to explain organisational change processes (Figure 2.19). These are *Life Cycle, Evolution, Dialectic,* and *Teleology*. *Life Cycle* theory sees change being imminent; organisation is moving from a start-up towards its termination through certain phases. Each of these phases is necessary, so the change is following always same steps. Environment may influence this change, but it is not a driving force. *Teleological* theory sees that the change takes place because the organisation is trying to achieve a certain goal or a purpose. Although this theory is also cyclical, fundamental difference is that there is no certain sequence of events to be followed. Moreover, the organisations do not "terminate", but are changing indefinitely. *Dialectical* theory assumes that organisation exist in world of continuous conflicts. The change takes place when two or more opposing forces gain power enough to confront the status quo. *Evolutionary* theory

sees change as a method to survive; competing from same resources causes elimination of some organisations.

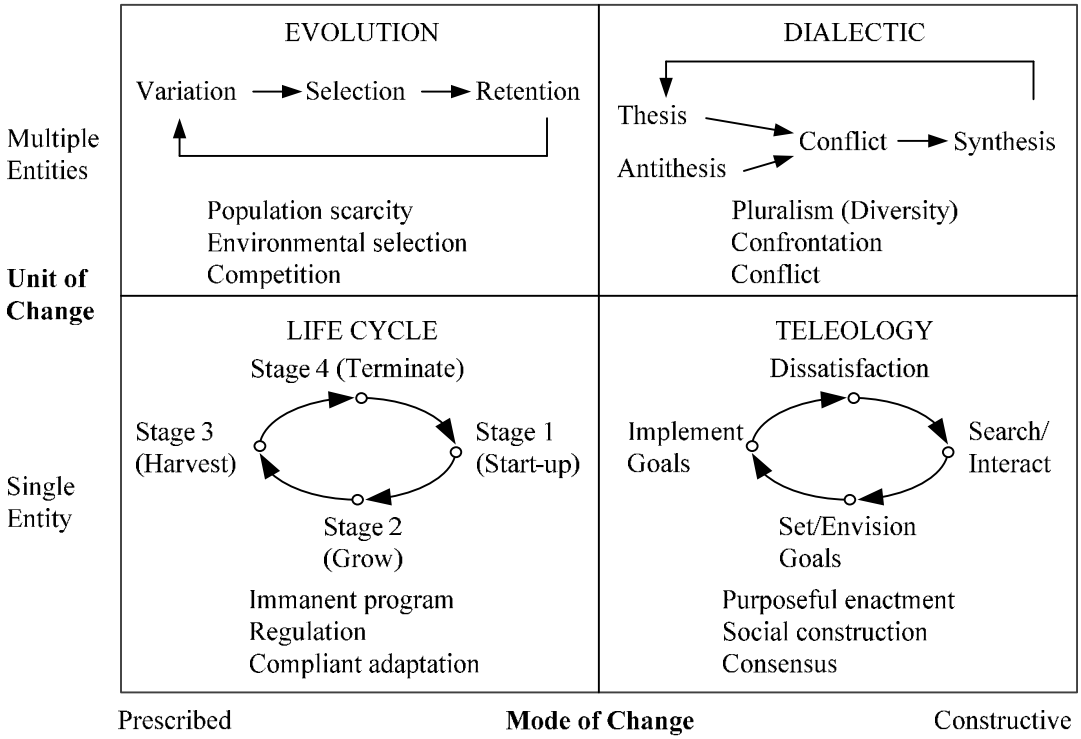


Figure 2.19 Process Theories of Organisational Development and Change (Van de Ven and Poole, 1995)

The most used theories in the current change management literature are life cycle and teleological theory (Van de Ven and Poole, 1995; Kezar, 2001). It can be argued that the latter one, teleological theory, explains the best EA adoption. First of all, EA is adopted in a single entity: an organisation (as defined in sub-section 2.2.1). Secondly, EA adoption is constructive, as it is aiming to a specific goal.

According to Csribra and Gergely (2007) there are two ways to predict future events in teleological change via goal attribution. These are an *action-to-goal* and *goal-to-action*. The former can be interpreted as a question: *What is the function of EA adoption?* In the same way the latter can be interpreted as a question: *What action should be taken to achieve EA being adopted?* A summary of differences of these two interpretation action can be seen in Table 2.1. EA adoption can be of both types. If the organisation has a problem it tries to solve with EA adoption, it would be action-to-goal type; function of EA adoption is to solve the problem. If, on the other hand, organisation's goal is to adopt EA, it would be goal-to-action type. The interest of this research is in the actions which should be taken to adopt EA so the type on inference is goal-to-action.

Table 2.1 The Functions of Teleological Interpretation of Actions (Csibra and Gergely, 2007)

Primary function	*Type of inference*	
	'Action-to-Goal'	*'Goal-to-Action'*
On-line Prediction	Goal prediction: Predicting the likely effect of an on-going action	Action anticipation: Predictive tracking of dynamic actions in real time
Social Learning	Discovering novel goals and artefact functions	Acquiring novel means actions by evaluating their causal efficacy in bringing about the goal

Another dimension of predicting future events in teleological change is the primary function of the prediction (Csibra and Gergely, 2007). There are two functions, *on-line prediction* and *social learning*. The former is aiming for prediction of either the goal or action, based on ongoing actions. The latter aims to learning and finding of novel goals or means actions. The interest of this research is in finding ways to successful EA adoption so the primary function is social learning.

2.5. Summary of Chapter 2

In this chapter the concept of Enterprise Architecture was introduced, and from theoretical point of view, the research were put into a context. Various definitions of Enterprise Architecture (EA) from the current literature were introduced and discussed, and the definitions used in this thesis were presented. EA can be defined as (i) a formal description of the current and future state(s) of an organisation, and (ii) a managed change between these states to meet organisation's stakeholders' goals and to create value to the organisation.

To better understand EA, it was examined from three different theoretical perspectives. Firstly, EA can be seen as a communication media used to describe both the current and future states of an organisation. In other words, EA is the ontology of the organisation. Secondly, EA can be seen as an activity system, having four high-level activities; (i) describing the current state of the organisation, (ii) describing the future state(s) of the organisation, (iii) managed change between the current and future states, and (iv) the EA adoption. Thirdly, EA can be seen as a technology or system, possibly restricting or changing ways how organisation works. As such, technology acceptance models may be used as a theoretical view point on understanding the EA adoption process challenges.

Enterprise Architecture adoption is a unique, one-time, and irreversible organisational change. It is aiming for a particular goal (e.g. EA adoption), and as such, can be regarded as a teleological change. The stance towards interpreting the actions of EA adoption in this thesis is goal-to-action and the primary function of interpreting these actions social learning.

In this chapter, EA and related concepts were introduced, including the traditional adoption method. In the next chapter, through literature review, the state of the EA adoption research is presented.

Chapter 3 Previous Research on EA Adoption

3.1. Introduction

In this chapter, a literature review conducted on Enterprise Architecture (EA) adoption is presented. To set the research in context, first a preliminary literature review on EA adoption is presented and discussed. In the following sections, Systematic Literature Review (SLR) is discussed and its selection as a review method is argued. This is followed by the explanation of the review process and finally the presentation of the results.

In the Information Systems (IS) field, theoretical research has not been given a lot of attention (Swanson and Ramiller, 1993; Webster and Watson, 2002). According to Webster and Watson (2002), this is due to the fact that IS as a research field is young. Although it IS field has matured during years, it is still reliant on theories from other disciplines (Grover, 2012). Moreover, IS is interdisciplinary so constructing a literature review can be challenging, as theories might need to be borrowed from another fields of science. This challenge needs to be addressed by carefully selecting an appropriate review method.

3.2. Preliminary Literature Review

In this section, the results of preliminary literature review conducted in late 2009 are presented. Purpose of the review was to shed a light to the level of available EA literature.

3.2.1. Organisational Capabilities in EA Adoption

TOGAF (2009) can be argued to be the de-facto Enterprise Architecture framework, including a conceptual framework and a development method. TOGAF has adopted best practices from all major EA frameworks, and it is developed by open community.

Capability can be defined as “the power or ability to do something” (Oxford Dictionaries, 2010). As an organisational capability, it can defined as an organisation’s ability to perform coordinated task by utilising its resources for achieving a particular result (Helfat, 2003).

TOGAF states that EA practice should be treated as any other operational unit of business (TOGAF, 2009). Successful adoption of EA requires a number of capabilities from the

organisation. TOGAF contains a list of capabilities which will be established or affected during the adoption of EA:

- Financial Management
- Performance Management
- Service Management
- Risk Management
- Resource Management
- Communications and Stakeholder Management
- Quality Management
- Supplier Management
- Configuration Management
- Environment Management.

In the TOGAF context, capabilities mentioned above are used for EA purposes, for instance Quality Management is defined as "The management of the quality aspects of the enterprise architecture practice" (TOGAF, 2009, p. 34). It is not realistic to require that EA specific capabilities are present before the adoption of EA. Therefore there is no point to assess such a capability to assess the readiness for EA, i.e. "Does your organisation have EA quality management practice implemented?". However, it can be assumed that if the general quality management capability is in place, this capability could be utilised also for EA purposes and therefore the organisation would be successful in adopting EA.

TOGAF (2009) also introduces a Business Transformation Readiness Assessment, which is used to measure the organisation's level of readiness to change. The ability to change is determined as an ability to conduct transition(s) between baseline and target architecture. According to TOGAF, there are several factors to be measured to assess readiness:

- Vision
- Desire, willingness, and resolve
- Need
- Business Case
- Funding
- Sponsorship and leadership
- Governance
- Accountability
- Workable approach and execution model
- IT capacity to execute
- Enterprise capacity to execute
- Enterprise ability to implement and operate.

The mentioned readiness factors should be presented using *Maturity Models*, which are generally speaking 6-step models that measures the level of maturity of a given capability of the organisation. Levels of maturity are *Not defined*, *Ad Hoc*, *Repeatable*, *Defined*,

Managed, and *Optimised*, respectively. However, TOGAF has only one example of such a maturity model (see TOGAF, 2009, p. 341) for readiness factors. To be able to use maturity models for measuring readiness factors, one must form a maturity model for each factor or find an existing one that suits the purpose.

As a conclusion, based on TOGAF, there are two kinds of important aspects involved in EA adoption. First of all, there are organisational capabilities that are required to adopt EA. Secondly, there are factors which can be used to measure the readiness for change. This can also be interpreted as *a capability to change*, which, furthermore, can be added under Change Management capability.

3.2.2. Key Success Factors in EA adoption

By searching the major electronic libraries, no Key Success Factors (KSFs) for EA were found during that time. As earlier stated, one of EA's purpose is to adjust the organisation's ICT with its business. One result of such an adjustment can be an Enterprise Resource Planning (ERP) system. The purpose of ERP is to help an organisation to run its business more efficiently, especially in terms of resource usage. The implementation and adoption of ERP system affects virtually all parts of the organisation, in similar way than as EA does.

As the ERP requires a tremendous amount of resources to implement and there are a number of benefits to gain (O'Leary, 2004), it has been in interest of industry and academia. The big difference between EA adoption and ERP implementation is that the latter one is something tangible that can be measured: there is always a resulting information system. There are several papers published on ERP implementation KSFs. Next the list of some of those is presented and compared with EA literature.

Umble *et al.* (2003) listed nine KSFs for ERP implementation in their paper, based on a literature review and a case study:

- Clear understanding of strategic goals
- Commitment by top management
- Excellent project management
- Organizational change management
- A great implementation team
- Data accuracy
- Extensive education and training
- Focused performance measures
- Multi-site issues

Somers and Nelson (2001) listed 22 KSFs for ERP implementation based on their literature review:

- Top management support
- Project champion
- User training and education
- Management expectations
- Vendor/customer partnerships
- Use of vendors' development tools
- Careful selection of the appropriate package
- Project management
- Steering committee
- Use of consultants
- Minimal customization
- Data analysis and conversion
- Business process reengineering
- Defining the architecture
- Dedicated resources
- Project team competence
- Change management
- Clear goals and objectives
- Education on new business processes
- Interdepartmental communication
- Interdepartmental cooperation
- Ongoing vendor support

As a summary, it can be stated that the KSF of ERP implementation are in line with the EA adoption aspects presented in the previous sub-section. There are capabilities, such as change management, project management, and supplier management. There are also factors affecting the change, such as top-management support, clear goals, and employers' capabilities (i.e. need for training).

3.2.3. Conclusions and Recommendations From a Previous HEI EA Pilot

In 2008, JISC (former Joint Information Systems Committee) funded an EA pilot on four universities in UK (JISC, 2009). The pilot was later studied in a PhD research (see Oderinde, 2011). In this sub-section, recommendations and conclusions from each participating organisations are summarised.

Liverpool John Moores University (LJMU) derived the following conclusions and recommendations. Firstly, there should be a common language between business and IT. Moreover, it is crucial to "sell" the EA to business people. Secondly, EA should have a home. This means a dedicated resources for EA. Thirdly, LJMU stated that every

organisation has already an implicit EA in place. This means that even it is not called EA, all the EA functionality is in place in some form. Therefore it is crucial to have some 'proper' problem where EA can help with, such as an ongoing change. This change could then be used as a 'burning platform' to demonstrate the need and power of EA. Final recommendation is that the organisation's strategy should be in place before EA.

In addition to LJMU's findings, King's College London (KCL) generated following conclusions and recommendations. Firstly, the organisational level of EA should be as high as possible. This means that it should be implemented on institution level rather than on organisational unit level. This is because there are processes and information systems that are dependent on other organisational units' processes and systems. Secondly, in addition to a dedicated resource, there should be a person, preferably expert on EA, who can influence the organisation. Thirdly, there should be enough time reserved for EA.

Third university in the pilot, Cardiff University suggested some additional conclusions and recommendations. First they emphasise the importance of top-down leadership, and present some possible challenges of federated organisations where governance is divided. Secondly, there are a number of initiatives going on at the same time, and it might be difficult to have enough support for EA. Thirdly, as EA has been developed outside Higher Education Institution (HEI) field, there is a challenge in describing its strengths for HEIs.

Fourth university, Roehampton University, joined the pilot at a later phase and therefore their case study was not available. However, in the final report of their project two important aspects are highlighted (King, 2010). First of all, stakeholder involvement is vital to success but found difficult to develop and maintain. Secondly, there should be a strong element of governance, shaped according to the requirements of each institution. As a recommendation, in addition to those presented by other institutions, the level of experience of enterprise level concepts in senior management should be raised.

As a summary, following list of conclusions and recommendations can be made:

- Common language between IT and business
- Dedicated EA resources
- A need or reason for EA
- Organisation strategy should be in place
- EA should be implemented on correct organisational level
- There should be enough time for EA
- Top-down leadership and management
- Number of ongoing initiatives affects EA
- Stakeholder involvement

- Strong EA governance
- Training of senior management

The conclusions and recommendations from the EA pilot are in line with the findings from the previous sub-sections, but there are also some differences. Similarities are for instance the need for dedicated EA resources, a clear goal, support from top-management, stakeholder involvement, and a proper training. What was surprising, however, was that the capabilities mentioned in previous sub-sections were not seen as an issue. The only mentioned capability was the EA governance. There can be various reasons for this. For instance, the aforementioned capabilities might already be mature enough for EA adoption. Another explanation could be that the importance of these capabilities are not recognised properly, which may indicate the low level of EA maturity.

3.2.4. Summary of Preliminary Literature Review

In this section, results of a preliminary literature review on EA adoption were introduced. In this sub-section a summary of these findings are presented.

Strategy, or strategic management, is a very important function of any modern organisation. Umble *et al.* (2003) found that a clear understanding of strategic goals is one of KSFs in an ERP implementation. Also one of JISC EA pilot's conclusions were that the strategy and its goals should be defined and in place before starting any EA projects.

Like strategy, Quality Management (QM) or Quality Assurance (QA) also have a key role in modern organisation management. In EA context, QA has a special meaning, as it practically covers the first EA layer, Business Architecture. A QA documentation usually contains, for example, process definitions and a list of stakeholders.

Project Management (PM) is crucial when an EA project is launched Umble *et al.* (2003) and Somers & Nelson (2001) found it to be one of top KSFs in ERP implementation. However, EA is not a one-time project in nature, but more like a continuous process. At the same time, EA usually has a number of projects (or activities), such as describing the current and target states, and EA adoption. Therefore an effective PM is important.

Top management support and commitment has been found to be the most important KSF in ERP implementation (Somers and Nelson, 2001). As EA and ERP do share characteristics (Aarabi *et al.*, 2011), it is assumed to be important also in EA adoption. This assumption is supported by the findings from the EA pilot (King, 2010; JISC, 2009).

Organisational structure can be understood in several different ways, and therefore might also affect EA adoption in several ways. Firstly, organisational structure can be understood as the physical boundaries of an organisation. For instance, the organisation might be divided into multiple geographical sites. Secondly, it can mean operative organisational boundaries. For instance, organisation might be structured so that there are different functional units, such as accounting, billing, production, etc. Thirdly, organisation structure can mean power relations in terms of management control.

As in any initiatives, there should be a clearly defined goal to aim in EA adoption (Somers and Nelson, 2001; JISC, 2009). It should be noted that according to EA specialists, EA itself is not an aim, but a method or tool achieve it (see Syynimaa, 2010b). Therefore there should be a need or a problem that could be addressed by utilising EA (JISC, 2009). When the goal is clearly defined, also the scope can be fixed in terms of time, money and other resources.

Literature reviewed in this section revealed some issues EA adoption may face and also some recommendations to follow. These can be used as a starting point for researching EA adoption. However, a rigour scientific basis for the PhD research requires a more systematic and rigorous literature review. This literature review is presented in the following section.

3.3. On Systematic Literature Review

Relevant literature review is a basis for all scientific research (Webster and Watson, 2002). In a PhD thesis, its purpose is to demonstrate gaps on current body of knowledge, and also where the research is positioned. Evidence-based Software Engineering (EBSE), adopted from medical science, was introduced in 2004 to bring rigour to IS field (Kitchenham *et al.*, 2004). As a result, a systematic literature review (SLR) concept was introduced later on the same year (Kitchenham, 2004). To build a rigorous scientific basis for the thesis, SLR is adopted to conduct the literature review. Guidelines presented by Kitchenham (2007) are followed throughout the review.

Reasons for conducting SLR are following; to summarise existing empirical evidence on particular subject, to identify gaps in current research, and to construct a framework for research (Kitchenham, 2007).

A major difference between another widely used approach in IS literature review by Webster and Watson (2002) is that SLR has a predefined review protocol that is followed throughout the review (Kitchenham, 2007). Webster and Watson (2002) suggested that one should go forward and backward in literature by following references. However, this is likely to bring bias to the review, which SLR tries to minimise. However, the publication bias, such as a tendency to report only positive outcomes, cannot be avoided even with SLR (Kitchenham, 2007).

During the preliminary literature review in 2009, it was noticed that very little scientific research on the subject was available. In such a case, instead of conducting a full-scale SLR, a systematic mapping study (SMS) could be utilised (Kitchenham, 2007). By systematic mapping study, one can identify research in a domain at a high level of granularity.

In this thesis, the systematic mapping study concept was adopted and the guidelines of Kitchenham were followed. Thus, unless otherwise stated, SLR and SMS are referring to Kitchenham (2007).

3.4. Systematic Literature Review Process

In this section the actual review process of SLR is explained in detail.

Prior to conducting SLR, a need for such review has to be confirmed. Such a need would be for example a need to summarise current body of knowledge on a certain phenomenon, or the lack of prior SLRs on the subject (Kitchenham, 2007). This is also the case in this thesis. There is a need to summarise the current body of knowledge on the subject to (i) identify gaps on current knowledge, and (ii) to find out research methods that could be utilised during the course of research. Moreover, during the preliminary literature review, no SLRs on the subject was found.

3.4.1. Research Questions

The most important part of the SLR is to clearly define research questions, as they are the drivers for SLR. The search process must identify studies that address the research questions, data to be extracted needs to answer those questions, and synthesis needs to be formed so that answers to research questions are given. (Kitchenham, 2007). The main research question of the thesis is *How can Enterprise Architecture be adopted successfully*

in Finnish Higher Education Institutions? Thus, by utilising SLR, it is tried to find out any current research conducted on the subject. Moreover, it is tried to find scientific research methods that could be utilised during the research. In SMS, the scope of research question are generally broader than in SLR (Kitchenham, 2007). As noted earlier, preliminary literature review found no scientific research on EA adoption.

The research questions used in SLR are as follows:

RQ1: What scientific research is conducted on EA adoption?

RQ2: What research methods is used to study EA adoption?

First question tries to find the current body of knowledge on EA adoption. Second question should be answered by the same material than for the first question. However, as EA is a relatively new research area, it is possible that there is not enough information on the subject. This can be addressed by including studies from related disciplines (Kitchenham, 2007).

The research question can be better structured by identifying certain criteria, such as *Population, Intervention, Comparison, Outcomes, Context,* and *Experimental design* (Kitchenham, 2007). In IS, population can be for example software engineers, a specific role, an industry group etc. Intervention refers to procedure that addresses a certain issue. Comparison is to what intervention is compared to. Outcomes refers for instance to outcomes of applying a certain procedure, such as improved reliability. Context refers to the context where the study is executed. Experimental design refers to the design used on conducting the research. (Kitchenham, 2007).

For the research questions RQ1 and RQ2, population can be defined as *organisations*. Intervention that is looked for is *the adoption of EA*. In this case, comparison criterion is not applicable, nor is the context. As all scientific research on EA adoption is tried to be found, no restrictions on outcomes (e.g. positive/negative) are applied. No limitations on the design of research are set either, since also the applicable research methods to be used in this research are also looked for.

3.4.2. Review Protocol

A review protocol specifies how, and using which methods, the SLR is conducted. A pre-defined protocol is used to reduce the bias caused by the researcher. Thus, review is

conducted so that researcher's expectations are not affecting the reviews (Kitchenham, 2007).

Besides background information and research questions presented in previous sub-section, the review protocol includes (i) strategy used to search for primary studies, (ii) study selection criteria, (iii) study selection procedures, (iv) study quality assessment procedures, (v) data extraction strategy, (vi) synthesis of the extracted data, and (vii) project time table. (Kitchenham, 2007).

Best sources for scientific knowledge are scientific journals and conference proceedings (Kitchenham, 2007; Webster and Watson, 2002). However, complete review is not focused only to one or few sources; information should be gathered on broad number of journals, conference proceedings, research registers, even from the internet (Kitchenham, 2007; Webster and Watson, 2002).

Kitchenham (2007) states that digital libraries are not adequate as a single source of SLR. Also reference lists from relevant primary studies and review articles, journals, research registers and internet should be used. However, manual review of such sources is time consuming, especially in PhD project, where there is only one researcher. Searches for relevant literature using digital libraries is much easier than manual. For instance, citations of found literature can be easily imported to a citation software, such as EndNote. Digital libraries are usually using multiple sources for their indexes and there are multiple libraries available to use. Thus the strategy of using multiple digital libraries for searching relevant studies is adopted. To satisfy the scientific completeness of the review, it is made sure that the digital libraries containing top journals and conferences in IS discipline are used. Also the general digital libraries and libraries from other disciplines are used. List of 13 digital libraries used in the SLR can be seen in Appendix II.

As an understanding of the current scientific knowledge on the subject is tried to be formed, the review is required to include top journals and conferences in the IS field (Webster and Watson, 2002). The Excellence in Research for Australia (ERA) initiative has ranked journals and conferences on various disciplines (Australian Research Council, 2010a; Australian Research Council, 2010b) including IS. The Association of Business Schools (ABS) has also ranked academic journals in their Academic Journal Quality Guide (ABS, 2010), but the ranking does not cover conferences. Mapping of digital libraries used in SLR to top journals and conferences of IS can be seen in Appendix II. Journals and conferences

are fetched from ERA's ranking list (quality rating A* or A). Highest grade journals in Information Management category from ABS ranking list are rated as A* in ERA's ranking list. Each digital library was studied to find out whether it contained mentioned journals and conferences. Information was fetched by using lists of available journals and conferences, or by using search function. Mapping indicates that the given title was found on the list of titles, or that search results included results from the given title. Types of search results were not limited in any way.

It is acknowledged that digital libraries do not necessarily cover all contents of journals and conferences. Moreover, some of the journal and conference titles are abbreviated differently in digital libraries. Thus, mapping does not demonstrate *full coverage* of titles on specific libraries. Titles found in multiple libraries do increase the coverage.

The study selection criteria seen in Box 3.1 are based on the SLR research questions. Studies will be selected if they are about EA adoption or if they contribute to research methodology. As the language of contemporary science is English (Drubin and Kellogg, 2012), only publications in English are selected. It should be noted that obvious exclusion criteria are not explicitly stated, such as articles from newspapers, commercials, non-scientific books, etc. The procedure for selection is straightforward as there is only one researcher.

SC1: Study is about EA adoption
SC2: Study contributes to research methodology of adoption (also in non-EA studies)
SC3: Language is English

Box 3.1 Selection Criteria

There is only one quality assessment criterion (Box 3.2). To form a rigour scientific basis for the thesis, in terms of current body of knowledge on the subject and applicable research methodology, only peer reviewed studies are included. However, all included studies, even those excluded in quality assessment, may be used as evidence on later phases on the research.

QA1: Study is peer reviewed

Box 3.2 Quality Assesment Criteria

Purpose of the data extraction phase in a thesis is to classify papers in a level of detail required to answer to research questions (Kitchenham, 2007). Data to be extracted includes (i) source of the study and full reference, (ii) classification of the study (exploratory etc.), (iii) scope of the study (adoption etc.), (iv) organisation type (public, private), (v) main topic area, (vi) context of the study, (vii) research question/issue, (viii) research methods used, and (ix) quality evaluation.

Data collected will be synthesised so that sound answers to the research questions are given. For a thesis, this phase is more about summarising the extracted data (Kitchenham, 2007). Three results of syntheses are included; (i) current scientific body of knowledge on EA adoption, (ii) research methods used, and (iii) overview of the topic.

Evaluation of the review protocol is a critical step on every SLR (Kitchenham, 2007). Internal consistency was evaluated by checking that (i) search string is appropriately formed, (ii) extracted data will address research question, and (iii) data analysis results to answers to research questions (Kitchenham, 2007).

3.4.3. Conducting SLR

Throughout the research, scientific literature related to Enterprise Architecture has been continuously reviewed. To make research more rigorous, SLR has been conducted in the beginning of research in 2010 and at the end in 2014. In this section the results of both SLRs are presented and discussed.

On March 29th 2010 and January 8th 2014 digital libraries (see Appendix II) were each searched using predefined search string. Some search engines and digital libraries required the search string to be broken into multiple fields. In these cases, it was made sure that the search logic (e.g. AND & OR operands) remained as originally intended. Whenever possible, search was limited to metadata used by libraries, namely the title, keywords, and abstract. No limits for dates or types of documents were used in 2010. However, in 2014 the search was limited to research published in 2010 or later.

The full process of conducting SLR is described in Appendix III, including the applying of selection and quality assessment criteria. Summary of the ranking of publications included in SLR (see Appendix IV) can be seen in Table 3.1. As it can be noted, most of the publications are from unranked conferences and journals. Low number of A ranked publications indicates the current low level of scientific maturity of EA research.

Table 3.1 Summary of Ranking of Included Publications

Rank/Year	*2010*	*2014*
*A/A**	9 (26 %)	4 (13 %)
B	5 (14 %)	3 (10 %)
C	6 (17 %)	5 (16 %)
Thesis	1 (3 %)	2 (6 %)
Unranked	14 (40 %)	17 (55 %)
Total	*35*	*31*

It is interesting to notice that the number of publications on EA adoption research before and between 2010 and 2014 are almost identical. It is a clear indication that EA adoption has become more interesting among academia. Moreover, there has been two PhD theses published on the subject between 2010 and 2014 versus one before 2010. This indicates that the need for doctoral level EA education has been noticed in academia. In 2013, a masters' thesis on EA adoption in public sector in Finland was published (Pehkonen, 2013). This is also included to the review due to its relevance to the thesis, thus the total number of SLR publications is 67. In a recent PhD thesis published in late 2014, critical problems and success factors of EA adoption in Finnish public sector organisations were researched (Seppänen, 2014). Due to its recentness it is not included in the SLR but discussed in Section 5.7.

3.5. Findings

In this section, SLR findings are presented from two viewpoints. First the findings of EA adoption are presented and summarised. Next the findings of research methods are presented.

3.5.1. EA Adoption

The first purpose of the SLR was to find out the current scientific body of knowledge of EA adoption. In this sub-section a summary of the findings is presented. Some studies were excluded from the synthesis (see Appendix III for details).

From the 67 studies of SLR, only 18 are conducted on the actual implementation or adoption of EA (see Table 3.2). As it can be noted, EA adoption has been researched in various contexts. Geographically the most researched context is USA, which has explicitly stated to be the context in six studies. Ten of the studies are explicitly stated to be conducted on public sector and seven in private sector. Only one of the studies is conducted in the HEI sector. However, it is assumed that some findings from other studies can be generalised also to HEI context.

Table 3.2 Studies Conducted on EA Adoption

Author(s)	*Topic*	*Context*
Richardson *et al.* (1990)	Experiences from using principles based EA in a merger	Two oil companies in USA
Miller's (2003)	EA's affect on IT services effectiveness	North Dakota state government in USA
Kaisler *et al.* (2005)	Survey of EA adoption problems and possible solutions.	EA work performed for Department of the Treasury of USA
Liu *et al.* (2005)	Using EA to form an inter-organisational Supply Chain Management system	A motorcycle company in China
Hjort-Madsen (2006)	Reasons for public sector organisations to adopt EA and how the interoperability across government EA programs are governed	Two hospitals in Copenhagen, Denmark
Hjort-Madsen (2007)	Institutional patterns of EA adoption	Federal agencies in USA
Matthee *et al.* (2007)	The status quo of EA adoption	Financial service companies in South Africa
Iyamu (2009b)	How organisations could success on EA adoption	A financial institution and a government department in South Africa
Carrillo *et al.* (2010)	Roadmap for implementing EA framework	Higher Education Institutions in Ecuador
Unhelkar and Ginige (2010)	Holistic approach for EA transformation	SME in Sydney, Australia
Rai *et al.* (2010)	Transitioning to modular EA	Global delivery corporation and SME electronics company
Espinosa *et al.* (2011)	How coordination and best practices lead to EA success	EA experts from various organisations and sectors in USA and Singapore
Närman and Ericcson (2011)	Adoption process of a common process for business improvement	Public sector agency in Sweden
AlSoufi (2012)	Development lifecycle of the National Enterprise Architecture Framework (NEAF)	Kingdom of Bahrain

Author(s)	*Topic*	*Context*
Makiya (2012)	EA assimilation	Federal government in USA
Hazen *et al.* (2014)	Reasons for the gap between EA adoption and usage	218 organisations using EA
Nogueira *et al.* (2013)	Action Research based methodology to adopt Zachman framework	Start-up enterprise in Mexico
Pehkonen (2013)	Main challenges of early phase EA adoption	Public sector organisations in Finland

Besides the 18 studies on EA adoption, also the remaining studies contains scientific knowledge relevant to this thesis. For instance Lemmetti and Pekkola (2012) and Hiekkanen *et al.* (2013) has studied how EA is perceived in Finnish public sector organisations. Next the findings on EA adoption are summarised.

Whether EA adoption is different in public and private sector is contradictory. Hjort-Madsen (2007), and McNabb and Barnowe (2009) found that public and private sector plan IS and EA differently. This could be interpreted to be caused by the differences of the "business" of public and private sectors. However, according to Gregor *et al.* (2007), public and private sectors conduct their business using similar processes. Moreover, "business" is sometimes used within EA to refer to the reason of organisation's existence (Vasilescu, 2012). Hjort-Madsen (2007) and McNabb & Barnowe (2009) found that reasons for differences in EA adoption and IS planning in public and private sectors are due to contextual factors.

Reasons for adopting EA are similar for both public and private sectors. In the public sector, main driver for EA is the change in the way that public sector is producing services. This change is characterised as requirements to produce services that span across organisations (Hjort-Madsen, 2007; Liimatainen *et al.*, 2008; Martin *et al.*, 2004; McNabb and Barnowe, 2009; Miller, 2003; van Veenstra and Zuurmond, 2009; Weerakkody *et al.*, 2007). This kind of change, or the new way of producing services, is called e-Government. Also requirements to increase efficiency by better utilisation of ICT was one the drivers in the public sector (McNabb and Barnowe, 2009; Miller, 2003; Hjort-Madsen, 2006). In the private sector, too, the changing business world is the main driver for EA (Liu *et al.*, 2005; Nassiff, 2012; Hazen *et al.*, 2014; Iyamu, 2011a; Themistocleous and Irani, 2002). In the private sector this is sometimes called Virtual Enterprise (VE), which is conceptually same as e-Government in the public sector. Thus, it can be stated that the main driver for EA in general is the change in business models spanning organisational boundaries.

There are, however, some fundamental reasons for EA adoption found in the public sector that are not in the private sector. In the public sector, there is evidence that external pressure may initiate EA adoption. This may be due to personal political agenda of top management (Hjort-Madsen, 2006), or due to requirements set by law (Hjort-Madsen, 2007). This is also case in Finnish public sector (Finnish Parliament, 2011). It is also typical for public sector to mimic similar organisations on initiatives, such as EA (Hjort-Madsen, 2007; Kaisler *et al.*, 2005).

Organisational structure and certain capabilities, such as change management, have a strong affect to EA adoption. In decentralised organisations EA is harder to adopt (Gregor *et al.*, 2007). This can be argued to be caused by the change management challenges. All organisations are already performing EA in their own unique way (Rafidah *et al.*, 2007), even though it is not necessarily called EA. Especially in the public sector, a great challenge is that EA requires changes in current organisational culture (McNabb and Barnowe, 2009). Organisation's capability to adopt changes is thus one of the biggest challenges (Hjort-Madsen, 2006). It has been found that the success of EA adoption depends on the effectiveness of the organisation’s change management capability (Iyamu, 2009b; Mezzanotte *et al.*, 2010; Rai *et al.*, 2010; Kaisler *et al.*, 2005). Besides strong management in general, EA adoption requires effective IT portfolio management (Kaisler *et al.*, 2005). Organisation's business strategy plan should be the driver for the change (Kaisler *et al.*, 2005; Struijs *et al.*, 2013; Iyamu, 2011a). EA requires also a structured decision-making process to be in place (Shupe and Behling, 2006). During the EA adoption, conformance to change is important (van der Raadt *et al.*, 2008).

Besides organisation structure and capabilities, also the people who forms the organisation have a great impact on EA adoption. Challenge in current EA frameworks is that as they are built originally for private companies, their focus on social perspective is limited (Hjort-Madsen, 2006). They can, however, bring the cultural clash to the surface (Liimatainen *et al.*, 2008). It has been found that the social perspective is important on IT/business alignment (Gregor *et al.*, 2007) and that EA is even more about people than technology (Miller, 2003). Thus the resistance to change is inevitable in EA adoption (Miller, 2003). It has been found that leadership is the fundamental element of EA adoption success (Miller, 2003; Mezzanotte *et al.*, 2010; McNabb and Barnowe, 2009). To be more specific, especially the change agent that can champion the adoption is crucial to EA adoption success (Miller, 2003).

The most important single thing affecting the success of EA adoption is the support of top management (Gregor *et al.*, 2007; Iyamu, 2011a; Vasilescu, 2012; Struijs *et al.*, 2013; Mezzanotte *et al.*, 2010; Liu and Li, 2009; Iyamu, 2009b; Kaisler *et al.*, 2005; North *et al.*, 2004; Shupe and Behling, 2006). The support of top management is important in terms of providing encouragement and resources (Kaisler *et al.*, 2005). One of the managerial challenges EA adoption is facing is the shortfall of ICT funding (McNabb and Barnowe, 2009). This is somewhat interesting since management in organisations having EA already implemented do understand the importance of EA. However, in these organisations, EA is in the responsibility of CIO, not CEO (Matthee *et al.*, 2007). Another managerial challenge is that the EA function should have a correct position within the organisation (van der Raadt and van Vliet, 2009; Pehkonen, 2013).

Communication also plays a crucial role during the EA adoption. Communication problems in general is a challenge for information systems projects (Gregor *et al.*, 2007). For EA adoption, there should be organisation-wide communication in place (Shupe and Behling, 2006). It has been found that communication exchange between stakeholders is a critical success factor for EA (van der Raadt and van Vliet, 2009). Problems have arisen in communicating for instance the data flow of organisation to stakeholders (Kaisler *et al.*, 2005), and in articulation of EA concepts (Iyamu, 2009b; Iyamu, 2011a; Pehkonen, 2013; Lemmetti and Pekkola, 2012; Valtonen *et al.*, 2011; Sembiring *et al.*, 2011). It has been found that in the beginning of EA adoption, EA concerns are not important for users but the value of EA is recognised later (Richardson *et al.*, 1990). In other words, the lack of general EA knowledge and understanding is low (Lemmetti and Pekkola, 2012; Rai *et al.*, 2010; Hiekkanen *et al.*, 2013). This can be interpreted to be a communication challenge.

For EA adoption, there should be a clear goal set that can be measured to assess the success of EA. EA adoption should be based on a sound business case (Martin *et al.*, 2004). Problem is that goals set for EA adoption are too vague, unrealistic, or aiming too high (Liimatainen *et al.*, 2008). If goals are not clear, it is difficult to measure the actual payoff (Liimatainen *et al.*, 2008) or to conduct end-to-end performance analysis (Kaisler *et al.*, 2005). Even though the goals would be clear, not all costs and benefits can be expressed in financial terms (Struijs *et al.*, 2013; Nassiff, 2012). One of the critical components of EA adoption is a relationship to organisation's strategy (Iyamu, 2009b). However, it has been found that it is difficult to satisfy expectations of all stakeholders, and that their objectives might be conflicting (van der Raadt *et al.*, 2008). Expectations should be clear (Miller,

2003), and stakeholders' objectives should be in line with goals of their formal role in the organisation. As there might be problems in the clear definition of goals and stakeholders' expectations, a pilot could be used to guide full-scale development (Martin *et al.*, 2004).

Environmental, or contextual, factors do also play a role in EA adoption. As already noted, reasons for EA adoption can be political. However, according to Kaisler *et al.*(2005), EA should not be adopted just to fulfil government requirements. This is an interesting argument, since one of the problems in public sector EA adoption has been found to be interoperability issues on different levels in governments (Weerakkody *et al.*, 2007). Moreover, typically there is no overall coordination of initiatives such as EA at the government level, although EA should be constituted with regard to other EA initiatives (Hjort-Madsen, 2006). Government level EAs are problematic to adopt, if there is no party having mandate to force the usage of certain EA, for example by utilising quality assurance mechanisms (Liimatainen *et al.*, 2008).

EA related factors are naturally important for EA adoption. For instance, the selection of EA framework to be used is a crucial task, since it is difficult to be changed afterwards (Kaisler *et al.*, 2005). On the other hand, current EA frameworks are argued to be too general to be usable "as is" by organisations (Weerakkody *et al.*, 2007). Even the definitions used in EA are found to be too vague (Hjort-Madsen, 2006; Sembiring *et al.*, 2011; Pehkonen, 2013; Lemmetti and Pekkola, 2012; Valtonen *et al.*, 2011). The principles used to guide the EA adoption are even more critical than the EA framework (Richardson *et al.*, 1990; Iyamu, 2009b). Experience and skills of EA architects are also important (van der Raadt and van Vliet, 2009), the employees should be properly trained or contractors to be hired (Kaisler *et al.*, 2005; Medini and Bourey, 2012). The importance of the support of top management was emphasised earlier. The reason behind the lack of top-management support is likely to be their lack of EA knowledge (Vasilescu, 2012). After all, value of EA to the organisation is directly influenced by how EA is understood by top-management (Nassiff, 2012). With proper EA knowledge, integrating it to the organisations activities would be easier (Hiekkanen *et al.*, 2013). There should also be a mutual understanding of EA between stakeholders (Iyamu, 2011a).

As acknowledged in Section 3.3, using SLR as a literature review method does not guarantee that all relevant literature is found. For instance research conducted by Janssen and Kuk (2006), Janssen and Hjort-Madsen (2007), and Kamal and Alsudairi (2009) were not found – despite the fact that the conferences and publications were included in used

libraries. Therefore these papers were not included in original literature review and are briefly summarised here. Janssen and Kuk (2006) analysed key EA interaction points of Dutch public administration using Complex Adaptive Systems (CAS) perspective. In CAS, agents (e.g. organisations) interact in an unpredictable and unplanned way. As a result, Janssen and Kuk (2006) proposes a set of simple rules to guide, not control, the EA development. These rules are; (i) stimulate and breed diversity, (ii) do not set targets without providing constraints, (iii) provide support (only) to successful projects, (iv) develop standard infrastructure components, (v) develop modular architectures, (vi) stimulate sharing, and (vi) develop competencies. Janssen and Hjort-Madsen (2007) analysed national EA programs of Denmark and the Netherlands. According to findings, at that time, both countries were struggling with EA governance. As result, they propose a set of elements to be given attention to in national EA; (i) policies, actors, and structures, (ii) governance, (iii) architecture model, (iv) architecture principles and standards, and (v) implementations. Finally, Kamal and Alusairi (2009) studied factors influencing enterprise architecture integration technologies in local government authorities in UK. They used Analytical Hierarchy Process (AHP) to rate various factors influencing the adoption. According to findings, the five most important factors were (i) return on investments, (ii) top management support, (iii) project champion, (iv) benefits, and (v) costs.

To sum up, the literature review revealed factors influencing the success of EA adoption, which can be classified to three distinct categories. These categories are *Organisational factors* (Table 3.3)*, EA related factors* (Table 3.4), and *Environmental factors* (Table 3.5). Organisational factors are those related to the capabilities, culture, or structure of the organisation. Environmental factors are related to the context where organisation is operating, such as laws and regulations. EA related factors are those related to the EA discipline or profession, such as EA skills.

Table 3.3 Organisational Factors Influencing EA Adoption

#	*Factor*	*Source(s)*
F1	Organisation structure	Gregor *et al.* (2007)
F2	Change management capability	Kaisler *et al.* (2005) Iyamu (2009b) Mezzanotte *et al.* (2010) Rai *et al.* (2010)
F3	Need of change in organisational culture	McNabb and Barnowe (2009)
F4	Organisation's capability to adopt changes	Hjort-Madsen (2007)
F5	IT portfolio management	Kaisler *et al.* (2005)

#	*Factor*	*Source(s)*
F6	Strategy driven change	Kaisler *et al.* (2005) Struijs *et al.* (2013) Iyamu (2011a)
F7	Structured decision making process	Shupe and Behling (2006)
F8	Conformance in change	van der Raadt *et al.* (2008)
F9	EA frameworks' lack of focus on social perspective	Hjort-Madsen (2006)
F10	EA adoption brings cultural clash to surface	Liimatainen *et al.* (2008)
F11	Social perspective is important	Gregor *et al.* (2007)
F12	EA is more about people than technology	Miller (2003)
F13	Resistance to change	Miller (2003)
F14	Importance of leadership	Miller (2003) McNabb and Barnowe (2009)
F15	Support of top management	North *et al.* (2004) Kaisler *et al.* (2005) Shupe and Behling (2006) Gregor *et al.* (2007) Liu and Li (2009) Iyamu (2009b) Mezzanotte *et al.* (2010) Iyamu (2011a) Vasilescu (2012) Struijs *et al.* (2013)
F16	Organisational position of EA function	van der Raadt and van Vliet (2009) Pehkonen (2013)
F17	Communication	Richardson *et al.*(1990) Kaisler *et al.* (2005) Shupe and Behling (2006) Gregor *et al.* (2007) Iyamu (2009b) van der Raadt and van Vliet (2009)
F18	Clear goal set for the EA adoption set by the organisation	Miller (2003) Martin *et al.* (2004) Iyamu (2009b)

Table 3.4 EA Related Factors Influencing EA Adoption

#	*Factor*	*Source(s)*
F19	Selection of the EA framework	Kaisler *et al.* (2005)
F20	Vague definition of EA	Hjort-Madsen (2006) Sembiring *et al.* (2011) Valtonen *et al.* (2011) Lemmetti and Pekkola (2012) Pehkonen (2013)
F21	Use of principles	Richardson *et al.*(1990) Iyamu (2009b)

#	*Factor*	*Source(s)*
F22	Experience and skills of EA staff	Kaisler *et al.* (2005) van der Raadt and van Vliet (2009) Medini and Bourey (2012)

Table 3.5 Environmental Factors Influencing EA Adoption

#	*Factor*	*Source(s)*
F23	Initiator of EA adoption	Kaisler *et al.* (2005)
F24	Interoperability issues of related EAs	Weerakkody *et al.* (2007) Hjort-Madsen (2006)
F25	Steering power of external parties	Liimatainen *et al.* (2008)

3.5.2. Research Methods

In this sub-section, findings of research methods and techniques used to research EA adoption are presented and discussed. It should be noted that only findings from SLR conducted in 2010 are included. Summary of the research methods can be seen in Table 3.6. Research methods are subject to the selected research approach, thus methods are discussed based on the research approach categorisation by Järvinen (2004).

Most of the papers utilised *conceptual-analytical* approach. Typical to this approach is that no empirical data is used. Research outcomes were based on a logical argumentation based on the current literature, a case description, or authors' personal experience on the subject. For instance Wu (2007) formed a roadmap for e-government transformation based on analysis of the current literature. Kaisler *et al.* (2005) describes challenges and possible solutions of EA adoption based on authors' experience and lessons learned over the past five years. McNabb & Barnowe (2009) discussed trends shaping public sector transformation and concluded their role in successful transformation. The study was based on the historical review of each particular trend. Umar and Zordan (2009) presented a cost-benefit model to help decision making on selecting a SOA implementation approach. They demonstrated the model's utilisation by a case study. In this sense, this study could be classified also as theory-creating. However, the model was not explicitly tested on the case study, but used it to illustrate the model's usage. The high number of conceptual-analytical papers implies that EA as a scientific discipline is relatively young.

Theory-creating papers utilised qualitative research methods. All studies used a single or multiple case studies as empirical basis for research. Data was gathered by using structured

or semi-structured interviews, documents, questionnaires, or by observations. All studies used some combination of these techniques for triangulation. Although data gathering techniques were more or less the same, data analysis were different. Hjort-Madsen (2006; 2007) used institutional theory to analyse data. Martin *et al.* (2004) used strategic alignment theory by Henderson and Venkatraman (1993). In all papers the used analysis method was not explicitly stated. Analysis method was selected based on the purpose of the particular paper.

Theory-testing papers utilised both quantitative and qualitative research methods. Tested theory was either formed for the particular research or used some available theory. In qualitative papers theories were tested by using empirical data from case studies, using similar techniques as in theory-creating studies. Van der Raadt and van Vliet (2009) formed a theory to assess efficiency of the EA function based on the literature. Theory was tested in a single case study by using fully structured interviews and documentation. Van der Raadt *et al.* (2008) used consumer research techniques to reveal how stakeholders perceive EA. Data was gathered by using in-depth semi-structured interviews. Acikalin *et al.* (2008) formed a conceptual model of the purpose of ERP based on literature and tested it on four case studies. Data was gathered using face to face semi-structured interviews. In quantitative papers theories were tested using statistical analysis. Matthee *et al.* (2007) used a modified questionnaire by Jaap Schekkerman from Institute For Enterprise Architecture Developments (IFEAD) to find out the current state of EA in South African financial sector. Statistical analysis was used even though only six companies were involved in the research. Van Veenstra and Zuurmond (2009) used *Transformational Government* theory to assess the effect of transformation on online services in local governments. Data was gathered by utilising surveys and from website benchmark data, and analysed statistically.

Innovation-building papers described a development process of innovations using case studies. Design science approach was used on all three papers. For instance Møller *et al.* (2008) described a longitudinal case of building a virtual enterprise architecture for a baggage handling system.

Innovation-evaluation papers described evaluation of certain innovation by using case studies. Themistocleous and Irani (2002) evaluated application integration on a multinational petroleum company. Richardson *et al.* (1990) evaluated principles based architecture on a merger of two oil companies.

As a summary, there are no EA specific research methods. Thus the research methods and techniques to be used depends on the selected research approach, not discipline (e.g. Enterprise Architecture). Many scholars have categorised EA as an IS discipline (Gregor *et al.*, 2007; Dietz *et al.*, 2013; Iyamu, 2011b), which imply that research methods used in IS research are applicable also in EA research. The low number of theory-testing and innovation-evaluation papers imply that EA as a research field is young.

Table 3.6 Summary of EA Adoption Research Methods

Research approach	*Occurrences*	*Research methods*
Conceptual-analytical	10	Logical argumentation based on current literature, a case description, or authors' personal experience
Theory-creating	8	Case studies
Theory-testing	7	Case studies Surveys
Innovation-building	3	Design Science Case descriptions
Innovation-evaluation	2	Case descriptions
Total	*30*	

3.6. Summary of Chapter 3

In this chapter a Systematic Literature Review (SLR) and its results conducted on the subject area of the thesis were presented. It has been demonstrated that there is a clear gap in the scientific knowledge about Enterprise Architecture adoption in HEI sector. However, there is some research conducted on the EA adoption in general, which revealed possible factors that might be affecting EA adoption also in HEIs. These factors (25) can be classified into three distinct categories, namely, *Organisational* (18)*, Enterprise Architecture related* (4), and *Environmental (contextual)* (3) factors. The number in parenthesis refers to the number of factors, which shows us that most of the factors are organisational related. Thus it can be argued that the success of EA adoption greatly depends on these organisational factors, such as the support of top-management and organisation's ability to change.

Research methods and techniques used in these studies suggests that they are to be chosen according to the selected research approach. EA has been categorised as an IS science by many scholars. EA research benefits from this categorisation, as the IS research methodologies can therefore be utilised as-is while researching EA. In the next chapter, research methodology used in this thesis is presented and discussed.

Chapter 4 Research Methodology

4.1. Introduction

In this chapter, research paradigms, methods, and techniques used in this thesis are introduced and discussed. Enterprise Architecture (EA) adoption is an instance of a teleological organisational change (see sub-section 2.4) aiming for adopting EA methods and tools, and, eventually to realisation of EA benefits. As discussed in the previous chapter, EA can be categorised as an Information Systems (IS) discipline. Therefore IS science and research methodologies are adopted to research EA adoption. Aim of this thesis is to improve the traditional EA adoption method to increase the likelihood of successful adoption. Therefore, after discussing IS research in general, the introduction and argumentation for the selection of Design Science approach used in this thesis are presented.

Research methodologies are about how researcher can find out what he or she is trying to find out (Guba and Lincoln, 1994). They are part of research paradigms discussed in following sections, as the question of how we know things is based on ontological and epistemological assumptions. Research approach can be understood as a synonym to research methodology. Distinction between methodology, methods and techniques are as follows (Kothari, 2005); Research *methodology* is a way to systematically solve the research problem. Examples of such methodologies are a *quantitative* and *qualitative* research, and a *case study*. Research *methods* are a constitute part of methodologies, they are considered to include all methods the researcher uses while conducting research, such as *surveys* or *interviews*. Research *techniques* are instruments used while using a certain method, such as a web or paper based *questionnaire*, or a *phone interview*. With these definitions in mind, next the discussion about IS research and paradigms are presented.

4.2. Information Systems Research and Paradigms

4.2.1. Introduction

Information Systems (IS) research is a wide field of science, regarded as an applied science (Iivari, 2010). Information systems can be defined as systems that consist of information

and communication technology (ICT) and people utilising ICT (Beynon-Davies, 2009b; Lee *et al.*, 2013). ICT can be understood as any physical artefact used for storing or for communicating information (Beynon-Davies, 2009a). It can be argued that both information system and ICT are broad concepts. Research interests in IS are also broad, they include research objects such as society, organisation, individual, technology, and methodology (Galliers and Land, 1987). Also the nature of information itself is one of IS research objects (Beynon-Davies, 2009c). Contemporary view to IS recognises three artefacts to research: (i) a technology artefact, (ii) an information artefact, and (iii) social artefact (Lee *et al.*, 2013).

In Chapter 2 the definition of EA was presented and studied from various perspectives. EA is defined as (i) a formal description of the current and future state(s) of an organisation, and (ii) a managed change between these states to meet organisation's stakeholders' goals and to create value to the organisation. The former definition can be categorised as an information artefact. The latter definition is one of the four activities related to EA; (i) describing the current state of an organisation, (ii) describing the future state of an organisation, (iii) managed change between these states, and (iv) adopting EA in an organisation. These activities (processes, methods) are human invented and therefore, according to Lee *et al.* (2013), technology artefacts. The social artefact related to EA is the organisation and its stakeholders.

In this thesis, the aim is to improve (design) the traditional EA method, resulting to a technology artefact (method). In the next sub-section, research paradigms are discussed and the selection of design research approach argued.

4.2.2. Research Paradigms

The concept of *research paradigm* can be defined as a "set of scientific habits" (Masterman, 1970, p. 66) or more specifically "set of interrelated assumptions about the social world which provides a philosophical and conceptual framework for the organized study of that world" (Filstead, 1979, p. 34). These assumptions are fundamental in their nature, and they are to be accepted as they are. Moreover, there is a constant scientific debate on these assumptions, as they cannot be proven to be either right or wrong (Guba and Lincoln, 1994).

Research paradigms are constituted on philosophical assumptions. Two major philosophical assumptions are *ontological* and *epistemological*. Ontology is about the form

or nature of reality, and what can be known about it (Guba and Lincoln, 1994). That is, does the reality exists as its own, or is it a construct of the human mind. Epistemology is about the nature of relationship between knower and would-be knower (Guba and Lincoln, 1994). That is, how a researcher can acquire information from reality.

Burrell and Morgan (1979) introduced a four-paradigm model for analysing social and organisational theory based on two dimensions, ontological (order-conflict) and epistemological (subjectivist-objectivist). On the ontological dimension, the *order* view characterises the social world as a world that is in perfect order. Contrary to this, the *conflict* view assumes that the social world is constantly changing, facing problems and stressing changes. On the epistemological dimension, *subjectivist* tries to understand how individuals interact with and within the social world. *Objectivist* view tries to apply methods and models used in natural sciences to study social world. On objectivist view, the basic assumption is that social world can be treated as a natural world.

Paradigms on Burrell's and Morgan's model are *radical humanist*, *radical structuralist*, *interpretivist* and *functionalist*. The functionalist paradigm is concerned on how the social world works as an integrated system. The interpretivist paradigm tries to understand the social world through subjective views of individuals being part of the social world. The radical structuralist paradigm understands the social world as a world that has social structures which needs to be changed. It is interested in the structure and power relationships of the social world. The radical humanist paradigm view to the social world is somewhat same as in radical structuralist, with one fundamental difference. In this paradigm, also changes on social level are needed, especially ideological.

Positivism is a positivistic research paradigm used in social sciences. It thrives the usage of methodology and philosophical assumptions used in natural sciences. According to Goles and Hirschheim (2000), positivism consists of five fundamental assumptions: *unity of the scientific method*, *search for Humean causal relationships*, *belief in empiricism*, *science* (and its process) *is value-free*, and the *foundation of science is based on logic and mathematics*. Positivism can be classified as a functionalist paradigm and mainstream perspective.

Hirschheim and Klein (1989) applied and tested Burrell's and Morgan's model in information systems development. Since then, the model has been widely used on IS research. There have been some criticism against the model, for example Deetz (1996)

introduced a substitute model. His model consists of two dimensions, which deal with the origin where research concepts rise ("local/emergent" vs. "elite/a priori"), and how the research orientation fits in the current knowledge structure ("consensus" vs. "dissensus").

It has been argued that researcher should use philosophical approach or approaches that best suits for research problem (Tashakkori and Teddlie, 1998). This paradigm is called *pragmatism* or *pluralism*. To address pragmatism in IS research, Goles and Hirschheim (2000) revised the Burrell's and Morgan's model to include *transition zones*. These transition zones allows researcher to move on the boundaries of different paradigms (Figure 4.1).

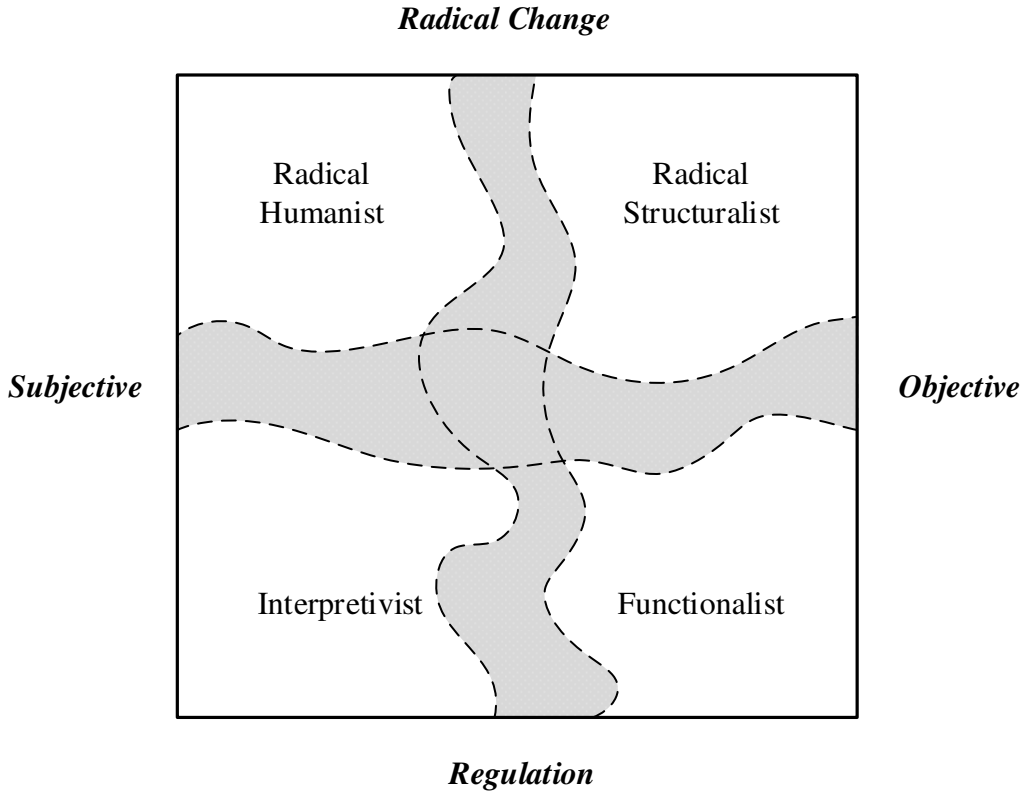


Figure 4.1 Research Paradigms (Goles and Hirschheim, 2000)

Two traditional research perspectives in IS and Management Sciences (MS) are *Positivist* and *Interpretive* (Vaishnavi and Kuechler, 2013). Third research perspective, *Design*, has been in interest of researchers during the last two decades (Nunamaker *et al.*, 1991; March and Smith, 1995; Hevner *et al.*, 2004; Järvinen, 2007a; Iivari, 2010; Vaishnavi and Kuechler, 2013). Differences of the philosophical assumptions grounding these perspectives can be seen in Table 4.1.

Based on the systemic view of organisations and their controlled development, Lee (2010) argues that the predominant theory type in IS (see Gregor, 2006) should be the one of *design and action*. Design Science (DS) is a research approach aiming to develop scientific knowledge by designing *artefacts* (van Aken, 2004). As such, DS is not concerned with the design action itself (van Aken, 2004) but the utility value of the resulting artefacts (Vaishnavi and Kuechler, 2013). As such, DS can be regarded as a synonym to the *design research perspective* by Vaishnavi and Kuechler.

Aim of this research is to improve the traditional EA adoption method, or in other words, develop a better method. Thus, by following Tashakkori and Teddlie (1998), the approach that best suits this aim should be used. Therefore, from the three IS research perspectives, the most suitable to improve the EA adoption method is *Design*. By following DS, also its philosophical assumptions are adopted. Ontological assumption is that there are multiple contextually situated world-states, as improving existing EA adoption method (introducing a novel artefact) changes the world-state. Epistemologically it is believed that knowledge emerges during the process of constructing an improved adoption method. Axiologically the utility is valued over the truth, which means that the aim is an improved EA adoption method, which may or may not be (absolutely) the best EA adoption method.

Table 4.1 Philosophical Assumption of the Three Research Perspectives (Vaishnavi and Kuechler, 2013)

Basic Belief	*Positivist*	*Interpretive*	*Design*
Ontology	A single reality. Knowable, probabilistic	Multiple realities, socially constructed	Multiple, contextually situated alternative world-states. Socio-technologically enabled
Epistemology	Objective: dispassionate. Detached observer of truth	Subjective, i.e. values and knowledge emerge from the research-participant interaction	*Knowing through making*: objectively constrained construction within a context. Iterative circumscription reveals meaning
Methodology	Observation; quantitative, statistical	Participation; qualitative. Hermeneutical, dialectical	Developmental. Measure artefactual impacts on the composite system.
Axiology: what is of value	Truth: universal and beautiful; prediction	Understanding: situated and description	Control; creation; progress (i.e. improvement); understanding

According to Iivari (2007), four major sources of ideas for design research are (i) practical problems and opportunities, (ii) existing artefacts, (iii) analogies and metaphors, and (iv)

theories. In this thesis, the aim is to improve the traditional EA adoption method (existing artefact). There is also an opportunity to study the usage of the traditional EA adoption method (see Section 5.4) to find actual practical problem(s) for the adoption method to solve. In this part of the research, as it is tried to understand EA adoption in a real-life pilot, subjective interpretations of world-states cannot be avoided. The understanding of the actual practical problems emerges from interaction with pilot participants. Therefore, in this phase of the research, adoption of philosophical beliefs from *Interpretive* research is inevitable. In the next sub-section, the IS research framework by Hevner *et al.* (2004) used in this thesis is introduced.

4.2.3. Information Systems Research Framework

Hevner *et al.* (2004) proposed a conceptual framework for information systems research (see Figure 4.2) in 2004. Since then, it has been in attention of many IS scholars (Gregor, 2006; Gregor and Jones, 2007; Järvinen, 2012; Vaishnavi and Kuechler, 2013). In the framework, *environment* defines the problem space under study. It consists of people, organisations and technology under the study. Relevance of research is justified by taking environment into account in the form of *business needs*. In this thesis the environment, or research context, is Higher Education Institutions (HEIs) in Finland. It also includes the traditional EA adoption method (technology under the study) and its utilisation during the EA pilot. The mentioned EA pilot refers to EA pilot conducted among 12 Finnish HEIs in 2010. I took part to pilot's preparation phase as a consultant but acted purely as an observer during the actual pilot. Details of the pilot are explained in Section 5.4.

The actual research takes place in two phases. The first phase is a *development* or *building* of *theories* or *artefacts*. In this thesis the artefact is the improved EA adoption method. Another research phase is a *justification* or *evaluation* of *theories* or *artefacts*. In this thesis the artefact (EA adoption method) is evaluated by the panel of EA experts, as explained in Section 6.4.

Rigorous research is conducted by applying appropriate theories and methodology to the research from the *knowledge base*. Knowledge base is composed of foundations, such as theories, and methodologies. In this thesis, knowledge base refers to the current knowledge of EA (Chapter 2), EA adoption (Chapter 3), and research methodology introduced in this chapter. The results of the research, e.g. artefacts and theories, are applied in the appropriate environment and added to knowledge base, respectively.

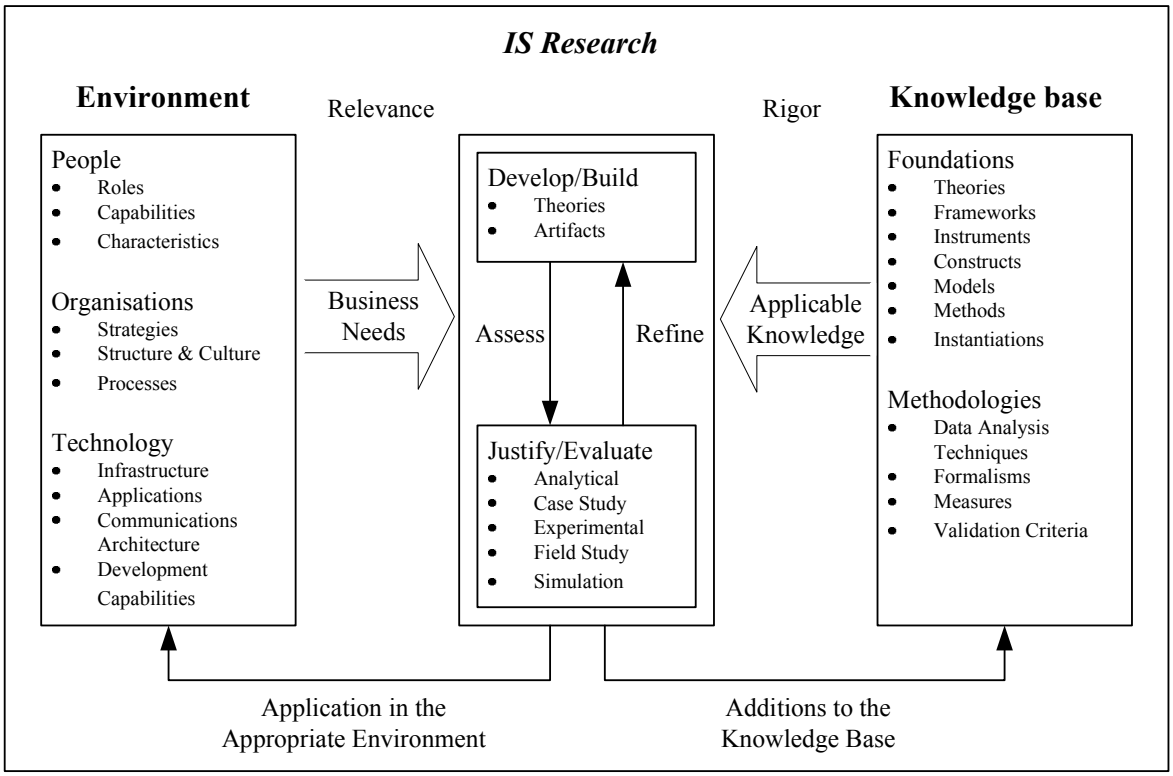


Figure 4.2 IS Research Framework (Hevner *et al.*, 2004)

As it can be noted, Hevner *et al.*'s (2004) framework is iterative, or cyclical. There are three research cycles, namely *Relevance Cycle, Design Cycle,* and *Rigour Cycle* (Hevner, 2007). Thus the constructed theory or artefact is under constant refinement. This means that first the environment is studied to recognise business needs (relevance) by utilising appropriate methods (rigour). Next an artefact to solve those business needs is built and evaluated (design) by utilising appropriate methods (rigour). Finally, results of the research are applied to the environment (relevance) and added to the knowledge base (rigour), which in turn allows us to further develop the method in the future. In the next sub-section, the research results are further categorised to better position the contributions of this thesis.

4.2.4. Science Categorisation

Scientific disciplines can be divided to three categories (van Aken, 2004, p. 224):

1. The *formal* sciences, such as philosophy and mathematics.
2. The *explanatory* sciences, such as the natural sciences and major sections of the social sciences.
3. The *design* sciences, such as the engineering sciences, medical science and modern psychotherapy.

As discussed earlier in this chapter, this research is categorised as a design science. One part of this thesis, namely REAP model (see Chapter 5), can categorised as an explanatory science.

Also the theories applied in, and resulting from, IS research can be categorised. Type or role of the theory depends on the research problem and question (Gregor, 2006; Järvinen, 2004). Gregor (2006) has listed five *research types* and questions in which particular type of theory gives an answer (see Table 4.2).

Table 4.2 A Taxonomy of Theory Types in IS Research (Gregor, 2006)

Theory type	*Distinguishing attributes*
Analysis	Says "what is". The theory does not extend beyond analysis and description. No causal relationships among phenomena are specified and no predictions are made.
Explanation	Says "what is", "how", "why", "when", "where". The theory provides explanations but does not aim to predict with any precision. There are no testable propositions.
Prediction	Says "what is" and "what will be". The theory provides predictions and has testable propositions but does not have well-developed justificatory causal explanations.
Explanation and prediction	Says "what is", "how", "why", "when", "where" and "what will be". Provides predictions and has both testable propositions and causal explanations.
Design and action	Says "how to do something". The theory gives explicit prescriptions (e.g., methods, techniques, principles of form and function) for constructing an artefact.

This thesis has two major theoretical contributions; REAP model and EAAM method. The former theory can be categorised as an *explanation and prediction* type of theory, and the latter one as a *design and action* type of theory. EAAM could also be categorised as an explanation and prediction theory, as it explains how to adopt EA in a way that the likelihood of success is higher. However, EAAM is a method (technology artefact), providing the steps to execute the EA adoption. As a result of following EAAM, the organisation (social artefact) has adopted EA as planned (designed).

Besides the type of the theory, research can also be classified based on the *research approach*. The taxonomy of research approaches by Järvinen (2004) can be seen on Figure 4.3. The first categorical level is a division between *research approaches studying reality* and *mathematical approaches*. The latter one is theoretical and interested purely in math (Järvinen, 2004). Approaches studying reality can be further divided to *research stressing*

what is reality and to *research stressing utility of innovations*. In this thesis, to achieve the aim of the research, the *innovation-building* approach is adopted. However, the REAP model has followed the *theory-testing approach*.

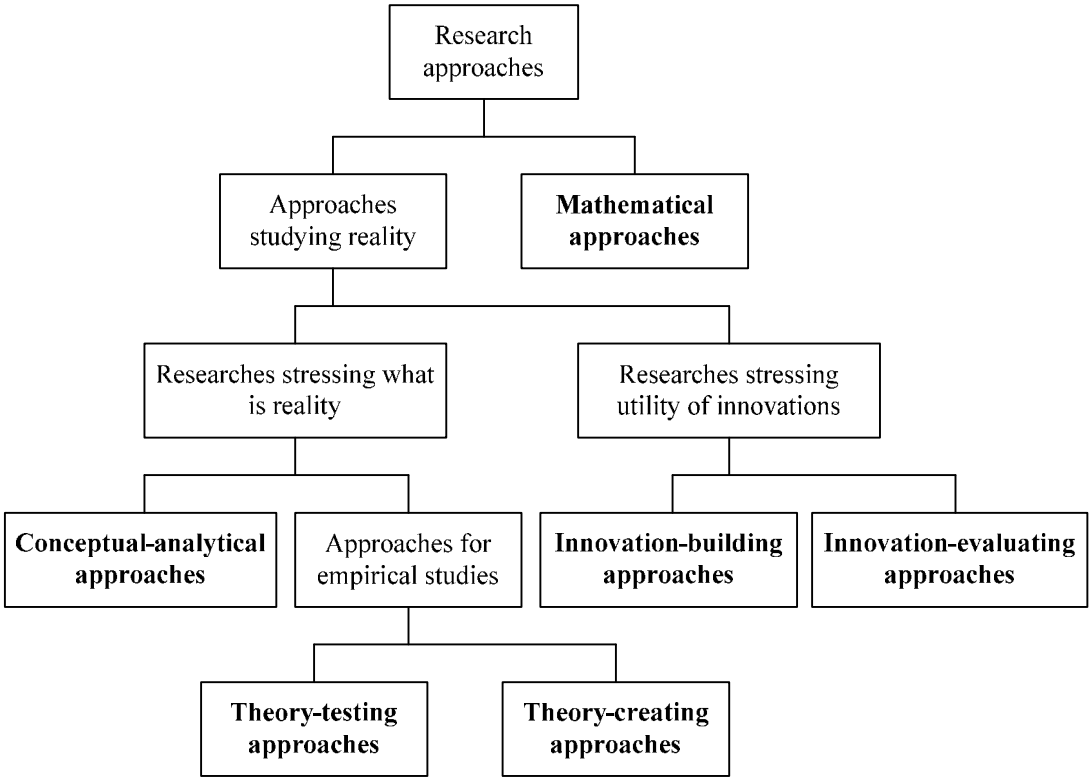


Figure 4.3 Taxonomy of Researchs Methods (Järvinen, 2004)

4.2.5. Summary of Information Systems Research and Paradigms

Enterprise Architecture has been categorised as an IS discipline by many scholars. Therefore, IS science and research methodologies are adopted to research EA adoption. Thus, in this sub-section, various research paradigms and methods applied in IS were reviewed.

IS as a science is a broad field studying technology, organisations, people, and information. Traditionally, dominant research perspectives in IS have been *Positivist* and *Interpretive*. During the last two decades the interest in IS research have been in *Design* perspective. It has been argued that the researcher should choose scientific paradigm, approach, perspective, methodology, etc. which best suits for solving the research problem. In this thesis the traditional EA adoption method is improved, and therefore, the design perspective was adopted. The target of the design is the EA adoption method, which is human invented, and therefore, a technology artefact.

Selecting the design research perspective has some implications for the research. First of all, the philosophical assumptions and beliefs of the design research are adopted. Ontologically it is believed that there are multiple alternative world-states and epistemologically that knowledge emerges from the construction of the artefact. Axiologically the utility is valued over the truth.

Hevner *et al.*'s (2004) IS research framework emphasises both relevance and rigour in design research. The former can be achieved by focusing to solve the actual business needs of the environment. In this thesis the environment, or research context, is the Finnish HEI's adopting EA. While studying the adoption process, the *Interpretive* research perspective needs to be adopted. Rigour can be achieved by utilising appropriate research methods of a particular research perspective.

Two majors theoretical contributions of the thesis, REAP model and EAAM method, can be categorised as an *interpretive science* and *design science*, respectively. As a theory, REAP can be categorised as an *explanation and prediction* type of theory, and EAAM as a *design and action*. Moreover, REAP follows a *theory-testing* approach and EAAM *innovation-building* approach.

In the next section, the research approach of this thesis is presented.

4.3. Research Approach for the Study

4.3.1. Introduction

In Section 1.4 the DS research framework (see Figure 1.1) by March and Smith (1995) adapted to this thesis was introduced. For clarification, it should be noted that this framework is included in the framework by Hevner *et al.* (2004) introduced in previous section. The framework by March and Smith (1995) consists of DS outputs, namely *construct*, *model*, *method*, or *instantiation*, and four research activities. *Build* and *evaluate* are DS research activities, whereas *theorise* and *justify* are natural science activities. "Natural science activities" refers to *Positivist* and *Interpretive* research perspectives as defined by Vaishnavi and Kuechler (2013). The basic idea of the framework is that first the artefact is built and evaluated by using DS approach. After that, by using natural science approach, the reasons of how or why the artefact worked (or not) is theorised and justified.

Aim of this research is to improve the traditional EA adoption process so that the likelihood of successful EA adoption increases. As stated in previous section, one of the sources for

ideas for DS is an existing artefact. In this thesis, this artefact is the traditional EA adoption method illustrated in Figure 2.17. Another source for ideas for DS is practical problems and opportunities. In this research, there was a unique source for empirical data from an actual EA pilot where Finnish HEIs are adopting EA (see Section 5.4).

In order to be able to improve the traditional EA adoption method, the problems related to it needs to be identified. Therefore, a descriptive model to explain EA adoption challenges (Objective 2) is formed first. As described in Chapter 2, EA adoption is regarded as an instance of organisational change. To be more specific, as a teleological change, aiming for EA adoption. This is also the theoretical view to EA adoption in this thesis. In Chapter 5, the construction and validation of the model is explained. More importantly, the identified EA adoption challenges faced during the EA pilot (Objective 3) are presented. This part of the research is following *Interpretive* research approach.

The remainder of the research is following DS approach. In the next sub-section, the research process and guidelines followed are presented.

4.3.2. Design Science

Gregor (2006, p. 625) has classified *Design and action* as its own type of theory, which "gives explicit prescriptions (e.g., methods, techniques, principles of form and function) for constructing an artefact". On Järvinen's (2004) taxonomy of research methods (see Figure 4.3), DS can be classified as a *research stressing utility of innovation*, and to be more specific, as *an innovation-building approach*.

Hevner *et al.* (2004) emphasised the rigour in research by stating that one should use applicable knowledge from the knowledge base. To support this in DS, they proposed a list of guidelines which can be seen in Table 4.3. In order to make the research in a rigorous manner, these guidelines will be followed.

Table 4.3 Design Science Research Guidelines (Hevner *et al.*, 2004)

Guideline	*Description*
Design as an Artefact	Design-science research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation.
Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.

Guideline	*Description*
Design Evaluation	The utility, quality, and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods.
Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies.
Research Rigour	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.
Design as a Search Process	The search for an effective artefact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Van Aken (2004) has compared the differences between description and prescription driven research approaches. Typical to DS approach is the role of researcher. Researcher is *a player,* closely involved in the subject under study, whereas in description approaches researcher is *an observer*. Also typical to DS is to focus on creating a *solution* and resulting in a *management theory*, whereas description-driven approaches are focusing on *explaining* problems and resulting in an *organisation theory*. In this thesis Objective 2 is to form an organisational theory to explain EA adoption challenges. Objective 4 is to form a management theory to overcome challenges identified by utilising the organisational theory (Objective 3).

The typical result of the DS is a tested and grounded *Technological Rule* (van Aken, 2004). Technological rule (TR), can be defined as "a chunk of general knowledge, linking an intervention or artefact with a desired outcome or performance in a certain field of application" (ibid., 2004, p. 228). By utilising analogical problem solving, such a solution to the problem in hand may be found from a very different context (Gick and Holyoak, 1980). Technological rule is the form of "if you want to achieve Y in situation Z, then perform action X" (ibid., 2004, p. 227). *Tested* technological rule means a rule that has been tested in the domain or context it is intended to be used (Houkes, 2013). *Grounded* technological rule means a rule which reasons for its effectiveness are known (Bunge, 1966; Houkes, 2013). According to Pries-Heje and Baskerville (2010), by utilising TRs "it is in fact possible to increase utility and help managers in a way that makes it possible and plausible to make better decision in complex and/or strategic decision situations" (ibid., p. 265). Therefore, in this thesis, the EA adoption model is constructed as a set of TRs.

Peffers *et al.* (2007) have introduced a Design Science Research Model (DSRM) to be utilised in DS research (Figure 4.4). DSRM nominal process consists of six distinct activities; (i) *problem identification and motivation*, (ii) *defining objectives for a solution*, (iii) *designing and developing an artefact*, (iv) *demonstration of the usage of the artefact*, (v) *evaluation of artefact's utility*, and (vi) *communication*.

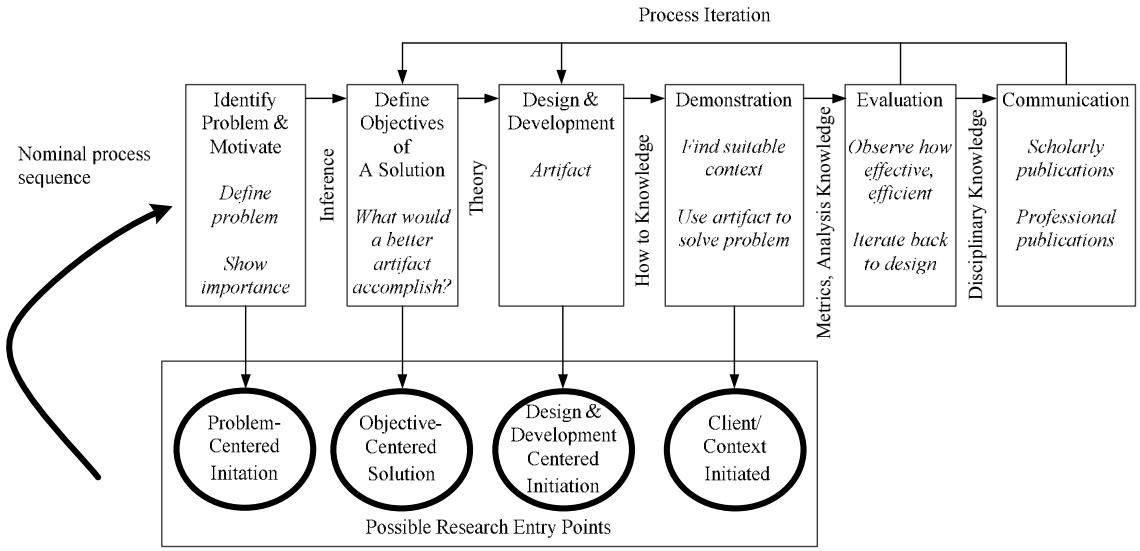


Figure 4.4 DSRM Process Model (Peffers *et al.*, 2007)

In this thesis the first activity, *problem identification and motivation*, is provided while accomplishing Objectives 1 to 3 in chapters 1 to 5. The second activity, *defining objectives of a solution*, is partly a result of accomplishing Objective 3 in Chapter 5, which reveals us the actual problems of the traditional EA adoption method. Part of the second activity is included in Objective 4 in the beginning of Chapter 6. Third activity, *design and development*, is a result of accomplishing the Objective 4 in Chapter 6. Fourth and fifth activities, *demonstration* and *evaluation* are results of accomplishing the Objective 5 in Chapter 6. The last activity, *communication*, is achieved through this thesis, and forthcoming publications and conference presentations.

4.3.3. Validation and Evaluation Methods

Validity is a critical issue in every discipline of science (Groesser and Schwaninger, 2012). In this sub-section, the validation and evaluation methods used in thesis are presented and discussed.

The concept of *model* can be defined as "a simplified description, especially a mathematical one, of a system or process, to assist calculations and predictions" (Oxford Dictionaries,

2010). The variance method used to form the model focuses "on variables that represent the important aspects or attributes of the subject under study." (Van de Ven and Poole, 2005, p. 1382). The explanations are logical causal statements, such as X causes Y. "A key criterion for assessing variance theories is their generality, which refers to the range of cases, phenomena, or situations that the causal explanation applies to." (Van de Ven and Poole, 2005, p. 1383).

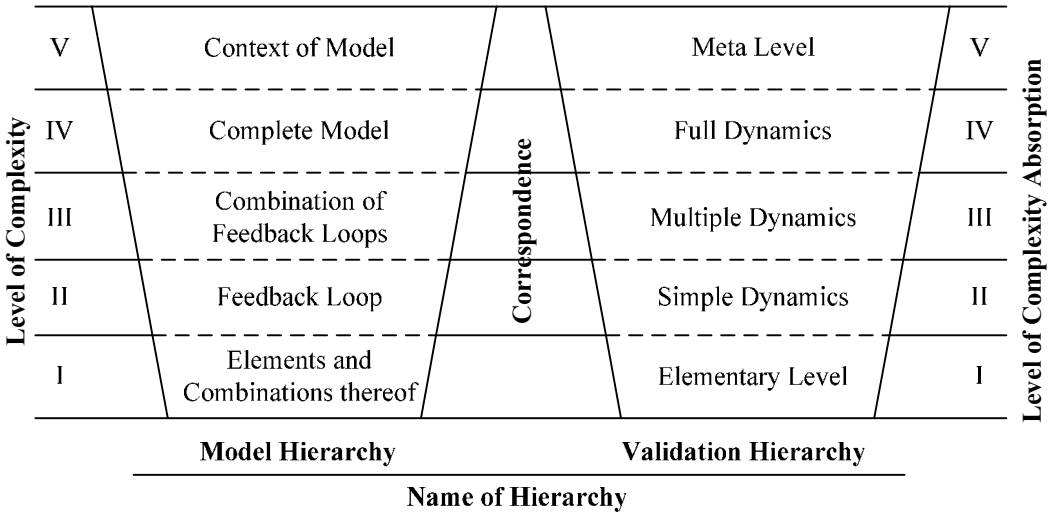


Figure 4.5 Correspondence of the Complexities Along the Model and Validation Hierarchies (Groesser and Schwaninger, 2012)

Model's validity is a primary measure of its utility and effectiveness (Groesser and Schwaninger, 2012). There is a number of validation methods to be used for validating model, but it has been found to be difficult to choose and apply an appropriate validation method. Groesser and Schwaninger (2012) have developed a *validation hierarchy* (see Figure 4.5), which consists of five layers of model complexity and corresponding types of validation tests. These layers are (I) *elements*, such as causal relationships, causal polarities, and combinations thereof, (II) *single feedback loops*, (III) *combination of feedback loops*, (IV) *the complete model*, and (V) *the context of the model*, such as boundaries and the purpose of the model. The degree of complexity increases from bottom to top, and each layer has the set of corresponding validity tests. These test types are (I) *elementary*, (II) *simple dynamics*, (III) *multiple dynamics*, (IV) *full dynamics*, and (V) *meta level*. In this thesis, the model explaining EA adoption consists of causal relationships between elements. As such, it is in the level I of complexity. Therefore the corresponding validity test is to be selected from the *elementary level* tests (see Table 4.4).

Table 4.4 Indicative List of Elementary Level Validation Tests (Groesser and Schwaninger, 2012)

Existing tests	*References*
• Parameter verification test • Structure verification test • Parameter adequacy test • Direct extreme condition test • Dimensional consistency test	Balci (1994) Barlas (1996) Forrester and Senge (1980) Oliva (2003) Richardson and Pugh (1981) Schwaninger (2009) Sterman (2000)

Barlas (1996) makes a distinction between models; *causal-descriptive* and *correlation*. The former is a theory-like or a white-box model, and the latter one a purely data-driven or black-box. Black-box models are assessed on the basis of their output, e.g. matching the real output within a specified range of accuracy. White-box models on the other hand are assessed based on their internal structure. White-box models are *theories* of the real systems and thus needs also *explain* the behaviour.

The model is explaining the EA adoption and therefore it can be categorised as a white-box model. As such, according to Barlas (1996), it should be tested using structure verification tests. In a *major behaviour patterns* test, the model's accuracy to reproduce real life behaviour is tested (Barlas, 1996). One major issues with the tests by Barlas is that they all are quantitative tests, which are not applicable with the qualitative model. Thus the approach to perform testing in *qualitative* manner is adopted.

The process of assessing the validity of a method is called evaluation (Pedersen *et al.*, 2000). According to Hevner *et al.* (2004, p. 85) "The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods". They also mention five types of evaluation methods; *observational*, *analytical*, *experimental*, *testing*, and *descriptive*. According to Peffers *et al.* (2007) the method of evaluation depends on the artefact and can conceptually include any empirical evidence or logical proof. In any case, "Rigorous, scientific research requires evidence" (Venable *et al.*, 2012, p. 424).

Evaluation can be done *ex ante*, i.e. before adoption, and *ex post*, i.e. after the adoption (Klecun and Cornford, 2005). The target of the evaluation can be either the *product* or the *process* of the research (Pries-Heje *et al.*, 2008).

There are also two ways to perform the evaluation, namely *naturalistic* and *artificial*. Naturalistic evaluation refers to the accomplishment of *real tasks* in *real settings.* Artificial evaluation on the other hand is somehow unreal. It may be both empirical and non-empirical, such as criteria-based analysis, theoretical argumentation, or mathematical proof. Both have their limitations. Naturalistic evaluation involves always some level of interpretation and therefore evaluation results may not be precise or truthful. On the other hand, artificial evaluation, due its nature, may lead to evaluation results that are not applicable in the real environment (Pries-Heje *et al.*, 2008).

Pries-Heje *et al.* (2008) have developed a 2 by 2 framework to help in choosing the evaluation strategy for DS project. A 3D illustration of the framework can be seen in Figure 4.6. The framework captures *when* the evaluation takes place (*ex ante*/*ex post*), *what* to evaluate (process/product), and *how* to evaluate (naturalistic/artificial).

Based on the DSR evaluation framework, Venable *et al.* (2012) formed two frameworks to (i) guide the selection of the evaluation strategy (Figure 4.7), and to (ii) guide the selection of evaluation method(s) (Figure 4.8).

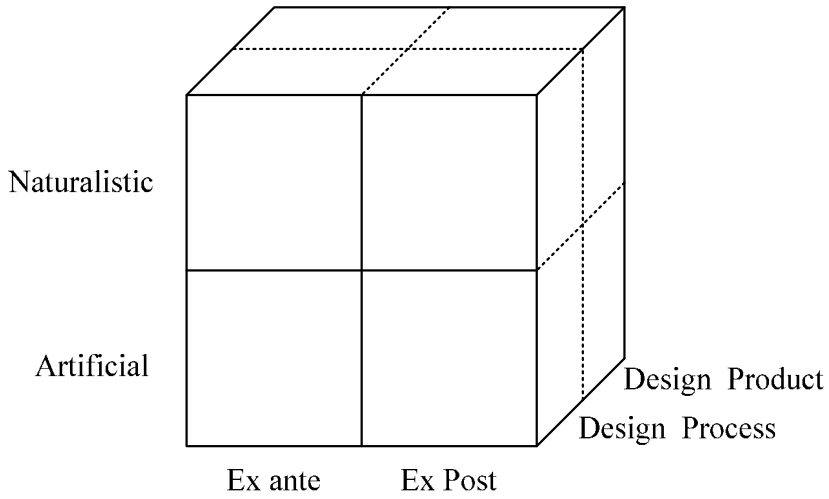


Figure 4.6 Strategic DSR Evaluation Framework (adapted from Pries-Heje *et al.*, 2008)

A four step method for DSR evaluation research design is following (Venable *et al.*, 2012):

1. Analyse the context of the evaluation – the evaluation requirements
2. Match the needed contextual factors to the DSR Evaluation Strategy Selection Framework criteria
3. Select appropriate evaluation method(s) from DSR Evaluation Method Selection Framework

4. Design DSR evaluation in detail

Evaluation strategy is chosen by mapping the requirements of the evaluation with the rows (artificial/naturalistic) and columns (*ex ante*/*ex post*) seen in Figure 4.7. After mapping, the quadrant that fulfils the most important requirements is chosen. In this thesis, the interest is in evaluation of the design product, not the design process. The evaluation will take place *ex post*. The method is concerned with organisational change related to EA adoption, and thus cannot be simulated. Therefore, the naturalistic *ex post* evaluation strategy is selected.

DSR Evaluation Strategy Selection Framework		**Ex Ante**	**Ex Post**
		• Formative • Lower build cost • Faster • Evaluate design, partial prototype, or full prototype • Less risk to participants (during evaluation) • Higher risk of false positive	• Summative • Higher build cost • Slower • Evaluate instantiation • Higher risk to participants (during evaluation) • Lower risk of false positive
Naturalistic	• Many diverse stakeholders • Substantial conflict • Socio-technical artifacts • Higher cost • Longer time – slower • Organisational access needed • Artifact effectiveness evaluation • Desired Rigor: ”Proof of the Pudding” • Higher risk to participants • Lower risk of false positive – safety critical systems	• Real users, real problem, and somewhat unreal system • Low-medium cost • Medium speed • Low risk to participants • Higher risk of false positive	• Real users, real problem, and real system • Highest cost • Highest risk to participants • Best evaluation of effectiveness • Identification of side effects • Lowest risk of false positive – safety critical systems
Artificial	• Few similar stakeholders • Little or no conflict • Purely technidal artifacts • Lower cost • Less time – faster • Desired Rigor: Control of variables • Artifact efficacy evaluation • Less risk during evaluation • Higher risk of false positive	• Unreal users, problem, and/or system • Lowest cost • Fastest • Lowest risk to participants • Highest risk of false positive re. effectiveness	• Real system, unreal problem and possibly unreal users • Medium-high cost • Medium speed • Low-medium risk to participants

Figure 4.7 DSR Evaluation Strategy Selection Framework (Venable *et al.*, 2012)

After the evaluation strategy quadrant is selected, the method of the actual evaluation is chosen from a matching quadrant (Figure 4.8). The real-life evaluation of the EA adoption model is not practically possible during the course of a PhD research. Therefore the only applicable evaluation methods are *Case Study*, *Focus Group*, and *Survey*.

DSR Evaluation Method Selection Framework	Ex Ante	Ex Post
Naturalistic	• Action Research • Focus Group	• Action Research • Case Study • Focus Group • Participant Observation • Ethnography • Phenomenology • Survey (qualitative of quantitative)
Artificial	• Mathematical or Logical Proof • Criteria-Based Evaluation • Lab Experiment • Computer Simulation	• Mathematical or Logical Proof • Lab Experiment • Role Playing Simulation • Computer Simulation • Field Experiment

Figure 4.8 DSR Evaluation Method Selection Framework (Venable *et al.*, 2012)

Delphi method can be seen as a combination of Focus Group and Survey, where the group of experts are evaluating and judging the subject matter. Therefore, the Delphi method is selected as an evaluation method. It is a research process, where judgements of experts are iteratively collected anonymously and refined by feedback (Skulmoski *et al.*, 2007). Delphi method is especially useful for forecasting, but also for issue identification and framework developments (Päivärinta *et al.*, 2011).

Four key features of the classical Delphi method are (i) the anonymity of participating experts, (ii) iteration to refine views, (iii) controlled feedback, and (iv) statistical aggregation of group response (Rowe and Wright, 1999). Also qualitative methods may be used with Delphi (Skulmoski *et al.*, 2007). In this thesis, the evaluation will follow the three-round method as suggested by Skulmoski *et al.* (2007).

Crucial to the reliability of the Delphi method is the expertise of the participants (Päivärinta *et al.*, 2011). They should have a knowledge and experience, capacity and time to participate, and good communication skills (Adler and Ziglio, 1996). Therefore, the panel of experts needs to be carefully selected to fulfil these requirements.

In this thesis a three-round approach was used in Delphi study. The study began by selecting the panel of 11 top Finnish EA experts from both industry and academia. A description of the EAAM method was sent to experts and they were asked to give one or more answers to following three questions; how of where does the method has an effect, what is the cause of the effect, and what are the consequences. Based on the answers, a list

of claims about the method was formed. The list was sent to experts and they were asked to state whether they agree with the claims or not. After this, averages were calculated and the claims were sent back to experts with averages. This allowed experts to reassess their opinion against the panel's average opinion. Finally the z-scores for each claim were calculated and ranked, leaving a list of statements about the method. The evaluation process is described in full detail in Section 6.4 on page 158.

In the next sub-section, data collection techniques and analysis methods used in Chapter 5 are explained.

4.3.4. Data Collection Techniques and Analysis Methods

In this sub-section, the data collection and analysis methods used to validate the model in Chapter 5 are introduced. Typical data collection techniques are interview, observation, questionnaire, and written material (Järvinen, 2012). The used techniques are to be selected regarding to used research method. Interviews can be described as a conversation between the interviewer and interviewee. Interviews may be informal, which suits for theory-creating research, or structured, which suits well for theory-testing research. (Järvinen, 2012). In this thesis, interviews are used to collect data to validate the model. Therefore semi-structured interviews are used as a research technique.

Wengraf (2001) distinguishes theory-questions (TQ) from interviewer-questions (IQ). He also introduces Central Research Question (CRQ), which is the actual research question of the particular research. CRQ consists of multiple TQs, which you want your interviews help to answer. Wengraf suggests that researches should not ask TQs from interviewees, as their natural language is not necessarily same than researcher's scientific language. Thus, one should seek answers to TQs by multiple IQs written out in interviewees' language.

In this thesis TQ questions are formed based on the factors affecting EA adoption found during the literature review in Chapter 3. Before conducting an interview, one should prepare for the interview accordingly. In this thesis the interview script is formed to include items suggested by Myers and Newman (2007):

- Preparing the opening
- Preparing the introduction
- Preparing the key questions
- Preparing the close

To analyse the interview data, it needs to be transferred to a form that could be analysed. The process of transferring audio of video material to textual form is called transcribing. According to Kvale (1996) there are no standard form nor code to transcribing interviews. However, there are some common choices to be made, such as the level of detail of transcription (Kvale, 1996).

There are multiple ways to analyse textual data, such as interviews and open ended questionnaire answers. The most common method used for analysing this type of data is Grounded Theory (GT), introduced by Strauss and Corbin (see for example Strauss and Corbin, 1990). It suits for situations where researcher is forming a theory based purely on data. "Pure" GT requires that there are neither pre-assumptions nor theories, but everything is emerging from data. As the existing "theory" is grounded and possibly expanded with empirical data, GT can't be utilised as is. However, content analysis techniques used in GT can be utilised also when testing or expanding an existing theory. This approach is called *directed content analysis*, where codes are derived from an existing theory (see Table 4.5).

Table 4.5 Major Coding Differences Among Three Approaches to Content Analysis (Hsieh and Shannon, 2005)

Type of Content Analysis	*Study Starts With*	*Timing of Defining Codes or Keywords*	*Source of Codes or Keywords*
Conventional content analysis	Observation	Codes are defined during data analysis	Codes are derived from data
Directed content analysis	Theory	Codes are defined before and during data analysis	Codes are derived from theory or relevant research findings
Summative content analysis	Keywords	Keywords are identified before and during data analysis	Keywords are derived from interest of researchers or reviews of literature

Content analysis can be defined "as a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns " (Hsieh and Shannon, 2005, p. 1278). Moreover, as already noted earlier,

> "The goal of a directed approach to content analysis is to validate or extend conceptually a theoretical framework or theory. Existing theory or research can help focus the research question. It can provide predictions about the variables of interest or about the relationships among variables, thus helping to determine the initial coding scheme or relationships between codes." (Hsieh and Shannon, 2005, p. 1279).

In this thesis the purpose of the data analysis is to validate the model. Therefore the directed content analysis is selected as an analysis approach.

4.4. Summary of Chapter 4

In this chapter, the general IS research and paradigms were presented and discussed, followed by introduction of Design Science (DS) approach used in this thesis. After this, validation methods, data collection techniques, and analysis methods used in the thesis were presented.

Aim of this thesis is to improve the traditional EA adoption so that the likelihood of adoption success increases. In order to achieve this aim, DS is adopted as a research approach of this thesis. Therefore also philosophical assumptions of DS are adopted. Ontological assumption is that there are multiple contextually situated world-states, epistemologically it is believed that knowledge emerges during the process of constructing an improved adoption method, and axiologically the utility is valued over the truth.

Before it is possible to construct an improved EA adoption method, the problems hindering EA adoption needs to be identified. In order to achieve this, the model of resistance in EA adoption process (REAP) is introduced in the next chapter.

Chapter 5 Model of Resistance in EA Adoption Process (REAP)

5.1. Introduction

In this chapter, the model of *Resistance in Enterprise Architecture Adoption Process* (REAP) is introduced. After presenting some key concepts of the EA adoption in the following section, a conceptual model of EA adoption based on the literature is introduced. Next the source of empirical data of the thesis, the EA pilot among 12 Finnish Higher Education Institutions, is introduced. After this, the process of data collection, data analysis, and the model validation are explained. Finally the results in the form of REAP model are presented, followed by the summary.

5.2. Enterprise Architecture Adoption Concepts

As the focus in this thesis is to research EA adoption, concepts related to it needs to be clearly defined. The word *adoption* can be defined as "the action or fact of adopting or being adopted" where adopt refers to "choose to take up or follow (an idea, method, or course of action)" (Oxford Dictionaries, 2010). Similar concepts are *implementation*, "the process of putting a decision or plan into effect; execution" (Oxford Dictionaries, 2010) and *institutionalisation*, which is to "establish (something, typically a practice or activity) as a convention or norm in an organization or culture" (Oxford Dictionaries, 2010). Following these definitions, in the EA context adoption can be defined as the process where an organisation starts using EA methods and tools for the very first time. Similarly, implementation can be defined as the process where the organisation for example executes the future state of the organisation by following EA descriptions (plans). Finally, the institutionalisation can be defined as the process of making EA an integral part of the organisation's practises and culture (Iyamu, 2009a).

Adoption can also be categorised as an instance of *change*, which is defined as "an act or process through which something becomes different" (Oxford Dictionaries, 2010). Enterprise Architecture, as defined earlier, is (i) a formal description of an organisation's current and future state(s), and (ii) a managed change between the current and future state(s) of an organisation. Thus an Enterprise Architecture Adoption can be understood as

an instance of teleological organisational change. This is also theoretical underpinning of the EA adoption model as discussed in Chapter 2.

Van de Ven and Poole (2005) has formed a typology of approaches to study organisational change (see Table 5.1). From the typology, *Approach I* is used while forming the model. This means that organisation is regarded as a real entity and variance method is used to study the change. This approach "treats change in an organizational entity as a dependent variable and explains it as a function of independent variables." (Van de Ven and Poole, 2005, p. 1387).

Table 5.1 A Typology of Approaches for Studying Organisational Change (Van de Ven and Poole, 2005)

		Ontology An organisation is presented as being:	
		A noun, a social actor, a real entity ('thing')	A verb, a process of organizing, emergent flux
Epistemology (Method for studying change)	Variance method	**Approach I** Variance studies of change in organizational entities by causal analysis of independent variables that explain change in entity (dependent variable)?	**Approach IV** Variance studies of organizing by dynamic modelling of agent-based models of chaotic complex adaptive systems
	Process narratives	**Approach II** Process studies of change in organizational entities narrating sequence of events, stages of cycles of change in the development of an entity	**Approach III** Process studies of organizing by narrating emergent actions and activities by which collective endeavours unfold

The concept of *model* can be defined as "a simplified description, especially a mathematical one, of a system or process, to assist calculations and predictions" (Oxford Dictionaries, 2010). When utilising Approach I, it should be noted that the influence of some factors are ruled out, such as "critical events, multiple causes operating unevenly in different parts of the organization and at different points in time, causes operating across greatly different time scales, and sequences of events that chain together to lead up to some outcome" (Van de Ven and Poole, 2005, p. 1388). Approach I has some limitations, which should be noted: "it is difficult to study the activities or steps in which change and innovation unfold using

variance methods." (Van de Ven and Poole, 2005, p. 1388) because "they require researchers to abstract variables from the process data, which forces them to study the process once removed (at least)." (Van de Ven and Poole, 2005, p. 1388). This is also the case in this research, and the challenges to test the model's validity is acknowledged.

Barnett *et al.* (1995) introduced a model to analyse and predict how different strategies and changing between them affects organisation's failure rate. In Figure 5.1 organisation's failure rate is represented by *r()*. *r(A)* represents a failure rate of strategy A, and *r(B)* a failure rate of strategy B. Thus the *content* effects of changing from strategy A to strategy B can be expressed as *r(B)-r(A)*. If difference is negative (the failure rate is lower), the strategy B is better. Besides the content effects, also the actual *change process* can be hazardous, which is presented as *r(ΔAB)*. The total effect can be calculated as: *r(B)-r(A)+ r(ΔAB)*. Thus, if the total effect is negative, the change from strategy A to strategy B is justified.

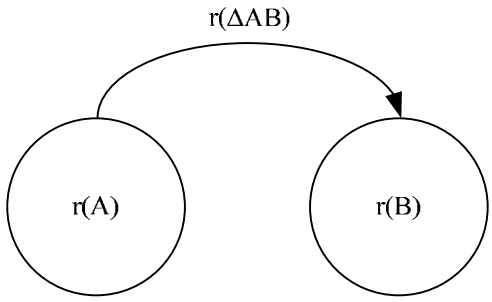


Figure 5.1 The Content and Process Effect of Organisational Change From Strategy A to Strategy B (Barnett and Carroll, 1995)

Usage and adoption of EA is clearly a strategic decision. In EA adoption, one can recognise two states of the organisation, the state before the EA adoption and the state after the EA adoption. Thus the decisions makers have two strategic options: (A) to continue without EA, and (B) to adopt EA.

The model introduced in this chapter attempts to capture concepts and processes related to the *change process* effects. Therefore, the actual *content* effects are out of the scope of the model, even though it is acknowledged that these two are linked to each other.

5.3. Conceptual Model

5.3.1. Introduction

In this sub-section, a tentative conceptual model of EA adoption is formed. First the individual components of the model are introduced. The model consists of three components. The first component, *the strategic level of Enterprise Architecture*, is based on selected Enterprise Architecture literature. Second and third components, *organisational change* and *change resistance*, respectively, are adopted from general organisational change literature. After introduction of the components, the conceptual model of EA adoption is presented.

5.3.2. Strategic level of Enterprise Architecture

Enterprise Architecture is a relatively new phenomenon, having multiple schools of thought. Lapalme (2011; 2012) has recognised three ideal Enterprise Architecture schools from the current EA literature. A summary of differences and properties of these schools can be seen in Table 5.2.

Enterprise IT Architecting school is aiming to alignment of organisation's IT assets and business activities. The school often describes EA as "the glue between business and IT" (Lapalme, 2012, p. 38). From a strategic point of view, EA is merely a tool to fulfil business objectives without questioning them in any way.

The goal of *Enterprise Integrating* school is to execute organisation's strategy by maximising organisation's coherency. Thus the school views EA as "the link between strategy and execution" (Lapalme, 2012, p. 40).

For *Enterprise Ecological Adaptation* school EA means designing all organisational facets, including bidirectional relationship to its environment. This school is interested also in what is happening outside of organisation's borders, and is actively trying to change also the surrounding environment. Thus EA is described to be "the means for organisational innovation and sustainability" (Lapalme, 2012, p. 41).

Table 5.2 Summary of EA Schools of Thought (Lapalme, 2012)

	Enterprise IT Architecting	*Enterprise Integrating*	*Enterprise Ecological Adaptation*
Motto	• Enterprise architecture is the glue between business and IT	• Enterprise architecture is the link between strategy and execution	• Enterprise architecture is the means for organizational innovation and sustainability
Objectives and concerns	• Effectively enable the enterprise strategy • Support IT planning and reduce costs • Enable business	• Effectively implement the enterprise strategy • Support organizational coherence	• Innovate and adapt • Support organizational coherence • Encourage system-in-environment co-evolution
Skills	• Have technical competence and engineering knowledge	• Facilitate small-group collaboration • Apply systems thinking	• Foster dialogue • Apply systems and system-in-environment thinking • Facilitate larger-group collaboration
Challenges	• Convince the organization to accept the designed plans	• Understand organizational systemic dynamic • Collaborate across the organization • Encourage systems thinking and paradigm shift	• Foster sense making • Encourage systems thinking and system-in-environment paradigm shift • Collaborate across the organization
Insights	• Permits the design of robust and complex technological solutions • Foster the creation of high-quality models and planning scenarios	• Permits the design of comprehensive solutions • Enables significant organizational efficiency by eliminating unnecessary contradictions and paradoxes	• Foster systems thinking and system-in-environment paradigm shifts • Fosters organizational innovation and sustainability

	Enterprise IT Architecting	*Enterprise Integrating*	*Enterprise Ecological Adaptation*
Limitations	• Can produce inadequate or unfeasible solutions for the larger organizational context • Struggles with solutions acceptance and implementation barriers • Susceptible to "perfect" designs that support unsustainable strategies	• Susceptible to "perfect" designs that support unsustainable strategies • Requires a paradigm shift from reductionism to holism	• Requires many organizational preconditions for management and strategy creation

Each of the three EA schools of thought can be seen being on a different strategic level. At the lowest level, EA is used merely as the glue between business and IT. On higher levels, EA is seen more as a tool for executing organisation's strategy, but also as way to systemically change its environment. Based on this, it can be argued that the higher the strategic level of EA, the more changes the organisation will face during the EA adoption.

In the next sub-section, the organisational changes resulting from increasing EA maturity are introduced.

5.3.3. Enterprise Architecture Maturity Stages

Ross *et al.* (2006) published their famous book titled "Enterprise Architecture as Strategy, creating a foundation for business execution" in 2006. The title suggests that their view to EA would be business oriented. They do, however, see EA merely as *Enterprise IT Architecting* (Lapalme, 2012).

Ross *et al.* (2006, p. 51) argue that organisations evolve in EA maturity always through four stages:

1. Business silos architecture
2. Standardised technology
3. Optimised core architecture
4. Business modularity architecture

In the first stage, *Business Silos*, organisations are focusing on their local IT investments. The role of IT in such an organisation is to automate specific business processes, and thus justified by cost reductions. Ideally in this stage the acquired information systems are 100 per cent specific to the business needs. Information systems are aligned with organisational structure, i.e. functional or geographical silos. (Ross *et al.*, 2006, pp. 72-73).

In the second stage, *Standardised Technology*, organisations are moving some of their IT investments to shared infrastructure. Technology standards are established to decrease the number of information systems. Acceptable consequence of the standardisation is the lower number of choices for IT solutions. The focus of IT management shifts from the information systems functionality of the local systems, to the cost-effectiveness and reliability of organisation level information systems. Thus the management of software technology is seen as a key to this stage (Ross *et al.*, 2006, pp. 74-75).

In the third stage, *Optimised Core*, organisations are moving from a local view to the organisation, or enterprise, view. Data redundancy is eliminated by extraction of data from individual applications and making it available to all required processes. Investments are moving to shared infrastructure, e.g. organisation level information systems and shared data. (Ross *et al.*, 2006, pp. 76-77).

In the fourth stage, *Business Modularity*, strategic agility is enabled through customised or reusable modules. Only about 6 per cent of organisations are on this level. Purpose of IT is to provide seamless linkage between business process modules. In this stage, focused add-on modules, either information systems or processes, may be developed very quickly to respond to changing market conditions (Ross *et al.*, 2006, pp. 77-79).

Changes in the level of organisational flexibility through the different stages are illustrated in Figure 5.2. In each stage, a new set of behaviours needs to be learned. The extent of the required time to learn may delay expected benefits. Because of these major organisational changes in each step, it is not possible to skip stages. (Ross *et al.*, 2006).

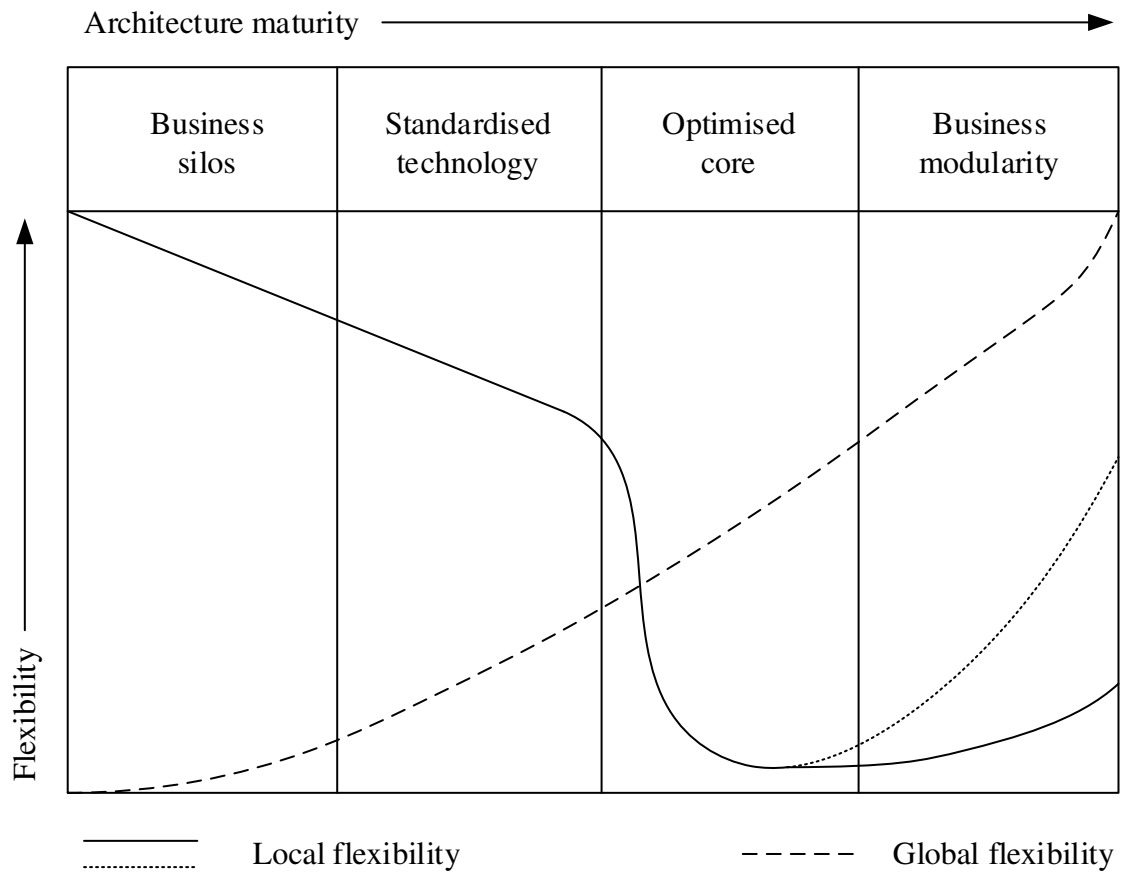


Figure 5.2 Changes in Organisational Flexibility Through the Architecture (adapted from Ross *et al.*, 2006)

As it can be noted in Figure 5.2, the local flexibility decreases when the maturity of EA increases. This reveals us a major implication of EA adoption: it changes organisation's power relationships. However, in the *Business Modularity* stage, it is possible to turn the local flexibility (dotted line) back to almost same level than in *Standardised Technology* stage, if the modularity is implemented in a proper way. One way to achieve this is to allow business unit managers more freedom to design their front-end processes (as modules) and connecting them to core back-end processes (Ross *et al.*, 2006). This, in turn, implies the importance of knowledge of different architectural approaches when moving to higher maturity levels.

The maturity steps introduced in this sub-section emphasises two important factors affecting EA adoption. First, as the maturity of EA needs to evolve through the specific steps, organisation adopting EA is moving from the *Business Silos* stage to *Standardised Technology* stage. Thus the adoption is affecting organisation's power relationships as the local flexibility is decreasing when the shared information systems and data are to be used. Secondly, moving between the stages requires learning new ways to work, but also

unlearning the current ones. Also new governance and decision making processes are likely needed. Therefore, there is a need to further study organisational change in order to increase the understanding of EA adoption.

In the next sub-section, theories of organisational change used in the model are introduced and discussed.

5.3.4. Organisational Change

In this sub-section, concepts and theories related to organisational change are introduced and discussed.

Oreg *et al.* (2011) have formed a model of change recipient actions, based on a literature review of 79 quantitative organisational change studies between 1948 and 2007 (see Figure 5.3). The model reveals that change and pre-change antecedents are linked to individual's explicit reactions and change consequences. Also explicit reactions are linked to change consequences. This model gives us a good starting point for the model for EA adoption. It can be assumed, that also in EA adoption pre-change and change antecedents will result in organisational and personal consequences, either directly or indirectly by explicit reactions.

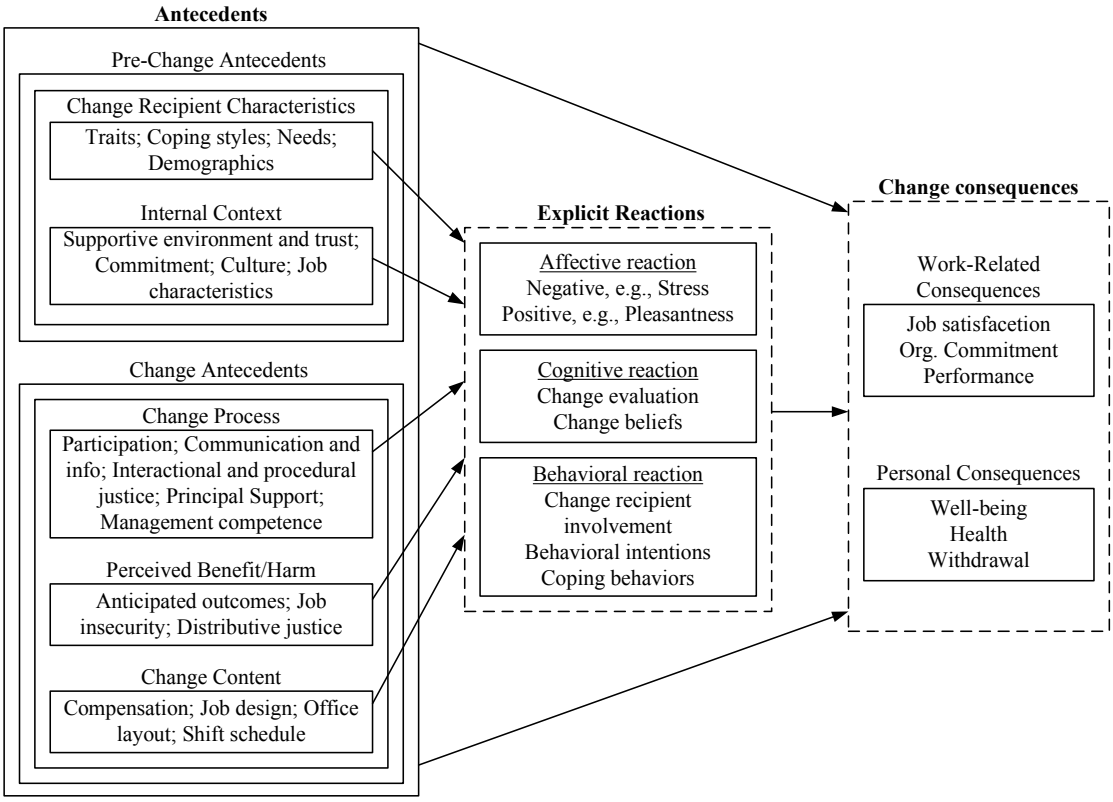


Figure 5.3 Antecedents, Explicit Reactions, and Change Consequences of Organisational Change (Oreg *et al.*, 2011)

One of the most used categorisation of organisational change types is that by Beer and Nohria (2000a). According to them, there are two different organisational change archetypes; *Theory E* and *Theory O*. Theory E has a purpose of creating economic value, and it focuses on organisation structure and systems. This type of change is planned and programmatic, executed using top-down approach. Theory O has a purpose of developing organisation's human capability, focusing especially on creation of high-commitment culture. This type of change is emergent and thus not so planned. Beer and Nohria argue that mixed use of these theories without resolution of their foundational differences leads to maximisation of costs and minimisation of benefits of each theory. Later, however, they have found some examples of mixing these strategies (Beer and Nohria, 2000b). They even see simultaneous usage of the strategies as a possible source of competitive advantage, due to its difficultness. A summary of the mentioned theories and their combination can be seen in Table 5.3.

Table 5.3 Comparing Theories of Change (Beer and Nohria, 2000b)

Dimensions of Change	*Theory E*	*Theory O*	*Combined*
Goals	Maximize shareholder value	Develop organisational capabilities	Explicitly embrace the paradox between economic value and organisational capability
Leadership	Manage change from the top down	Encourage participation from the bottom up	Set direction from the top and engage the people below
Focus	Emphasise structure and systems	Build up corporate culture: employees' behaviour and attitudes	Focus simultaneously on the hard (structure and systems) and the soft (corporate culture)
Reward System	Motivate through financial incentives	Motivate through commitment-use pay as fair exchange	Use incentives to reinforce change but not to drive it
Use of Consultants	Consultants analyse problems and shape solutions	Consultants support management in shaping their own solutions	Consultants are expert resources who empower employees

Enterprise Architecture adoption *per se* does not aim for any particular type of change; it can be used to achieve both. Thus there is not much usage in the model for Theory E and Theory O, which can be seen more as a reason behind the change, e.g. EA adoption. Therefore a better way to categorise change type is Cao *et al.*'s (2000; 2003) categorisation. According to the categorisation, four types of organisational change are; (i) *changes in processes*, (ii) *changes in functions* (structural change), (iii) *changes in values* (cultural change), and (iv) *changes in power within the organisation* (political change). Types of change and their interactions are illustrated in Figure 5.4. This categorisation gives us a tool for classifying anticipated consequences and results caused by EA adoption.

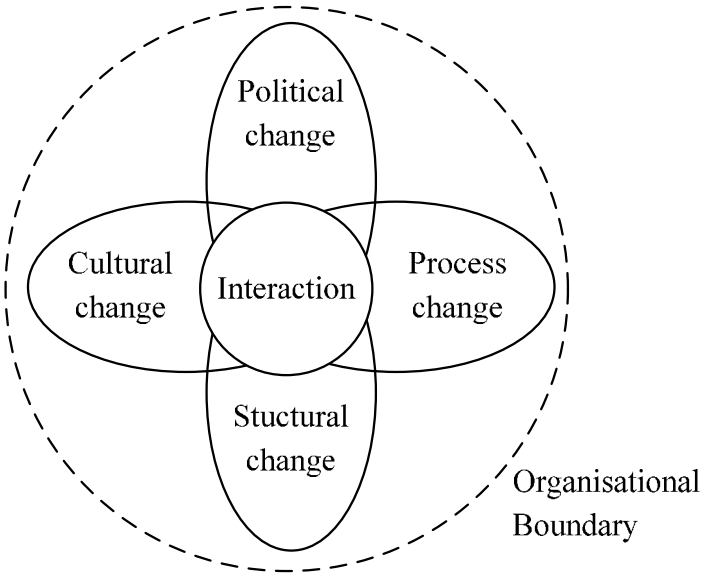


Figure 5.4 Four Types of Organisational Change and Their Interactions (Cao *et al.*, 2003)

5.3.5. Change Resistance

In this sub-section, concepts of organisational change resistance and inertia are discussed.

Every change, no matter how big or small, will face resistance. Change resistance can be defined as "any phenomenon that hinders the process at its beginning or its development, aiming to keep the current situation" (Pardo del Val and Martinez Fuentes, 2003, p. 152). Resistance can be intentional or unintentional, can be recognised by target, and can be recognised by observer (Hollander and Einwohner, 2004). Another concept closely related to resistance is inertia, which can be defined "a tendency to do nothing or to remain unchanged" (Oxford Dictionaries, 2010). In other words, for some reason, organisation resists changing the *status quo* of the organisation. One example of inertia is a *structural inertia*, which "refers to a correspondence between the behavioural capabilities of a class of organizations and their environments" (Hannan and Freeman, 1984, p. 151). In the other words, the organisation has high structural inertia when the speed of reorganisation is lower than the speed of environmental conditions change. The EA adoption model does not make a difference between change resistance and inertia because the concepts are interrelated and overlapping. Therefore the term resistance is adopted to refer to both resistance and inertia.

Pardo del Val and Martinez Fuentes (2003) have recognised two types of change resistance related to change; *inertia during the formulation stage*, and *inertia in the implementation*

stage. Reasons behind the first type of inertia are (i) distorted perception, interpretation barriers and vague strategic priorities, (ii) low motivation, and (iii) lack of creative response. Reasons behind the second type of inertia are (iv) political and cultural deadlocks, and (v) other reasons. Complete list of sources of resistance can be seen in Table 5.4. In the context of EA adoption, inertia can occur during the planning of the adoption and during its execution.

Table 5.4 Sources of Change Resistance (adapted from Pardo del Val and Martinez Fuentes, 2003)

#	*Resistance*
R1.1	**Distorted perception, interpretation barriers and vague strategic priorities**
R1.1.1	Myopia Myopia, or inability of the company to look into the future with clarity.
R1.1.2	Denial Denial or refusal to accept any information that is not expected or desired.
R1.1.3	Perpetuation of ideas Tendency to go on with the present thoughts although the situation has changed.
R1.1.4	Implicit assumptions Assumptions, which are not discussed due to its implicit character and therefore distort reality.
R1.1.5	Communication barriers Communication barriers, that lead to information distortion or misinterpretations.
R1.1.6	Organisational silence Organisational silence, which limits the information flow with individuals who do not express their thoughts, meaning that decisions are made without all the necessary information.
R1.2	**Low motivation**
R1.2.1	Direct costs of change
R1.2.2	Cannibalisation costs Change that brings success to a product but at the same time brings losses to others, so it requires some sort of sacrifice.
R1.2.3	Cross subsidy comforts Need for a change is compensated through the high rents obtained without change with another different fact, so that there is no real motivation for change.
R1.2.4	Past failures Past failures, which leave a pessimistic image for future changes.
R1.2.5	Different interests among employees and management Different interests among employees and management, or lack of motivation of employees who value change results less than managers value them.
R1.3	**Lack of creative response**
R1.3.1	Fast and complex environmental changes Fast and complex environmental changes, which do not allow a proper situation analysis.

#	*Resistance*
R1.3.2	Resignation Reactive mind-set, resignation, or tendency to believe that obstacles are inevitable.
R1.3.3	Inadequate strategic vision Inadequate strategic vision or lack of clear commitment of top management to changes.
R2.1	**Political and cultural deadlocks**
R2.1.1	Implementation climate and relation between change values and organisational values Implementation climate and relation between change values and organisational values, considering that a strong implementation climate when the values' relation is negative will result in resistance and opposition to change.
R2.1.2	Departmental politics Departmental politics or resistance from those departments that will suffer with the change implementation.
R2.1.3	Incommensurable beliefs Incommensurable beliefs, or strong and definitive disagreement among groups about the nature of the problem and its consequent alternative solutions.
R2.1.4	Deep rooted values Deep rooted values and emotional loyalty.
R2.1.5	Forgetfulness of the social dimension of changes
R2.2	**Other sources**
R2.2.1	Leadership inaction Leadership inaction, sometimes because leaders are afraid of uncertainty, sometimes for fear of changing the *status quo*.
R2.2.2	Embedded routines
R2.2.3	Collective action problems Collective action problems, specially dealing with the difficulty to decide who is going to move first or how to deal with free-riders.
R2.2.4	Capabilities gap Lack of the necessary capabilities to implement change.
R2.2.5	Cynicism

The sources of resistance listed in Table 5.4 gives us a categorisation for the organisational resistance likely to be faced during the EA adoption. Moreover, the categorisation makes a distinction between resistance occurring during the planning and executing the EA adoption.

5.3.6. Model of Resistance in EA Adoption Process

In this sub-section, the EA adoption model based on the three concepts introduced in previous sub-sections is introduced and discussed. Purpose of the model is to provide explanation to the resistance faced during the planning and execution of EA adoption.

The tentative EA adoption model can be seen in Figure 5.5. The model is based on the literature of EA and organisational change introduced in the previous sub-sections. Logical reasoning of the model is as follows. Enterprise Architecture can be used on different strategic levels (Lapalme, 2012). The selected strategic level sets boundaries to EA adoption, e.g. what kind of objectives are set for the adoption and thus what kind of organisational change types may result (Cao *et al.*, 2003). These antecedents are affecting the resulting change directly and via explicit reactions of people (Oreg *et al.*, 2011). During the planning and execution phases of the adoption, organisational resistance may distort adoption and thus affect outcomes (Pardo del Val and Martinez Fuentes, 2003).

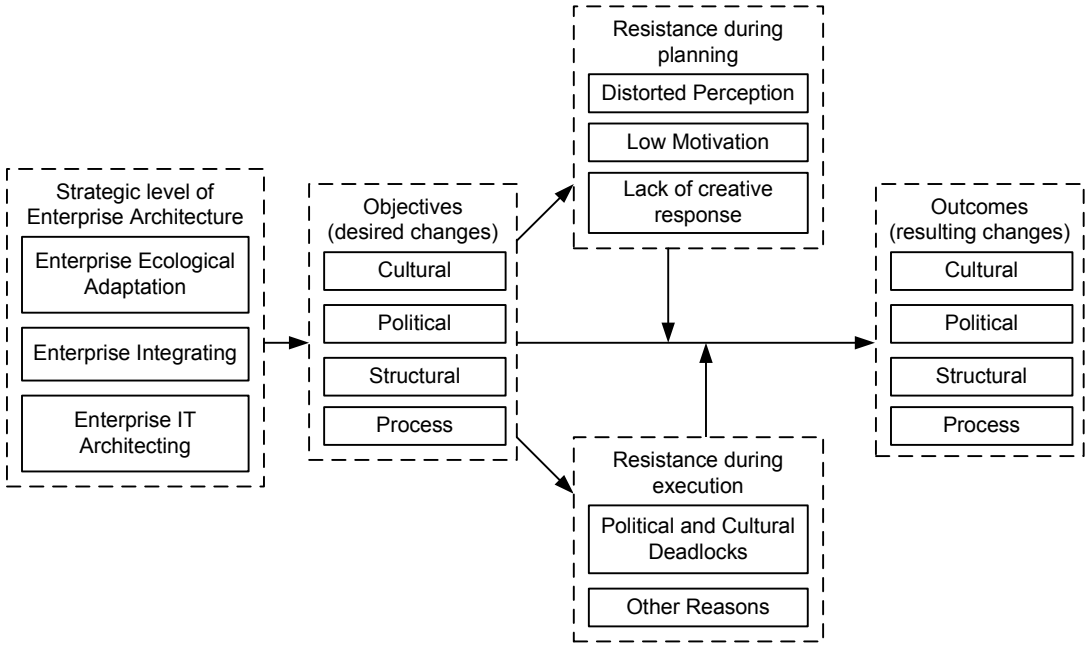


Figure 5.5 Conceptual Model of Resistance in EA Adoption Process (REAP)

The REAP model introduces previously unexplored relationships between the strategic level of EA and desired organisational changes. Moreover, it captures the influence of the desired changes to the resistance and to resulting changes. Therefore it can be argued that the REAP model increases the understanding of issues affecting the EA adoption.

5.3.7. Summary of Conceptual Model

In this section, a conceptual model of resistance in EA adoption process (REAP) and its components are presented and discussed. As a result, the REAP model is formed to explain how the strategic level of EA affects the desired objectives set to the EA adoption. These changes are causing resistance during the planning and execution phases of EA adoption. The resistance is affecting EA adoption by influencing the realisation of objectives set to

the adoption and thus affecting the adoption outcomes. Therefore the model contributes to the overall aim of the thesis, as it increases the understanding of issues affecting the EA adoption.

5.4. Case Description: EA pilot

5.4.1. Introduction

In this section, the EA pilot is described in detail. First the demographic data of participating institutions are introduced, followed by the explanation of the structure of the pilot in terms of schedule and its organisation. Finally the results of the pilot are summarised.

In 2009 new forms of co-operation were emerging among Finnish Higher Education Institutions (HEIs). In Northern Finland, three HEIs decided to form a consortium and to merge some of their administrative services. In Southern Finland two HEIs had decided to merge and four others had plans to co-operate on study programmes. These kinds of changes also heavily affects ICT-systems, and they had to be dealt somehow. Instead of doing it individually, HEIs decided to co-operate with each other and with the Ministry of Education and Culture. This way the whole HEI field would benefit from the actions. (CSC, 2011c).

In 2009, an initiative called RAKETTI[4] was launched by the Finnish Ministry of Education (CSC, 2009). One of the sub-initiatives of RAKETTI was called KOKOA[5], which was focused on EA on HEIs.

The CIO network of Finnish Universities of Applied Sciences (AAPA) made a proposal for EA co-operation project in 2009. Later in 2009 AAPA decided to propose to the steering group of RAKETTI initiative that this co-operation project should be an official EA pilot of RAKETTI-KOKOA. (CSC, 2011c).

[4] RAKETTI is a Finnish translation to the word rocket. It is an abbreviation from the Finnish words ”RAkenteellisen KEhittämisen Tukena TIetohallinto”, which translates to “supporting structural development by utilising information management”.

[5] KOKOA is a Finnish word meaning “Put together!”, or “Assemble!” It is an abbreviation from the Finnish words “KOrkeakoulujen KOkonaisArkkitehtuuri”, which translates to “Enterprise Architecture for Higher Education Institutions”.

5.4.2. Participating Institutions and the Structure of the Pilot

The higher education in Finland (ISCED level A5) is divided into *Universities* and *Universities of Applied Sciences* (UAS), formerly known as *Polytechnics* (Finnish Ministry of Education and Culture, 2011). UASs are equivalent to UK's post-92 universities. The purpose of UASs is to provide higher education for the workforce needs of local private and public sector. Universities' purpose is to conduct basic research and provide higher education based on the scientific research.

There were 11 institutions participating in the pilot. Originally there were 12 institutions, but two of them merged in the beginning of the pilot. Nine of the institutions were UASs and two were Universities (CSC, 2011c). A list of institutions and their demographic data can be seen in Table 5.5. Names of the participating institutions are undisclosed to protect their identities. The demographic data is based on public information found on each institution's web pages in May 2011. The student counts includes both full-time and part-time students and are rounded to the nearest hundred. The employee count includes all staff, e.g. teaching and administrative staff. In 2011, there was a total number of 309 000 students in Finnish Higher Education Institutions (Official Statistics of Finland (OSF), 2011a; 2011b). In participating institutions there were together about 80 000 students, which is roughly 26 per cent of all Finnish higher education students. In total, there were 27 UASs and 17 Universities in Finland in 2011. Therefore the participating institutions were representing 29 per cent of Finnish HEIs.

Table 5.5 Participating Organisations of the EA Pilot

ID	*Students*	*Employees*	*Location*
ORG01	8 100	800	Southern Finland
ORG02	2 000	200	Northern Finland
ORG03	2 900	300	Northern Finland
ORG04	5 200	400	Southern Finland
ORG05	4 800	600	Northern Finland
ORG06	7 500	600	Southern Finland
ORG07	16 000	1 200	Southern Finland
ORG08	4 800	400	Western Finland
ORG09	3 000	300	Northern Finland
ORG10	15 900	2 900	Northern Finland
ORG11	10 000	800	Southern Finland

The EA pilot was organised so that there was a steering group having members from each organisation's top-management, namely rectors or other administrative executives. There

were also a project group that consisted of CIOs and IT specialists from participating organisations. The steering and project groups were supported by two external consultants (CSC, 2011c).

The pilot was organised originally in to six sub-projects, each focusing on a certain problem area. These sub-projects were *Education*, *Adult Education*, *Merger*, *Consortium*, *Quality Assurance*, and *Network*. Quality Assurance (QA) and Adult Education (AE) sub-projects were combined during the pilot.

Table 5.6 Sub-projects of the EA Pilot

ID	*Name*	*Institutions*
GRP01	Network	ORG01, ORG04, ORG06
GRP02	Education	ORG07
GRP03	Consortium	ORG03, ORG05, ORG09
GRP04	Merger	ORG11
GRP05	QA & AE	ORG02, ORG08, ORG10

The pilot preparation phase took place between September 2009 and January 2010. Actual pilot activities took place between February 2010 and February 2011.

5.4.3. Pilot Results

There were two main objectives for the pilot. First was to start EA work in the Higher Education field. The second one was to create conditions for continuous EA development for the HEI sector. To support these objectives, an Enterprise Architecture framework for Higher Education Institutions, called *Kartturi*[6], was developed during the pilot. Also a draft for a shared conceptual level EA was produced. Some HEIs and groups developed reference architectures for their internal use. Therefore, according to the final report of the pilot, pilot exceeded its expectations. (CSC, 2011c).

During the pilot, participating HEIs adopted the Kartturi framework and learned how to use it to support management and development of the HEI (CSC, 2011c). The Kartturi framework is an EA framework developed especially for Finnish HEIs. It contains architecture description templates, an architecture development method, and a maturity measurement tool (CSC, 2011b). Due to its popularity, the second edition was published in 2013 (CSC, 2013). Kartturi is based on TOGAF and is compatible with another EA

[6] Kartturi is a Finnish argot word meaning a co-driver of a rally car.

framework used in Finnish public sector, JHS 179 (JUHTA, 2011). JHS 179 is under development and it is to be made mandatory by legislation by end of 2015 (JulkICT, 2014).

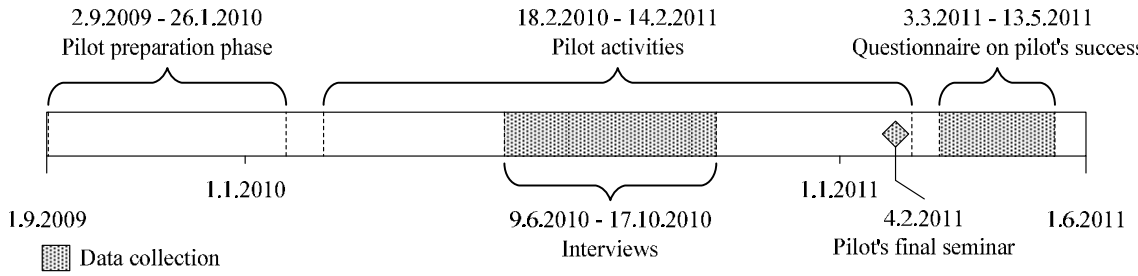


Figure 5.6 EA Pilot and Research Timeline

After the pilot a questionnaire on pilot success was conducted as a part of author's research on measuring EA success (Syynimaa, 2013a). The anonymous questionnaire was sent to steering and project groups of each participating institute. The number of responses (*n*=24) is too low to draw statistically definite conclusions. Therefore the results should be regarded as tentative. The perceived success was studied by asking respondents opinion to the claim; "I consider EA pilot being successful". The Likert scale from 1 to 5 was used, with the labels *Disagree, Partially disagree, Neither agree or disagree, Partially agree*, and *Agree*, respectively. All sub-projects had a mean from 3 to 4 when asked about success. According to the results, the most important result of the pilot was the adoption of EA, which all sub-projects mentioned. Only two sub-projects mentioned also business or process improvement as an important result. The column *Success* in Table 5.5 is a mean of each organisation's responses. Some participants of the EA pilot published their final reports on the pilot's web page (CSC, 2011a), as indicated in Table 5.5. These reports were all fetched for analysis. However, reports were not available for all participants and the information was aggregated to final report, so no analysis of individual reports were performed. The timeline of the pilot and research activities in terms of data collection can be seen in Figure 5.6.

Table 5.7 Collected Data of Results of the EA Pilot

ID	*Success*	*Maturity*	*Final report available?*
ORG01	5.00	10	Yes
ORG02	2.67	9	Yes
ORG03	4.00	7	No
ORG04	4.00	9	No
ORG05	3.00	4	No
ORG06	2.67	5	Yes
ORG07	4.25	10	No

ID	*Success*	*Maturity*	*Final report available?*
ORG08	3.50	6	Yes
ORG09	-	7	Yes
ORG10	3.00	5	No
ORG11	3.67	11	Yes

The independent study on the maturity of EA work in the Finnish Higher Education Institutions was conducted in late 2013 by Kella (2014). The level of EA work maturity was studied by asking respondents to choose a claim that best describes their current level of EA practice. There were 14 claims to choose from. Claims were compiled so that they would form a non-linear scale from 1 to 14 (see Table 5.8).

Table 5.8 Scale Used in EA Maturity Study (translated from Kella, 2014)

Level	*Claim*
1	We have not familiarised to EA
2	We have preliminarily familiarised to EA
3	We have familiarised to EA and currently decided not to use it
4	We have familiarised and are preparing to adopt EA in IT department
5	We have familiarised and in addition to adopting EA in IT department, we are preparing to adopt EA for business development and management needs
6	We have piloted EA in one or more targets, mainly in IT department
7	We are utilising EA partly by consideration, without a comprehensive adoption plan
8	We have compiled an adoption plan and have decided to apply it outside IT department on some degree
9	We are about to adopt EA in organised way and have assigned one or more people responsible to do EA work mainly in IT department.
10	We are using ADM, we have resourced and organised IT department centric EA work, and are producing as-is and to-be EA descriptions without EA description system
11	We are using ADM, we have resourced, organised, and instructed EA work, IT department works in co-operation with business developers and top-management, EA descriptions are produced with or without EA description system
12	Our EA work is well organised and we are utilising EA description system and besides IT department, results are utilised also in business development and management
13	We have integrated EA work and QA in the whole organisation to support IT, business development, and management, we are utilising EA description system
14	EA work and QA are assimilated as an integral part of daily activities, development, management, and IT, this work is regularly monitored and its maturity assessed

The summary of the level of maturity of EA work in Finnish HEIs can be seen in Figure 5.7. As a conclusion, the current EA maturity level in Finnish HEIs is still quite low, even among some of the HEIs participated in the pilot.

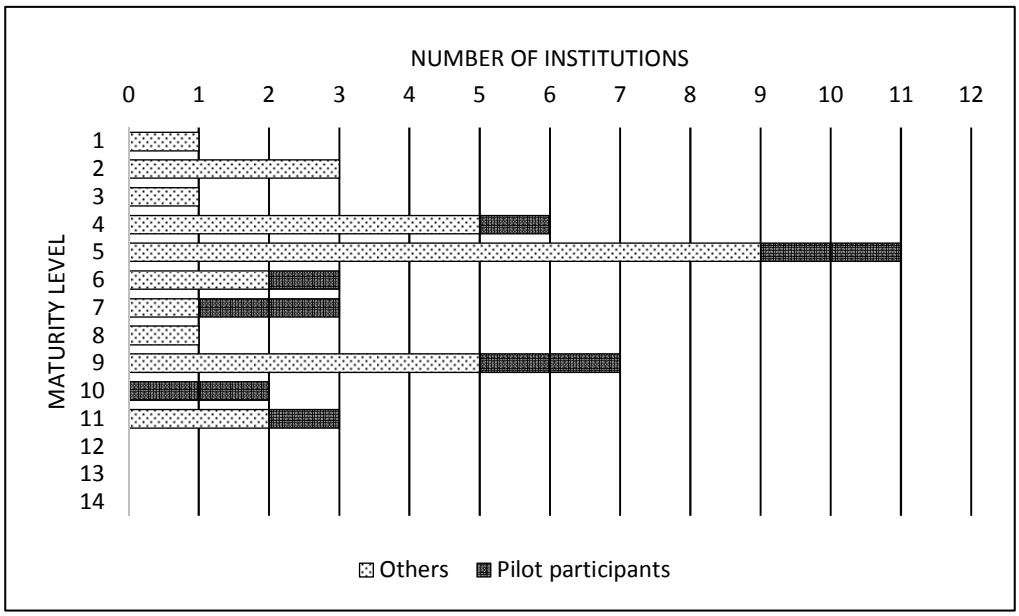


Figure 5.7 EA Maturity Level of Finnish HEIs in 2013 (adapted from Kella, 2014)

5.5. Model Validation and Data Analysis

5.5.1. Introduction

In this section the tentative conceptual EA adoption model is validated by analysing the empirical data. Data was gathered from an actual EA pilot, where EA was adopted by 12 Finnish Higher Education Institutions (HEIs). The pilot is described in more detail in the Section 5.4.

5.5.2. Data Collection

In this sub-section, the data collection process is described and discussed in detail.

As discussed in sub-section 4.3.4, interview should have a Central Research Question (CRQ). CRQ of the thesis is *How can Enterprise Architecture be adopted successfully in Finnish Higher Education Institutions?* Results of the Systematic Literature Review conducted in EA adoption (Chapter 3) suggested some factors having effect on EA adoption in general. Purpose of the interviews is to gather research data using these factors as themes for semi-structured interviews. These themes also form the theory-questions (TQs), on which the answers are tried to be found using respondent-friendly interview-

questions (IQs). Summary of these questions can be seen in Table 5.9 (format adopted from Kvale, 1996). TQs are grouped according to factors presented in Table 3.3, namely organisational (OR), EA related (EA), and environmental (EN). Source factor column refers to factors seen in Table 3.3, Table 3.4, and Table 3.5, respectively, on page 58. Mapping of the factors to theory and interview questions is illustrated in Appendix V.

Table 5.9 Interview-questions and Related Theory-questions

#	*Theory-question*	*Source factor(s)*	*IQ formulation*
IQ1	OR1: What is organisation's capability to adopt changes?	F4, F8, F10, F11	Think about some major change(s) your organisation have faced during the past few years. Describe such a change and how it was conducted. Which challenges, if any, the change faced.
	OR2: What is the level of organisation's change management capability?	F2, F8	
	OR4: What is the level of change resistance in the organisation?	F10, F13	
IQ2	OR3: What is the level of organisation IT portfolio management?	F5, F7	Describe the process how new information systems are defined, acquired or implemented, and introduced in your organisation.
IQ3	OR5: Is there a champion that drives EA or similar initiatives?	F1, F7, F11, F12, F14	Describe how new development initiatives are introduced in your organisation. Who or which party is driving such initiatives? How important this is for the success of the initiative?
IQ4	OR6: Does top management provide adequate support to EA or similar initiatives?	F7, F14, F15	Describe on what basis are development initiatives given resources in your organisation.
IQ5	OR7: Where is EA positioned in an organisation?	F14, F16	Describe how EA is organised in your organisation.
	OR8: Who is responsible for EA?	F14, F16	
IQ6	OR9: Is organisation wide communication in place?	F17	Describe how communication is organised in your organisation. How about between external stakeholders?
	OR10: What is the level of inter-stakeholder communication?	F17	
	OR11: How is new initiatives communicated in organisation?	F17	
IQ7	OR12: Is there a clear goal set for the EA pilot?	F18	About EA pilot, explain what are your or your organisation's expectations for the pilot. How are
	OR13: Is there a business case to be solved with EA?	F6, F18	

#	*Theory-question*	*Source factor(s)*	*IQ formulation*
	OR14: Is EA related to organisations strategy?	F6, F18	they related to your organisation's strategy?
IQ8	OR15: What are stakeholders' expectations and are they conflicting?	F6, F18	Which kind of expectations from other stakeholders have you faced/know?
	OR16: Are expectations in line with stakeholders' formal role?	F6, F18	
IQ9	EN1: Is EA adopted to satisfy external pressure?	F23	Explain how EA pilot or similar initiatives are related to the government level programs. How are such programs coordinated? What are the power relationships in such coordination?
	EN2: How is EA related to government or similar EAs?	F24	
	EN3: How EA is coordinated in government level?	F24	
	EN4: Can EA be forced to be used by government?	F23, F25	
IQ10	EA1: How is EA framework selected?	F9, F19	Tell me about EA pilot, explain how was the used framework selected? Does the framework require any modification to suit your purposes? Explain. On which kind of principles is the EA pilot based on? Explain in your own words EA and related terms.
	EA2: Could selected EA framework used as is?	F19	
	EA3: Is EA definition too vague?	F20	
	EA4: Are principles used?	F21	
IQ11	EA5: Is there enough EA skills?	F22	Explain your and your organisation's EA experience. Has there been any training during the pilot? Which parts of EA, if any, you think your organisation has most challenges? Have you used contracted specialists/consultants during the pilot?

Interviews were performed between June and October 2010 by phone and were recorded to be transcribed later. The interview process followed Myers' and Newman's (2007) instructions (see sub-section 4.3.4); opening and introduction were rehearsed, key questions prepared in the form of IQs, and permissions for follow-ups asked.

It was decided that the word by word approach were not to be used but interviews were transcribed so that answers to IQ questions were given. This decision was made because all interviews were recorded so it was possible to transcribe them in more detail later if necessary. Transcriptions were produced by using NCH Express Scribe (v 5.06) and Microsoft Office 2007. The form used while transcribing can be seen in Appendix VI.

Transcriptions were sent for respondents for review and corrections were made accordingly. The analysis explained in the next sub-section were performed using the reviewed transcriptions.

5.5.3. Analysis Method

Interviews were analysed by utilising directed content analysis as explained in sub-section 4.3.4. Categories used in the coding and analysis were derived from the REAP model formed in section 5.3. Strategic levels of EA are adopted from Lapalme (2012), objectives from Cao *et al.* (2003), and sources of resistance from Pardo del Val & Martinez Fuentes (2003). Categories to be used as a basis for analysis can be seen in Table 5.10. A full list of sources of resistance can be seen in Table 5.4 on page 96.

Table 5.10 Categories Used in the Directed Content Analysis

Main category and source	*#*	*Sub categories*
Strategic level of EA Lapalme (2012)	S1	Enterprise Ecological Adaptation
	S2	Enterprise Integrating
	S3	Enterprise IT Architecting
Objectives Cao *et al.* (2003)	C1	Cultural
	C2	Political
	C3	Structural
	C4	Processes
Resistance during planning Pardo del Val & Martinez Fuentes (2003)	R1.1	Distorted perception, Interpretation barriers, and Vague strategic priorities
	R1.2	Low motivation
	R1.3	Lack of creative response
Resistance during execution Pardo del Val & Martinez Fuentes (2003)	R2.1	Political and cultural deadlocks
	R2.2	Other reasons

5.5.4. Coding Process

As the view to EA adoption is the one of organisational change, only the answers to OR questions were analysed, namely from IQ1 to IQ8 (see Table 5.9 on page 105). Coding was performed using NVivo software package; Version 9.2.81.0 (64-bit). Transcriptions were first imported to NVivo and automatically organised as *nodes* using NVivo's *Auto code* feature so that each IQ formed a node. Each of these nodes contained all answers for the particular IQ from all interviews. The analysing process is illustrated in Figure 5.8 using BPMN notation.

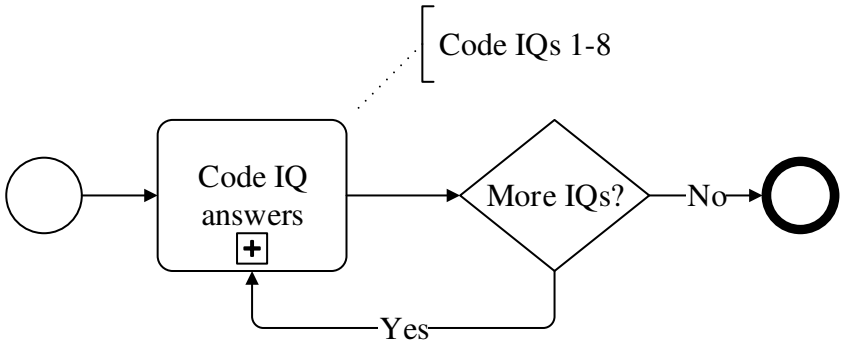


Figure 5.8 Interviews Analysing Process

The actual coding of each node were performed using the process illustrated in Figure 5.9. The IQ under analysis contained multiple answers (see Table 5.11). Each of these answers contains qualitative data to be analysed (e.g. text). Data were coded in English by looking for occurrences of the codes mentioned in Table 5.10. First the strategic level of EA was coded, followed by coding of change type and resistance. The number of occurrences of the codes and the number of sources can be seen in Appendix VII.

Table 5.11 Number of Answers per Interview-question

#	*Answers*	#	*Answers*	#	*Answers*
IQ1	21	IQ5	7	IQ9	2
IQ2	9	IQ6	18	IQ10	2
IQ3	20	IQ7	19	IQ11	15
IQ4	9	IQ8	19		

It should be noted that the table of codes in Appendix VII contains all occurrences of codes, including those not included in the resulting REAP model as explained in sub-section 5.5.6.

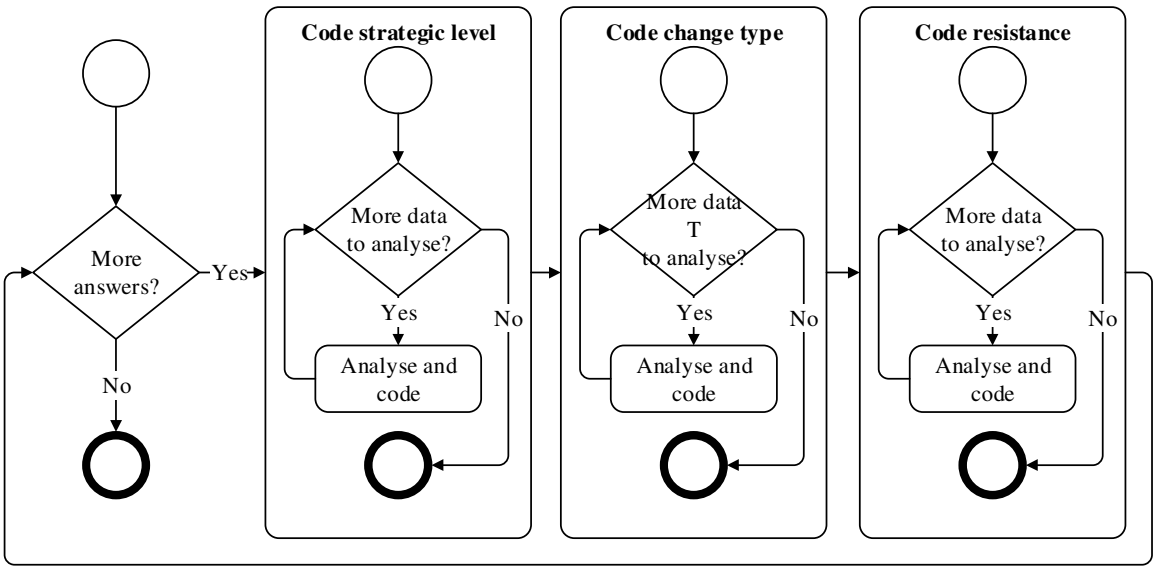


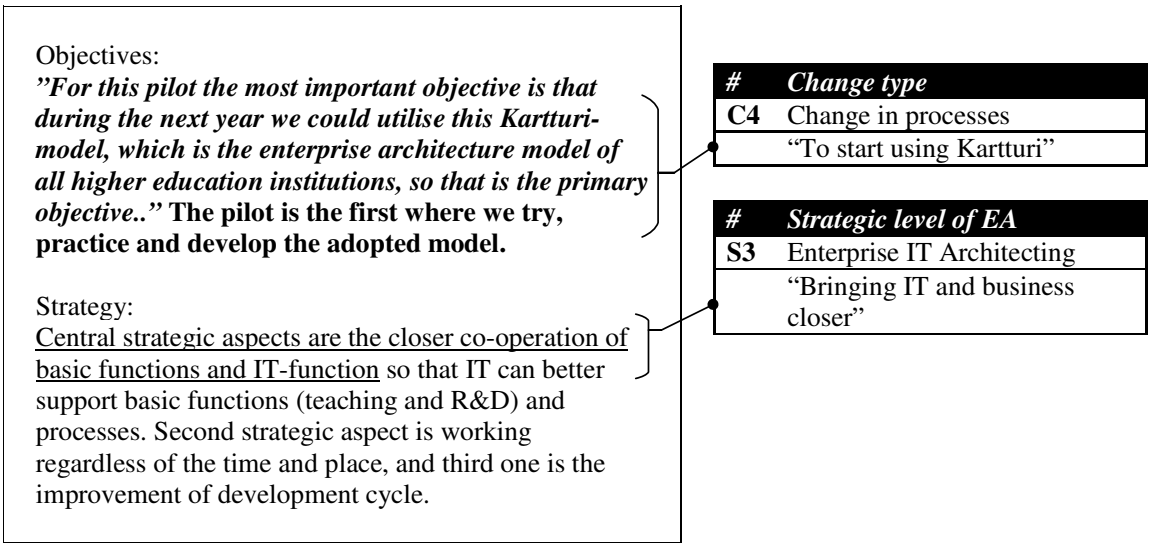
Figure 5.9 Coding Process of Interview-questions

To demonstrate the internal validity of the research, in the next sub-section the coding of different IQs are explained in detail. Also some excerpts of answers are given in English (for original Finnish excerpts see Appendix VIII).

5.5.5. Data Analysis

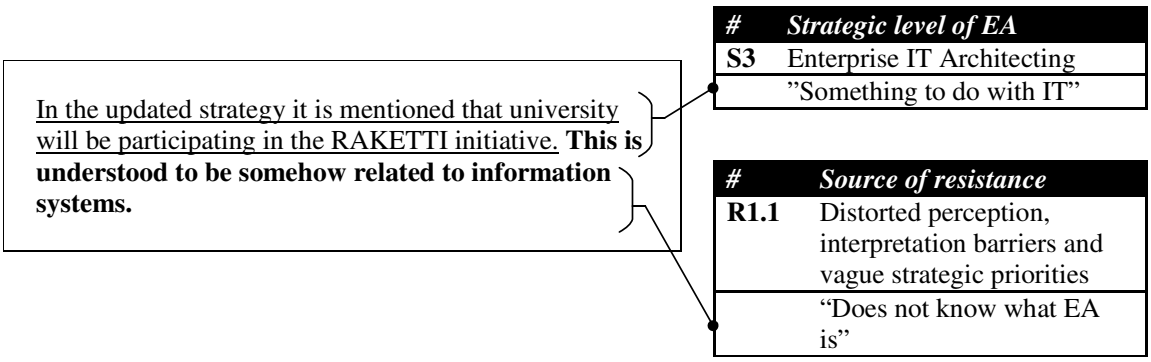
In this sub-section, examples of the coding of the answers to different IQs are presented in detail. Examples are provided to demonstrate the coding process so that the internal validity of this part of the research can be assessed. As such, the given examples does not indicate their significance.

Strategic level and pilot objectives were interpreted from answers to IQ7 and IQ8. A translated example of coding of one of IQ7 answers can be seen in Box 5.1. For the strategic level of EA, the underlined text were interpreted as “Bringing IT and business closer” and coded as the *Enterprise IT Architecting*. The text in boldface was interpreted so that the pilot objective was “To start using Kartturi”. As the Kartturi is actually the EA framework resulted from the pilot, it will cause changes (only) in processes, and thus this code were coded as *Processes*. No resistance related codes were found from this particular answer.



Box 5.1 Coding of Answer ID26 to IQ 7

IQs 7 and 8 are about the objectives and expectations for the EA pilot. Thus by analysing these questions using the REAP model, it can be found out on which strategic level EA is seen. This can be interpreted directly from the answer or indirectly from the objectives. For instance excerpts in Box 5.2 in boldface were interpreted as "Something to do with IT". In this case the strategic level of EA can thus be coded as *Enterprise IT Architecting*.

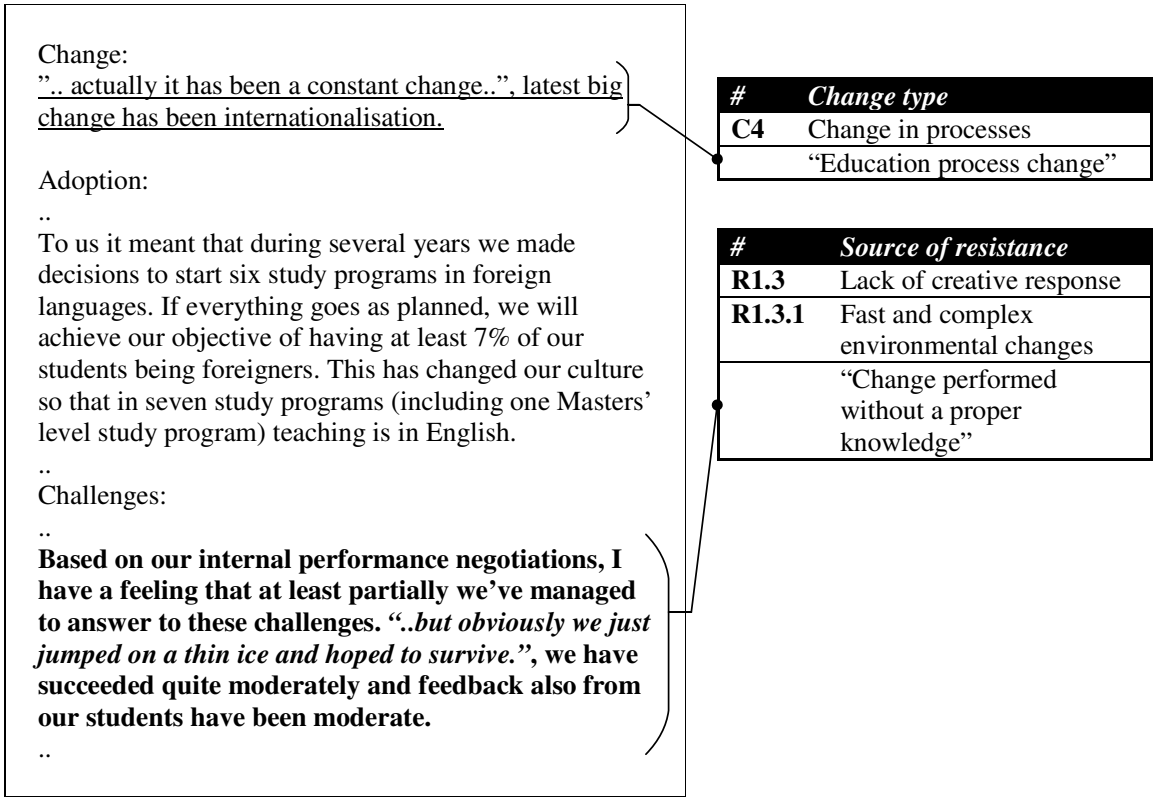


Box 5.2 Coding of Answer ID54 to IQ 7

Also possible sources of resistance could be interpreted from the answers. For instance the underlined excerpt in Box 5.2 were interpreted as "Does not know what EA is" and coded as *Communication barriers* under *Distorted perception, interpretation barriers and vague strategic priorities* category.

Answers to IQ1 were analysed to find out which type of organisational changes the organisation have had in the past, and what kind of challenges these changes has caused or faced.

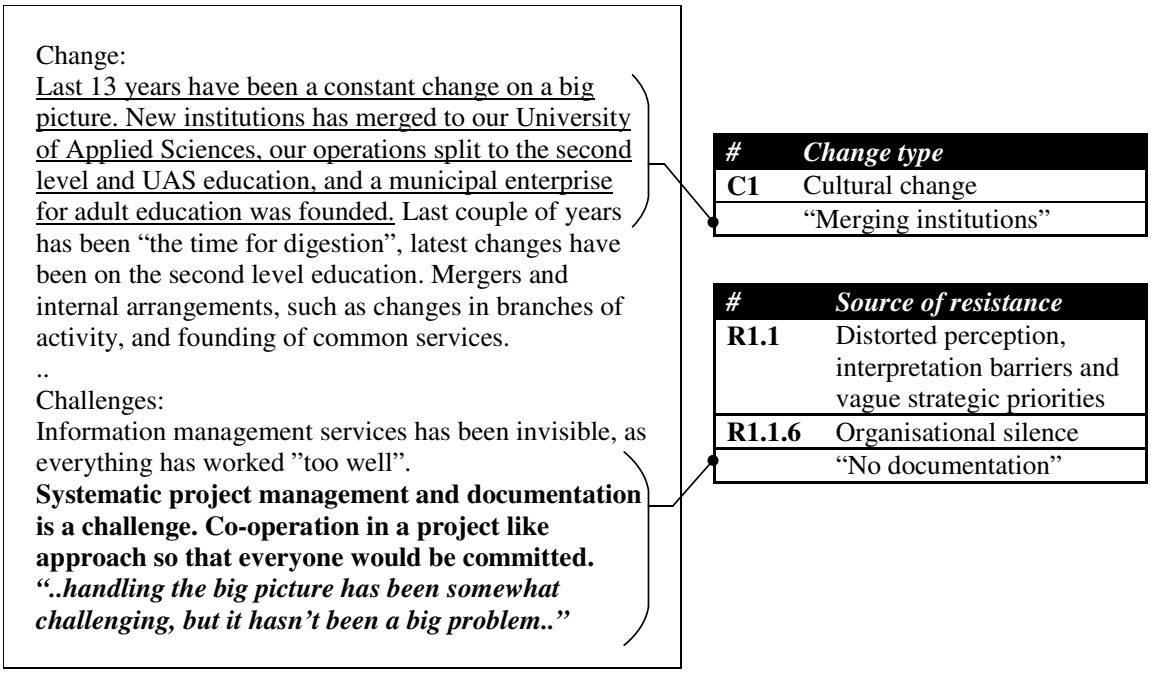
The underlined change described in Box 5.3 was coded as *Processes.* International study programs have not caused changes to the organisation structure, but to the processes of education. Thus this change was not coded as *Structural.* The boldface text was interpreted as "Change performed without a proper knowledge" and coded as *Fast and complex environmental changes* under the *Lack of creative response* category. In this case the lack of proper knowledge does not refer to capability gap, but to the lack of knowledge what to do to achieve objectives. Thus they had to jump to the adoption without a proper planning, because objectives had to be achieved as scheduled.



Box 5.3 Coding of Answer ID10 to IQ1

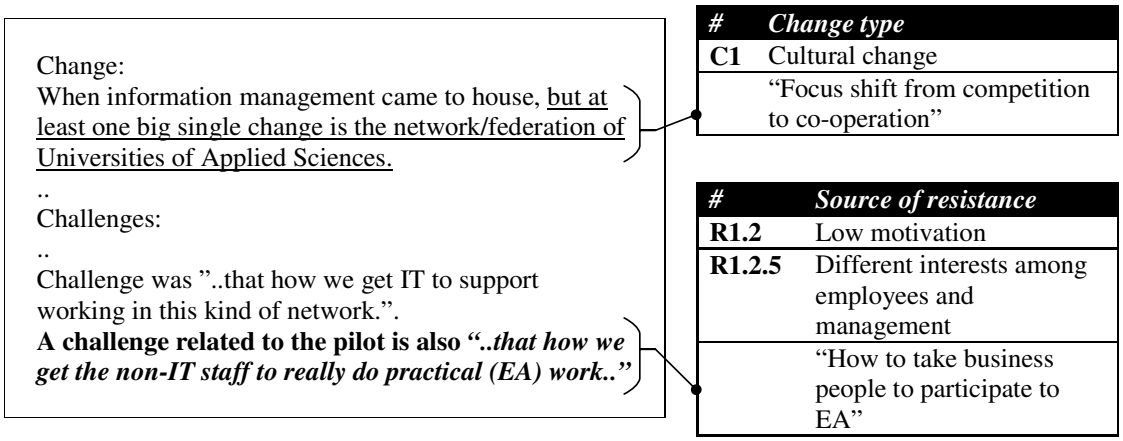
The underlined text in Box 5.4 was coded as *Culture* type of a change, as merging multiple institutions has affected organisational cultures. The text in boldface was interpreted as "No documentation" and coded as *Organisational silence* under *Distorted perception, interpretation barriers and vague strategic priorities* category. No documentation refers to a situation, where IT staff is not keen to document for example environment, solutions, and

decisions made. This is same with the business people, as they are not keen to document their processes, information structure, etc. So organisation is keeping information to themselves and thus considered being silent.



Box 5.4 Coding of Answer ID22 to IQ1

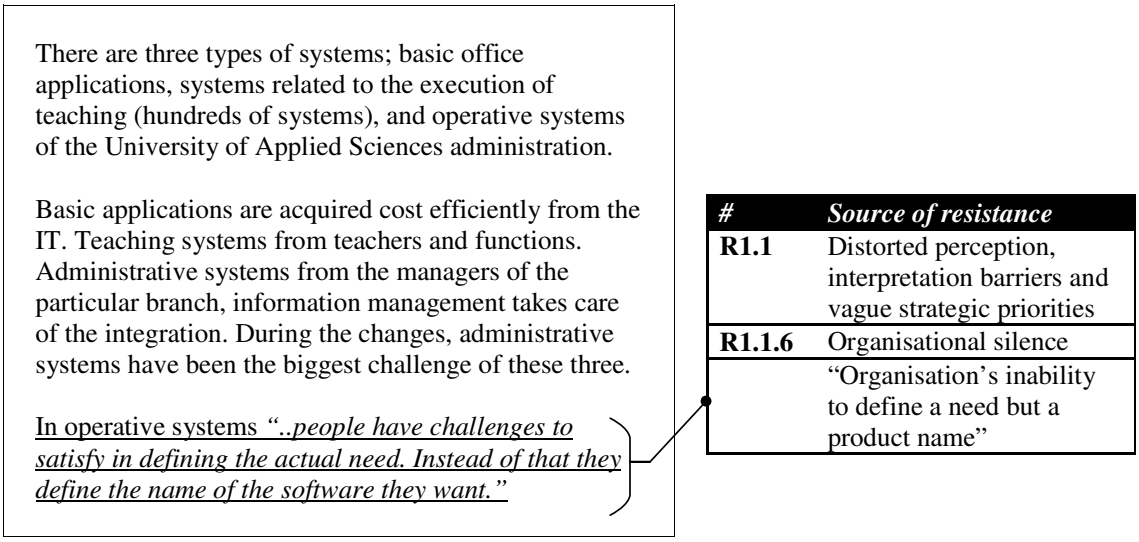
The underlined text in Box 5.5 is coded as a *Cultural* change, as networking shifts focus from competition to co-operation. Challenge in boldface is interpreted as "How to take business people to participate to EA" and coded as *Different interest among employees and management* under *Low motivation* category. It is interpreted that the will of management is to practice EA, while some business people are reluctant in participating.



Box 5.5 Coding of Answer ID26 to IQ1

Answers to IQ question from 2 to 6 were analysed to find out possible sources of resistance.

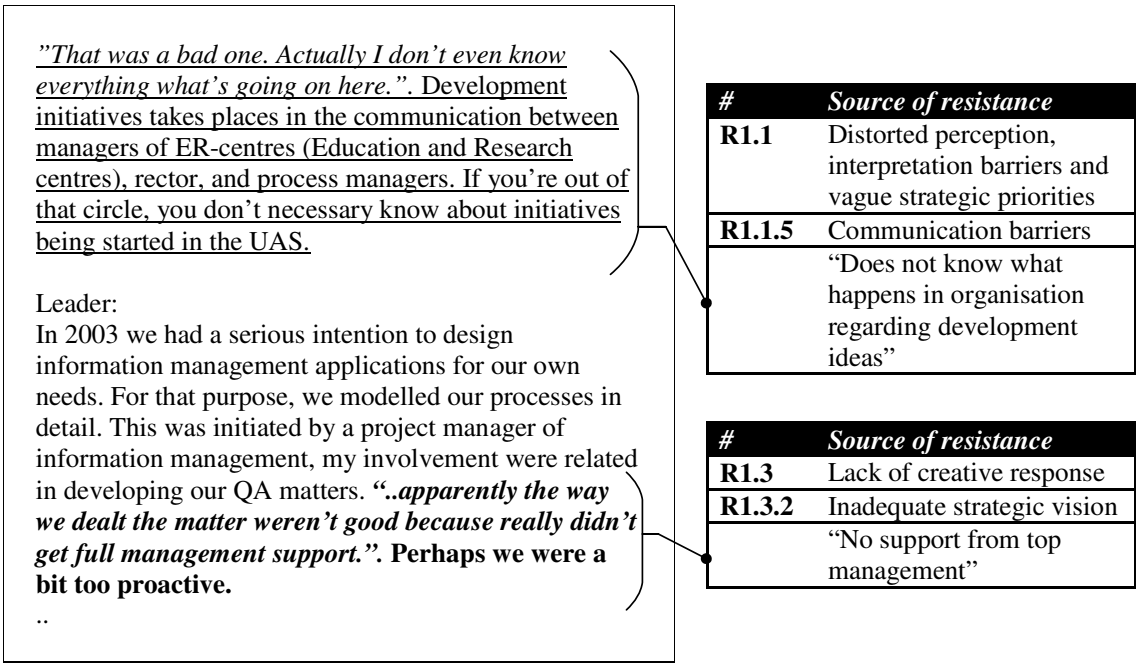
The underlined text in Box 5.6 was interpreted as "Organisation's inability to define a need but a product name" and coded as *Organisational silence* under *Distorted perception, interpretation barriers and vague strategic priorities* category.



Box 5.6 Coding of Answer ID05 to IQ 2

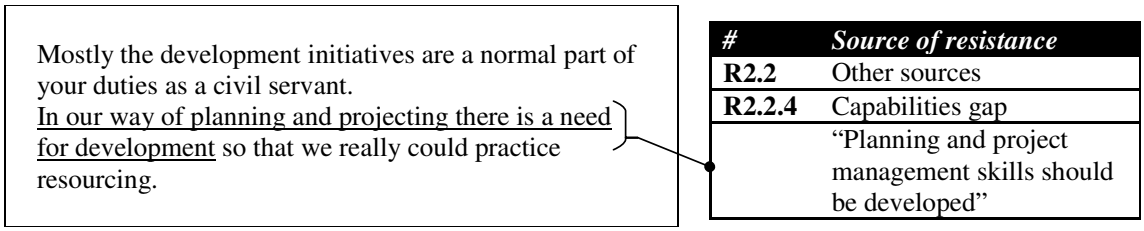
The underlined text in Box 5.7 was interpreted as "Does not know what happens in organisation regarding development ideas" and coded as *Communication barriers* under *Distorted perception, interpretation barriers and vague strategic priorities* category.

The text in boldface was interpreted as "No support from top management" and coded as *Inadequate strategic vision* under *Lack of creative response* category.



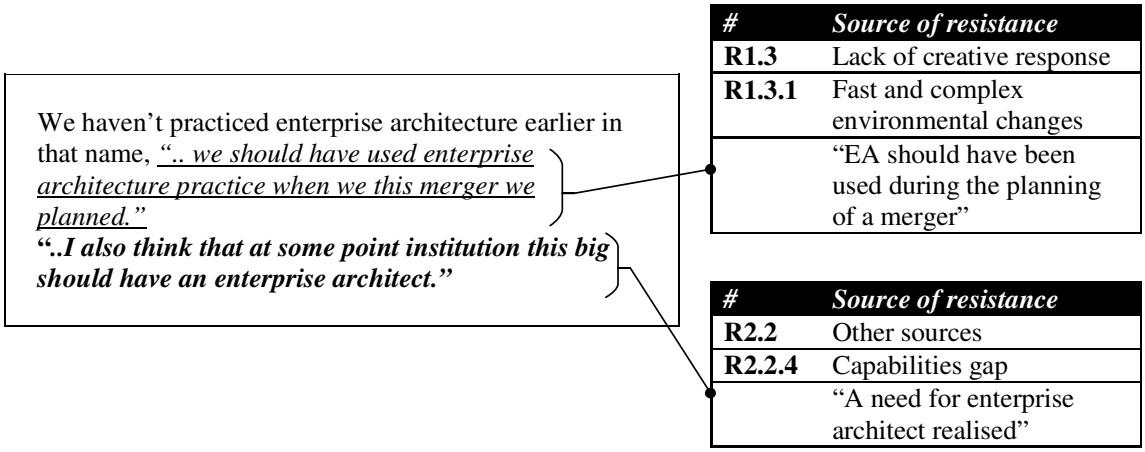
Box 5.7 Coding of Answer ID46 to IQ 3

The underlined text in Box 5.8 was interpreted as "Planning and project management skills should be developed" and coded as *Capabilities gap* under *Other sources* category.



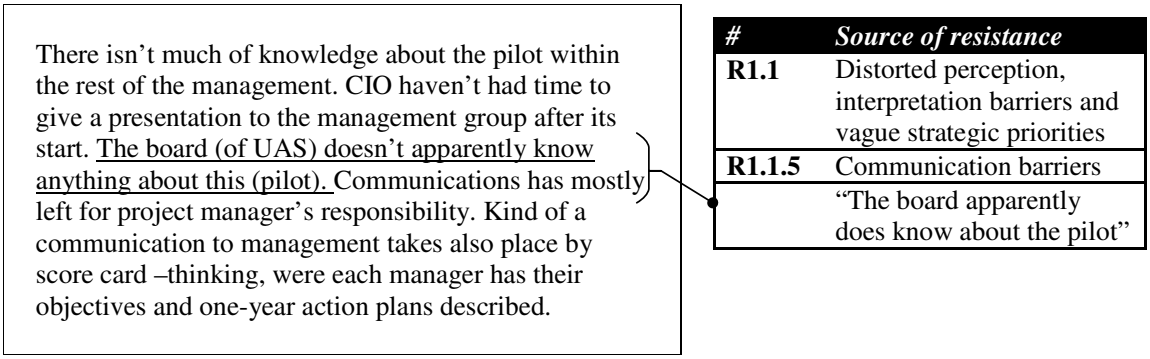
Box 5.8 Coding of Answer ID46 to IQ 4

The underlined text in Box 5.9 was interpreted as "EA should have been used during the planning of a merger" and coded as *Fast and complex environmental change* under *Lack of creative response* category. This was due to the fact that the environment has interpreted to be changing so fast that there were no time to EA. The text in boldface was interpreted as "A need for enterprise architect realised" and thus coded as *Capabilities gap* under *Other* category.



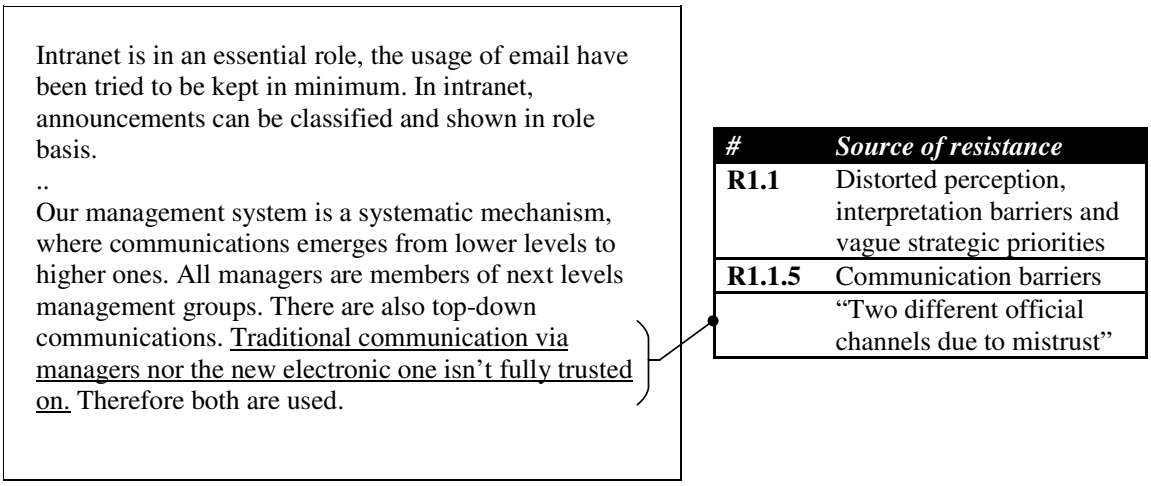
Box 5.9 Coding of Answer ID32 to IQ 5

The underlined text in Box 5.10 was interpreted as "The board apparently does know about the pilot" and coded as *Communication barriers* under *Distorted perception, interpretation barriers and vague strategic priorities* category.



Box 5.10 Coding of Answer ID32 to IQ 6

The underlined text in Box 5.11 was interpreted as "Two different official channels due to mistrust" and coded as *Communication barriers* under *Distorted perception, interpretation barriers,* and *vague strategic priorities* category.



Box 5.11 Coding of Answer ID05 to IQ 6

5.5.6. Summary of Model Validation and Data Analysis

The illustrated summary of analysis per organisation can be seen in Figure 5.10. Boxes on the left represents strategic levels of EA; *Enterprise Ecological Adaptation* (S1)*, Enterprise Integrating* (S2)*,* and *Enterprise IT Architecting* (S3). Boxes in the middle represents the types of organisational change; *Cultural* (C1)*, Political* (C2)*, Structural* (C3)*,* and *Process* (C4). Boxes on the right which labels' start with R represents the categories of sources of resistance; *Distorted Perception* (R1.1)*, Low Motivation* (R1.2)*, Lack of Creative Response* (R1.3)*, Political and Cultural Deadlocks* (R2.1)*,* and *Other Reasons* (R2.2). First three sources for resistance are occurring during the planning, and the latter two during the execution of the change. The legend is provided in Table 5.12.

Table 5.12 Legend of Analysis Diagrams and Tables

Strategic level		*Change type*		*Resistance*	
S1	Enterprise Ecological Adaptation	C1	Cultural	R1.1	Distorted Perception
S2	Enterprise Integrating	C2	Political	R1.2	Low Motivation
S3	Enterprise IT Architecting	C3	Structural	R1.3	Lack of Creative response
		C4	Process	R2.1	Political and Cultural Deadlocks
				R2.2	Other Reasons

Black and white circles represents findings from the analysis of the questions related to the *goals and objectives of the EA pilot*. A white circle indicates that the particular concept is found from the data. Solid black circle indicates that it is found from the data and *linked* to

another finding. For instance in ORG 01 it can be seen that there is evidence in the data suggesting that the level of EA is seen as *Enterprise Integrating*. However, the same *respondent* has not mentioned any particular change, so there is nothing it could be linked to. It can also be noted that there is a link between *Enterprise IT Architecting* and *Process* change. In this case, the respondent has expressed both the strategic level of EA, and the actual change it is about to achieve. In some cases, such as in ORG04, there is also a link between the change and a source of resistance, supported by the data. Black and white squares represents findings from the analysis of the questions related to *past changes and challenges*, and diamonds to the questions related to *possible sources of resistance*. The legend of the symbols can be seen in Table 5.13.

To demonstrate how to interpret Figure 5.10 the analysis of ORG11 is explained in detail. In the pilot (illustrated as circles and dots), EA has been seen in two levels. Firstly, it is seen as *Enterprise IT Architecting* (S3), aiming for changes in *processes* (C4). Secondly, EA is seen as *Enterprise Integration* (S2) aiming for *political* (C2) and *process* (C4) changes. In the pilot, political changes (C2) would face resistance during the planning of EA adoption caused by communication barriers categorised under *distorted perception* (R1.1). Moreover, during the execution of EA adoption, resistance would be faced due to cynicism categorised under *other reasons* (R2.2). In the past (illustrated as squares), *cultural* change (C1) has faced resistance when executing change. Resistance was caused by *political and cultural deadlocks* (R2.1) and by *other reasons* (R2.2). Also *structural* change (C3) has faced resistance caused by *political and cultural deadlocks* (R2.1). Previously there has been changes in *processes* (C4) which it has not faced resistance and thus could not be linked to any. Similarly (illustrated as diamonds), there are internal communication challenges, which might cause resistance in the form of *distorted perception* (R1.1) but could not be linked to any particular change.

As it can be seen from the analysis, the REAP model can be used to categorise the adoption process. Moreover, as stated by Barlas and Carpenter (1990) a valid model can be assumed to be one of the many possible ways to describe a real world. Thus it can be argued that the model is valid in this context, i.e. it does reproduce real life behaviour found from the EA pilot.

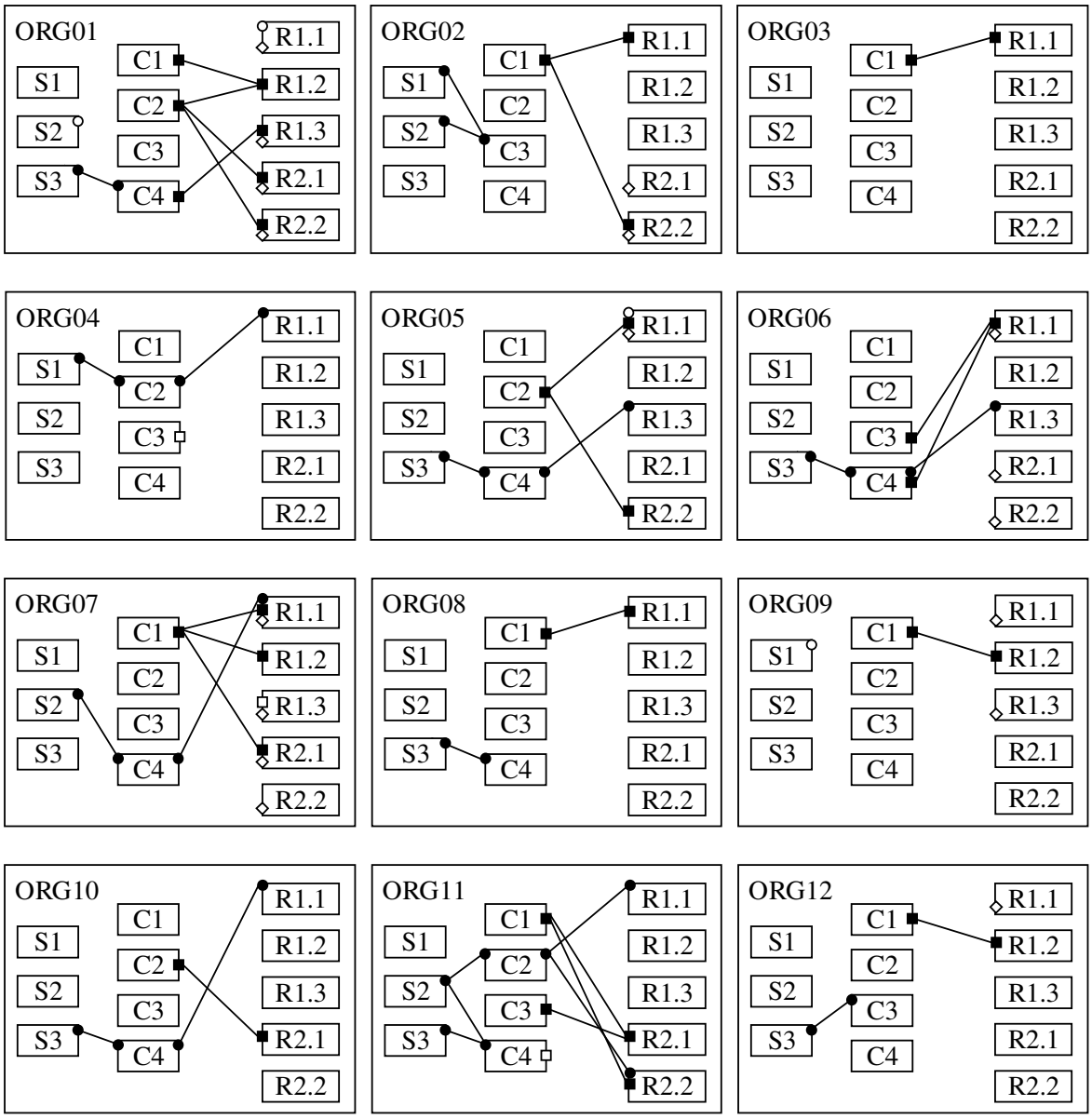


Figure 5.10 Organisation Level Analyses of EA Pilot

Table 5.13 Legend of Analysis Diagram Symbols

Symbol	*Source*	*Symbol*	*Source*
●	This pilot with a link	○	This pilot without a link
■	Previous change(s) with a link	□	Previous change(s) without a link
◇	Interpreted from capabilities	—	Link

As described in sub-section 5.4.2, the EA pilot was organised to sub-projects in groups (see Table 5.6). A summary of the group level analysis can be seen in Figure 5.11, where the analyses of organisations of particular group are combined in to a single diagram.

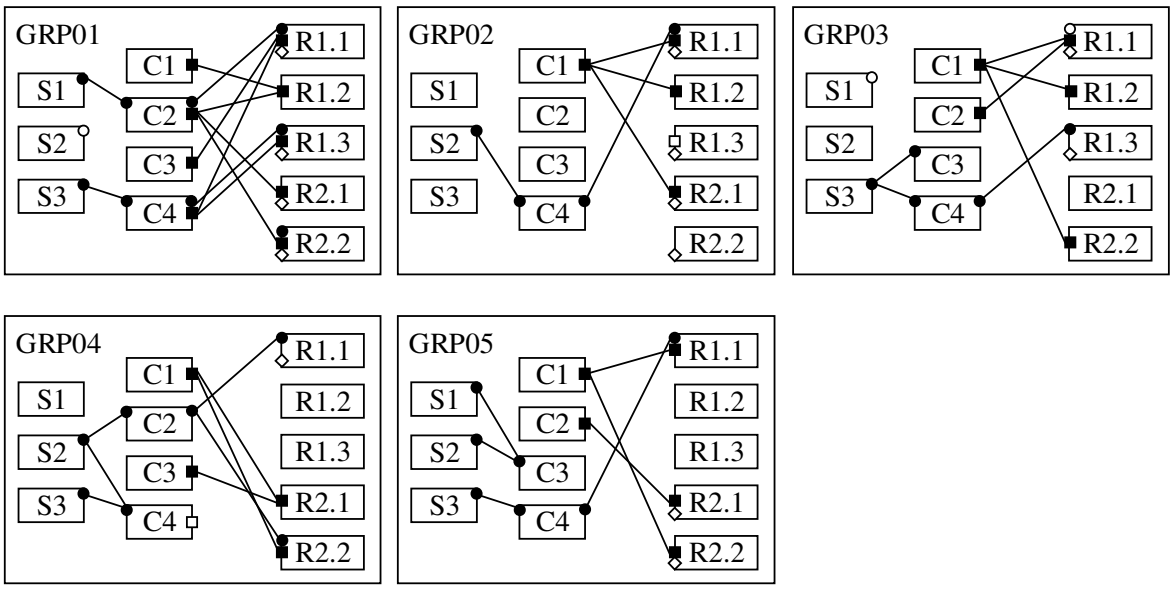


Figure 5.11 Group Level Analysis of EA Pilot

A summarised pilot level analysis can be seen in Figure 5.12. It contains all the links found from the EA pilot and from previous changes. All extra circles, squares, and diamonds are discarded, and overlapping lines between boxes combined. Also the links between Cultural change and sources of resistance are discarded, as that type of changes were not present in the EA pilot. Therefore the figure summarises the findings from the analysis.

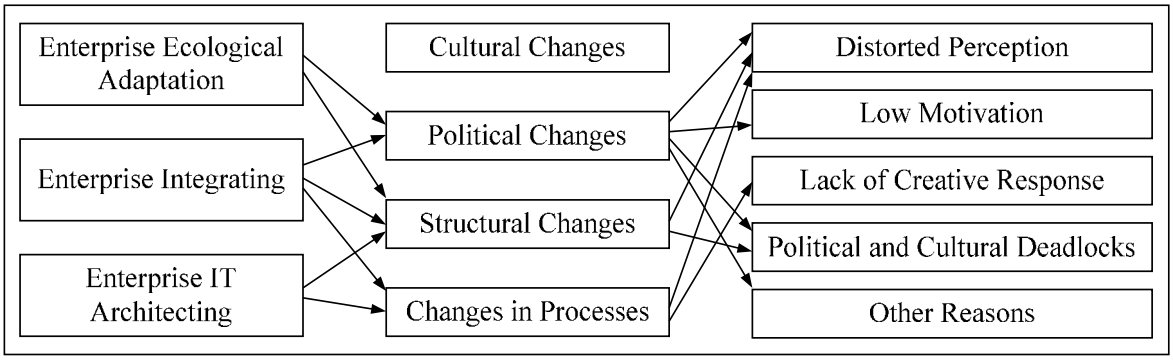


Figure 5.12 Pilot Level Analysis of EA Pilot

All occurrences of organisational changes and sources of resistance from the analysis are summarised in Table 5.14 and Table 5.15, respectively.

Table 5.14 Summary of Observed Organisational Changes

Strategy	*Change*	*Code*
S1	C2	Student management system provided outside the HEIs
S1	C3	Adult education
S2	C2	Business leads instead of IT
S2	C4	Eases reporting
S2	C4	To make EA a part of normal business
S2	C4	Development of processes and systems
S2	C4	A new way for reporting
S2	C3	Adult education service centre
S3	C4	Tools for IT development
S3	C4	Working method
S3	C4	Eases communication
S3	C4	To combine QA and EA
S3	C4	To lead IT in a managed way
S3	C4	A new way to develop things
S3	C4	To start using Kartturi
S3	C3	To combine three IT departments

Table 5.15 Summary of Observed Sources of Resistance

Change	*Resistance*	*Code*
C2	R2.2.4	Merging
C2	R1.1.5	EA concepts not understood
C2	R1.1.5	Internal communication
C2	R2.2.5	Has doubts
C2	R2.1.2	Inter departmental decision model
C2	R1.2.5	Process descriptions were not seen important
C2	R2.1.5	Moving people around is sensitive
C2	R1.1.3	Staff's lack of knowledge about IT
C3	R1.1.5	Message formulation
C3	R2.1.1	Challenges to learn new things
C4	R1.1.5	EA concepts not understood
C4	R1.1.5	Internal communication
C4	R1.3.1	No strategic connections
C4	R1.3.1	Change performed without proper knowledge
C4	R1.3.3	EA not related to strategy

5.6. Results

5.6.1. Introduction

In this section, results of the analysis are presented and discussed in detail.

In Section 5.3 the conceptual REAP model was formed based on the current literature. This model was validated by analysing the empirical data in Section 5.5. The summary of findings is illustrated in Figure 5.13. Dotted arrows indicates *logically deduced influence*, as described in the REAP. Solid arrows, in turn, indicates *empirically validated influence*. Next the results are explained and discussed in textual form.

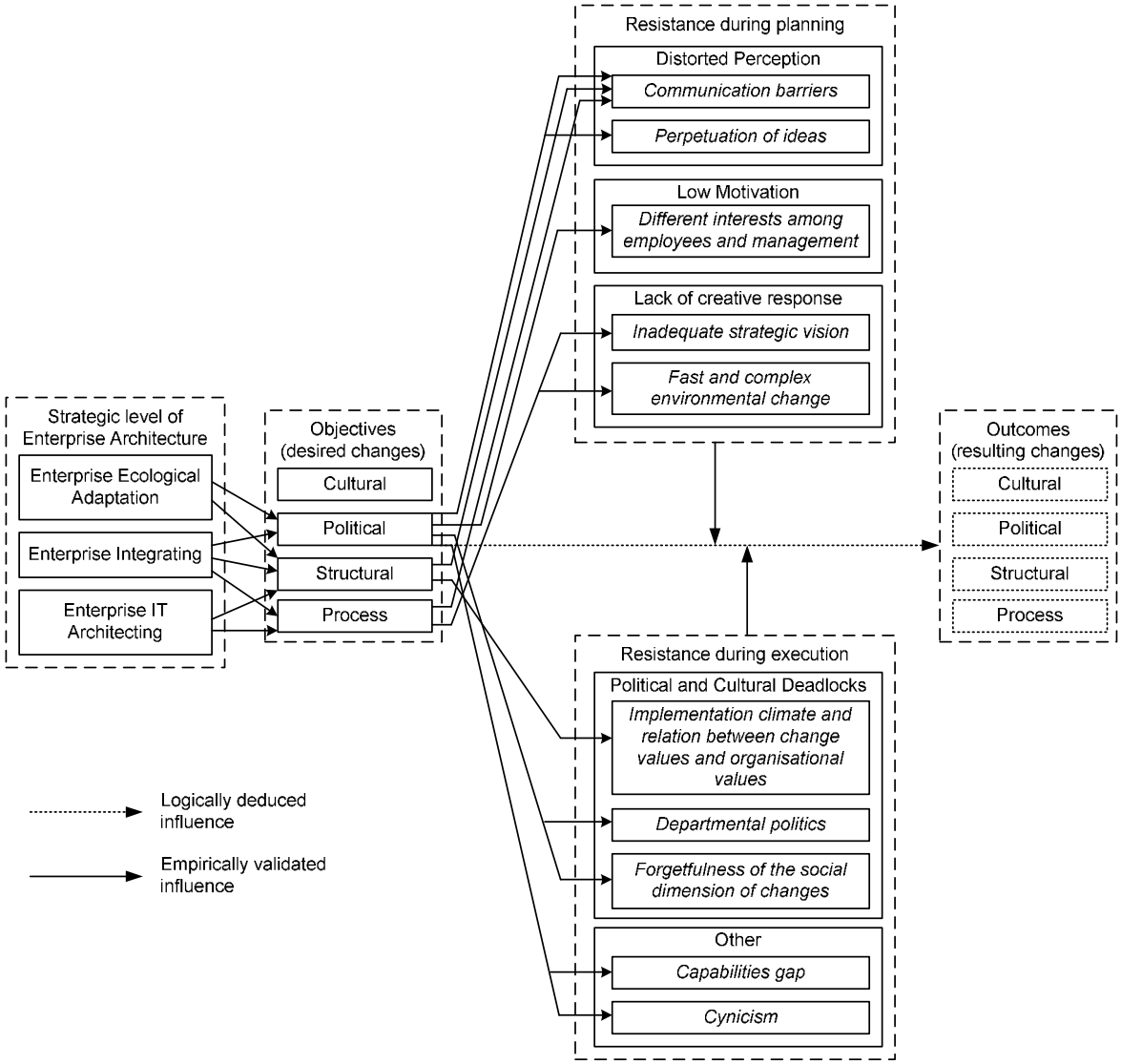


Figure 5.13 Results of Data Analysis of EA Pilot

As suggested by REAP model, all strategic levels of EA were present in the data. However, there were no evidence of the adoption aiming for cultural changes of the organisation.

Therefore *Cultural* change was removed from the results, as described in the previous section. One possible explanation for this is that as EA is used for the very first time, it is safer to focus on easier changes first. After all, as it can be seen in Figure 5.12, previous cultural changes in organisations have caused resistance in four out of five resistance categories, as has political changes.

Sources of resistance were found in all five categories, as suggested by the REAP model. However, only 10 out of 24 sources were found from the data. This leaves 14 sources of resistance (see Table 5.16) which were not faced in the EA pilot. One explanation for this is that such sources of resistance is not faced in Finnish HEIs at all. More likely explanation is that those sources of resistance were not met in this particular pilot but would likely be faced in other settings. For instance during the executing of cultural changes, political and cultural deadlocks are probably faced. As noted earlier, there were no cultural changes executed nor planned during the pilot. In the next three sub-sections, changes influenced by different strategic levels of EA are elaborated. This is followed by three sub-sections of elaboration of resistance influenced by different change types.

Table 5.16 Sources of Change Resistance Observed in EA pilot

#	*Resistance*	*Observed*
R1.1	**Distorted perception, interpretation barriers and vague strategic priorities**	
R1.1.1	Myopia	
R1.1.2	Denial	
R1.1.3	Perpetuation of ideas	x
R1.1.4	Implicit assumptions	
R1.1.5	Communication barriers	x
R1.1.6	Organisational silence	
R1.2	**Low motivation**	
R1.2.1	Direct costs of change	
R1.2.2	Cannibalisation costs	
R1.2.3	Cross subsidy comforts	
R1.2.4	Past failures	
R1.2.5	Different interests among employees and management	x
R1.3	**Lack of creative response**	
R1.3.1	Fast and complex environmental changes	x
R1.3.2	Resignation	
R1.3.3	Inadequate strategic vision	x
R2.1	**Political and cultural deadlocks**	
R2.1.1	Implementation climate and relation between change values and organisational values	x

#	*Resistance*	*Observed*
R2.1.2	Departmental politics	x
R2.1.3	Incommensurable beliefs	
R2.1.4	Deep rooted values	
R2.1.5	Forgetfulness of the social dimension of changes	x
R2.2	**Other sources**	
R2.2.1	Leadership inaction	
R2.2.2	Embedded routines	
R2.2.3	Collective action problems	
R2.2.4	Capabilities gap	x
R2.2.5	Cynicism	x

5.6.2. Changes Influenced by Enterprise Ecological Adaptation

When EA is seen on *Enterprise Ecological Adaptation* strategic level, it will cause *Political* and *Structural* changes, as seen in Figure 5.14. Typical to this level is that HEI is seen as a part of a larger context.

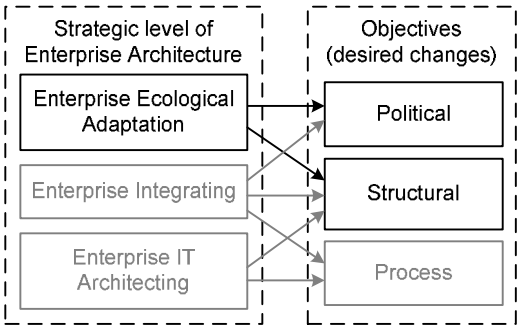


Figure 5.14 Changes Influenced by Enterprise Ecological Adaptation

First of all, EA can be used by the government to control the HEI field, same way as the recent Act on Information Management Governance in Public Administration (Finnish Parliament, 2011). Idea behind the controlling seems to be quite similar than behind the concept of *extended enterprise* (see for example Browne *et al.*, 1995; Post *et al.*, 2002). In the extended enterprise, production is divided among organisations. Drivers for this are for instance reduced product life cycles, time based competition, and challenge of creating organisations that attract high-quality people (Browne *et al.*, 1995). In the HEI field this means that by using EA, HEIs could focus on their core activities, and "compete" with those instead of tying their assets to support functions. This would be achieved for instance by using a common student management system for the whole HEI field. This kind of

change would affect the level of freedom the HEI would have on using and selecting a student management system.

Table 5.17 Changes Influenced by Enterprise Ecological Adaptation

#	*Change*	*Codes*
C2	Political	Student management system provided outside the HEIs
C3	Structural	Adult education
C4	Process	N/A

Another way to use EA on a larger context is to use it on mergers and co-operative networks (Syynimaa, 2010a). This is also similar to the concept of extended enterprise, but differs from the previous in the controlling power. Merging and co-operation is usually based on voluntariness, thus HEIs can select the other parties of the co-operation. For instance some operations may be centralised. These kinds of changes would affect the structure of HEI.

5.6.3. Changes Influenced by Enterprise Integrating

On *Enterprise Integrating* level, *Political, Structural*, and *Process* changes are caused, as seen in Figure 5.15. It is interesting to note that *Enterprise Integrating* level will cause the most different types of change. Typical to this level is that EA is seen as an enabler of strategy execution, but also as a tool of measuring it.

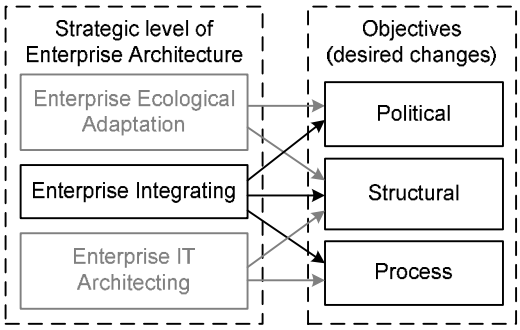


Figure 5.15 Changes Influenced by Enterprise Integrating

First, EA can be used to help strategy execution. In practice, this would mean that business would lead the development of information systems instead of IT department. This kind of paradigm shift towards systems thinking (Lapalme, 2012) would affect the power relations between business and IT. In HEIs where business already leads, strategy execution would affect more the structure of the HEI.

Secondly, EA can be used for measuring operations for mainly two reasons; to improve quality and to provide information for strategic decisions. The former is called Quality Assurance (see for example El-Khawas *et al.*, 1998). Each Finnish HEI needs to have a QA practice in place, which is audited regularly by The Finnish Higher Education Evaluation Council (FINHEEC). The latter reason is called Decision Support System, which is closely related to Business Intelligence (see for example Turban *et al.*, 2010). HEIs are required to report annually the number of students, graduates, taught study points, etc. to the Ministry of Education and Culture. In both cases EA is used to ease processes related to information gathering, by automating repetitive manual tasks. Thus EA will affect HEI's processes.

Table 5.18 Changes Influenced by Enterprise Integrating

#	*Change*	*Codes*
C2	Political	Business leads instead of IT
C3	Structural	Adult education service centre
C4	Process	Eases reporting To make EA a part of normal business Development of processes and systems A new way for reporting

5.6.4. Changes Influenced by Enterprise IT Architecting

On *Enterprise IT Architecting* level, *Structural* and *Process* changes are caused. Typical to this level is that is EA seen as a way to bring IT and management closer to each other, but also as a common language between business and IT.

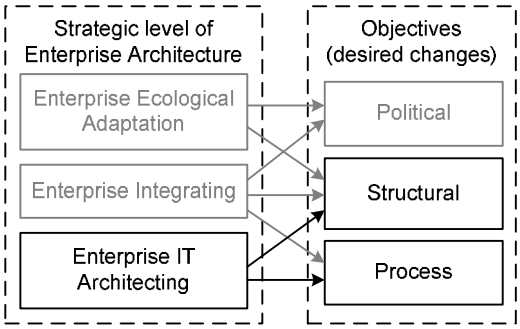


Figure 5.16 Changes Influenced by Enterprise IT Architecting

First, EA is seen as a way to bring IT closer to the management. Especially in a situation where multiple institutions has formed a common management but IT departments are still scattered. In such case EA would help management to receive proactive input from IT department about possibilities, dependencies, and limitations; it can be used as a kind of

risk management tool. In practise, it would mean merging of different IT departments, and thus lead to structural changes. In HEIs where there is already a centralised IT department it could mean adopting EA framework, and bringing it to a part of a QA system.

Secondly, EA is seen as a common language between business and IT. When there is a predefined formal way to describe both business and IT, communication is easier. It will also show to all parties which things need to be considered. As such, EA adoption will lead to changes in processes.

Table 5.19 Changes Influenced by Enterprise Architecting

#	*Change*	*Codes*
C3	Structural	To combine three IT departments
C4	Process	Tools for IT development Working method Eases communication To combine QA and EA To lead IT in a managed way A new way to develop things To start using Kartturi

5.6.5. Resistance Influenced by Political change

During the planning phase of EA adoption, *Political change* is influencing two types of resistance; *Distorted Perception* and *Low Motivation*, as seen in Figure 5.17. Distorted Perception is caused by *Communication Barriers* and *Perpetuation of Ideas*, whereas Low Motivation is caused by *Different interests among employees and management*.

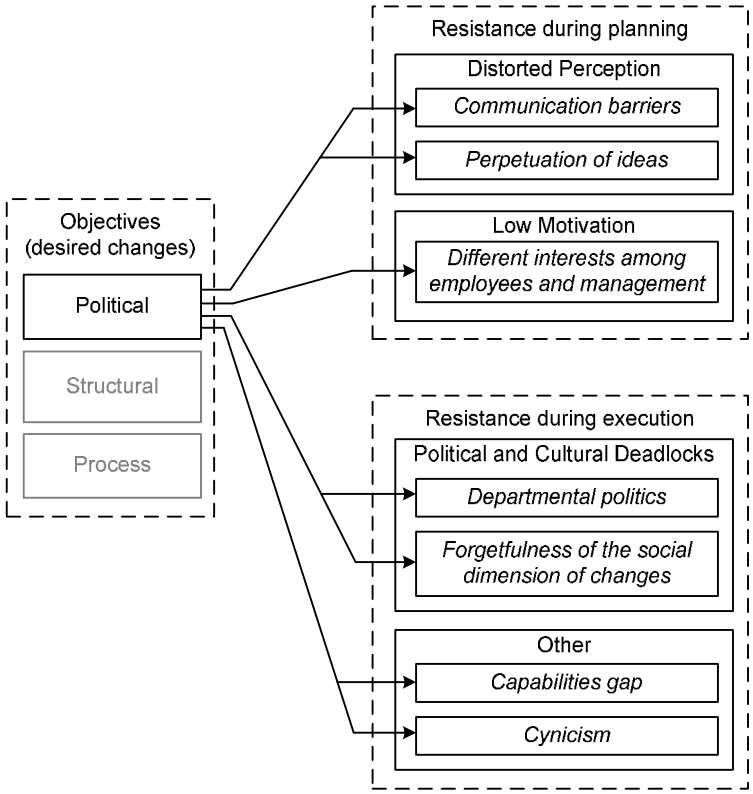


Figure 5.17 Resistance Influenced by Political Change

Communication barriers can be divided in to two categories; misunderstood EA concepts and internal communication problems. EA seems to be understood being equal to its possible output, such as a data warehouse (DW). Thus the view of EA is very limited. Also internal communication problems seem to be quite common, both in general and related to EA. First of all, there might be internal challenges in communication related to the management structure. For instance management board's decisions might not be systemically communicated to the organisation's mid-managers and vice versa. Secondly, goals and purpose of EA adoption may have not been clearly communicated to all stakeholders.

Perpetuation of ideas is related to the organisation's traditional view of IT and Information Management (IM). Possibilities and limitations of modern IM is not known by the staff and management.

Different interests among employees and management are related to what is seen important during the change. For instance during reorganising and redistribution of power, "tools" such as process descriptions are not necessarily seen as important by the staff and middle management.

During the execution phase, *Political change* is influencing two types resistance; *Political and cultural deadlocks* and *Other.* Political and cultural deadlocks are caused by *Departmental politics* and *Forgetfulness of social dimension of changes*. Other resistance is caused by *Capabilities gap* and *Cynicism*.

Departmental politics are rising in cases where power is decentralised and given to department leaders. For instance if reorganisation is not executed by the management also inside departments, it may result to different organisation models and unclear responsibilities among departments.

Forgetfulness of the social dimension of changes seems to be emphasised in HEIs. Moving resources away from someone and giving them to someone else is seen very sensitive internal matter.

Capabilities gap refers to the lack of skills to unify processes, for instance during the merging. This may result in a situation, where differences in processes prevents organisation to function effectively.

Cynicism refers to doubts in EA adoption. Change where power would be distributed in a way that would result to business led IT development is not seen very convincing.

Table 5.20 Resistance Influenced by Political Changes

#	*Resistance*	*Codes*
R1.1.5	Communication barriers	EA concepts not understood Internal communication
R1.1.3	Perpetuation of ideas	Staff's lack of knowledge about IT
R1.2.5	Different interests among employees and management	Process descriptions were not seen important
R2.1.2	Departmental politics	Inter departmental decision model
R2.1.5	Forgetfulness of the social dimension of changes	Moving people around is sensitive
R2.2.4	Capabilities gap	Merging
R2.2.5	Cynicism	Has doubts

5.6.6. Resistance Influenced by Structural change

As seen in Figure 5.18, *Structural change* is influencing two types of resistance; *Distorted perception* during the planning, and *Political and cultural deadlocks* during the execution. Distorted perception is caused by *Communication barriers*. Political and cultural deadlocks

on the other hand are caused by *Implementation climate and relation between change values and organisational values*.

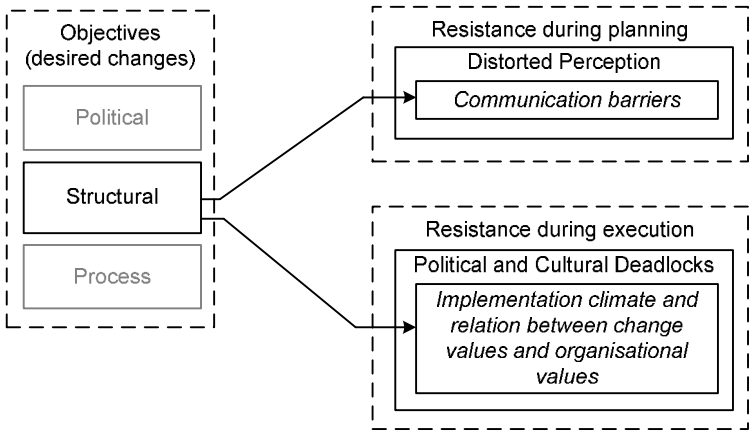


Figure 5.18 Resistance Influenced by Structural Change

Communication barriers refer to difficulties in explaining the role and possibilities of IT and IM to people who do not understand them. The IT department is seen in traditional way and as such slowing things down. This perception is seen difficult to change.

Implementation climate and relation between change values and organisational values refers to a situation where structural change is conflicting with current organisational values. For instance when changing the organisational structure from a functional (hierarchical) organisation to a matrix organisation, learning a new way to do work may be difficult and slow. Difficulties and slowness is caused more by people's attitudes than the actual learning required.

Table 5.21 Resistance Influenced by Structural Changes

#	*Resistance*	*Codes*
R1.1.5	Communication barriers	Message formulation
R2.1.1	Implementation climate and relation between change values and organisational values	Challenges to learn new things

5.6.7. Resistance Influenced by Process change

As seen in Figure 5.19, *Process change* is, interestingly, influencing resistance only during the planning phase. Two types of resistance are *Distorted perception* and *Lack of creative response*. Distorted perception is caused by *Communication barriers* and lack of creative response by *Inadequate strategic vision*, and *Fast and complex environmental change*.

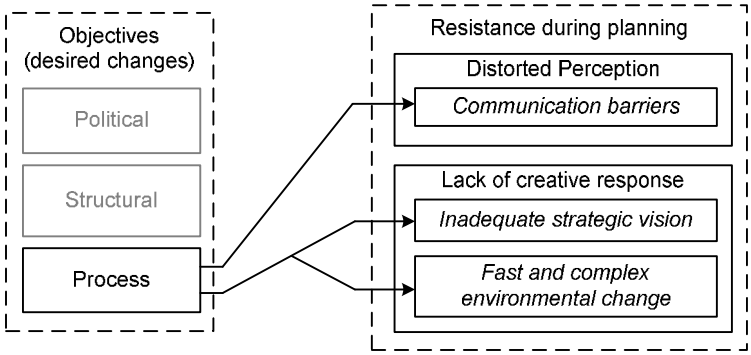


Figure 5.19 Resistance Influenced by Process Change

In the same way as in the resistance influenced by political change, communication barriers can be divided to two categories; misunderstood EA concepts and internal communication problems. First of all, HEIs' staff and management might not be familiar with EA concept at all. This may be one of the key questions when EA is trying to be "sold" and communicated to business. Moreover, as in resistance influenced by political change, EA is seen equal to its possible outputs, such as an automatic Quality Management System to be used for reporting. Secondly, internal communication is challenging, especially when related to EA adoption. Communication of EA adoption is assigned to a project manager, even when the adoption is initiated by management. This may lead to a situation where top management, board, or staff do not know the goals or purpose of EA adoption.

Inadequate strategic vision refers to a situation where EA adoption is not connected to HEI's strategy. First of all, EA can be seen barely as a tool without a strategic connection *per se*. Secondly, goals for the EA adoption may be purely operative, having no connection to HEI's strategy.

Fast and complex environmental change refers to a situation where the environment is changing so fast that there is no time to conduct proper planning. Also there might not be enough information about the change consequences.

Table 5.22 Resistance Influenced by Process Change

#	*Resistance*	*Codes*
R1.1.5	Communication barriers	EA concepts not understood Internal communication
R1.3.3	Inadequate strategic vision	EA not related to strategy No strategic connections
R1.3.1	Fast and complex environmental change	Change performed without proper knowledge

5.7. Comparison With Recent Advancements on EA Adoption Research

In a recent PhD thesis by Seppänen (2014) critical problems and success factor of EA adoption are researched. Research context of the thesis is mainly Finnish public sector organisations (n=17), but also two private companies were include. Some of the organisations studied are same as those used in this thesis. Therefore, next the findings are presented and their relations to this thesis are discussed.

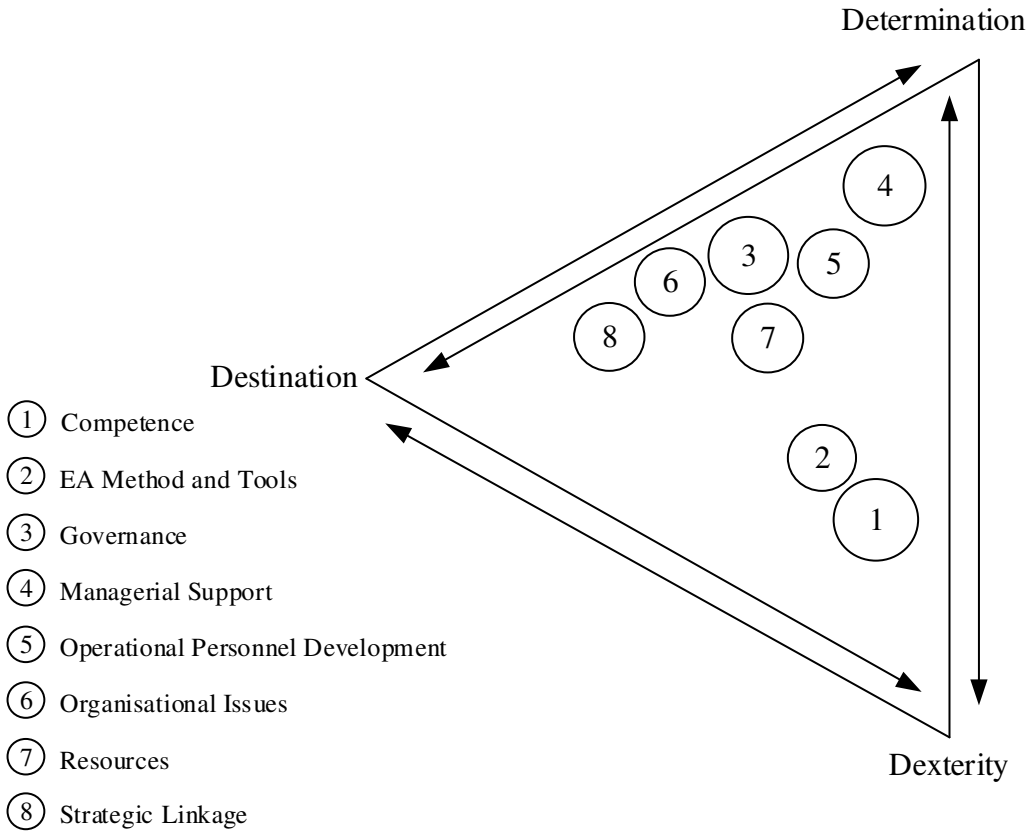


Figure 5.20 EA Adoption Problems 3D Model (Seppänen, 2014)

In the aforementioned study, a Grounded Theory (GT) method was used to form a 3D model of EA adoption problems as illustrated in Figure 5.20. 3D refers to the three core categories; *Determination, Destination,* and *Dexterity*. Determination refers to organisation's dedication to EA adoption, destination to the purpose or focus of EA adoption, and dexterity to the capability to quickly adapt when needed (Seppänen, 2014). Position of axial problem categories illustrated as circles in Figure 5.20 refers to the strength of their relations to core categories. The size of the circle refers to the relatively weight of its importance.

Table 5.23 EA Adoption Problems (adapted from Seppänen, 2014)

Category	*#*	*Problem*
Competence	1B	Lack of understanding purpose and goals of EA
	1E	Lack of practical EA skills
	3E	Lack of EA related communication
	4A	Difficulties to transforms goals to practical tasks
	5D	Lack of skills related to EA modelling
EA Methods and Tools	1C	EA has an image problem due to technical representation
	1D	EA is lost among other organisational development methodologies
	5A	EA methods are inflexible and not fully suited to modelling organisation's architecture
	5B	EA method and modelling are focusing too much to IS and IT
	5C	EA deliverables do not produce benefits for the organisation
	6A	EA benefits are difficult to measure
Governance	2D	Appointing accountable for EA is problematic
	4B	Delegation of EA related decision-making is difficult
	4C	EA cannot have true influence due to a narrow mandate
	4D	EA governance is difficult to integrate with existing practices
Managerial Support	1A	Organisation is reluctant to follow the new ways of working
	2A	Managers are not adequately engaging to EA development
	2D	Appointing accountable for EA is problematic
	4B	Delegation of EA related decision-making is difficult
	4C	EA cannot have true influence due to a narrow mandate
	5E	Information needed for defining the target state is difficult to obtain
Operational Personnel Development	2B	Employees cannot participate to EA due to lack of time
	2C	Employees are unwilling to participate to EA development
Organisational Issues	1A	Organisation is reluctant to follow the new ways of working
	1D	EA is lost among other organisational development methodologies
	2D	Appointing accountable for EA is problematic
	3B	The entire organisation cannot commit to the goals set for EA
	3E	Lack of EA related communication
	4B	Delegation of EA related decision-making is difficult
	4D	EA governance is difficult to integrate with existing practices
	5E	Information needed for defining the target state is difficult to obtain
	6D	Organisation has problems in developing operations in long-term manner
Resources	2B	Employees cannot participate to EA due to lack of time
	3C	The goals set for EA are too ambitious
	6B	Continues struggle to justify expenses of EA
	6C	EA is developed in a short-term projects
Strategic Linkage	2E	EA projects are primarily staffed with IT department
	3A	Goals of EA are difficult to understand and poorly reasoned
	3D	Goals of EA do not solve real problems and can't yield real benefits
	4A	Difficulties to transforms goals to practical tasks
	4B	Delegation of EA related decision-making is difficult
	4C	EA cannot have true influence due to a narrow mandate
	5E	Information needed for defining the target state is difficult to obtain
	6A	EA benefits are difficult to measure

It should be noted that the categories are actually typologies, as the problem can be included in multiple categories. For instance the problem 3E (Lack of EA related communication) is included in *Competence* and *Organisational Issues* categories. Comparison of these problems to the findings of this thesis can be seen in Table 5.24. As it can be noted, there are five sources of resistance which are found in both studies, five which are found only by this research, and five which are only found by Seppänen. Thus it may be argued that findings by Seppänen partially supports the findings of this thesis. Moreover, the findings of Seppänen increases the validity of REAP, as the new sources of resistance were identified. It should also be noted that there are seven problems which cannot be categorised using REAP (marked with * in Table 5.24). These problems are mostly related to EA methods and tools, and thus are by nature out scope of REAP. Differences between findings can be explained by the different empirical data and the used coding method.

Table 5.24 Comparison of Results to EA Adoption Problems by Seppänen (2014)

Resistance observed by; ◆ this research, ◇ Seppänen, ◈ both

	R1.1.1	R1.1.2	R1.1.3	R1.1.4	R1.1.5	R1.1.6	R1.2.1	R1.2.2	R1.2.3	R1.2.4	R1.2.5	R1.3.1	R1.3.2	R1.3.3	R2.1.1	R2.1.2	R2.1.4	R2.1.5	R2.2.1	R2.2.1	R2.2.2	R2.2.3	R2.2.4	R2.2.5
			◆		◈	◇	◇		◇		◈	◆		◈	◆	◈		◆	◇	◇			◈	◆
1A											x													
1B					x																			
1C					x																			
1D*																								
2A																			x					
2B*																								
2C											x													
2D														x					x					
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6A*																								
6B							x																	
6C*																								

5.8. Summary of Chapter 5

In this chapter, the model of resistance in EA adoption process (REAP) was formed and validated. First various concepts related to EA adoption were defined, followed by building the actual REAP model based on the literature. REAP model suggests that the strategic level EA has an effect on the desired objectives set to the EA adoption. These changes, in turn, are causing resistance during the planning and execution phases of EA adoption. The resistance is affecting EA adoption by influencing the realisation of objectives set to the adoption and thus affecting the adoption outcomes.

The REAP model was validated by analysing empirical data collected from a real life EA pilot. As a result from the analysis, various organisational changes and sources of resistance were identified.

The findings were compared to the findings of a recent PhD thesis which was conducted partially in the same context than this thesis. Comparison revealed that the findings of this research were supported by the findings of the other thesis.

Chapter 6 EA Adoption Method (EAAM)

6.1. Introduction

In this chapter, the *Enterprise Architecture Adoption Method* (EAAM) is introduced, and its building process and evaluation described. EAAM is formed using Design Science (DS) approach to overcome problems found by REAP model while analysing empirical data from the real-life EA pilot. Pilot was conducted among 12 Higher Education Institutions (HEIs) in Finland. The chapter structure follows the DSRM Process Model (see Figure 4.4.).

The fundamental idea behind the model is that it provides solutions to overcome the Enterprise Architecture adoption resistance introduced in the previous chapter. This is achieved by providing Grounded Technological Rules (GTRs) to minimise resistance during Enterprise Architecture adoption. As the aim of the thesis is to improve the traditional EA adoption process, GTRs are transformed to process descriptions, resulting to the EAAM method.

First the problem definition and objectives for the EAAM are presented. Next the building process of the EAAM is described, followed by its evaluation. Finally an example on how to use EAAM is given.

6.2. Problem Definition and Objectives of EAAM

With the REAP model presented in Chapter 5 a number of sources of resistance were revealed (see Figure 5.13). In order to increase the likelihood of successful EA adoption, resistance during the planning and execution of the adoption needs to be minimised. Mapping of these phases with the traditional EA adoption process can be seen in Figure 6.1.

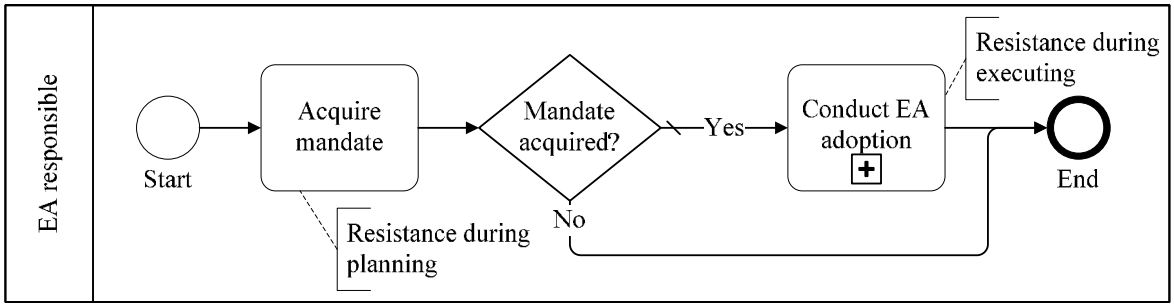


Figure 6.1 Resistance in Traditional EA Adoption Process

The REAP model is a qualitative model, e.g. it captures the resistance emerging from the data, but does not judge any source of resistance being more important than others. If the sources of resistance (see Table 6.1) are studied, it can be noticed that most of the resistance is related to understanding of, or knowledge about, Enterprise Architecture and IT in general. Similarly in the execution phase (see Table 6.2), it can be noticed that some resistance is related to attitudes of staff, and to the lack of skills needed in EA adoption. The legend for resistance column codes can be seen in Table 5.12 on page 116.

Table 6.1 Sources of Resistance in EA Adoption Planning Phase

#	*Resistance*	*Description*
R1.1.5	EA concepts not understood	• Limited view to EA; EA understood as equal to its outputs • HEI's staff not familiar with EA concepts prevents selling it to the business • EA understood as an equal to its outputs
R1.1.5	Internal communication	• Communication challenges caused by the management structure • Goals and purpose of EA adoption not clearly communicated to stakeholders • Assigning the responsibility of EA communication to PM instead of top-management does not guarantee communication
R1.1.5	Message formulation	• Difficulties in explaining IT and its possibilities to laymen
R1.2.5	Process descriptions were not seen important	• Staff and middle management doesn't understand the importance of process descriptions
R1.3.1	Change performed without proper knowledge	• Due to fast environmental changes, change is performed without time to proper planning
R1.3.3	No strategic connections	• EA used or seen barely as a tool
R1.3.3	EA not related to strategy	• EA adoption is purely operative without relation to strategy

#	*Resistance*	*Description*
R1.1.3	Staff's lack of knowledge about IT	• Possibilities and limitations of modern IT/IM is not understood by the staff and management

Table 6.2 Sources of Resistance in EA Adoption Execution Phase

#	*Resistance*	
R2.2.4	Merging	• Lack of skills to unify processes for instance during merging
R2.2.5	Has doubts	• Business led IT development is not seen convincing
R2.1.2	Inter departmental decision model	• Decentralised power and decision model
R2.1.5	Moving people around is sensitive	• Moving people around is seen as very sensitive internal matter
R2.1.1	Challenges to learn new things	• Difficulties in learning how to work with new organisation type caused by staff's attitude

Other studies have also noticed the lack of EA knowledge in the Finnish public sector. For instance Lemmetti and Pekkola (2012) argues that current definitions of EA are inconsistent and thus confusing both researchers and practitioners. According to their findings, "EA was not thoroughly understood by the public sector authorities." (Lemmetti and Pekkola, 2012, p. 170). This is supported by Hiekkanen *et al.* (2013); EA is underutilised due to lack of understanding it properly. In general, poor communication have been found to be one of the factors contributing to EA adoption failures (Mezzanotte *et al.*, 2010). Moreover, value of EA is directly influenced by how EA is understood in the organisation (Nassiff, 2012).

Based on the findings of the REAP model and other research conducted on EA adoption, it can be argued that the lack of understanding of EA concepts is a major source of resistance during EA adoption. As such, it is important to minimise this resistance. Therefore, the problem definition for EAAM is as follows:

> *How to minimise the resistance in the EA adoption process caused by the lack of understanding of EA concepts?*

Design Science is an approach which aims to finding alternative solutions for a class of problems (van Aken, 2004). A class can be defined as "a set or category of things having

some property or attribute in common and differentiated from others by kind, type, or quality" (Oxford Dictionaries, 2010).

The objective of the EAAM is to *improve the traditional EA adoption process to minimise the resistance during EA adoption caused by the lack of understanding of EA concepts*. Thus the output of the research is an artefact, EAAM.

6.3. Design and Development of the EAAM

6.3.1. Introduction

The problem identification and objectives for the artefact are presented in previous sections. In this section, the actual development of the artefact is described.

Generally speaking, surpassing communication problems and avoiding resistance caused by communication barriers can be achieved by a proper training (Pardo del Val and Martinez Fuentes, 2003). During organisational change, besides learning, there is a need for unlearning current behaviour (Becker and Karayan, 2005). Especially during the EA adoption, organisation is moving from business silos towards standardised operations and the need for learning is strong (Ross *et al.*, 2006). It has also been found that the stronger radical and transformational the change is, the stronger resistance it faces (Pardo del Val and Martinez Fuentes, 2003).

In the following sub-sections from 6.3.2 to 6.3.5 different aspects affecting organisational change and learning are introduced and discussed. In the sub-section 6.3.6, these are summarised in the form of propositions and a conceptual model explaining their relations. Finally the conceptual model is transferred to GTRs and to a more usable process descriptions, EAAM.

6.3.2. Readiness for Change

In this sub-section, concepts related to readiness for change are introduced and discussed.

Besides organisation culture (Burnes and James, 1995), also readiness for change has an impact on successful change (Jones *et al.*, 2005). Holt *et al.* (2007) have developed a scale for measuring readiness for organisational change on individual level. The scale is based on to the relationship between the change content, process, context, and individual attributes with readiness (see Figure 6.2). The model "does provide a conceptual

framework to guide the development of a comprehensive readiness measure, suggesting that a general set of beliefs shape readiness and provide the foundation for resistance or adoptive behaviors" (Holt *et al.*, 2007, p. 235).

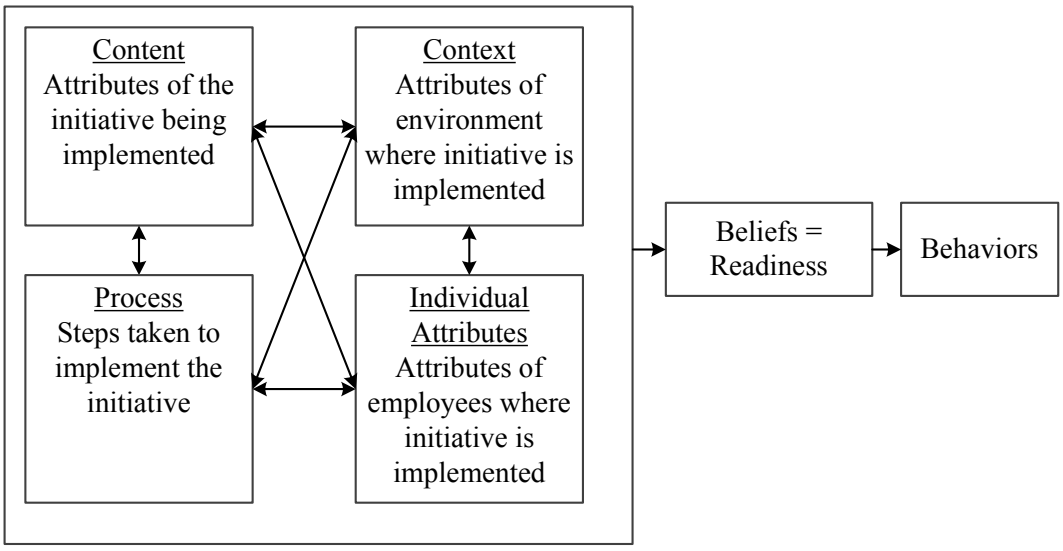


Figure 6.2 The Relationship Between Content, Process, Context, and Individual Attributes With Readiness (Holt *et al.*, 2007)

The most influential factors are (i) *discrepancy* (the belief that a change was necessary), (ii) *efficacy* (the belief that the change could be implemented), (iii) *organisational valence* (the belief that the change would be organizationally beneficial), (iv) *management support* (the belief that the organizational leaders were committed to the change), and (v) *personal valence* (the belief that the change would be personally beneficial). (Holt *et al.*, 2007).

The model by Holt *et al.* (2007) implies that the content, context, and process of EA adoption together with individual attributes affects the readiness for EA adoption. More specifically, individuals should believe that EA adoption is necessary, possible, beneficial to organisation, and supported by top-management. They should also feel that EA adoption would be beneficial to themselves.

It has been found that the managers who understand the change efforts are more likely to be less resistant to the change (Washington and Hacker, 2005). This implies that managers should also understand what EA adoption really means.

Elving (2005) has formed a conceptual model of role of communication in organisational change (see Figure 6.3). According to the model, effective change is showed as a low level of resistance or high level of readiness. Communication, either to inform the reasons for

change or to creating a community to increase commitment, have a positive effect to the readiness for change. On the other hand, uncertainty has a negative effect to readiness for change, but this can be influenced by communication.

The model by Elving (2005) suggests that readiness for EA adoption can be increased by communication, either directly or by decreasing uncertainty.

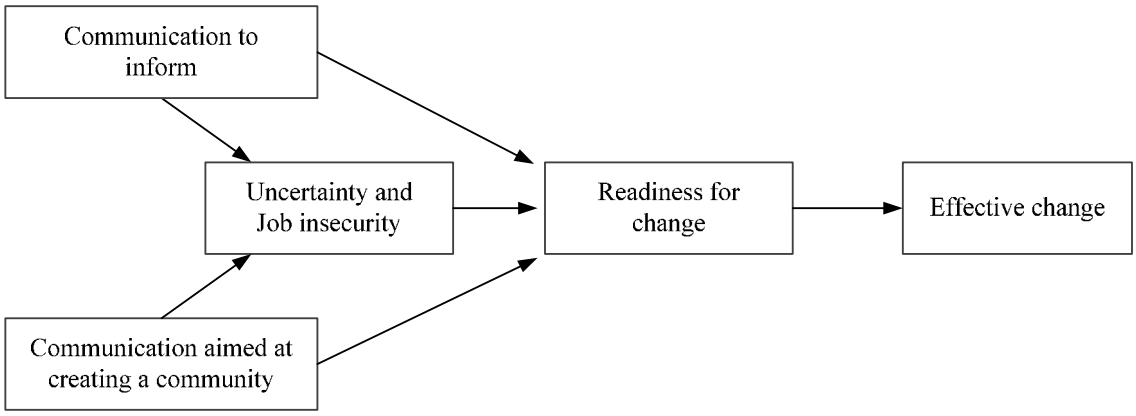


Figure 6.3 Conceptual Model of Communication During Organisational Change (Elving, 2005)

In the sub-section 2.3.3, EA was studied as an information communication technology. General acceptance models suggests that individual acceptance of information technology (IT) is influenced by beliefs and attitudes, which in turn is influenced by *Managerial interventions* and *Individual differences* (see Figure 6.4). As it can be seen, there are notable similarities with the factors seen in Figure 6.2, such as *Situational influences* vs. *Context* and *Individual differences* vs. *Individual Attributes*.

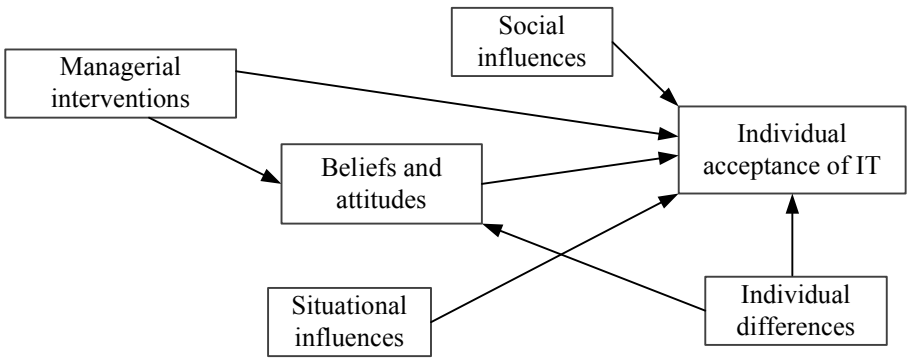


Figure 6.4 The Phenomenom of Individual Acceptance of IT (Agarwal, 2000)

Conceptually individual acceptance can be regarded to be close to the readiness for change. Both are influenced by beliefs and attitudes. These beliefs can be influenced by managerial intervention, e.g. communication. Therefore, in order to increase the likelihood of EA

adoption success, the readiness for change needs to be increased by a proper communication by managers.

6.3.3. Individual and Organisational Learning

Learning can be defined as a transformation where "the initial state in the learner's mind is transformed to the new state which is different from the initial state if learning has occurred." (Koponen, 2009, p. 14, italics removed). *State of mind* consists of following cognitive beliefs; *beliefs (knowledge), values,* and *know-how*. Skills are included in know-how. If learning occurs, the state of mind is transferred to a new state of mind with different cognitive beliefs. Learning can occur through acts in reality or by learner's own thinking. The former learning mode means learning by perceptions, by having new experiences, or by acquiring information. (Koponen, 2009).

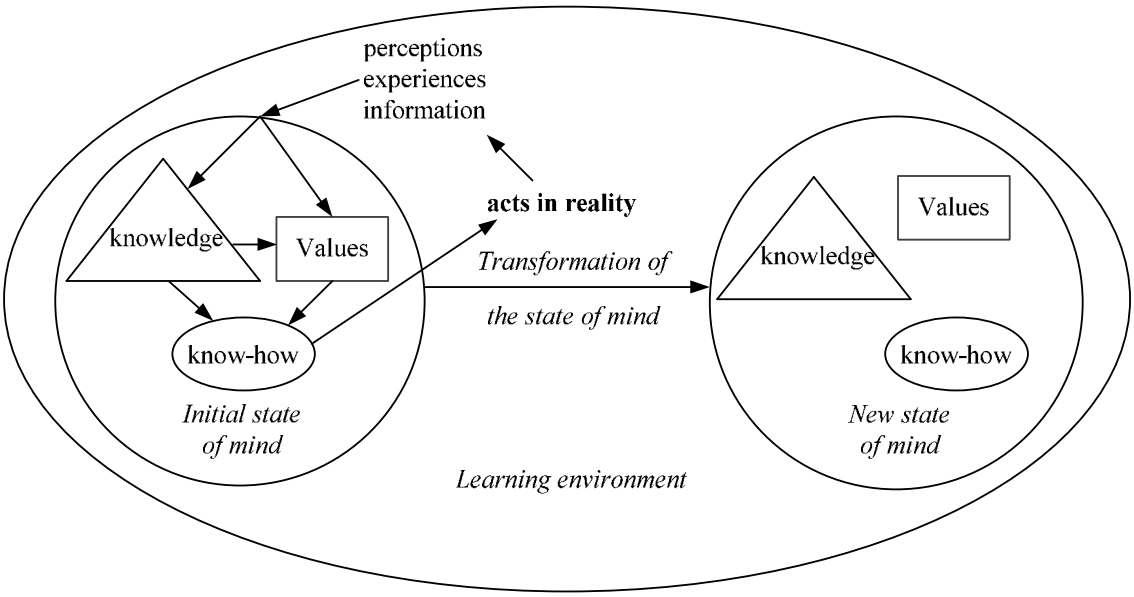


Figure 6.5 Learning (adapted from Koponen, 2009)

The current position of IS research is rooted in methodological individualism, which sees organisations as collection of individuals (Lee, 2010). This theoretical point of view is problematic, as it suggests that if the new people are coming in to the organisation, a new organisation would emerge (Lee, 2004). Therefore, according to Lee (2004), the better conceptualisation would be that the organisation stays (somewhat) the same, and the people moving in would change towards the organisation's culture.

Organisational learning can be explained using *4I framework* by Crossan *et al.* (1999) (see Figure 6.6), where learning occurs on individual, group, and organisational levels. These

levels are linked by four processes; *intuiting, interpreting, integrating,* and *institutionalising*.

> "*Intuiting* is a subconscious process that occurs at the level of the individual. It is the start of learning and must happen in a single mind. *Interpreting* then picks up on the conscious elements of this individual learning and shares it at the group level. *Integrating* follows to change collective understanding at the group level and bridges to the level of the whole organization. Finally, *institutionalising* incorporates that learning across the organization by imbedding it in its systems, structures, routines, and practices" (Mintzberg *et al.*, 1998, p. 212).

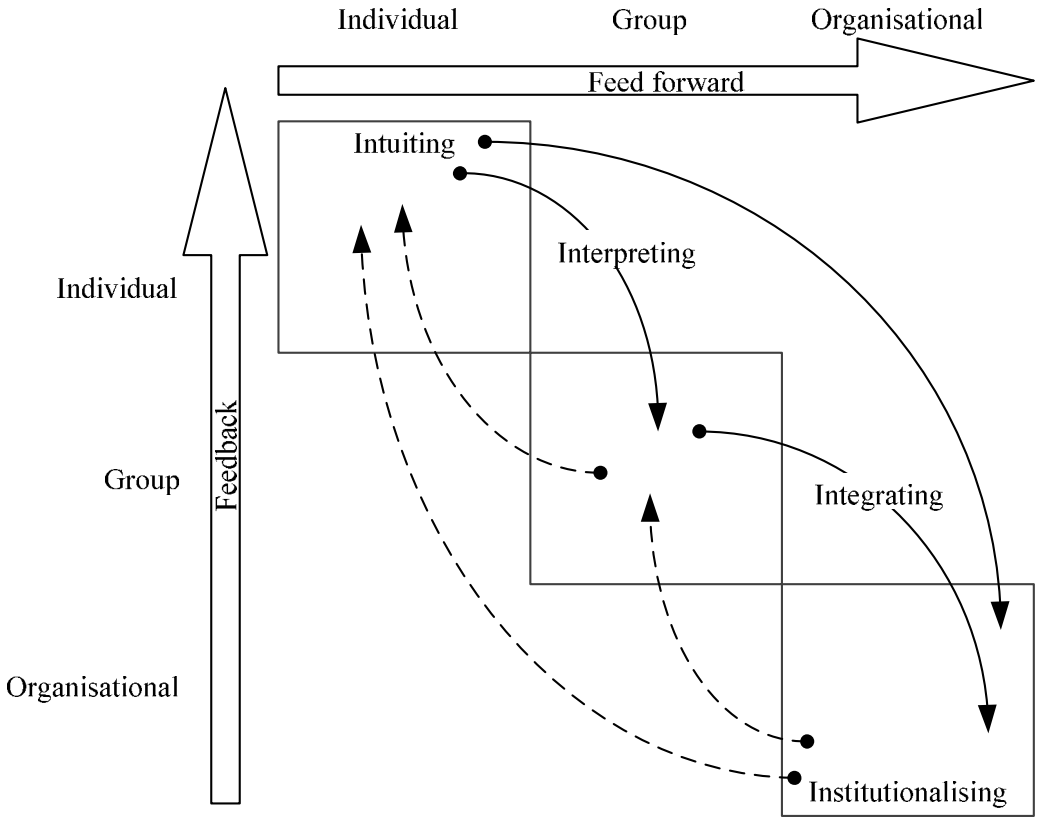


Figure 6.6 Organisational Learning as a Dynamic Process (Crossan *et al.*, 1999)

Individual learning is in a crucial part on the organisational learning, as organisations are "after all, a collection of people and what the organisation does is done by people" (March and Simon, 1958). Also, "change is not just about how people act, but it is also about how they think as well." (Kitchen and Daly, 2002, p. 49). It can said that organisational learning has occurred, when EA concepts are understood on individual level, and processes and methods adopted and embedded to organisation's routines.

Individual and organisational learning has direct implications to EA adoption. Organisational level learning occurs only through individuals. Similarly, individuals learn from the organisation. However, organisation is not the only source of learning for

individuals. Learning may occur whenever the individual is interacting with the reality (i.e. communicating, perceiving, observing) but also by barely thinking (Koponen, 2009). Therefore, in order to adopt EA in an organisation, individuals of the organisation needs to learn EA adoption.

6.3.4. Effects of EA Training and Understanding EA Benefits

Hazen *et al.* (2014) studied the causes behind the gap between EA adoption and usage. That is, what is the reason why EA is not used to a degree which realises its most benefits, such as a greater level of organisational alignment, improved decision-making, and improved performance. The study is based on the Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh *et al*. (2003), which can be seen in Figure 2.16. The study is especially interested in which *performance expectancy* drives organisational acceptance of EA. Performance expectancy is defined as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance" (Venkatesh *et al.*, 2003, p. 447). According to findings, partial mediation model (see Figure 6.7) explains the EA use significantly more than full or no mediation models. Even though their study is conducted in a post-adoption setting of EA, results are likely applicable in the adoption phase too, although this is not empirically tested.

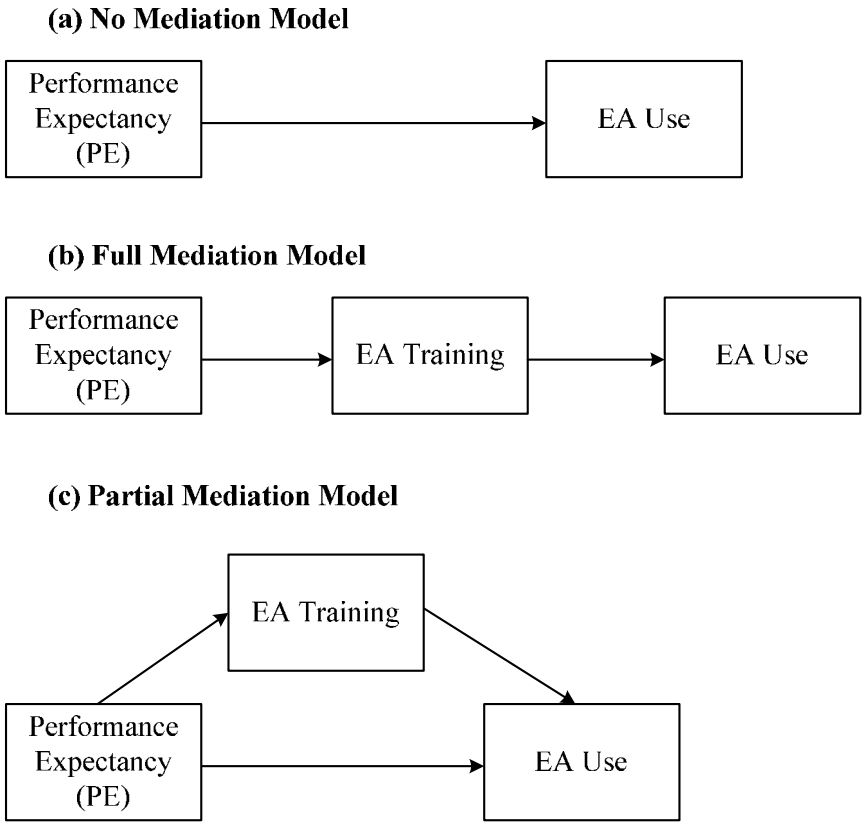


Figure 6.7 Mediation Models (Hazen *et al.*, 2014)

The partial mediation model implies that in order to increase EA adoption (and its success), individuals' performance expectancy of EA needs to be increased and proper EA training provided.

In his doctoral dissertation, Nassiff (2012) studied why EA is not more widely adopted, by analysing how organisation's executives value EA. According to his findings, EA has four meanings among executives; *Business and IT alignment*, *a holistic representation of the enterprise*, *a planned vision of the enterprise*, and *a process, methodology, or framework enhancing enterprise decision making*. Also 16 unique benefits of EA were identified. Based on these, a theoretical model describing how the value of EA is determined was formed (see Figure 6.8). Value of EA is directly influenced by how the EA is understood in the organisation. Regardless of the meaning of EA, three common benefits were expected; *alignment between business and IT*, *make better decisions*, and *the simplification of system or architecture management*.

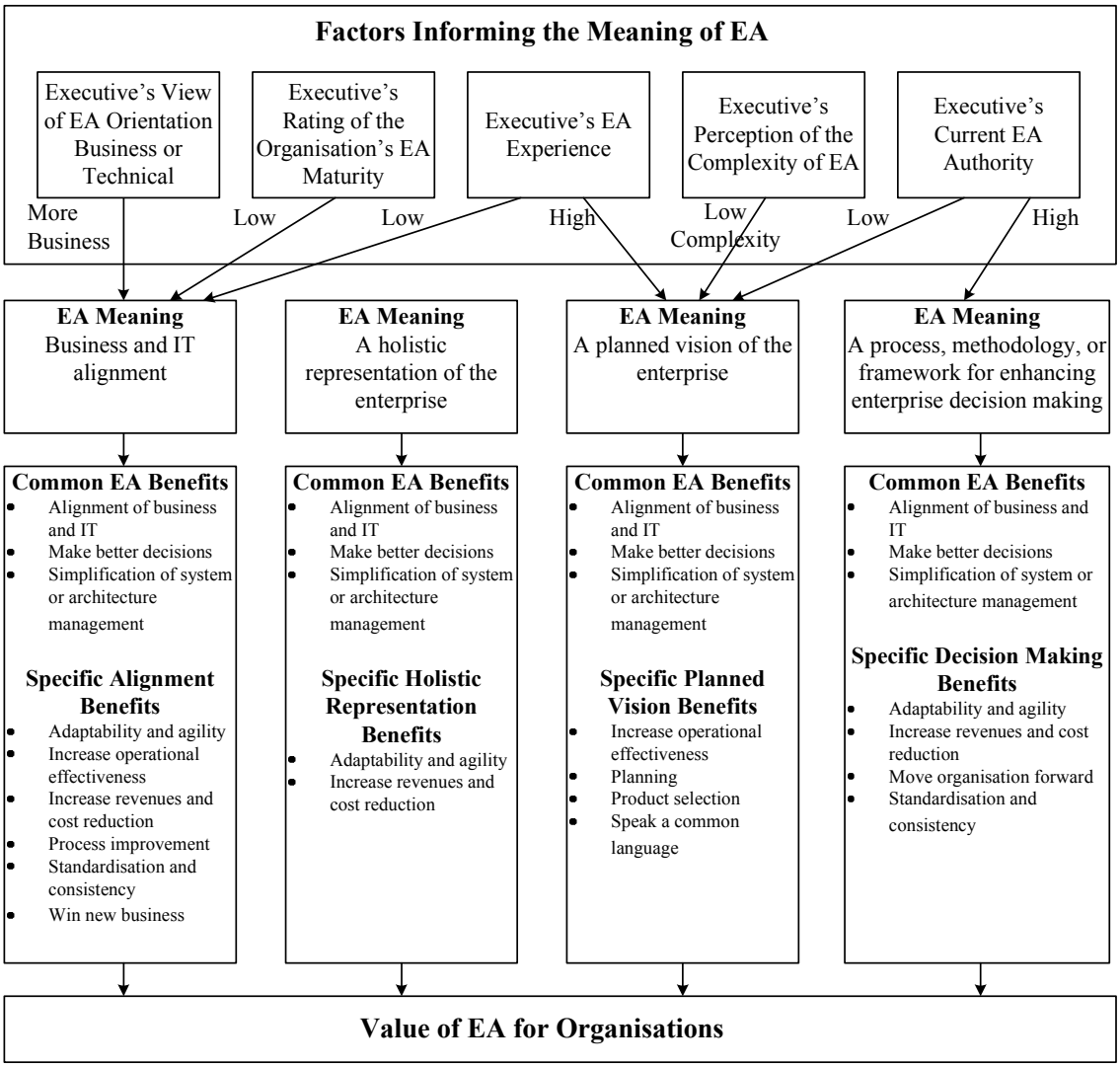


Figure 6.8 Theoretical Model Informing the Value of EA for Organisations (adapted from Nassiff, 2012)

The model implies that in order to increase the individual's performance expectancy of EA adoption, EA benefits needs to be communicated according to what EA means to the individual. This implication actually means also adopting *andragogy* instead of *pedagogy* as an assumption of learning; individual learning is depending on and occurring on top of the past experiences of the individual (Knowles, 1970). These past experiences and existing "knowledge" can have a negative effect to learning EA adoption, as individuals "have a strong tendency to reject ideas that fail to fit our preconceptions" (Mezirow, 1997, p. 5). Therefore, the model helps us to understand the importance of the current meaning of EA to individuals.

In his PhD thesis, Oderinde (2011) studied EA adoption in four UK Higher Education Institution, the JISC pilot (see JISC, 2009) to be more specific. EA benefits to HEIs found during the research (see Table 6.3) are in line with the benefits seen in Figure 6.8. This

implies that those benefits can be used to strengthen the performance expectancy also in HEIs.

Table 6.3 Summary of EA benefits to Higher Education Institutions (Oderinde, 2011)

Value target	*Value*
HEI	• Ability to make better-informed decisions • Better visualisation of institutional capability including IT resources • Better focus and optimisation for critical business functions/operations
HEI's IT	• Improved responsiveness to business requirements • Better visibility across processes & systems • Ability to maximise some level of control over IT solutions & decisions
HE Sector	• Improved compliance to regulations and data requirements • Improvements in the overall IT capability of institutions

6.3.5. Role of Managerial Intervention and Leadership Style in EA Adoption

In a longitudinal research about factors influencing EA institutionalisation within the U.S. federal government, the adoption process has been studied for nine years (Makiya, 2012). The research studies a time period from 1999 to 2007 where EA is adopted gradually, starting from adoption (as defined in this thesis) ending to assimilating EA as an integral part of organisation. Conceptually this is an instance of *organisational learning* seen in Figure 6.6. The research was divided in to three three-year phases. During the first phase, when the adoption took place, factors like parochialisms and cultural resistance, organisation complexity, and organisation scope had a significant influence. According to the findings, parochialisms and cultural resistance did not exist in phase two, likely due to coercive pressure by organisation. This can be interpreted so that by using force mandated by organisational position, one can greatly influence EA adoption. This is conceptually similar to *managerial intervention*, but also to *situational* and *social influence*, seen in Figure 6.4. It should be noted that this approach had no effect in the phase three, so it should be utilised only during the adoption phase. Moreover, as a result, it suggested that one should use innovative leadership style as it is a key in advancing EA adoption. For instance labelling EA as an administrative innovation instead of a strategic tool could help in value perception and adoption of EA.

Vera and Crossan (2004) has expanded the model of organisational learning by Crossan *et al.* (1999) seen in Figure 6.6. They added the concept of *learning stocks*. Learning stocks exists in each level of organisational learning, namely individual, group, and organisation levels. These learning stocks contains the inputs and outputs of learning processes, taking place between layers. They argue that different leadership styles (transactional or transformational) needs to be used based on which type of organisational learning (feed-forward or feedback) needs to be promoted.

There are some behavioural differences between transactional (Table 6.4) and transformational (Table 6.5) leadership styles. These styles are not exclusive but should be used accordingly based on the situation (Vera and Crossan, 2004). Transactional leadership is based on "transactions" between the manager and employees (Bass, 1990). They are performing their managerial tasks by rewards and by either actively or passively handling any exceptions to agreed employee actions. Transformational leadership style aims to elevating the interests of employees by generating awareness and acceptance of the purpose of the group or initiative (Bass, 1990). This is achieved by utilising charisma, through inspiring, intellectual stimulation, and by giving personal attention to employees.

Table 6.4 Characteristics of Transactional Leaders (Bass, 1990)

Characteristics	*Explanation*
Contingent Reward	Contracts exchange of rewards for effort, promises rewards for good performance, recognises accomplishments.
Management by Exception (active)	Watches and searches for deviation from rules and standards, corrective action.
Management by Exception (passive)	Intervenes only if standards are not met
Laissez-Faire	Abdicates responsibilities, avoids making decisions.

Based on the characteristics of transactional and transformational leadership styles, it can be argued that, generally speaking, transactional leadership style suits better in a situation where *status quo* should be maintained. On the other hand, transformational leadership style works better in a situation where organisation faces changes.

Table 6.5 Characteristics of Transformational Leaders (Bass, 1990)

Characteristics	*Explanation*
Charisma	Provides vision and sense of mission, instils pride, gains respect and trust.
Inspiration	Communicates high expectations, uses symbols to focus efforts, and expresses important purposes in simple ways.

Characteristics	*Explanation*
Intellectual Stimulation	Promotes intelligence, rationality, and careful problem solving.
Individualised Consideration	Gives personal attention, treats each employee individually, coaches, advises.

The feed-forward learning allows organisation to innovate and renew, whereas the feedback process reinforces what has already learned. There can be two types learning; learning that reinforces institutionalised learning and learning that challenges institutionalised learning. Transformational leadership have a positive impact to learning when current institutionalised learning is challenged, and when organisation is in a turbulent situation. In turn, transactional leadership have positive impact to learning when the institutionalised learning is reinforced, and when organisation is in a steady phase. There some differences also how the learning stocks are aligned. Transformational leadership foster an open culture, an organic structure, flexible procedures and prospector-like strategy. Transactional leadership foster a closed culture, mechanistic structure, rigid systems and procedures, and a defender-like strategy. (Vera and Crossan, 2004).

The role of managerial or leadership style to organisational and individual learning is significant. The key is the current organisational learning stock, or institutionalised learning, regarding to EA adoption. If EA adoption conflicts with the current institutionalised learning, the transformational leadership should be used in order increase the feed-forward learning. Vice versa, if EA adoption does not conflict with the current institutionalised learning, the transactional leadership should be used to increase feedback learning.

Espinosa *et al.* (2011) have studied the coordination of EA, focusing on increasing understanding how coordination and best practices lead to EA success. According to their model (see Figure 6.9), cognitive coordination plays a critical role in effectiveness of architecting. Their model consists of two models, static and dynamic models. Whereas the static model affects the effectiveness on "daily basis", a dynamic model strengthens group cognition over the time. There are three coordination processes in the model: *organic*, *mechanistic*, and *cognitive*. Mechanistic coordination refers to coordination of the routine aspects with minimal communication by using processes, routines, specification, etc. Organic coordination refers to communication processes used in more uncertain and less routine tasks. Cognitive coordination is achieved implicitly when each collaborator have knowledge about each other's tasks, helping them to anticipate and thus coordinate with a

reduced but more effective communication. As it can be noted, the term "cognitive" is not referring to term cognition, which is usually defined as a "mental action or process of acquiring knowledge and understanding through thought, experience, and the senses" (Oxford Dictionaries, 2010). Instead, they are referring to the *shared cognition* of a high performance group of individuals having similar or compatible knowledge, which can coordinate its actions without the need for communication (Cannon-Bowers and Salas, 2001).

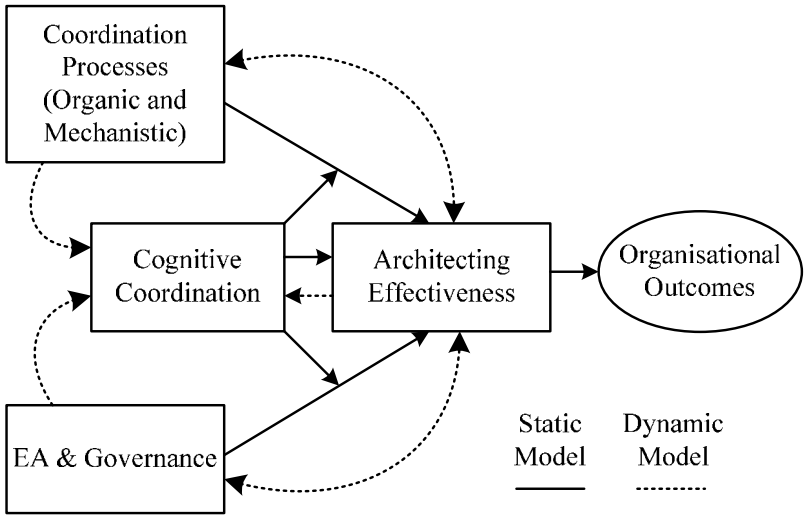


Figure 6.9 Effective EA Governance Model (Espinosa *et al.*, 2011)

According to the findings by Espinosa *et al.* (2011), cognitive coordination plays a central role in effective architecting, but also strengthens the other two coordination mechanisms. They also found that once EA and EA governance are adopted, they will become a part of normal governance mechanisms, and thus have a positive effect on architecting effectiveness. Therefore, in order increase the effectiveness of EA adoption, the shared cognition of individuals within the organisation needs to be strengthened. This can be achieved by providing similar level of EA knowledge to all individuals.

6.3.6. Emerging EA Adoption Method

In this sub-section, the concepts presented in previous sub-sections (Table 6.6) are first summed up, and the list of propositions based on these concepts and their interrelations (Table 6.7) is formed. Based on these proposition, six Grounded Technological Rules (GTRs) are presented, and finally EAAM process descriptions are introduced.

The concepts presented in Table 6.6 are derived from the concepts and theories introduced in previous sub-sections. The table follows a *Concept Matrix* introduced by Webster and Watson (2002) which allows moving the focus from author-centric to concept-centric analysis. Similar concepts are grouped together and the originating theory or research is presented. Next the concepts are synthesised and their interrelations are presented and discussed. Based on these interrelations, nine propositions regarding to EA adoption method are formed. The referring proposition (P1 to P9) is included in parenthesis.

Table 6.6 Concepts of EA Adoption Method

Concept	*Source*
EA Benefits	EA Benefits (Nassiff, 2012)
Performance Expectancy (PE)	Personal Valence (Holt *et al.*, 2007) Organisational Valence (Holt *et al.*, 2007) Performance Expectancy (Hazen *et al.*, 2014) Goals of EA adoption (Syynimaa, 2013a)
Individual's Learning Stock	Beliefs (Holt *et al.*, 2007) Readiness for Change (Elving, 2005) Uncertainty (Elving, 2005) Beliefs and Attitudes (Agarwal, 2000) Individual Differences (Agarwal, 2000) Learning (Koponen, 2009) Value of EA (Nassiff, 2012) Individual Learning Stock (Vera and Crossan, 2004) Leadership Style (Bass, 1990) Cognitive Coordination (Espinosa *et al.*, 2011) EA Training (Hazen *et al.*, 2014)
Organisation's Learning Stock	Social Influences (Agarwal, 2000) Organisational Learning (Crossan *et al.*, 1999) Organisation's Learning Stock (Vera and Crossan, 2004) Coordination Processes (Espinosa *et al.*, 2011) EA Governance (Espinosa *et al.*, 2011)
Managerial Intervention	Discrepancy (Holt *et al.*, 2007) Communication (Elving, 2005) Managerial Interventions (Agarwal, 2000) Changing Leadership Style (Vera and Crossan, 2004)
EA Adoption	Behaviours (Holt *et al.*, 2007) Effective Change (Elving, 2005) Individual Acceptance of IT (Agarwal, 2000) EA Use (Hazen *et al.*, 2014) Architecting Effectiveness (Espinosa *et al.*, 2011)

EA Benefits refers to all those benefits that may result of adopting Enterprise Architecture. These benefits influences *Performance Expectancy (PE)*, which refers to individual's expectations towards EA adoption (P1). *Individual's Learning Stock* refers to all

individual's current knowledge, know-how, values, and processes related on changing these (i.e. learning). *Performance Expectancy* influences *Individual's Learning Stock* (P3) by giving some meaning to EA's performance properties. *Performance Expectancy* also has a direct influence to *EA Adoption* (P5). *Individual's Learning Stock* influences *EA Adoption* (P7), as it contains all individual's knowledge, know-how, and values related to Enterprise Architecture. Managers' and executives' *Individual Learning Stock* influences *EA Benefits* (P2) in terms of his or hers capability to comprehend possible benefits related to EA adoption. Similarly, managers' and executives' *Individual Learning Stock* influences how they are capable in using *Managerial Intervention* to increase EA adoption success (P8). *Organisation's Learning Stock* refers to the current organisation's institutionalised knowledge (i.e. patents), know-how (i.e. processes, instructions, rules), and values (i.e. culture). Feed-forward and feedback learning occurs between *Organisation's Learning Stock* and *Individual's Learning Stock* (P4). As organisations are composed of its members, changes in *Organisation's Learning Stock* (i.e. organisational learning) may only occur through *Individual's Learning Stock*. *Organisation's Learning Stock* however is only one of many sources that influences *Individual's Learning Stock*. *Managerial Intervention* refers to those actions which organisation's managers and executives may use to increase the success of EA adoption. *Managerial Intervention* has a direct influence on *EA Adoption* (P9), as managers and executives may provide coercive pressure to "force" EA adoption. *Managerial Intervention* influences also organisational learning (P6) taking place between *Individual's* and *Organisation's Learning Stocks* where managers and executives may promote learning by choosing their leadership style accordingly.

Table 6.7 Propositions of EA Adoption Method

#	*Proposition*	*Source*
P1	Understanding EA Benefits influences Performance Expectancy	Nassiff (2012)
P2	Executive's understanding of EA meaning influences benefits	Nassiff (2012)
P3	Performance Expectancy influences EA training	Hazen *et al.* (2014)
P4	Individual's and organisation's learning stocks influences each other	Crossan *et al.* (1999)
P5	Performance Expectancy influences EA adoption	Hazen *et al.* (2014)
P6	Managerial Intervention influences feed-forward and feedback learning	Crossan *et al.* (1999)

#	*Proposition*	*Source*
P7	Individual's learning stock influences EA Adoption	Agarwal (2000) Elving (2005) Espinosa *et al.* (2011) Hazen *et al.* (2014) Holt *et al.* (2007)
P8	Executives Individual Attributes influences leadership style	Bass (1990) Crossan *et al.* (1999)
P9	Managerial Invention influences EA Adoption	Agarwal (2000) Makiya (2012)

A graphical illustration of the concepts and propositions related to EA adoption can be seen in Figure 6.10. The numbers refers to propositions introduced above.

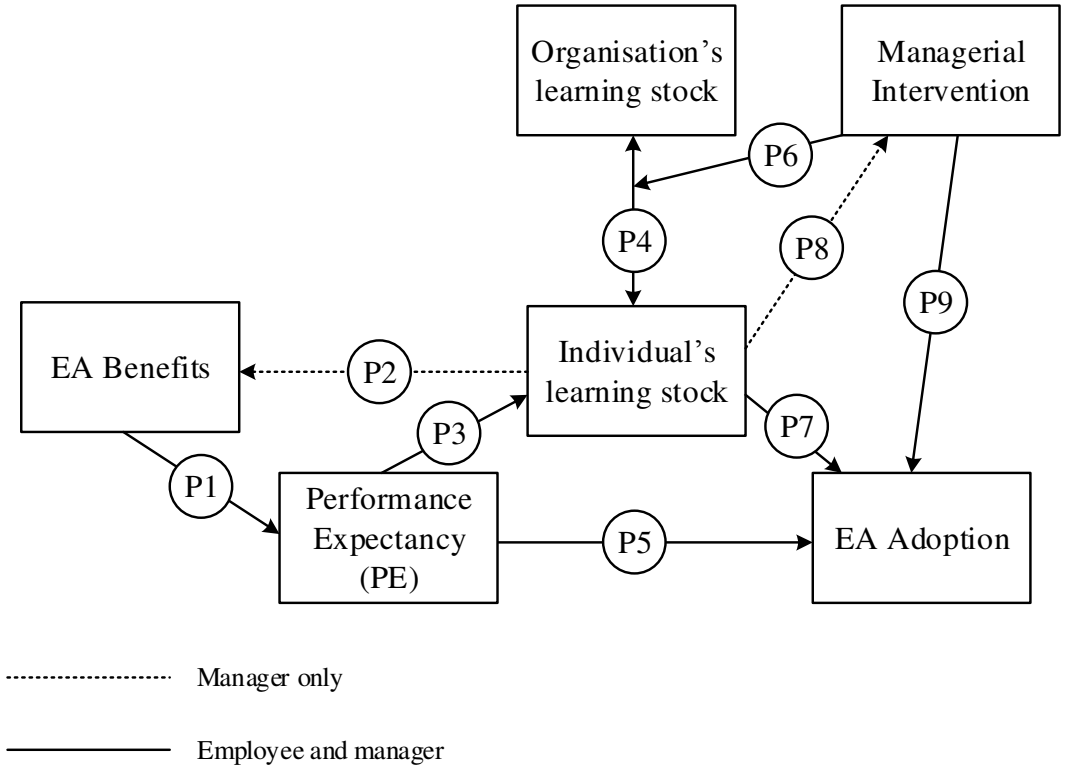


Figure 6.10 Conceptual EA Adoption Model

Based on the conceptual model, following six GTRs are provided. The format of GTRs are adopted from Pries-Heje and Baskerville (2010). As suggested by propositions P1, P2, P3, P4, P5, and P7, understanding EA benefits influences the EA adoption indirectly through performance expectancy and individual's learning stock. In order to acquire the mandate for EA adoption from the top-management, GTRs from Box 6.1 to Box 6.4 are provided. The propositions from which the GTR are derived are included in parenthesis.

If you want to acquire a mandate for Enterprise Architecture adoption from top-management, explain *Common EA Benefits* (P1, P3, P5, P7).

Box 6.1 EA Adoption Rule #1

If you want to acquire a mandate for Enterprise Architecture adoption from top-management in a situation where manager's
- view to EA is more business oriented,
- rating of the organisation's EA maturity is low, or
- EA experience is low, explain *Alignment Specific Benefits* (P1, P2, P3, P4, P5, P7).

Box 6.2 EA Adoption Rule #2

If you want to acquire a mandate for Enterprise Architecture adoption from top-management in a situation where manager's
- EA experience is high,
- perception of EA complexity is low, or
- current EA authority is low, explain *Planned Vision Specific Benefits* (P1, P2, P3, P4, P5, P7).

Box 6.3 EA Adoption Rule #3

If you want to acquire a mandate for Enterprise Architecture adoption from top-management in a situation where manager's
- current EA authority is high, explain *Decision Making Specific Benefits* (P1, P2, P3, P4, P5, P7).

Box 6.4 EA Adoption Rule #4

As suggested by propositions P6 and P9, managerial intervention influences EA adoption directly, but also indirectly by influencing organisational learning. GTRs for these are provided in Box 6.6 and Box 6.5, respectively.

If you want to improve organisational learning during EA adoption in a situation where
- EA challenges the current organisational learning, use *Transformational Leadership Style*. Otherwise use *Transactional Leadership Style* (P6).

Box 6.5 EA Adoption Rule #5

If you want to improve EA adoption, use *Coercive Organisational Pressure* (P9).

Box 6.6 EA Adoption Rule #6

Based on the conceptual model presented in Figure 6.10, and the GTRs provided above, three process descriptions are formed using BPMN 2.0 notation. First description, *process of EA adoption*, can be seen in Figure 6.11. The process has one actor, *EA responsible*, which represents a person responsible for EA adoption. This person can be for instance a project manager, a development manager, EA champion, or CIO. The process consists of four tasks; *Explain EA benefits*, *Acquire Mandate, Organise EA learning*, and *Conduct EA adoption*. The collapsed sub-process of *Organise EA learning* is expanded in Figure 6.12 and Figure 6.13, and *Conduct EA adoption* in Figure 6.14 and Figure 6.15. When compared to the traditional EA adoption process seen in Figure 2.17, two additional tasks are added.

The logic of the process is as follows. A mandate from top management of the organisation is a requirement for successful EA adoption. In order to increase the likelihood of getting the mandate, one needs to explain the benefits of EA to management. If mandate is given, the next task is to organise EA learning to increase the understanding of EA concepts. After these tasks are completed, the actual EA adoption can be started.

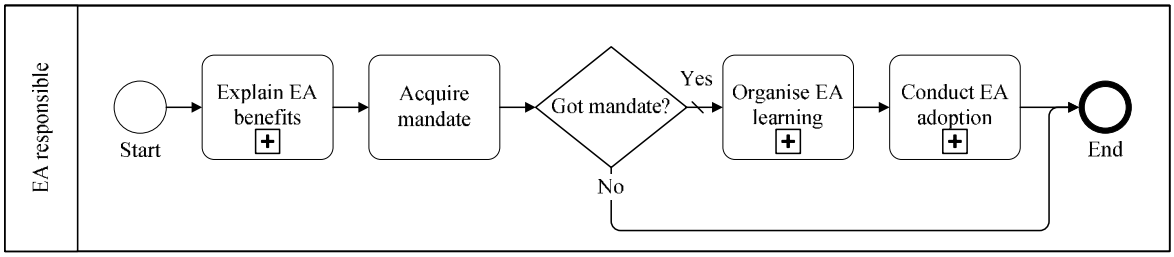


Figure 6.11 Process of EA Adoption

The *process of explaining EA benefits* can be seen in Figure 6.12 and Figure 6.13. This process has two actors, the *EA responsible* and *Manager*. The former actor is the same than in the previous process, whereas the latter on refers to the manager or executive whose support to EA adoption is seen as important.

The first task of the process is to *explain common EA benefits* (see Figure 6.8 on page 145) such as alignment of business and IT. Next task is to *assess manager's views to EA* in terms of EA business orientation, organisation's EA maturity, EA experience, perception of EA's complexity, and current EA authority. Based on the assessments, one should explain the

more specific EA benefits accordingly. For example if the manager's EA experience is low, one should explain the benefits specific to alignment, such as increased operational effectiveness and process improvements.

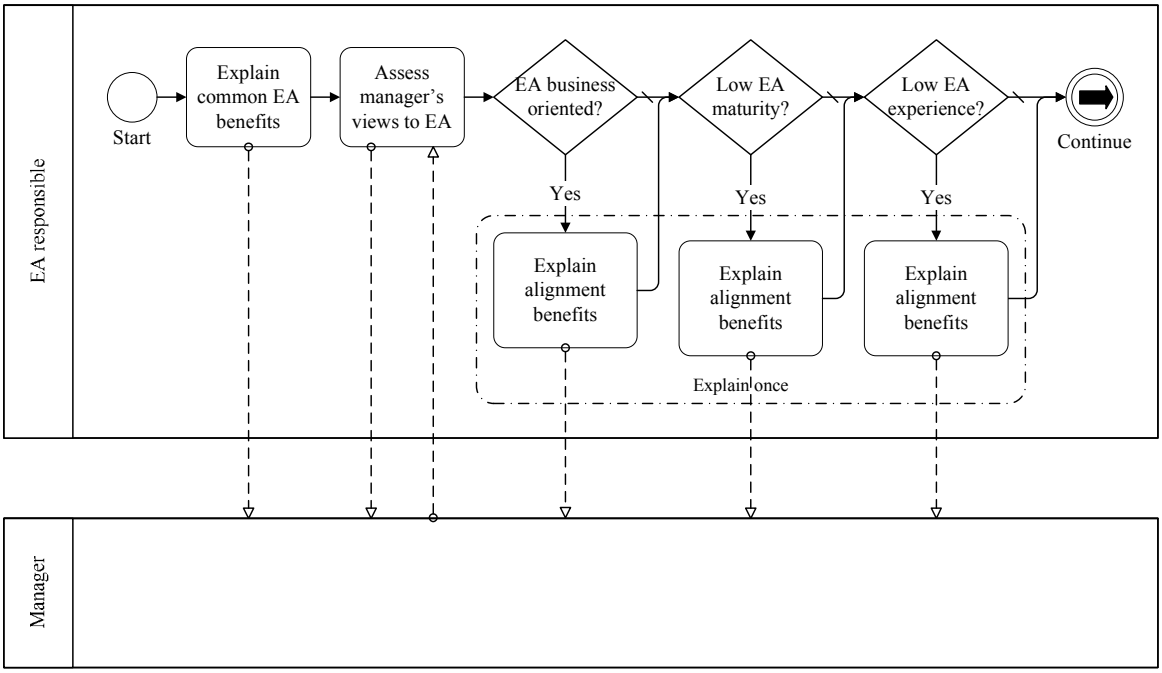


Figure 6.12 Process of Explaining EA Benefits, Part I

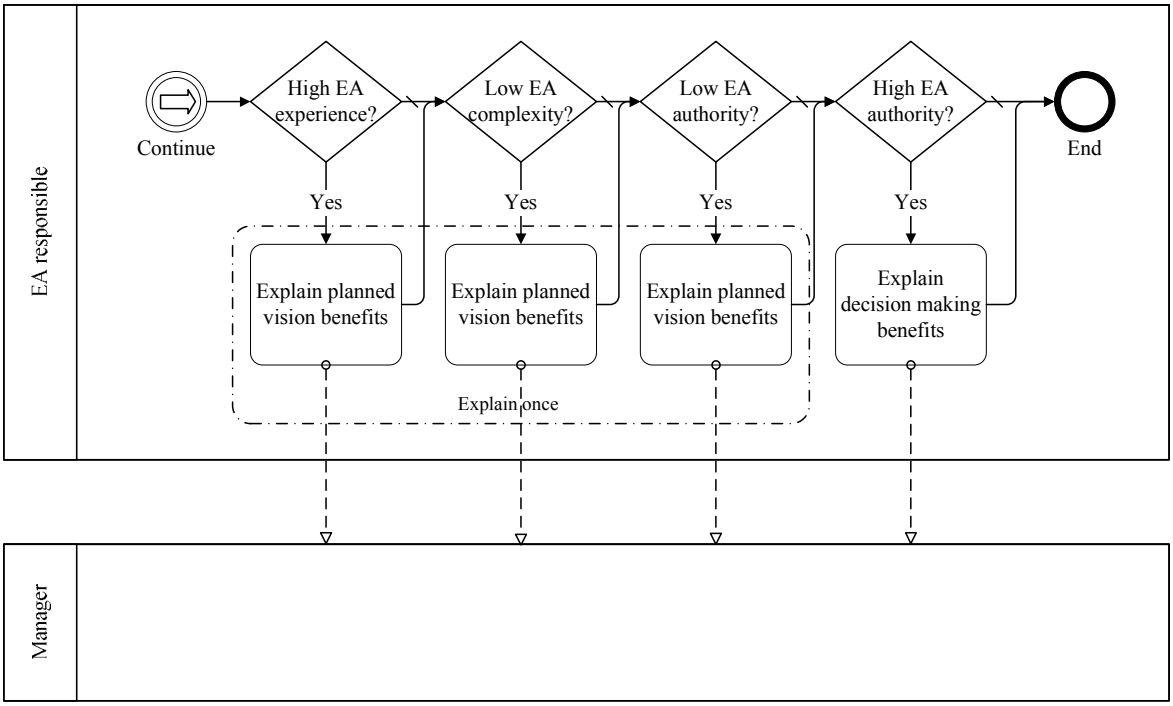


Figure 6.13 Process of Explaining EA Benefits, Part II

The *process of providing EA learning* can be seen in Figure 6.14 and Figure 6.15. This process has also two actors, *EA responsible*, as described earlier, and *Employees*, which

represents organisation's personnel. First task is to *assess organisation's current learning stock*, i.e. what is organisation's current knowledge, know-how, and values related to Enterprise Architecture. As we are in the adoption phase, the level of EA specific knowledge is ought to be low, but one should assess capabilities and practices such as project management, change management, and internal communication. Second task is to *assess employee's learning stock*. Based on these two learning stock assessments, one should choose a proper leadership style. If *EA adoption challenges institutionalised learning*, i.e. it is different than *status quo*, one should choose to *use transformational leadership style*. If the learning does not challenge institutionalised learning, one should choose to *use transactional leadership style*. By using the chosen leadership style, next task is to *promote learning* accordingly. Next task is to *provide EA learning* based on assessments of current learning stocks. The last task is to *use coercive organisational pressure*.

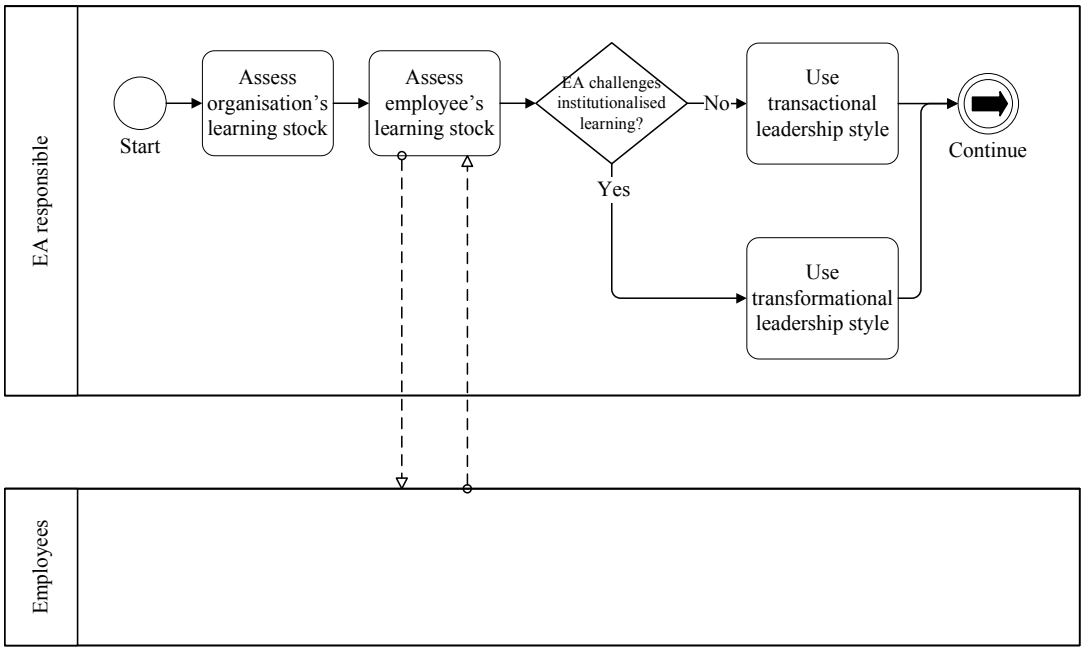


Figure 6.14 Process of Organising EA Learning, Part I

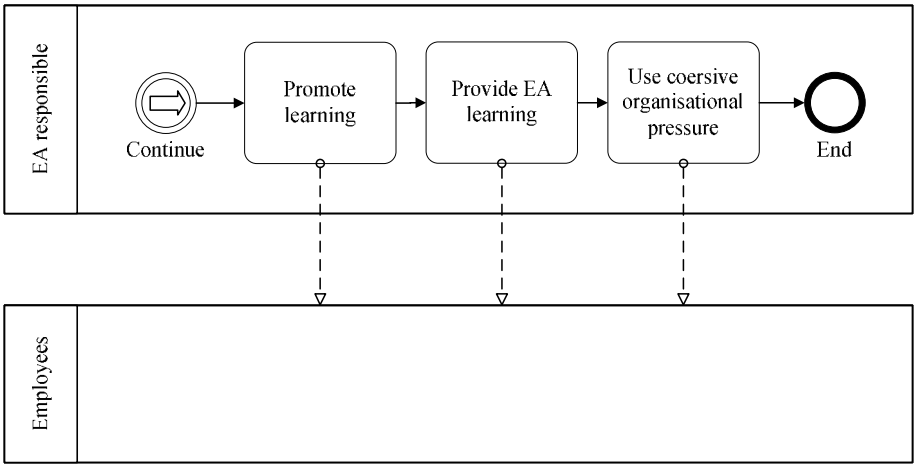


Figure 6.15 Process of Organising EA Learning, Part II

6.3.7. Summary of Design and Development of the EAAM

In this section, the EAAM method was formed to minimise the resistance during the planning and executing EA adoption. This is achieved by introducing two additional sub-processes to the traditional EA implementation method (see Figure 6.16). The first process, *Explain EA benefits*, reduces resistance during the planning phase before acquiring the mandate for EA adoption. The second process, *Organise EA learning*, overlaps planning and execution phases and thus reduces resistance in both.

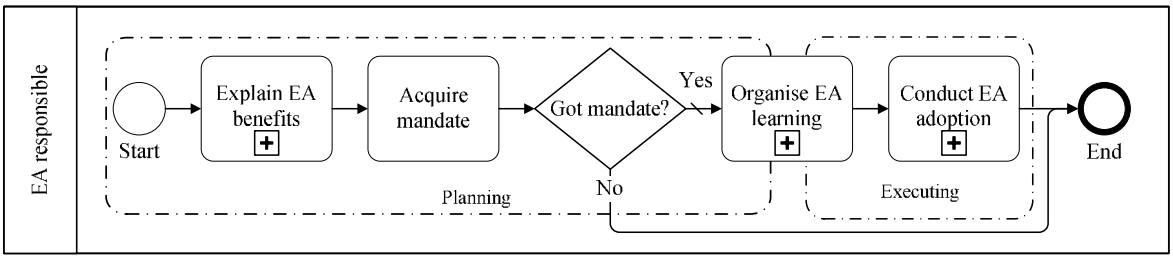


Figure 6.16 Resistance in EAAM

Explaining EA benefits helps management to understand why to adopt EA and thus helps selling it to the business. It also exposes the strategic nature of EA. Organising EA learning increases the mutual understanding of EA and related concepts. The proper leadership style (transactional or transformational) helps to deal with learning challenges. EA adoption resistance reduced by EAAM processes is summarised in Table 6.8.

Table 6.8 Sources of Resistance Reduced by EAAM Processes

#	*Resistance*	*Explain EA benefits*	*Organise EA learning*
R1.1.5	EA concepts not understood	x	x
R1.1.5	Internal communication	x	x

#	*Resistance*	*Explain EA benefits*	*Organise EA learning*
R1.1.5	Message formulation	x	
R1.2.5	Process descriptions were not seen important		x
R1.3.1	Change performed without proper knowledge		
R1.3.3	No strategic connections		x
R1.3.3	EA not related to strategy	x	x
R1.1.3	Staff's lack of knowledge about IT		x
R2.2.4	Merging		x
R2.2.5	Has doubts		x
R2.1.2	Inter departmental decision model		
R2.1.5	Moving people around is sensitive		
R2.1.1	Challenges to learn new things		x

6.4. EAAM Evaluation

6.4.1. Introduction

Purpose of the EAAM evaluation is to assess whether it has the intended effects, or in other words, it works as it is intended.

In this section, the design of the evaluation was first explained, followed by the descriptions of the three evaluation rounds. Finally the analysis of evaluation is provided followed by the summary of this section.

6.4.2. Evaluation Design

The evaluation design follows the guidelines by Venable *et al.* (2012) described in sub-section 4.3. Target of the evaluation is the design product, EAAM, and the evaluation takes place *ex post*.

The audience of the EAAM is mainly EA responsible, i.e. EA champions, project managers, and Enterprise Architects. Audience is heterogeneous in terms of how to utilise EAAM. By its nature, EAAM is socio-technical, having organisational and, in the long run, strategic consequences. Rigour is important when concerning the effectiveness in the real life working situation. However, evaluating EAAM in a real life EA adoption during the

course of a PhD research is practically impossible. When these requirements and facts are mapped to the evaluation strategy selection framework (see Figure 4.7 in page 79), it can be found that the naturalistic *ex post* strategy is the one to be chosen.

From the evaluation methods (see Figure 4.8 in page 80), *Action Research*, *Participant Observation*, *Ethnography*, and *Phenomenology* are against budgetary and time constraints of this PhD research. Thus the *Case Study*, *Focus Group*, and *Survey* are the only applicable evaluation methods.

Delphi method (see sub-section 4.3.3) can be seen as a combination of Focus Group and Survey, where the group of experts are evaluating and judging the subject matter. Data is collected with the research techniques used in surveys, such as questionnaires. Due to time and budgetary constraints, the Delphi method was selected as an evaluation method. For the panel of experts, eleven top Finnish EA experts was carefully selected from both industry and academia (see Table 6.9)[7].

Table 6.9 Members of the Expert Panel

Name	*Title*	*Organisation*
Mika Karjalainen	IT-governance and IT service management consultant	Silver Planet Ltd
Ari Kuusio	CIO	Hämeenlinna UAS
Risto Hyvönen	CIO	Kajaani UAS
Patrik Maltusch	Head of IT-architecture	Aalto University
Jussi Koskivaara	Development Manager	University of Helsinki
Jaakko Riihinen	Senior Vice President, Products and Technologies	QPR
Samuli Pekkola	Professor	Tampere University of Technology
Jukka "Jups" Heikkilä	Professor, Head of Department of Management	University of Turku
Erkki Salminen	Development Director	Gofore Ltd
Juha Siltanen	Senior Service Architect	Gofore Ltd
Jaakko Riihimaa	CIO	Seinäjoki UAS

For the first round of the evaluation, experts are asked to read the method description and to compare it to EA adoption. Traditionally the first round of Delphi method has an open ended question to give their input for the challenge or issue. According to Päivärinta *et al.* (2011), one should ask two more questions in addition; the *reason* which causes the issue

[7] Expert's names are hyperlinked to their LinkedIn profiles

and the *consequence(s)* of the issue. This would force the "panellists to consider their own local theories related to the issues." (Päivärinta *et al.*, 2011, p. 6).

For the second round, issues are aggregated to a list, which are then sent back to panellists. Their task is to state their opinions about claims formed from the first round answers. In the third and final round, the list of claims is sent back to panellists. They are given an opportunity to review their judgement as they can compare their opinions to averages. The evaluation process is illustrated in Figure 6.17.

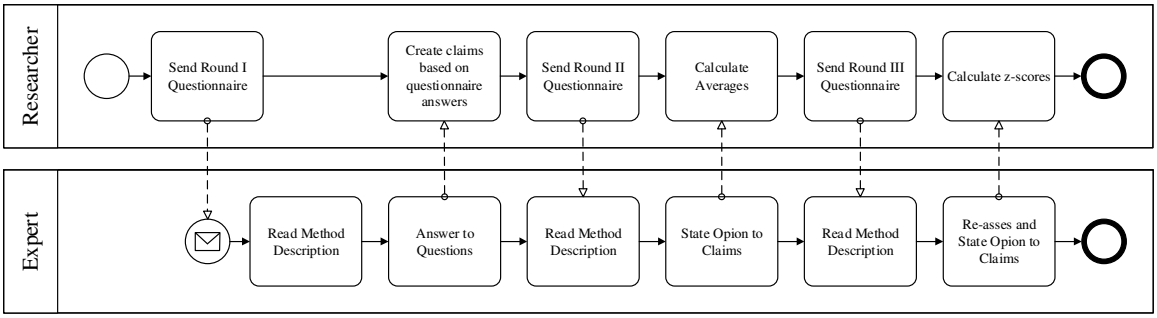


Figure 6.17 EAAM Evaluation Process

The language of the questionnaires and other used materials was Finnish. In this thesis the English translations are used.

6.4.3. Evaluation Round I

In the first round of Delphi evaluation, the expert panel was asked to carefully read the description of the adoption method (see Appendix IX) and to answer to the questionnaire (see Box 6.7). Google Forms was used as a tool to implement the questionnaires.

Expert evaluation of Enterprise Architecture adoption method

Please answer to the following three questions about the cause, target of the effect(s), and consequences of the usage of the method.

You may name as many causes, targets, and consequences you wish. If you name more than one, number the options so that the answers from different questions can be linked to each other.

1. Cause of the effect
Why does the method have the effect?

2. Target of the effect
To what or where does the method has an effect?

3. Consequences of the effect
What consequences the effect of the method has to the target of the effect and to adoption?

Box 6.7 Questionnaire Excerpt – Round I

The evaluation was first piloted with one of the panellists before sending it to all panel members. From the first round, the total number of eight responses were received. Translations of all of the answers can be seen in Appendix X.

6.4.4. Evaluation Round II

For the second round of the evaluation, claims about the adoption method was formed based on the first round answers. From some answers, multiple claims were formed. As an example, the answer A4 seen in Table 6.10 was transformed to the claim ID 4 seen in Table 6.11.

Table 6.10 Evaluation Round I: Answer A4

#	*Cause*	*Target*	*Consequence(s)*
A4	Method recognises the meaning of communicating the benefits to help in the formation of positive endeavour and in acquiring the mandate.	Method affects the central parameters of situational management, which is the organisation's individuals' willingness to change.	Likely shifts the distribution of willingness (to change) so that the mean would be more willing. On the other hand, the deviation may increase as part of the target group is not capable to digest the benefits in any form.

All the claims used in the second round can be seen in Appendix XI. *Src* column refers to the corresponding first round answer in Appendix X.

Table 6.11 Evaluation Round II: Claim C4

#	*Claim*	*Src*
C4	The average of organisation's individuals' willingness to change will change to more positive, because the communication of benefits increases the formation of positive image and the acquirement the mandate from top-management.	A4

In the second round, the expert panel was asked to carefully read the description of the method again and to give their opinions to the presented claims. The purpose was to study whether they agree or disagree with the presented claim. This was conducted using a questionnaire seen in Box 6.8. The scale used in the questionnaire (-3 to +3) was formed so that it can be treated as an *interval scale* as defined by Stevens (1946). There were no labels given for the choices besides the numbers, which helped respondents to avoid confusing it with the *nominal scale*. This allows the calculation of mean and standard deviation.

Expert evaluation of Enterprise Architecture adoption method. Round II.

As a part of the expert panel, your duty on the first round was to evaluate the effects of the presented method to the adoption and results using a selected scenario. In the second round you'll state your opinions to claims formed based on the answers of the first round.

Your duty is to familiarise yourself with the presented claims about the ADOPTION METHOD and to state whether you disagree, agree, or being neutral regarding to each claim. You may also arguments to justify your choices. There are totally 31 claims, which are randomly distributed on six pages. Responding to survey will take approximately 15 minutes.

Instructions:

1. Read carefully the Expert evaluation of Enterprise Architecture adoption method -document
2. Familiarise yourself with each claim and state your opinion

---

Claim 4

Do you disagree (-), agree (+), or are you neutral (0) with the claim.

The average of organisation's individuals' willingness to change will change to more positive, because the communication of benefits increases the formation of positive image and the acquirement the mandate from top-management.

	-3	-2	-1	0	+1	+2	+3
4.	○	○	○	○	○	○	○

Arguments(4)
If you will, you may give arguments of your statement

Box 6.8 Evaluation Questionnaire Excerpt – Round II

Eight responses were received before the deadline. Results of the second round can be seen in Table 6.12. The *ID* column refers to the ID of the claim, and columns from *E1* to *E9* to individual experts. Experts' names are not disclosed to protect their identity. The statistical columns *mean* ($\bar{x}$), *standard deviation* (*s*), *median* (*Med*), and *mode* (*Md*) were calculated using Microsoft Excel 2007 built-in functions. It should be noted that when the number of samples is even, the median is a mean of the two centremost values.

Table 6.12 Evaluation Round II Results

ID	*E1*	*E2*	*E3*	*E4*	*E5*	*E6*	*E7*	*E8*	*E9*	$\bar{x}$	*s*	*Med*	*Md*
1	1	1	2	2	0	3	2	0	-	1.4	1.1	1.5	2
2	2	2	2	3	3	3	1	2	-	2.3	0.7	2	2
3	0	0	0	-1	0	3	0	0	-	0.3	1.2	0	0
4	2	1	1	3	2	1	2	3	-	1.9	0.8	2	2
5	0	2	1	2	0	3	0	2	-	1.3	1.2	1.5	0
6	1	0	2	2	2	0	-1	0	-	0.8	1.2	0.5	0
7	2	1	2	2	-1	2	1	0	-	1.1	1.1	1.5	2
8	-2	-3	0	2	-2	-2	1	-2	-	-1.0	1.8	-2	-2
9	0	2	-1	2	-1	0	1	-1	-	0.3	1.3	0	-1
10	3	2	3	2	2	3	2	2	-	2.4	0.5	2	2
11	3	1	2	3	-1	2	0	-1	-	1.1	1.6	1.5	3
12	2	-1	2	2	-2	2	2	3	-	1.3	1.8	2	2
13	1	3	3	2	1	1	3	2	-	2.0	0.9	2	1
14	1	1	0	3	-3	1	2	3	-	1.0	1.9	1	1
15	3	-2	1	1	0	1	2	0	-	0.8	1.5	1	1
16	1	2	1	3	1	2	2	1	-	1.6	0.7	1.5	1
17	3	2	3	2	3	3	3	3	-	2.8	0.5	3	3
18	0	2	2	2	2	2	3	3	-	2.0	0.9	2	2
19	2	2	0	3	1	2	1	0	-	1.4	1.1	1.5	2
20	2	3	-1	2	-2	2	2	0	-	1.0	1.8	2	2
21	1	2	3	2	3	3	3	2	-	2.4	0.7	2.5	3
22	3	3	2	2	0	1	0	2	-	1.6	1.2	2	2
23	0	2	2	2	2	2	2	1	-	1.6	0.7	2	2
24	0	-2	-1	1	3	2	3	-1	-	0.6	1.9	0.5	-1
25	3	3	1	2	0	1	2	2	-	1.8	1.0	2	2
26	2	2	2	3	1	1	2	0	-	1.6	0.9	2	2
27	0	2	1	3	-3	3	2	2	-	1.3	2.0	2	2
28	1	3	1	3	0	2	2	2	-	1.8	1.0	2	2
29	0	1	1	2	1	1	1	2	-	1.1	0.6	1	1
30	2	1	2	3	3	2	3	-1	-	1.9	1.4	2	2
31	2	-1	3	1	3	1	-1	0	-	1.0	1.6	1	-1

6.4.5. Evaluation Round III

In the third round the expert panel was asked again to carefully read the description of the method and to iterate their opinions to the presented claims. As a difference to the second round, a mean of all answers to each claim were revealed to experts. Also their answers from the II round were preselected. This gave them an opportunity to reassess their opinion

against the average "opinion" of the panel. The questionnaire used in the third round can be seen in Box 6.9.

Expert evaluation of Enterprise Architecture adoption method. Round III.

As a part of the expert panel, your duty on the second round was to familiarise yourself with the presented claims about the adoption method and to state whether you disagree, agree, or being neutral regarding to each claim. You also had a possibility to give arguments to justify your choices. There were totally 31 claims, which were randomly distributed on six pages.

On the third and last round of the evaluation you have a possibility to change your opinion based on the sample mean of all answers. Your second round answers are pre-filled on the form.

Instructions:

1. Read carefully the Expert evaluation of Enterprise Architecture adoption method -document
2. Familiarise yourself with each claim and state your opinion

---

Claim 4

Do you disagree (-), agree (+), or are you neutral (0) with the claim.

The average of organisation's individuals' willingness to change will change to more positive, because the communication of benefits increases the formation of positive image and the acquirement the mandate from top-management.

	-3	-2	-1	0	+1	+2	+3
4. ($\bar{x}$ 1.9)	○	○	○	○	○	●	○

Box 6.9 Evaluation Questionnaire Excerpt – Round III

For the third round evaluation, nine answers were received so one additional expert gave a response. However, one of the experts did not participate to any of the evaluation rounds for unknown reason. In the third round, the standard deviation decreased by 0.20 and mean increased by 0.07 from the second round. This implies that the opinions given on the second round were not significantly altered, although the level of unanimity slightly increased. Results of the third round can be seen in Table 6.13.

Table 6.13 Evaluation Round III Results

ID	*E1*	*E2*	*E3*	*E4*	*E5*	*E6*	*E7*	*E8*	*E9*	$\bar{x}$	*s*	*Med*	*Md*
1	1	1	2	2	2	3	2	0	1	1.56	0.88	2	2
2	2	2	2	3	3	3	2	2	1	2.22	0.67	2	2
3	0	0	0	-1	0	3	0	0	0	0.22	1.09	0	0
4	2	1	2	3	2	2	2	3	1	2.00	0.71	2	2
5	0	2	1	2	1	3	1	2	1	1.44	0.88	1	1
6	1	1	2	2	2	1	-1	0	0	0.89	1.05	1	1
7	2	1	2	2	0	2	1	0	0	1.11	0.93	1	2
8	-2	-3	0	2	-2	0	1	-2	0	-0.67	1.66	0	-2
9	0	-1	-1	2	-1	1	1	-1	-1	-0.11	1.17	-1	-1
10	3	2	3	3	2	3	2	2	2	2.44	0.53	2	2
11	3	1	2	2	-1	2	1	-1	1	1.11	1.36	1	1
12	2	-1	2	2	1	2	1	3	1	1.44	1.13	2	2
13	1	2	3	2	1	1	3	2	0	1.67	1.00	2	1
14	1	1	0	3	-1	1	2	3	1	1.22	1.30	1	1
15	3	-2	1	1	0	1	2	0	0	0.67	1.41	1	1
16	1	2	2	3	1	2	2	1	1	1.67	0.71	2	1
17	3	3	3	2	3	3	3	3	1	2.67	0.71	3	3
18	0	2	2	2	2	2	3	3	1	1.89	0.93	2	2
19	2	2	1	3	1	2	1	0	2	1.56	0.88	2	2
20	2	2	-1	2	1	2	2	1	1	1.33	1.00	2	2
21	2	3	3	2	3	3	3	2	3	2.67	0.50	3	3
22	3	2	2	2	2	1	1	2	1	1.78	0.67	2	2
23	0	2	2	2	2	2	2	1	2	1.67	0.71	2	2
24	0	-2	-1	1	3	2	2	0	1	0.67	1.58	1	0
25	3	2	2	2	0	2	2	2	1	1.78	0.83	2	2
26	2	2	2	3	1	1	2	0	1	1.56	0.88	2	2
27	0	2	1	3	-2	3	2	2	0	1.22	1.64	2	2
28	1	2	1	3	1	2	2	2	2	1.78	0.67	2	2
29	0	1	1	2	1	1	1	2	1	1.11	0.60	1	1
30	2	2	2	3	3	2	3	-1	2	2.00	1.22	2	2
31	2	-1	3	1	3	2	1	1	2	1.56	1.24	2	2

6.4.6. Evaluation Analysis

The purpose of the evaluation is to have a unanimous opinion of the panel of experts about EAAM. Thus the interest lies in the claims having a high mean and low standard deviation. In Table 6.14 claims are ranked based on their z-scores. The z-score is calculated with the formula $z=(x-\mu)/\sigma$ where x is the mean value of the particular claim, μ is 0 (the centre of the scale), and σ is the standard deviation of the particular claim.

Table 6.14 Ranked List of Evaluation Claims

Rank	*ID*	*z*	*Rank*	*ID*	*z*	*Rank*	*ID*	*z*
1.	21	5.33	12.	29	1.85	23.	14	0.94
2.	10	4.64	13.	1	1.76	24.	6	0.84
3.	17	3.77	13.	19	1.76	25.	11	0.81
4.	2	3.33	13.	26	1.76	26.	27	0.74
5.	4	2.83	16.	13	1.67	27.	15	0.47
6.	22	2.67	17.	5	1.64	28.	24	0.42
6.	28	2.67	18.	30	1.63	29.	3	0.20
8.	16	2.36	19.	20	1.33	30.	9	-0.10
8.	23	2.36	20.	12	1.28	31.	8	-0.40
10.	25	2.13	21.	31	1.26			
11.	18	2.04	22.	7	1.20			

The higher the z-score is, the more unanimous are the experts. To include only the most unanimous claims, a critical z-value for 0.95 significance is used as a threshold. The critical value for 0.95 is 1.65 as calculated by Excel 2007 NORMSINV function. Claims with the z-score less than 1.65 are thus rejected, which leaves us 16 statements of EAAM seen in Table 6.15.

Table 6.15 Expert Statements about EAAM

#	*Claim*
C21	Considered and appropriate leadership style helps in adoption because it is all about changing the way to perform development.
C10	Benefits of the adoption and the temporal nature of the resulting extra work is understood better, because the benefits are communicated using the target group's comprehension and point of view.
C17	The meaning of the top-management's own example for the organisation is becoming more aware, because by the commitment of the top-management also the rest of the organisation is obligated to the EA adoption.
C2	IM department's estimates of change targets are improved, because the anticipation of changes are improved and visualised.
C4	The average of organisation's individuals' willingness to change will change to more positive, because the communication of benefits increases the formation of positive image and the acquirement the mandate from top-management.
C22	The reasons for actions will be communicated.
C28	Top-managements support to EA as a continuous part of organisation's normal management and operational development increases, because the recognition of the purpose and justification of EA-work, and communication of benefits, builds the foundation to acquire the mandate of top-management.
C16	The total development of organisational knowledge would be improved in general, because also other actors beside the top-management are taken into account.
C23	The leadership point of view is correct because the communication of EA is shaped according to the target group.

#	*Claim*
C25	Setting the target and objectives of the adoption can be performed faster and in managed manner because the participants has a common picture of concepts, objectives, and methods before the actual execution phase.
C18	The commitment and motivation to the adoption increases, because the understanding of reasons and objectives of EA increases.
C29	Effects to the quality of results and to communicating them are positive, because the meaning of broad-enough knowledge is emphasised.
C1	Documentation of QA system is improved, because method has a positive effect in the creation of basic documentation
C19	Improves commitments and possibilities to acquire the mandate, because the person responsible for adoption is helped to improve targeting and content of the communication, and to considering the appropriate influencing methods and approaches.
C26	Definitions of the roles and tasks are naturally forming according to the target, because the communication using the language of the target group affects the understanding of the benefits of each group.
C13	Securing of top-management's commitment to adoption of EA and similar concepts increases, because the adoption is strongly based on top-management's commitment and communication of the adoption.

As stated in the problem definition, the purpose of the EAAM is to provide improvements to the traditional EA adoption process to minimise the resistance caused by the lack of understanding of EA concepts. For this purpose, EAAM introduced two sub-processes: *Explain EA benefits* and *Organise EA learning*.

Goal of the *Explain EA benefits* process is to increase the likelihood of getting a mandate from top-management for EA adoption. This is achieved by explaining EA benefits based on each manager's characteristics. Experts' statements supports achievement of this goal strongly, as most of the statements are related to this process. This also indicates the importance of securing top-management mandate.

Goal of the *Organise EA learning* process is to increase the understanding of EA concepts. This is achieved by assessing the current learning stock and by providing appropriate training with a help of appropriate leadership style. Experts' statements supports also achievement of this goal.

According to March and Smith (1995, p. 261) "Evaluation of methods considers operationality (the ability to perform the intended task or the ability of humans to effectively use the method if it is not algorithmic), efficiency, generality, and ease of use". The first two criteria, operationality and efficiency is evaluated above; EAAM can be used to perform intended task (e.g. adopt EA in an organisation) and it is efficient. The last two

criteria, generality and ease of use, can be evaluated only by applying EAAM in other settings. As stated earlier, this has been limited out-of-scope of this thesis.

It cannot be argued that EAAM would be the best alternative solution to the traditional EA adoption method. However, as demonstrated in this section, it can be argued that EAAM is better than the traditional EA adoption method.

6.4.7. Summary of EAAM Evaluation

In this section, EAAM was evaluated by using a Delphi method. The panel of top Finnish EA experts, from both industry and academia, were each asked to describe anonymously what effects EAAM has, what is the target of these effects, and what is causing the effect. After this, experts were asked to state whether they agree or disagree with the claims formed on the basis of experts' answers. As a result, 16 statements were rated so that the unanimity of the expert panel can be seen achieved. Experts' statements provides support that EAAM improves the traditional EA adoption process as intended.

6.5. How to use EAAM

In this section, the usage of the EAAM is demonstrated using merger of two fictional Higher Education Institutions as a case study. University of South (US) and University of West (UW) are medium sized universities, each having roughly 5 000 students. Each university has also teaching staff around 200 and other staff 200. In the time of heavy competition, universities have decided to combine their forces in to a new University of South-West.

A team is formed for preparing the merger. The team consists of development managers from both universities, and it is responsible for planning the merger. Universities have some overlapping study programs which should be dealt with. One of the development managers is keen on EA, as he attended NORSA conference in 2010 and saw a presentation about an EA based framework. The framework, called HMEF, is used to evaluate different scenarios of merging HEIs (Figure 6.18).

HMEF is a high level framework consisting of five phases. In phase one, the current *Business Architecture* of both HEIs are described. In phase 2, different scenarios of merged HEI's target Business Architecture are crafted, for instance in terms of target course portfolio. In phase 3, scenarios are evaluated and target Business Architecture of the

merged HEI is selected. In phase 4, the target *Information Architecture*, *Systems Architecture*, and *Technology Architecture* are described. In phase 5, transition steps for merging HEIs are formed. (Syynimaa, 2010a). As a framework, HMEF is similar to any other EA framework in terms of how to utilise EAAM during its adoption. This means that EAAM is followed before the actual usage of HMEF is started.

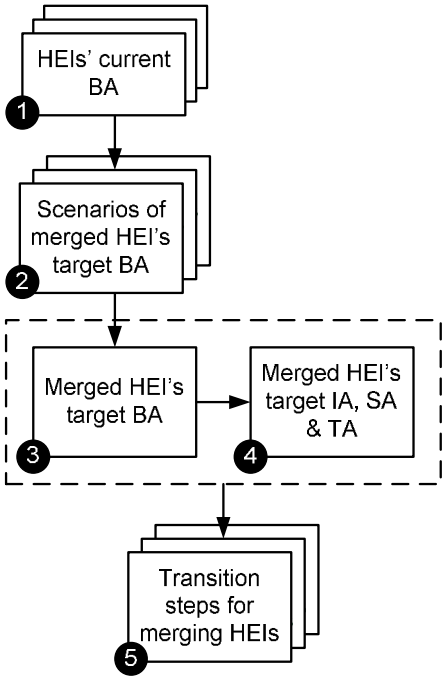


Figure 6.18 HMEF: Framework to Evaluate Merging of HEIs (Syynimaa, 2010a)

The team decides to adopt Enterprise Architecture to support the merging process. One of the development managers, Pete, is appointed to be responsible for the EA. With a new role as EA responsible, Pete is using EAAM as an adoption method.

First task of EAAM is to *explain EA benefits* to top management. Pete prepares a presentation to be given to the board of both universities. As suggested by EAAM, first the general EA benefits should be presented.

During the presentation, Pete points out that with EA, the board is able to *make better decisions*. Another benefit from EA adoption is that it *simplifies the management* of systems, which most likely will be an issue in the merging as the number of information systems would be doubled. He continues by emphasising that by EA, information systems would be *aligned* with the business functions.

Pete knows that managers are not IT savvy and that their experience on EA is low. Thus he decides to continue by explaining *alignment specific benefits*. He starts by telling that

with EA, the merged University of South-West would be more *agile* and could more easily *adapt* to changing environment. Their *operational effectiveness* would increase, as they would be able to teach more students (*increase revenues*) while at the same time *reduce costs* by eliminating overlaps. Processes would be *improved* and *standardised*, which is very important when two organisations are merging. By combining assets, it is possible for instance to expand research activities to new areas (*win new business*).

As the board has the highest authority regarding to EA, at the end of his presentation Pete tells to board that EA allows organisation to *move forward*. Finally, Pete asks for a *mandate* to continue with EA adoption. After the board meeting, Pete is told that he may continue with EA adoption.

Next task is to *arrange EA training*. Organisation has never utilised EA, so there are no EA related capabilities present (*learning stock*). Therefore Pete assesses some other current organisational capabilities, such as *project management* and *change management*. He notices that US has a good project management practice in place, but WS doesn't. Next he assesses staff's EA knowledge using a survey in both organisations intranet. He finds out that the EA knowledge is low. As such, Pete decides to use *transformational* leadership style when promoting the organisational learning. As an exception to this, he uses *transactional* leadership style when promoting change management related learning to US.

Pete promotes EA learning by providing a *vision* of new University of South-West, and explaining how EA helps the *mission* of getting there. He communicates that *expectations* to staff are high while adopting EA. As much as possible, he discusses with the staff about EA *personally*.

EA learning is provided on the basis of the assessment of EA knowledge. Pete makes sure that the training provided by a training company contains at least following: EA is a formal *description* of the organisation's current state and one or more future states. These descriptions are produced from four views, namely *business*, *information*, *systems*, and *technology*. EA is also the *transition* from the current state to the future state of the organisation. The purpose of EA is to *achieve* stakeholders' goals and create *value* to organisation.

In this section, it was demonstrated how to use EAAM in a merger of two fictional HEIs. Pete, who was selected as a person responsible for EA in the example, utilised EAAM in

various ways. First, Pete acquired the mandate for EA adoption by arguing the achievable benefits of EA. Secondly, Pete selected an appropriate leadership style for promoting EA training based on the assessment of organisations' current EA knowledge. Thirdly, Pete made sure that the concept of EA is trained similarly to all participants.

6.6. Summary of Chapter 6

In this chapter, improvement targets of the traditional EA adoption process were identified utilising REAP model introduced in the previous chapter. Resistance caused by the lack of understanding of EA concepts was identified as a major improvement target. Thus the objective was to improve the traditional EA adoption process to minimise this resistance. This was achieved by developing Enterprise Architecture Adoption Model (EAAM) based on the relevant literature. EAAM added two sub-processes to the traditional adoption process; *Explain EA benefits* and *Organise EA learning*. EAAM's utility was demonstrated with a Delphi study using a panel of Finnish EA experts. Also an example how to use EAAM was provided.

Chapter 7 Evaluation

7.1. Introduction

In this chapter, the evaluation of the research is provided. First the achievement of the research objectives and overall research aim are evaluated. To demonstrate the rigour and relevance of the research, the research is also evaluated against the DSRM phases by Peffers *et al.* (2007) and DSR guidelines by Hevner *et al.* (2004).

7.2. Evaluation of Objectives

In this section, the research is evaluated against the research objectives set in Chapter 1.

7.2.1. Objective 1: Review EA Literature

Objective 1 was to review the Enterprise Architecture literature to investigate the current body of knowledge of EA and related concepts, and to identify the research gap. This is demonstrated (i) in Chapter 2 where Enterprise Architecture definitions and theoretical perspectives are presented, and (ii) in Chapter 3, where the Systematic Literature Review (SLR) on EA adoption is explained. The main outcome from this objective is the increased understanding of EA and related concepts, including the current state of EA adoption research.

If compared to traditional literature review method, SLR is more systematic and rigorous. SLR was conducted by searching publications from various digital libraries while making sure that the top conferences and publications on IS science were included. The downfall of using digital libraries is that they do not necessarily contain all published research, such as PhD and Masters' Theses. Despite this limitation, I believe that choosing SLR as a review method and using the selected digital libraries were suitable for this thesis.

7.2.2. Objective 2: Construct EA Adoption Model

Objective 2 was to construct a model to explain Enterprise Architecture adoption challenges by exploring appropriate theories from the literature, informed by outcomes of the 1st objective. This was achieved (i) by demonstrating in Chapter 2 that the Enterprise Architecture adoption is an instance of teleological organisational change, (ii) by reviewing

systematically the current EA adoption literature in Chapter 3, and (iii) by forming EA adoption model in Chapter 5. The main outcome from this objective is the *model of Resistance in Enterprise Architecture Adoption Process* (REAP) to be used to identify resistance during Enterprise Architecture adoption process.

REAP is based on selected EA literature, and to general organisational change and change resistance literature. As informed by the outcomes of the 1st objective, EA is indeed more about people than technology. Therefore EA adoption is also about people. Organisations are composed of individuals whose actions are affecting all organisational changes. Therefore it can be argued that the model explaining EA adoption through organisational resistance is appropriate for the purpose of this thesis.

7.2.3. Objective 3: Identify EA Adoption Challenges

Objective 3 was to identify Enterprise Architecture adoption challenges by analysing the empirical data from EA pilot using the constructed model. The objective includes the validation of the model. This was achieved by (i) analysing the empirical data from the EA pilot using the REAP model, and is demonstrated in Chapter 5. The main outcomes from this objective are the identified sources of resistance in Enterprise Architecture adoption.

EA adoption challenges were identified by analysing empirical data collected from the participants of a real-life EA adoption pilot. All participants were Higher Education Institutions and therefore suitable for the purpose of this thesis. Data was collected by interviewing the participants during the pilot using semi-structured interviews. The themes used during the interviews were derived from the outcomes of the 1st objective. Data was analysed with directed content analysis method by using REAP model for coding and categorising data. Data analysis revealed a number of sources of resistance, which were in line with findings from other studies. Therefore it can be argued that using the selected data collection and analysis methods were appropriate for this thesis.

7.2.4. Objective 4: Construct EA Adoption Method

Objective 4 was to construct a method to overcome Enterprise Architecture adoption challenges identified by the REAP model, by exploring appropriate theories from literature. This was achieved by (i) researching and (ii) developing a method based on literature, and is demonstrated in Chapter 6. The main outcome from this objective is the *Enterprise Architecture Adoption Method* (EAAM).

EAAM was constructed to overcome the adoption challenges identified as a result of achieving the 3rd objective. The most important EA adoption challenges were related to the lack of understanding of EA concepts. Therefore the research was focused on the literature of change readiness, individual and organisational learning, and organisational management. As the EAAM was constructed to solve EA adoption challenges, and is based to appropriate literature and theories, the EAAM method is suitable for this thesis.

7.2.5. Objective 5: Evaluate EA Adoption Method

Objective 5 was to evaluate the method using an appropriate evaluation method. This was achieved by (i) carefully selecting an appropriate evaluation method, and (ii) conducting the evaluation accordingly and in rigorous manner. This is demonstrated in Chapter 6.

The most challenging part of the Design Science research is to evaluate its outcomes accordingly. Especially in a case such as EAAM, finding a suitable real-life organisational setting for evaluation can be difficult. Evaluating EAAM in such way is also time consuming, as EA adoption can take several years. Therefore the Delphi method was selected to be used for evaluation. For this purpose, a panel of top Finnish EA experts were carefully selected to evaluate the method. Therefore, the chosen evaluation method and evaluation outcomes can be argued to be appropriate for this thesis.

7.2.6. Summary of Evaluation of Objectives

The purpose of the research was to improve the traditional EA adoption method to increase the likelihood of successful EA adoption. The aim of this research was to develop a method of EA adoption based on thorough understanding of issues surrounding EA adoption. This overall aim was achieved by meeting all objectives. Based on the statements of the panel of EA experts during the evaluation, EAAM increases the likelihood of successful EA adoption. Although this is still to be evaluated in a real-life EA adoption, it can be argued that the overall aim of the research is fulfilled.

7.3. DSRM Process

In this section, the thesis is evaluated against the phases of the Design Science Research Method by Peffers *et al.* (2007) seen in Figure 4.4. More specifically, I will demonstrate that DSRM process is followed accordingly and all phases are completed by referring to

corresponding parts of the thesis. Evaluation of the actual research is presented in the next section.

7.3.1. Problem identification and motivation

Motivation and importance of EAAM is described in Chapter 2 and Chapter 3, by demonstrating the research gap and by highlighting the EA adoption challenges. The problem identification takes place in Chapter 5, where the sources of resistance are identified from an EA pilot, and in Section 6.2, where the problems to be solved are defined in detail.

Motivation for improving the traditional EA adoption method was raised from practical challenges; EA adoption has been found to be difficult. In this thesis REAP model to explain EA adoption challenges is formed. Also, by utilising REAP, the actual problems from an actual EA adoption are identified. Therefore, it can be argued that problem identification and motivation phase has been conducted adequately.

7.3.2. Objectives of the Solution

Objectives of the solution are described in section 6.2, by highlighting the resistance caused by lack of EA understanding, found from the EA pilot. Objectives for the improved EA adoption method are set to solve problems identified in an actual EA adoption.

7.3.3. Design and Development

Design and development phase is described in detail in section 6.3. First the theoretical explanations and solutions for the problems under study are acquired from the literature. Based on these, the method is built and descibed as process descriptions using Business Process Modeling and Notation 2.0 (BPMN). BPMN is de-facto standard for producing process descriptions and was therefore selected as the notation to describe EAAM.

Other widely used notation with EA is ArchiMate, which suits for describing all EA layers and their relations. However, as a process description notation, ArchiMate is higher on abstraction level. In ArchiMate, detailed descriptions are suggested to be produced using BPMN (Open Group, 2013). Therefore using BPMN as a notation is justified.

7.3.4. Demonstration

Demonstration of method usage is described in section 6.5 by providing an example how to use EAAM in a merger of two fictional HEIs. The best way to demonstrate the usage of EAAM would be to use a real-life case study. However, during the course of PhD research, there were no such a case study available. Despite this limitation, I believe that using fictional example will demonstrate how to gain benefits by utilising EAAM.

7.3.5. Evaluation

Evaluation of the result of the DS research process, EAAM, is demonstrated in Section 6.4. Evaluation was performed by a panel of top Finnish EA experts using the Delphi method.

7.3.6. Communication

Communication of the research is met through this thesis and forthcoming conferences and publications. More details is provided in Sub-section 7.4.7 on page 179.

7.4. DSR Guidelines

In this section, the research is evaluated against Design Science Research guidelines by Hevner *et al.* (2004) seen in Table 4.3.

7.4.1. Design as an Artefact

Design Science research must produce an artefact, such as a model or method. This guideline has been met, as the research has produced a model (REAP) and a method (EAAM).

Main outcome of this thesis is the EAAM method, which is presented as process descriptions using BPMN notation. BPMN is de-facto standard to describe processes and therefore easily understood by a large audience. Using BPMN notation, EAAM phases could be described in chronological order and in exact form. During the evaluation a textual form was used (see Appendix IX). This was problematic, as not all experts participating to the evaluation did perceive EAAM containing chronological steps. Therefore using the BPMN notation is justified. If there is a need for instance to describe the relationships with EAAM phases and organisation's capabilities, BPMN description can easily be converted to ArchiMate notation.

7.4.2. Problem Relevance

The relevance and importance of the solution is demonstrated by recognising business problems from a real-life EA pilot by utilising REAP model. The research provides a solution to overcome these problems in the form of EAAM.

In this thesis, the problems to-be-solved recognised by REAP are limited to a particular HEI EA pilot, and thus are not generalisable to other contexts. However, similar problems has been recognised by other researchers also in other contexts, such as in public sector organisations. This implies that also problems identified by REAP may be faced in other contexts. Therefore, it can be argued that the problem is relevant also in a wider context, and EAAM may be used to also solve those problems.

7.4.3. Design Evaluation

Evaluation of the EAAM was performed rigorously using Delphi method with the panel of top Finnish EA experts from both industry and academia. All experts are experienced in EA in HEI sector, some also in other sectors. Limitation of the evaluation is that the panel of experts were asked to evaluate the method in the Higher Education context. Therefore the evaluation can be argued to be applicable only in the context of Finnish HEIs.

As mentioned earlier, during the evaluation some experts did not understand EAAM being a step by step. Moreover, it appears that the purpose of the evaluation and Delphi method adopted were not clearly understood. In the first round of the evaluation (see sub-section 6.4.3) experts had a chance to leave comments and suggest improvements to EAAM. Some suggestions for improvements were given. One expert commented afterwards that he was expecting that his suggestions would be embedded to EAAM on remaining rounds. However, as this was not the purpose of the evaluation, improvements were left for future work. The communication challenges between researcher and experts during the evaluation could have been avoided using other evaluation methods, such as participant observation in a real-life setting. However, during the course of this PhD research this was not practically possible. Despite these limitations of the selected evaluation method, the results indicate that Delphi method was appropriate for this thesis.

7.4.4. Research Contributions

As described in Sections 8.2 and 8.3, the research contributes for both organisation and management sciences, in the form of REAP model and EAAM method.

7.4.5. Research Rigour

The research has followed the DSRM process throughout the research. Both REAP and EAAM are validated or evaluated using appropriate methods, as demonstrated in Sections 5.5 and 6.4, respectively. Whenever qualitative data is analysed, examples of the empirical data are provided so that readers can critically assess the author's interpretations, as suggested by Bacharach (1989) and Krefting (1991).

The validation of the REAP model was performed using a qualitative analysis, a directed content analysis to be more specific. It is acknowledged that as in all qualitative analysis, the coding is a result of researcher's interpretations of interviewees' interpretations. Thus it is possible that other researcher coding the same data might end up with a different interpretation. However, findings from a recent PhD thesis by Seppänen (2014) are similar to my findings, and therefore supports the interpretations of this thesis.

7.4.6. Design as a Search Process

The search for the solution (EAAM) has been iterative throughout the research process. This includes Systematic Literature Reviews conducted in the beginning of the research in 2010 and at the end in 2014. The literature reviews and background research in IS, management, and organisational sciences has provided solutions which eventually took the form of EAAM.

7.4.7. Communication of Research

The main research output, EAAM, is provided in both theoretical and practical forms. Thus the method is easily adaptable with both industry and academia through this thesis and forthcoming conferences and publications.

Part of the Chapter 2 is presented in 4th Nordic EA Summer School conference (Syynimaa, 2013b). Publication of three additional papers are planned. A paper about REAP will be presented in 17th International Conference on Enterprise Architecture Information Systems (Syynimaa, 2015). A journal paper about EAAM is submitted for review to MISQ Executive special issue on them of *Enterprise Architecture for Business Transformation* (Syynimaa and Nakata, 2015). Also paper concerning using Delphi method for DS evaluation is planned to be published in due course.

7.5. Limitations

As all research, also this thesis is not without limitations. In this section, these limitations are acknowledged and discussed. Summary of limitation can be seen in Table 7.1.

This thesis has exclusively focused to the Enterprise Architecture adoption. As such, other EA activities, such as describing the current and future states of an organisation, and managing the change between these states, are limited out.

EAAM is built to solve a subset of problems faced during the course of EA adoption pilot. Its purpose is to minimise the resistance in the EA adoption process caused by the lack of understanding of EA concepts. As such, there are other problems that needs to be addressed.

The problems EAAM is built to solve were identified from the empirical data collected from a real-life EA pilot. The pilot took place among Finnish HEIs in 2010. Thus the problems EAAM solves might not be present in other countries, domains, or even in EA adoption by other Finnish HEIs.

Due to time and availability constraints of this PhD research, EAAM is not evaluated in a real-life setting. Instead, EAAM was evaluated by a panel of top Finnish EA experts having extensive experience in HEI field.

As suggested by UTAUT (Venkatesh *et al.*, 2003) and various other theories discussed in this thesis, the ease-of-use of technology is important. The ease-of-use of EAAM is not evaluated in this thesis. Comments provided by one of the EA experts during the Delphi study suggests that the textual form of EAAM was not clear.

Table 7.1 Thesis Limitations

ID	*Limitation*
1	Thesis is focusing exclusively to EA adoption.
2	EAAM is solving a subset of known problems related to EA adoption.
3	EAAM is built to solve problems found from EA pilot among Finnish HEIs.
4	EAAM is not evaluated in a real-life setting but using Delphi study.
5	EAAM's ease-of-use is not evaluated.

7.6. Summary of Chapter 7

In this chapter, the research was evaluated against the overall research aim and objectives, DSRM phases, and DSR guidelines. Research aim and objectives were achieved, so the results of the research are satisfactory. Research has followed DSRM phases and DSR guidelines, which has demonstrated that the research process has been rigorous and results relevant.

Also the limitations of the thesis was acknowledged and discussed. The major limitation of this thesis is that EAAM was built to solve problems found from a particular EA pilot among Finnish HEIs.

Chapter 8 Discussion and Conclusions

8.1. Introduction

This chapter provides discussion of the research followed with the implications to science and practice. After highlighting the implications, the directions for future research are presented and finally the thesis conclusion is provided.

8.2. Implications to Science

This thesis has various implications to science. First, the thesis provides definitions of Enterprise Architecture concepts and its theoretical background. Second, the thesis contributes both organisational and management theories. Next these contributions are presented and discussed in detail.

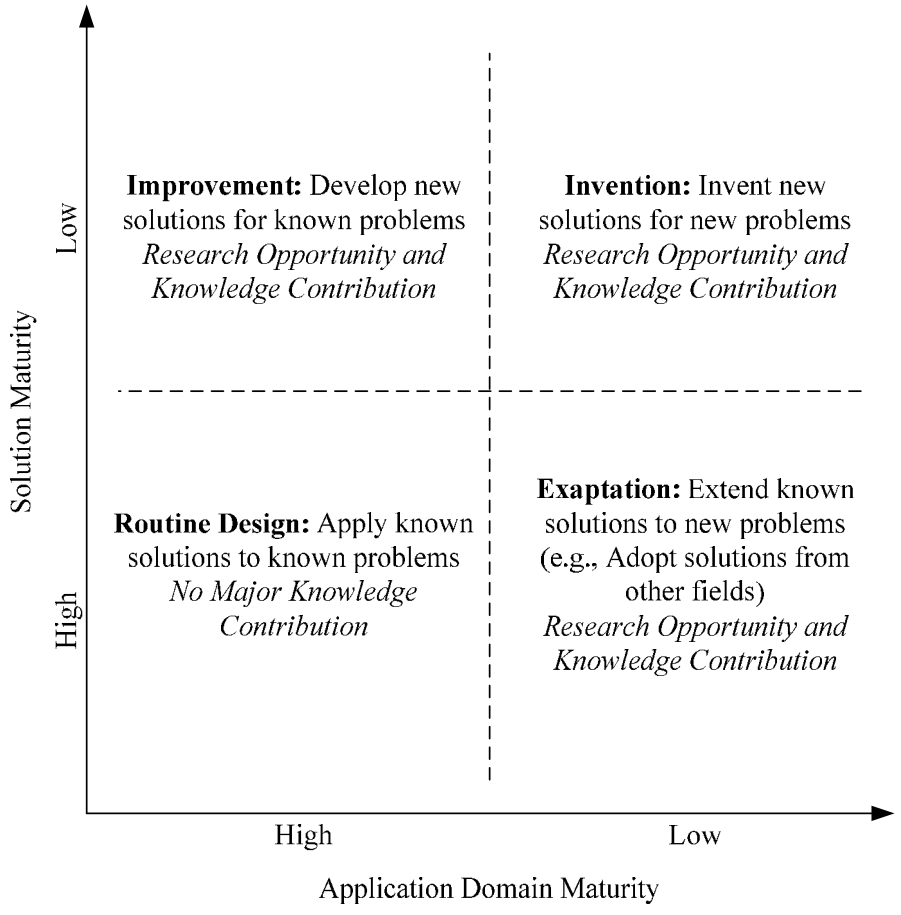


Figure 8.1 DSR Knowledge Contribution Framework (Gregor and Hevner, 2013)

According to Paolo B. Goes, Editor-In-Chief of MIS Quarterly (MISQ), IS field needs more rigorous DS work providing interdisciplinary contributions. Between Nov 2012 and Nov 2013, only 5 per cent of the published articles in MISQ were DS research (Goes, 2014). In order to increase the publication of DS research the knowledge contribution of the research should be increased. Gregor and Hevner (2013) has presented a DSR knowledge contribution framework seen in Figure 8.1. As it can be noted, to be publishable, DS research outcome should be an *improvement*, an *exaptation*, or an *invention*.

Järvinen (2007b) suggests a classification for reporting DS research results, which may be either artefacts of innovations. Resulting artefacts can be classified as (i) totally new artefacts, (ii) artefacts which goal function's value equals to the best earlier artefact, (iii) artefacts which goal function's value is better than the best earlier artefact, and (iv) failed artefacts (Järvinen, 2007b). Impilications of this thesis to science are next reported using this classification.

REAP model is a *totally new artefact*, which examines previously unexplored relationship with the strategic level of EA, organisational change, and change resistance. As demonstrated in Chapter 5, REAP can be used to study EA adoption and to reveal the aforementioned relationships. As such, REAP can be used as a theoretical framework to study EA adoption. The novel contribution of the model is that the adoption is about organisation science rather than information systems science. In van Aken's (2004) classification, REAP is an organisation theory, and in Gregor's (2006) classification, an explanation.

EAAM is an artefact having a better goal function's value than earlier artefact, e.g. the traditional EA adoption method illustrated in Figure 2.17 on page 35. *Goal function* refers to the term by Järvinen (2007b) which is used to describe all kinds of different interests an artefact may have, such as its utility. Therefore, EAAM is an improvement to the traditional EA adoption method. This was achieved by extending theories from readiness for change, individual and organisational learning, and management sciences to the field of EA adoption. As such, EAAM can be classified as an *improvement* and thus having a publication opportunity besides this thesis. In van Aken's classification, EAAM is a management theory and in Gregor's classification, a design and action theory.

The level of theoretical contribution can be assessed using the taxonomy provided by Colquitt and Zapata-Phelan (2007) seen in Figure 8.2. As already stated, REAP model

reveals previously unexplored relationships, such as the relationship between strategic level of EA and desired organisational changes. EAAM, in turn, introduces an improved EA adoption method. Therefore this research has a potential to have a high theoretical contribution.

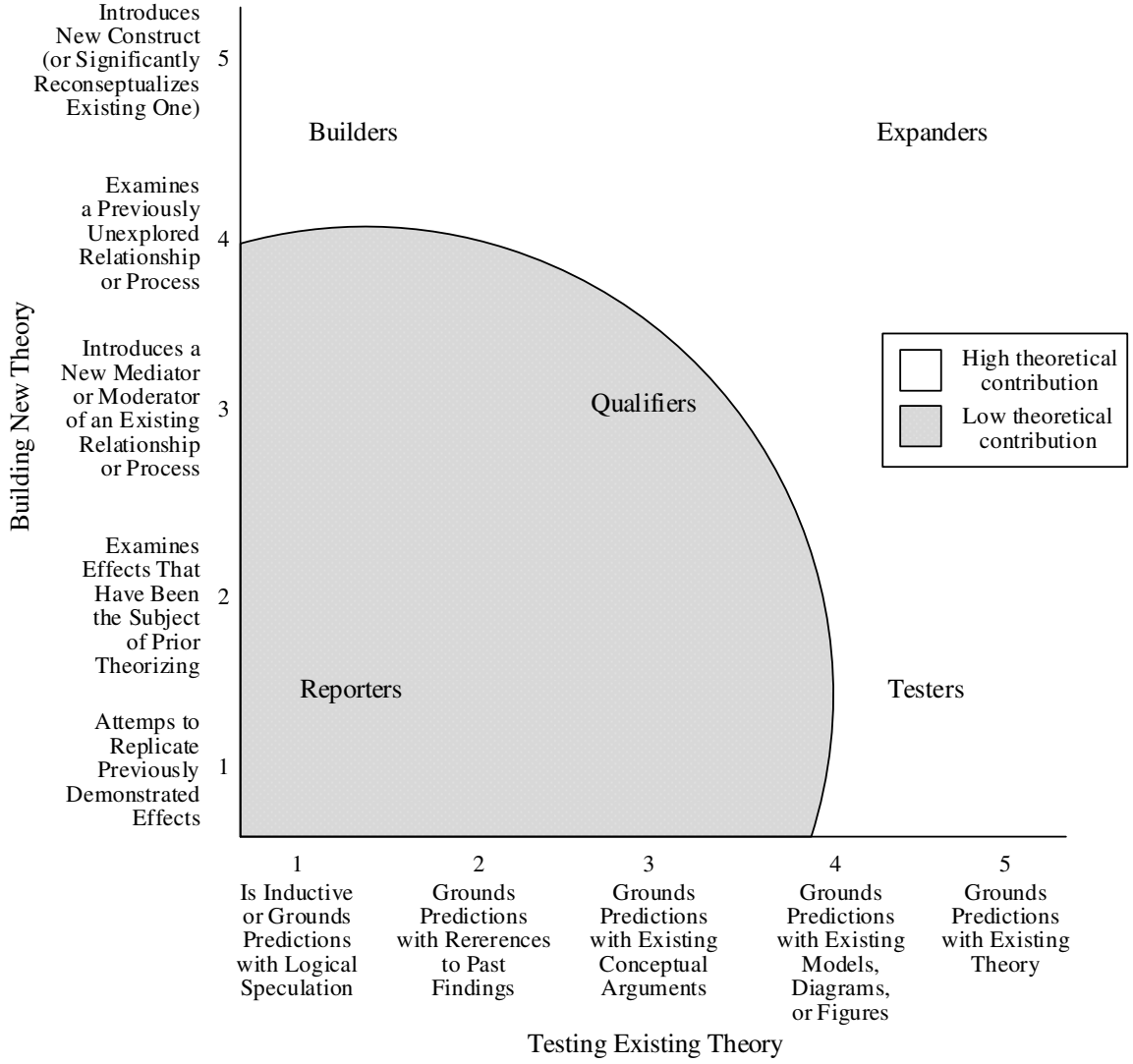


Figure 8.2 A Taxonomy of Theoretical Contributions for Empirical Articles (Colquitt and Zapata-Phelan, 2007)

Besides the aforementioned DS results, there are also other implications to science. While analysing the EA pilot data, the strategic levels of EA, how these affected the desired changes, and sources of resistance they faced were discovered. In Gregor's classification, this is an analysis type of theory.

8.3. Implications to Practice

The main practical contribution of the thesis are EAAM process descriptions. By following EAAM processes, one can minimise the resistance during the planning and execution of EA adoption caused by the lack of understanding EA concepts. EAAM is built from the general literature, e.g. it is not based on HEI specific literature. This suggests that EAAM is likely to be applicable also to other domains besides HEIs, such as public and private sectors.

Novel contribution of EAAM to practice is that it emphasises the importance of explaining EA benefits to top-management using tailored argumentation. That is, by choosing the arguments that are the most beneficial to the individual. Similarly, EAAM emphasises the importance of EA training, especially the role of managerial intervention. That is, by using a proper leadership style, one can improve the EA training.

For policy makers and legislators EAAM reveals the importance of organisational learning and management. This means that instead of barely mandating EA by legislation, the support for adopting EA should also be provided. This support should include a common EA framework, general EA training, and EA adoption training. The most crucial and needed support is to provide training about EA benefits to top-management of public sector. This would help public sector organisations to adopt EA in a way that fulfils the legislation requirements and realises EA benefits.

REAP also has practical contributions. By utilising REAP, one can identify and prepare for sources of resistance that are not covered by EAAM. Also REAP is based on general literature. Therefore it is most likely to be applicable in other domains as is, such as public and private sectors.

8.4. Future Work

The future research directions provided in this section are addressing the limitations of this thesis presented in the previous chapter. Summary of these directions can be seen in Table 8.1.

This thesis is focusing exclusively to EA adoption. This has limited out the research of other EA related activities, such as describing the current and future states of an

organisation, and the managed change between these states. Therefore I suggest that these activities should also be researched.

EAAM is solving a subset of known problems related to EA adoption. Therefore EAAM needs to be expanded to cover also other EA adoption challenges.

EAAM is built to solve problems found from an EA pilot among Finnish HEIs. Therefore REAP should be applied also in other fields, both public and private sectors. This could provide evidence of other sources of resistance and thus would make possible future improvements of EAAM.

EAAM is evaluated using a Delphi study with a panel of Finnish EA experts. It should also be evaluated in a real-life setting by instantiation. This instantiation should be conducted both in HEI and other fields in order to increase its generalisability.

EAAM should also be evaluated for its ease-of-use during the instantiation. This could help to further improve the EAAM and increase its utilisation among practitioners.

Table 8.1 Directions for Future Research

ID	*Limitation*
1	Research on other EA activities.
2	Expanding EAAM to cover other known EA adoption challenges.
3	Analysing EA adoption in other fields with REAP to identify sources of resistance.
4	Evaluation of EAAM in a real-life setting by instantiation.
5	Evaluation of EAAM's ease-of-use in a real-life setting.

8.5. Conclusion

Through this research two theories were formed to expand the body of knowledge of Enterprise Architecture. First, an organisational theory, *the model of resistance during EA adoption process* (REAP), was formed and validated. As a result of validation, sources of resistance from an EA-pilot conducted among 12 Finnish HEIs were revealed. To overcome the identified sources of resistance, a management theory, *the EA adoption method* (EAAM), was formed and evaluated. As such, the research has both theoretical and practical contributions.

The REAP model introduced previously unexplored relationships between the strategic level of EA, resulting organisational changes, and change resistance caused by these changes. By utilising the REAP model, organisations can identify possible sources of

resistance in their EA adoption projects beforehand. Sources of resistance presented in this research are likely present also in Finnish HEIs not participating to the EA pilot. Therefore also EAAM should be applicable in these HEIs as-is.

The EAAM method emphasises the importance of acquiring the mandate for EA adoption from the top-management and the importance of a proper EA training. EAAM helps in acquiring the mandate by formulating the argumentation of EA benefits according to the individual's interests. Moreover, EAAM helps in EA training by providing directions in choosing a proper leadership style to promote EA training. Thus by following EAAM, organisations can minimise the resistance during the planning and execution of EA adoption caused by the lack of EA knowledge.

This thesis also presents a comprehensive review of theoretical aspects of EA. This contributes to the EA body of knowledge and gives a starting point for future EA research.

References

Aarabi, M., Zameri, M. S., Wong, K. Y., Beheshti, H. M. & Rahman, A. (2011). The Effect of Enterprise Architecture for Enterprise Resource Planning in Small and Medium Enterprises: a Review and Research Direction. *In:* Proceedings of Industrial Engineering and Service Science, Sep 20th-21st, 2011.

ABS. (2010). Academic Journal Quality Guide. Version 4. URL: http://www.associationofbusinessschools.org/sites/default/files/Combined%20Journal%20Guide.pdf [Sep 21st 2014].

Acikalin, U., Kuruoglu, M., Isikdag, U. & Underwood, J. (2008). Evaluating the integrative function of ERP systems used within the construction industry. *In:* Zarli, A. & Scherer, R., eds. ECPPM 2008, 7th European conference on product and process modelling, 10-12 September 2008 Sophia Antipolis, France. Taylor & Francis Group, 245-254.

Adler, M. & Ziglio, E. (1996). *Gazing into the oracle: the Delphi method and its application to social policy and public health.* London: Jessica Kingsley Publishers.

Agarwal, R. (2000). Individual acceptance of information technologies. *In:* Zmud, R. W. (ed.) *Framing the domains of IT management: Projecting the future through the past.* Cincinnati, OH: Pinnaflex Education Resources.

AlSoufi, A. (2012). Bahrain National Enterprise Architecture Framework: a Platform towards a GCC EA Initiative. *GSTF Journal on Computing, 2*(1), 73-80.

Aulin, A. (1989). *Foundations of Mathematical System Dynamics: The Fundamental Theory of Causal Recursion & its Application to Social Science & Economics.* Oxford: Pergamon Press.

Australian Research Council. (2010a). *ERA 2010 Ranked Journal List*. URL: http://www.arc.gov.au/xls/ERA2010_journal_title_list.xls [May 10th 2010].

Australian Research Council. (2010b). *Ranked Conference List for ERA 2010*. URL: http://www.arc.gov.au/xls/ERA2010_conference_list.xls [May 10th 2010].

Bacharach, S. B. (1989). Organizational theories: Some criteria for evaluation. *Academy of Management Review, 14*(4), 496-515.

Balci, O. (1994). Validation, verification, and testing techniques throughout the life cycle of a simulation study. *Annals of Operations Research, 53*(1), 121-173.

Barlas, Y. (1996). Formal aspects of model validity and validation in system dynamics. *System Dynamics Review, 12*(3), 183-210.

Barlas, Y. & Carpenter, S. (1990). Philosophical roots of model validation: two paradigms. *System Dynamics Review, 6*(2), 148-166.

Barnett, W. P. & Carroll, G. R. (1995). Modeling Internal Organizational Change. *Annual Review of Sociology, 21*(1995), 217-236.

Barron, T., Chiang, R. & Storey, V. (1999). A semiotics framework for information systems classification and development. *Decision Support Systems, 25*, 1-17.

Baskerville, R. & Pries-Heje, J. (2010). Explanatory Design Theory. *Business & Information Systems Engineering, 2*(5), 271-282.

Bass, B. M. (1990). From Transactional to Transformational Leadership: Learning to Share the Vision. *Organizational Dynamics, 18*, 19-31.

Baumgartner, T. (1986). Actors, models and limits to societal self-steering. *In:* Geyer, F. & Van der Zouwen, J. (eds.) *Sociosybernetic Paradoxes: Observation, Control and Evolution of Self-steering Systems.* London: SAGE.

Becker, K. L. & Karayan, J. E. (2005). Leading people and communities through change: the case for unlearning. *Journal of Interdisciplinary Studies, 18*(1), 121-130.

Beer, M. & Nohria, N. (2000a). *Breaking the code of change.* Harvard Business Press.

Beer, M. & Nohria, N. (2000b). Cracking the code of change. *Harvard Business Review, 78*(3), 133-141.

Beynon-Davies, P. (2009a). Formated technology and informated action: The nature of information technology. *International Journal of Information Management, 29*(4), 272-282.

Beynon-Davies, P. (2009b). The 'language' of informatics: The nature of information systems. *International Journal of Information Management, 29*(2), 92-103.

Beynon-Davies, P. (2009c). Neolithic informatics: The nature of information. *International Journal of Information Management, 29*(1), 3-14.

Browne, J., Sackett, P. & Wortmann, J. (1995). Future manufacturing systems—towards the extended enterprise. *Computers in industry, 25*(3), 235-254.

Bunge, M. (1966). Technology as Applied Science. *Technology and Culture, 7*(3), 329-347.

Burnes, B. & James, H. (1995). Culture, cognitive dissonance and the management of change. *International Journal of Operations & Production Management, 15*(8), 14-33.

Burrell, G. & Morgan, G. (1979). *Sociological Paradigms and Organizational Analysis.* London: Heinemann Books.

Cannon-Bowers, J. A. & Salas, E. (2001). Reflections on Shared Cognition. *Journal of Organizational Behavior, 22*(2), 195-202.

Cao, G., Clarke, S. & Lehaney, B. (2000). A systemic view of organisational change and TQM. *The TQM Magazine, 12*(3), 186-193.

Cao, G., Clarke, S. & Lehaney, B. (2003). Diversity management in organizational change: towards a systemic framework. *Systems Research and Behavioral Science, 20*(3), 231-242.

Carrillo, J., Cabrera, A., Román, C., Abad, M. & Jaramillo, D. (2010). Roadmap for the implementation of an enterprise architecture framework oriented to institutions of higher education in Ecuador. *In:* Software Technology and Engineering (ICSTE), 2010 2nd International Conference on, 2010. IEEE, V2-7-V2-11.

CIO Council (2001). A Practical Guide to Federal Enterprise Architecture. *Available at http://www.cio.gov/documents/bpeaguide.pdf*.

Colquitt, J. A. & Zapata-Phelan, C. P. (2007). Trends in theory building and theory testing: A five-decade study of the Academy of Management Journal. *The Academy of Management Journal ARCHIVE, 50*(6), 1281-1303.

Committee of Public Accounts (2011). *45th Report of Session 2010-12. The National Programme of IT in the NHS: an update on the delivery of detailed care records systems.* London: The Stationery Office Limited.

Crossan, M. M., Lane, H. W. & White, R. E. (1999). An organizational learning framework: from intuition to institution. *Academy of management review*, 522-537.

CSC. (2009). *Overall architecture for improving university IT management*. URL: http://www.csc.fi/english/csc/news/news/overall_architecture [Sep 5th 2010].

CSC. (2011a). *KA-pilotin päätösseminaari 4.2.2011*. URL: http://www.csc.fi/csc/kurssit/arkisto/ka-pilotti_2011-02-04 [Feb 4th 2011].

CSC (2011b). *KARTTURI - Korkeakoulujen kokonaisarkkitehtuurin menetelmäopas.* Helsinki: CSC Tieteen tietotekniikan keskus Oy.

CSC. (2011c). *Kokonaisarkkitehtuuri eli KA-pilotti*. URL: http://raketti.csc.fi/kokoa/pilotti [May 30th 2011].

CSC (2013). *KARTTURI 2.2 - Korkeakoulujen kokonaisarkkitehtuurin menetelmäopas.* Helsinki: CSC Tieteen tietotekniikan keskus Oy.

Csibra, G. & Gergely, G. (2007). 'Obsessed with goals': Functions and mechanisms of teleological interpretation of actions in humans. *Acta Psychologica, 124*(1), 60-78.

Davis, F. D. (1986). Technology Acceptance Model for Empirically Testing New End-user Information Systems Theory and Results. Unpublished Doctoral Dissertation, MIT.

Davis, F. D. (1993). User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. *International Journal of Man-Machine Studies, 38*(3), 475-487.

Deetz, S. (1996). Describing differences in approaches to organization science: Rethinking Burrell and Morgan and their legacy. *Organization Science, 7*(2), 191-207.

Dietz, J. L. G., Hoogervorst, J. A. P., Albani, A., Aveiro, D., Babkin, E., Barjis, J., Caetano, A., Huysmans, P., Iijima, J., van Kervel, S. J. H., Mulder, H., Op ‘t Land, M., Proper, H. A., Sanz, J., Terlouw, L., Tribolet, J., Verelst, J. & Winter, R. (2013). The discipline of enterprise engineering. *Int. J. Organisational Design and Engineering, 3*(1), 86-114.

Drubin, D. G. & Kellogg, D. R. (2012). English as the universal language of science: opportunities and challenges. *Molecular Biology of the Cell, 23*(8), 1399.

Eco, U. (1976). *A theory of semiotics.* Bloomington: Indiana University Press.

El-Khawas, E., DePietro-Jurand, R. & Holm-Nielsen, L. (1998). *Quality Assurance in Higher Education: Recent Progress; Challenges Ahead.* The World Bank.

Elving, W. J. L. (2005). The role of communication in organisational change. *Corporate Communications: An International Journal, 10*(2), 129-138.

Engeström, Y. (1987). *Learning by Expanding: an activity-theoretical approach to developmental research.* Helsinki: Orienta-Konsultit.

Engeström, Y. (1999). Activity theory and individual and social transformation. *In:* Engeström, Y., Miettinen, R. & Punamäki, R.-L. (eds.) *Perspectives on activity theory.* Cambridge: Cambridge University Press.

Engeström, Y. (2000). Activity theory as a framework for analyzing and redesigning work. *Ergonomics, 43*(7), 960-974.

Espinosa, J. A., Armour, F. & Boh, W. F. (2011). The Role of Group Cognition in Enterprise Architecting. *In:* System Sciences (HICSS), 2011 44th Hawaii International Conference on, 4-7 Jan. 2011 2011. 1-10.

Filstead, W. J. (1979). Qualitative methods: A needed perspective in evaluation research. *In:* Cook, T. D. & Reichardt, C. S. (eds.) *Qualitative and quantitative methods in evaluation research.* Beverly Hills, CA: Sage.

Finnish Ministry of Education and Culture (2011). The Finnish education system.

Finnish Ministry of Finance. (2011). *Act on Information Management Governance in Public Administration (643/2011).* URL: https://www.vm.fi/vm/en/04_publications_and_documents/03_documents/20110902ActonI/Tietohallintolaki_englanniksi.pdf.

Finnish Parliament (2011). Laki julkisen hallinnon tietohallinnon ohjauksesta. *10.6.2011/634.*

Flor, N. & Hutchins, E. (1991). Analyzing distributed cognition in software teams: A case study of team programming during perfective software maintenance. *In:* Koenemann-Belliveau, J. & *et al.* (eds.) *Proceedings of the Fourth Annual Workshop on Empirical Studies of Programmers.* Norwood, NJ: Ablex Publishing.

Forrester, J. & Senge, P. (1980). Tests for building confidence in system dynamics models. *In:* Legasto, A., Forrester, J. & Lyenis, J. (eds.) *System Dynamics: TIMS Studies in the Management Sciences.* Amsterdam: North-Holland.

Galliers, R. D. & Land, F. F. (1987). Viewpoint: choosing appropriate information systems research methodologies. *Communications of the ACM, 30*(11), 901-902.

Gartner. (2013). *IT Glossary: Enterprise Architecture (EA).* URL: http://www.gartner.com/it-glossary/enterprise-architecture-ea/ [Feb 21st 2013].

GERAM (1999). GERAM: Generalised Enterprise Reference Architecture and Methodology. Version 1.6.3. *IFIP-IFAC Task Force on Architectures for Enterprise Integration.* IFIP-IFAC Task Force.

Gick, M. L. & Holyoak, K. J. (1980). Analogical problem solving. *Cognitive psychology, 12*(3), 306-355.

Goes, P. B. (2014). Editor's Comments. Design Science Research in Top Information Systems Journals. *MIS Quarterly, 38*(1), iii-viii.

Goles, T. & Hirschheim, R. (2000). The paradigm is dead, the paradigm is dead...long live the paradigm: the legacy of Burrell and Morgan. *Omega, 28*(3), 249-268.

Gregor, S. (2006). The Nature of Theory in Information Systems. *Management Information Systems Quarterly, 30*(3), 611-642.

Gregor, S., Hart, D. & Martin, N. (2007). Enterprise architectures: enablers of business strategy and IS/IT alignment in government. *Information Technology & People, 20*(2), 96-120.

Gregor, S. & Hevner, A. R. (2013). Positioning and Presenting Design Science Research for Maximum Impact. *MIS Quarterly, 37*(2), 337-355.

Gregor, S. & Jones, D. (2007). The anatomy of a design theory. *Journal of the Association for Information Systems, 8*(5), 312-335.

Groesser, S. N. & Schwaninger, M. (2012). Contributions to model validation: hierarchy, process, and cessation. *System dynamics review, 28*(2), 157-181.

Grover, V. (2012). The information systems field: Making a case for maturity and contribution. *Journal of the Association for Information Systems, 13*(4), 254-272.

Guba, E. & Lincoln, Y. (1994). Competing paradigms in qualitative research. *Handbook of qualitative research, 2*, 163-194.

Hammer, M. & Champy, J. (1993). *Reengineering the corporation: a manifesto for business revolution.* London: Nicholas Brearly.

Hannan, M. T. & Freeman, J. (1984). Structural inertia and organizational change. *American sociological review*, 149-164.

Hazen, B. T., Kung, L., Cegielski, C. G. & Jones-Farmer, L. A. (2014). Performance expectancy and use of enterprise architecture: training as an intervention. *Journal of Enterprise Information Management, 27*(2), 6-6.

Helfat, C. (2003). *The SMS Blackwell handbook of organizational capabilities: emergence, development, and change.* Wiley-Blackwell.

Henderson, J. C. & Venkatraman, N. (1993). Alignment: Leveraging Information Technology for transforming organisations. *IBM Systems Journal, 32*(1), 4-6.

Hevner, A., March, S., Park, J. & Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly, 28*(1), 75-106.

Hevner, A. R. (2007). A Three Cycle View of Design Science Research. *Scandinavian Journal of Information Systems, 19*(2).

Hiekkanen, K., Korhonen, J. J., Collin, J., Patricio, E., Helenius, M. & Mykkanen, J. (2013). Architects' Perceptions on EA Use -- An Empirical Study. *In:* Business Informatics (CBI), 2013 IEEE 15th Conference on, 15-18 July 2013 2013. 292-297.

Hirschheim, R. & Klein, H. (1989). Four Paradigms of Information Systems Development. *Communications of the ACM, 32*(10), 1199-1216.

Hjort-Madsen, K. (2006). Enterprise Architecture Implementation and Management: A Case Study on Interoperability. *In:* HICSS-39. Proceedings of the 39th Annual Hawaii International Conference on System Sciences, 2006 Kauai, Hawaii, USA.

Hjort-Madsen, K. (2007). Institutional patterns of enterprise architecture adoption in government. *Transforming Government: People, Process and Policy, 1*(4), 333-349.

Hollander, J. A. & Einwohner, R. L. (2004). Conceptualizing Resistance. *Sociological Forum, 19*(4), 533-554.

Holt, D. T., Armenakis, A. A., Feild, H. S. & Harris, S. G. (2007). Readiness for Organizational Change: The Systematic Development of a Scale. *The Journal of Applied Behavioral Science, 43*(2), 232-255.

Houkes, W. N. (2013). Rules, Plans and the Normativity of Technological Knowledge. *In:* de Vries, M. J., Hansson, S. O. & Meijers, A. W. M. (eds.) *Norms in Technology.* Springer.

Hsieh, H.-F. & Shannon, S. E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research, 15*(9), 1277-1288.

Iivari, J. (2007). A paradigmatic analysis of information systems as a design science. *Scandinavian Journal of Information Systems, 19*(2), 5.

Iivari, J. (2010). Twelve theses on Design Science Research in Information Systems. *In:* Hevner, A. & Chatterjee, S. (eds.) *Design Research in Information Systems - Theory and Practice.* Springer.

ISO/IEC/IEEE (2011). Systems and software engineering -- Architecture description. *ISO/IEC/IEEE 42010:2011(E) (Revision of ISO/IEC 42010:2007 and IEEE Std 1471-2000).*

Iyamu, T. (2009a). The Factors Affecting Institutionalisation of Enterprise Architecture in the Organisation. *In:* CEC '09. IEEE Conference on Commerce and Enterprise Computing, Jul 20th-23rd 2009a. 221-225.

Iyamu, T. (2009b). Strategic Approach for the Implementation of Enterprise Architecture: A Case Study of Two Organizations in South Africa. *In:* Feng, X., Liu, K. & Jiang, G., eds. ICISO. 11th International Conference on Informatics and Semiotics in Organisations, Apr 11-12 2009b Beijing University of Technology, Beijing, China. 375-381.

Iyamu, T. (2011a). Engineering Change Through the Domains of Enterprise Architecture. *Proceedings of the European Conference on Information Management & Evaluation*, 222-230.

Iyamu, T. (2011b). Enterprise Architecture as Information Technology Strategy. *In:* Commerce and Enterprise Computing (CEC), 2011 IEEE 13th Conference on, 5-7 Sept. 2011 2011b. 82-88.

Janssen, M. & Cresswell, A. (2005). Enterprise architecture integration in e-government. *38th Annual Hawaii International Conference on System Sciences, HICSS'05.* Hawaii, USA.

Janssen, M. & Hjort-Madsen, K. (2007). Analyzing enterprise architecture in national governments: The cases of Denmark and the Netherlands. *40th Annual Hawaii International Conference on System Sciences. HICSS 2007.* Hawaii, USA.

Janssen, M. & Kuk, G. (2006). A complex adaptive system perspective of enterprise architecture in electronic government. *39th Annual Hawaii International Conference on System Sciences.HICSS'06.* Hawaii, USA.

JISC (2009). *Doing Enterprise Architecture: Enabling the agile institutions.* JISC.

Jones, R. A., Jimmieson, N. L. & Griffiths, A. (2005). The Impact of Organizational Culture and Reshaping Capabilities on Change Implementation Success: The Mediating Role of Readiness for Change. *Journal of Management Studies, 42*(2), 361-386.

JUHTA. (2011). *JHS 179 Developing the ICT services: The enterprise architecture development*. URL: http://www.jhs-suositukset.fi/web/guest/jhs/recommendations/179 [Jul 7th 2014].

JulkICT. (2014). *JHS 179 ICT-palvelujen kehittäminen: Kokonaisarkkitehtuurin kehittäminen -päivityshanke*. URL: http://www.jhs-suositukset.fi/web/guest/jhs/projects/jhs-179-update [March 3rd 2015].

Järvinen, P. (2004). *On Research Methods.* Tampere: Opinpajan kirja.

Järvinen, P. (2007a). Action Research is Similar to Design Science. *Quality & Quantity, 41*(1), 37-54.

Järvinen, P. (2007b). On Reviewing of Results in Design Research. *ECIS 2007 Proceedings*, 1388-1397.

Järvinen, P. (2012). *On Research Methods.* Tampere: Opinpajan kirja.

Kaisler, H., Armour, F. & Valivullah, M. (2005). Enterprise Architecting: Critical Problems. *In:* HICSS-38. Proceedings of the 38th Annual Hawaii International Conference on System Sciences, 2005 Waikoloa, Hawaii, USA.

Kamal, M. M. & Alsudairi, M. (2009). Investigating the importance of factors influencing integration technologies adoption in local government authorities. *Transforming Government: People, Process and Policy, 3*(3), 302-331.

Kella, T. (2014). Kokonaisarkkitehtuurin tila ja periaatteet Suomen korkeakouluissa. URL: https://confluence.csc.fi/download/attachments/31819654/KA-ty%C3%B6n+ja+-periaatteiden+status+20140218.pdf [Apr 7th 2014].

Kezar, A. (2001). Understanding and facilitating organizational change in the 21st century. *ASHE-ERIC Higher Education Report. John Wiley & Sons, Inc*.

King, J. (2010). *Project CAIRO Final Report*. URL: http://www.roehampton.ac.uk/uploadedFiles/Pages_Assets/PDFs_and_Word_Docs/JISC_Projects/CAIRO/Project_documentation/Project-Cairo-Final-Report.pdf.

Kitchen, P. J. & Daly, F. (2002). Internal communication during change management. *Corporate Communications: An International Journal, 7*(1), 46-53.

Kitchenham, B. (2004). *Procedures for Performing Systematic Reviews.* Keele: Keele University.

Kitchenham, B. (2007). *Guidelines for performing Systematic Literature Reviews in Software Engineering.* Keele: Keele University.

Kitchenham, B. A., Dybå, T. & Jørgensen, M. (2004). Evidence-Based Software Engineering. *Proceedings of the 26th International Conference on Software Engineering.* IEEE Computer Society.

Klecun, E. & Cornford, T. (2005). A critical approach to evaluation. *European Journa of Information Systems, 14*(3), 229-243.

Knowles, M. S. (1970). *The Modern Practice of Adult Education.* New York: New York Association Press.

Koponen, E. (2009). The development, implementation and use of e-learning: critical realism and design science perspectives. *Acta Electronica Universitatis Tamperensis: 805.* Tampere, Finland: University of Tampere.

Kothari, C. (2005). *Research Methodology: Methods & Techniques.* New Delhi: New Age International.

Kotter, J. P. (2008). *A sense of urgency.* Harvard Business Press.

Krefting, L. (1991). Rigor in Qualitative Research: The Assesment of Trusthworthiness. *The American Journal of Occupational Therapy, 45*(3), 214-222.

Kuutti, K. (1996). Activity theory as a potential framework for human-computer interaction research. *Context and consciousness: Activity theory and human-computer interaction*, 17-44.

Kvale, S. (1996). *Interviews: An introduction to qualitative research interviewing.* Thousand Oaks, California: Sage Publications, Inc.

Lapalme, J. (2011). 3 Schools of Enterprise Architecture. *IT Professional, PP*(99), 1-1.

Lapalme, J. (2012). Three Schools of Thought on Enterprise Architecture. *IT Professional, 14*(6), 37-43.

Lave, J. (1988). *Cognition in Practice: Mind, mathematics, and culture in everyday life.* Camgridge, UK: Cambridge University Press.

Lee, A. S. (2004). Thinking about Social Theory and Philosophy for Information Systems. *In:* Mingers, J. & Willcocks, L. (eds.) *Social Theory and Philosophy for Information Systems.* Chichester: John Wiley & Sons.

Lee, A. S. (2010). Retrospect and prospect: information systems research in the last and next 25 years. *Journal of Information Technology, 25*, 336-348.

Lee, A. S., Manoj, T. A. & Baskerville, R. L. (2013). Going Back to Basics in Design: From the IT Artifact to the IS Artifact. *In:* Proceedings of the Nineteenth Americas Conference on Information Systems, Aug 15th-17th 2013 Chicago, Illinois. 1-7.

Lee, Y., Kozar, K. A. & Larsen, K. R. (2003). The technology acceptance model: Past, present, and future. *The Communications of the Association for Information Systems, 12*(1), 53.

Lemmetti, J. & Pekkola, S. (2012). Understanding Enterprise Architecture: Perceptions by the Finnish Public Sector. *In:* Scholl, H., Janssen, M., Wimmer, M., Moe, C. & Flak, L. (eds.) *Electronic Government.* Berlin: Springer.

Liimatainen, K., Heikkilä, J. & Seppänen, V. (2008). A Framework for Evaluating Compliance of Public Service Development Programs with Government Enterprise Architecture. *In:* ECIME 2008. Proceedings of the 2nd European Conference on Information Management and Evaluation, 2008 London, UK. 269-276.

Liu, J., Zhang, S. & Hu, J. (2005). A case study of an inter-enterprise workflow-supported supply chain management system. *Information & Management, 42*(3), 441-454.

Liu, K. (2000). *Semiotics in Information Systems Engineering.* Cambridge: Cambridge University Press.

Liu, K., Clarke, R., Andersen, P. & Stamper, R. (2001). *Information, organisation, and technology: studies in organisational semiotics.* Kluwer Academic Pub.

Liu, Y. & Li, H. (2009). Applying Enterprise Architecture in China E-Government: A Case of Implementing Government-Led Credit Information System of Yiwu. *In:* WHICEB2009. Eighth Wuhan International Conference on E-Business, 2009 Wuhan, China. 538-545.

Makiya, G. K. (2012). *A multi-level investigation into the antecedents of Enterprise Architecture (EA) assimilation in the U.S. federal government: a longitudinal mixed methods research study.* PhD Thesis, Case Western Reserve University.

March, S. T. & Smith, G. F. (1995). Design and natural science research on information technology. *Decision Support Systems, 15*(4), 251-266.

Martin, N., Gregor, S. & Hart, D. (2004). Using a common architecture in Australian e-Government: The Case of Smart Service Queensland. *In:* ICEC'04. Proceedings of the 6th International Conference on Electronic Commerce, 2004 Delft, The Netherlands. 1052285: ACM, 516-525.

Masterman, M. (ed.) (1970). *Criticism and the Growth of Knowledge,* Cambridge: Cambridge Univ Pr.

Matthee, M. C., Tobin, P. K. J. & van der Merwe, P. (2007). The status quo of enterprise architecture implementation in South African financial services companies. *South African Journal of Business Management, 38*(1), 11-23.

McNabb, D. E. & Barnowe, J. T. (2009). Trends Shaping Public Sector Transformation: Knowledge Management, E-Government and Enterprise Architecture. *Journal of Information & Knowledge Management, 8*(1), 25-34.

Medini, K. & Bourey, J. P. (2012). SCOR-based enterprise architecture methodology. *International Journal of Computer Integrated Manufacturing, 25*(7), 594-607.

Megginson, L. C. (1963). Lessons from Europe for American Business. *Southwestern Social Science Quarterly, 44*(1), 3-13.

Mezirow, J. (1997). Transformative Learning: Theory to Practice. *New Directions for Adult and Continuing Education, no. 74*, 5-12.

Mezzanotte, D. M., Dehlinger, J. & Chakraborty, S. (2010). On Applying the Theory of Structuration in Enterprise Architecture Design. *In:* Computer and Information Science (ICIS), 2010 IEEE/ACIS 9th International Conference on, 18-20 Aug. 2010 2010. 859-863.

Miller, P. C. (2003). *Enterprise architecture implementation in a state government.* D.M. Doctoral Dissertation, University of Phoenix.

Mintzberg, H., Ahlstrand, B. & Lampel, J. (1998). *Strategy Safari: the Complete Guide Trough the Wilds of Strategic Management.* London: Financial Times Prentice Hall.

Myers, M. D. & Newman, M. (2007). The qualitative interview in IS research: Examining the craft. *Information and Organization, 17*(1), 2-26.

Møller, C., Chaudhry, S. S. & Jørgensen, B. (2008). Complex service design: A virtual enterprise architecture for logistics service. *Information Systems Frontiers, 10*(5), 503-518.

Nardi, B. A. (1996). Studying Context: A Comparison of Activity Theory, Situated Action Models, and Distributed Cognition. *In:* Nardi, B. A. (ed.) *Context and consciousness: activity theory and human-computer interaction.* Massachusetts: Massachusetts Institute of Technology.

Nassiff, E. (2012). *Understanding the Value of Enterprise Architecture for Organizations: A Grounded Theory Approach.* PhD Thesis, Nova Southeastern University.

Nogueira, J. M., Romero, D., Espadas, J. & Molina, A. (2013). Leveraging the Zachman framework implementation using action – research methodology – a case study: aligning the enterprise architecture and the business goals. *Enterprise Information Systems, 7*(1), 100-132.

North, E., North, J. & Benade, S. (2004). Information Management and Enterprise Architecture Planning--A Juxtaposition. *Problems and Perspectives in Management,* (4), 166-179.

Nunamaker, J. F. J., Chen, M. & Purdin, T. D. M. (1991). Systems Development in Information Systems Research. *Journal of Management Information Systems, 7*(3), 89-106.

Närman, P. & Ericsson, E. (2011). Case study: Merging technology management methods. *In:* Technology Management in the Energy Smart World (PICMET), 2011 Proceedings of PICMET '11:, Jul 31 - Aug 4 2011. 1-11.

O'Leary, D. E. (2004). Enterprise Resource Planning (ERP) Systems: An Empirical Analysis of Benefits. *JOURNAL OF EMERGING TECHNOLOGIES IN ACCOUNTING, 1*, 63-72.

Oderinde, D. O. (2011). *Understanding Enterprise Architecture in four UK Universities.* PhD Thesis, University of Bolton.

Odgen, C. K. & Richards, I. A. (1923). *The Meaning of Meaning: A Study of the Influence of Languate Uon Thought and of the Science of Symbolism.* London: Routledge & Kegan Paul.

Office of Management and Budget. (1997). *M-97-02: Funding Information Ssytems Investments*. URL: http://www.whitehouse.gov/omb/memoranda_m97-02/ [Feb 10th 2011].

Official Statistics of Finland (OSF). (2011a). *Polytechnic education 2011*. URL: http://www.tilastokeskus.fi/til/akop/index_en.html.

Official Statistics of Finland (OSF). (2011b). *University education 2011*. URL: http://www.tilastokeskus.fi/til/yop/2011/01/yop_2011_01_2012-04-20_tie_001_en.html.

Oliva, R. (2003). Model calibration as a testing strategy for system dynamics models. *European Journal of Operational Research, 151*(3), 552-568.

OMG. (2011a). *Documents Associated with Business Process Model and Notation (BPMN) Version 2.0*. URL: http://www.omg.org/spec/BPMN/2.0/ [Aug 8th 2014].

OMG. (2011b). *Unified Modeling Language™ (UML®)*. URL: http://www.omg.org/spec/UML/ [Aug 8th 2014].

Open Group (2013). *A Pocket Guide to ArchiMate® 2.1.* Reading, UK: The Open Group.

Oreg, S., Vakola, M. & Armenakis, A. (2011). Change Recipients' Reactions to Organizational Change: A 60-Year Review of Quantitative Studies. *The Journal of Applied Behavioral Science, 47*(4), 461-524.

Oxford Dictionaries. (2010). *Oxford Dictionaries. April 2010.* URL: http://oxforddictionaries.com/ [Nov 18th 2014].

Pardo del Val, M. & Martinez Fuentes, C. (2003). Resistance to change: a literature review and empirical study. *Management Decision, 41*(2), 148-155.

PEAF. (2010). *160 Character Challenge. What is the Purpose of EA?* URL: http://www.pragmaticea.com/docs/160-char-challenge-analysis.pdf [Sep 24th 2014].

PEAF. (2013). *Definition of "Enterprise".* URL: http://www.pragmaticef.com/frameworks.htm [Feb 21st 2013].

Pedersen, K., Emblemsvag, J., Bailey, R., Allen, J. K. & Mistree, F. (2000). Validating design methods and research: the validation square. *2000 ASME Design Theory and Methodology Conference.* Baltimore, Maryland: ASME.

Peffers, K., Tuunanen, T., Rothenberger, M. A. & Chatterjee, S. (2007). A Design Science Research Methodology for Information Systems Research. *Journal of management information systems*, 45-77.

Pehkonen, J. (2013). *Early Phase Challenges and Solutions in Enterprise Architecture of Public Sector.* Master's Thesis, Tampere University of Technology.

Peirce, C. S. (1934). Pragmatism and Pragmaticism. *In:* Hartshorne, C. & Weiss, P. (eds.) *Collected Papers of Charles Sanders Peirce.* Cambridge, MA: Harvard University Press.

Peirce, C. S. (1974). *Collected papers of Charles Sanders Peirce.* Harvard University Press.

Peirce, C. S. & Houser, N. (1998). *The essential Peirce: selected philosophical writings.* Indiana University Press.

Post, J. E., Preston, L. E. & Sachs, S. (2002). Managing the extended enterprise. *California Management Review, 45*(1), 6-28.

Pries-Heje, J. & Baskerville, R. (2010). Management Design Theories. *In:* Pries-Heje et al. (ed.) *Human Benefit through the Diffusion of Information Systems Design Science Research.* Boston: Springer.

Pries-Heje, J., Baskerville, R. & Venable, J. (2008). Strategies for Design Science Research Evaluation. *In:* Golden, W., Acton, T., Conboy, K., van der Heijden, H. & Tuunainen, V. K., eds. 16th European Conference on Information Systems, Jun 9th-11th 2008 Galway, Ireland. 255-266.

Proper, H. A. (2013). Enterprise Architecture. Informed steering of enterprises in motion. *ICEIS 2013.* Angers, France.

Pulkkinen, M. (2006). Systemic Management of Architectural Decisions in Enterprise Architecture Planning. Four Dimensions and Three Abstraction Levels. *HICSS'06.* Hawaii.

Pulkkinen, M. (2008). *Enterprise Architecture as a Collaboration Tool.* PhD Thesis, University of Jyväskylä.

Päivärinta, T., Pekkola, S. & Moe, C. E. (2011). Grounding Theory from Delphi Studies. *Thirty Second International Conference on Information Systems.* Shanghai.

Rafidah, A. R., Dahalin, Z. M., Dahari, R., Kamaruddin, S. S. & Abdullah, S. (2007). Enterprise Information Architecture (EIA): Assessment of Current Practices in Malaysian Organizations. *In:* HICSS-40. 40th Annual Hawaii International Conference on System Sciences, 2007 Waikoloa, Hawaii, USA.

Rai, A., Venkatesh, V., Bala, H. & Lewis, M. (2010). Transitioning to a Modular Enterprises Architecture: Drivers, Constraints, and Actions. *MIS Quarterly Executive, 9*(2), 83-94.

Richardson, G. & Pugh, A. (1981). *Introduction to System Dynamics Modeling with DYNAMO.* Cambridge, MA: Productivity Press.

Richardson, G. L., Jackson, B. M. & Dickson, G. W. (1990). A Principles-Based Enterprise Architecture: Lessons from Texaco and Star Enterprise. *MIS Quarterly, 14*(4), 385-403.

Riihimaa, J. (2009). [personal communication]. *University of Tampere, Doctoral Seminar.* Seinäjoki.

Ross, J. W., Weill, P. & Robertson, D. C. (2006). *Enterprise architecture as strategy: Creating a foundation for business execution.* Boston, Massachusetts, USA: Harvard Business School Press.

Rowe, G. & Wright, G. (1999). The Delphi technique as a forecasting tool: issues and analysis. *International journal of forecasting, 15*(4), 353-375.

Schekkerman, J. (2005). Trends in Enterprise Architecture 2005: How are Organizations Progressing? Amersfoort, Netherlands: Institute for Enterprise Architecture Developments.

Schwaninger, M. (2009). *Intelligent Organizations: Powerful Models for Systemic Management.* Berlin: Springer.

Sembiring, J., Nuryatno, E. T. & Gondokaryono, Y. S. (2011). Analyzing the Indicators and Requirements in Main Components Of Enterprise Architecture Methodology Development Using Grounded Theory in Qualitative Methods. *Society of Interdisciplinary Business Research Conference.* Bangkok.

Seppänen, V. (2014). *From problems to critical success factors of enterprise architecture adoption.* Jyväskylä: University of Jyväskylä.

Shupe, C. & Behling, R. (2006). Developing and Implementing a Strategy for Technology Deployment. *Information Management Journal, 40*(4), 52-57.

Skulmoski, G. J., Hartman, F. T. & Krahn, J. (2007). The Delphi Method for Graduate Research. *Journal of Information Technology Education, 6*(1), 1-21.

Somers, T. & Nelson, K. (2001). The impact of critical success factors across the stages of enterprise resource planning implementations. *In*, 2001. Citeseer, 215-215.

Sowa, J. F. (2000). Ontology, Metadata, and Semiotics. *In:* Ganter, B. & Mineau, G. W., eds. Conceptual Structures: Logical, Linguistic, and Computational Issues. Lecture Notes in AI #1867, 2000. Berlin: Springer-Verlag, 55-81.

Stamper, R. (1973). *Information in business and administrative systems.* John Wiley & Sons, Inc. New York, NY, USA.

Stamper, R., Liu, K., Hafkamp, M. & Ades, Y. (2000). Understanding the Roles of Signs and Norms in Organisations - A semiotic approach to information systems design. *Journal of Behaviour & Information Technology, 19*(1), 15-27.

Sterman, J. (2000). *Business Dynamics: Systems Thinking and Modeling for a Complex World.* Boston, MA: McGraw-Hill.

Stevens, S. S. (1946). On the Theory of Scales of Measurement. *Science, New Series, 103*(2684), 677-680.

Strauss, A. & Corbin, J. (1990). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory.* Sage Publ.

Struijs, P., Camstra, A., Renssen, R. & Braaksma, B. (2013). Redesign of Statistics Production within an Architectural Framework: The Dutch Experience. *Journal of Official Statistics, 29*(1), 49-71.

Swanson, E. B. & Ramiller, N. C. (1993). Information Systems Research Thematics: Submissions to a New Journal, 1987-1992. *Information Systems Research, 4*(4), 299-330.

Syynimaa, N. (2009). *Application of Government Enterprise Architecture in Seinäjoki University of Applied Sciences.* M.Sc. (Economics & Business Administration) url:http://www.tritonia.fi/fi/kokoelmat/gradu_nayta_pdf.php?id=3412, University of Vaasa.

Syynimaa, N. (2010a). HMEF: framework to evaluate merging of Higher Education Institutions – Application of Enterprise Architecture. *NORSA 2010, 3rd Conference of the Nordic Section of the Regional Studies Association.* Seinäjoki, Finland.

Syynimaa, N. (2010b). Taxonomy of purpose of Enterprise Architecture. *12th International Conference on Informatics and Semiotics in Organisations, ICISO 2010.* Reading, UK.

Syynimaa, N. (2012). Enterprise Architecture: The Misunderstood Silver bullet. Widening the Scope of EA.

Syynimaa, N. (2013a). Measuring Enterprise Architecture Success: Tentative Model for Measuring EA Implementation Success. *In:* Liu, K., Li, W. & Gulliver, S. R., eds. 14th International Conference on Informatics and Semiotics in Organisations, ICISO 2013, 25-27 Mar 2013a Stockholm, Sweden. 264-271.

Syynimaa, N. (2013b). Theoretical Perspectives of Enterprise Architecture. *4th Nordic EA Summer School, EASS 2013.* Helsinki, Finland.

Syynimaa, N. (2015). Modelling the Resistance of Enterprise Architecture Adoption: Linking Strategic Level of Enterprise Architecture to Organisational Changes and Change Resistance. *17th International Conference on Enterprise Information Systems, ICEIS 2015.* Barcelona, Spain.

Syynimaa, N. & Nakata, K. (2015). [submitted for review] Overcoming Resistance for Enterprise Architecture Adoption: Guidelines Emerged from a Finnish Higher Education Pilot Study. *MISQ Executive,* (Special issue of Enterprise Architecture for Business Transformation).

Tashakkori, A. & Teddlie, C. (1998). *Mixed methodology: Combining qualitative and quantitative approaches.* London: Sage Publications, Inc.

Themistocleous, M. & Irani, Z. (2002). Evaluating and Adopting Application Integration: The Case of a Multinational Petroleum Company. *In:* HICSS-35. Proceedings of the 35th Annual Hawaii International Conference on System Sciences, 2002 Waikoloa, Hawaii, USA. 3715-3723.

TOGAF (2009). *TOGAF Version 9.* Van Haren Publishing.

Trunick, P. A. (1999). ERP: Promise or Pipe Dream? *Transportation and Distribution, 40*, 23-26.

Turban, E., Sharda, R. & Delen, D. (2010). *Decision Support and Business Intelligence Systems.* Prentice Hall Press.

Umar, A. & Zordan, A. (2009). Reengineering for service oriented architectures: A strategic decision model for integration versus migration. *Journal of Systems and Software, 82*(3), 448-462.

Umble, E., Haft, R. & Umble, M. (2003). Enterprise resource planning: Implementation procedures and critical success factors. *European Journal of Operational Research, 146*(2), 241-257.

Unhelkar, B. & Ginige, A. (2010). A framework to derive holistic business transformation processes. *In:* e-Business (ICE-B), Proceedings of the 2010 International Conference on, 26-28 July 2010 2010. 1-7.

Uschold, M. & Gruninger, M. (1996). Ontologies: Principles, methods and applications. *Knowledge engineering review, 11*(2), 93-136.

Vaishnavi, V. & Kuechler, B. (2013). Design Science Research in Information Systems. URL: http://desrist.org/desrist/.

ValtIT (2007). Finnish National Enterprise Architecture Development Project - Final Report. *Unified model for holistic planning of functionality and information systems.* Ministry of Finance.

Valtonen, K., Mäntynen, S., Leppänen, M. & Pulkkinen, M. (2011). Enterprise Architecture Descriptions for Enhancing Local Government Transformation and Coherency Management: Case Study. *In:* Enterprise Distributed Object Computing Conference Workshops (EDOCW), 2011 15th IEEE International, Aug 29-Sep 2 2011. 360-369.

van Aken, J. E. (2004). Management Research Based on the Paradigm of the Design Sciences: The Quest for Field-Tested and Grounded Technological Rules. *Journal of Management Studies, 41*(2), 219-246.

Van de Ven, A. H. & Poole, M. S. (1995). Explaining Development and Change in Organizations. *The Academy of Management Review, 20*(3), 510-540.

Van de Ven, A. H. & Poole, M. S. (2005). Alternative Approaches for Studying Organizational Change. *Organization Studies, 26*(9), 1377-1404.

van der Raadt, B., Schouten, S. & van Vliet, H. (2008). Stakeholder perception of enterprise architecture. *In:* ECSA 2008, Second European Conference on Software Architecture, September 29 - October 1 2008 Paphos, Cyprus. Springer, 19-34.

van der Raadt, B. & van Vliet, H. (2009). Assessing the Efficiency of the Enterprise Architecture Function. *In:* Proper, E., Harmsen, F. & L.G.Dietz, J. (eds.) *Advances in Enterprise Engineering II. First NAF Academy Working Conference on Practice-Driven Research on Enterprise Transformation, PRET 2009, held at CAiSE 2009, Amsterdam, The Netherlands, June 11, 2009. Proceedings.* Amsterdam, The Netherlands: Springer Berlin Heidelberg.

van Veenstra, A. F. & Zuurmond, A. (2009). Opening the Black Box: Exploring the Effect of Transformation on Online Service Delivery in Local Governments. *EGOV 2009. 8th International Conference on Electronic Government.* Linz, Austria.

Washington, M. & Hacker, M. (2005). Why change fails: knowledge counts. *Leadership & Organization Development Journal, 26*(5), 400-411.

Vasilescu, C. (2012). General Enterprise Architecture Concepts and the Benefits for an Organization. *7th International Scientific Conference, Defence Resources Management in the 21st Century.* Braşov: Romanian National Defence University, Regional Department of Defence Resources Management Studies.

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

Weerakkody, V., Janssen, M. & Hjort-Madsen, K. (2007). Integration and Enterprise Architecture Challenges in E-Government: A European Perspective. *International Journal of Cases on Electronic Commerce, 3*(2), 13-35.

Venable, J., Pries-Heje, J. & Baskerville, R. (2012). A Comprehensive Framework for Evaluation in Design Science Research. *In:* Peffers, K., Rothenberger, M. & Kuechler, B. (eds.) *Design Science Research in Information Systems. Advances in Theory and Practice.* Springer Berlin Heidelberg.

Wengraf, T. (2001). *Qualitative research interviewing: Biographic narrative and semi-structured methods.* London: Sage Publications Ltd.

Venkatesh, V. & Davis, F. D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science, 46*(2), 187.

Venkatesh, V., Morris, M. G., Davis, G. B. & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 425-478.

Vera, D. & Crossan, M. (2004). Strategic Leadership and Organizational Learning. *The Academy of Management Review, 29*(2), 222-240.

Wu, R. C.-Y. (2007). Enterprise integration in e-government. *Transforming Government: People, Process and Policy, 1*(1), 89 - 99.

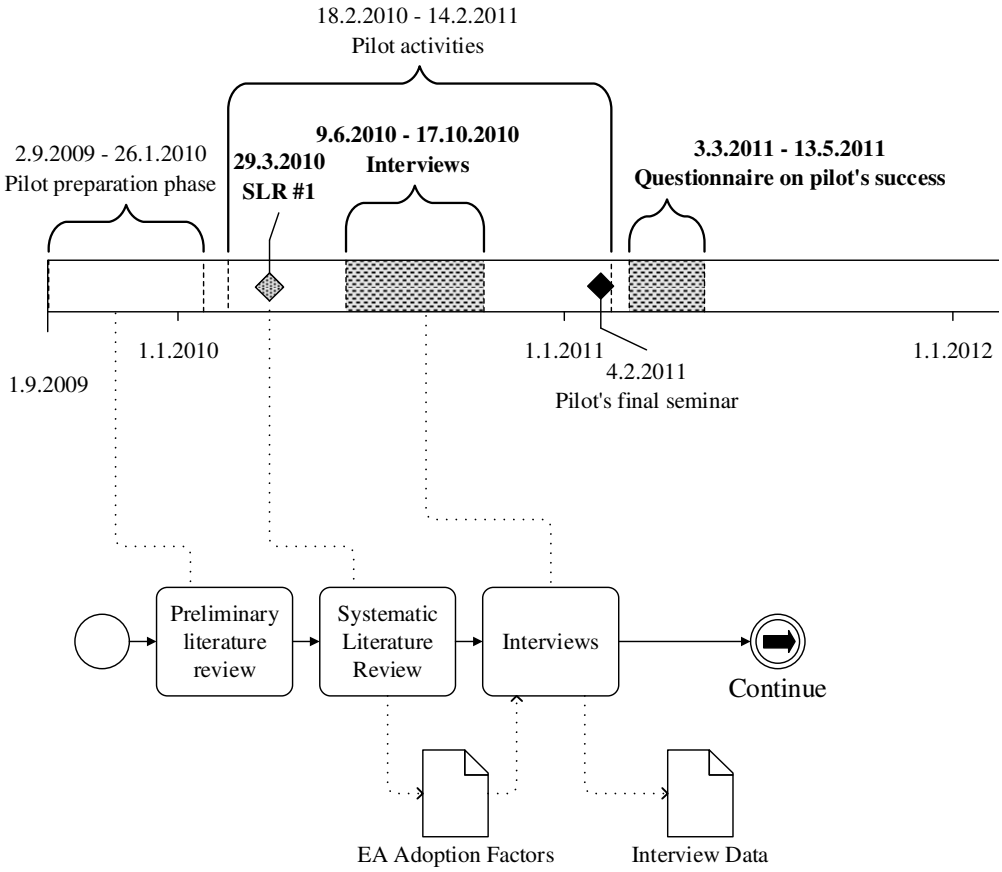
Zachman, J. (2008). John Zachman's Concise Definition of the The Zachman Framework™. URL: https://www.zachman.com/about-the-zachman-framework [Feb 13th 2012].

Zachman, J. A. (1987). A framework for information systems architecture. *IBM Systems Journal, 26*(3).

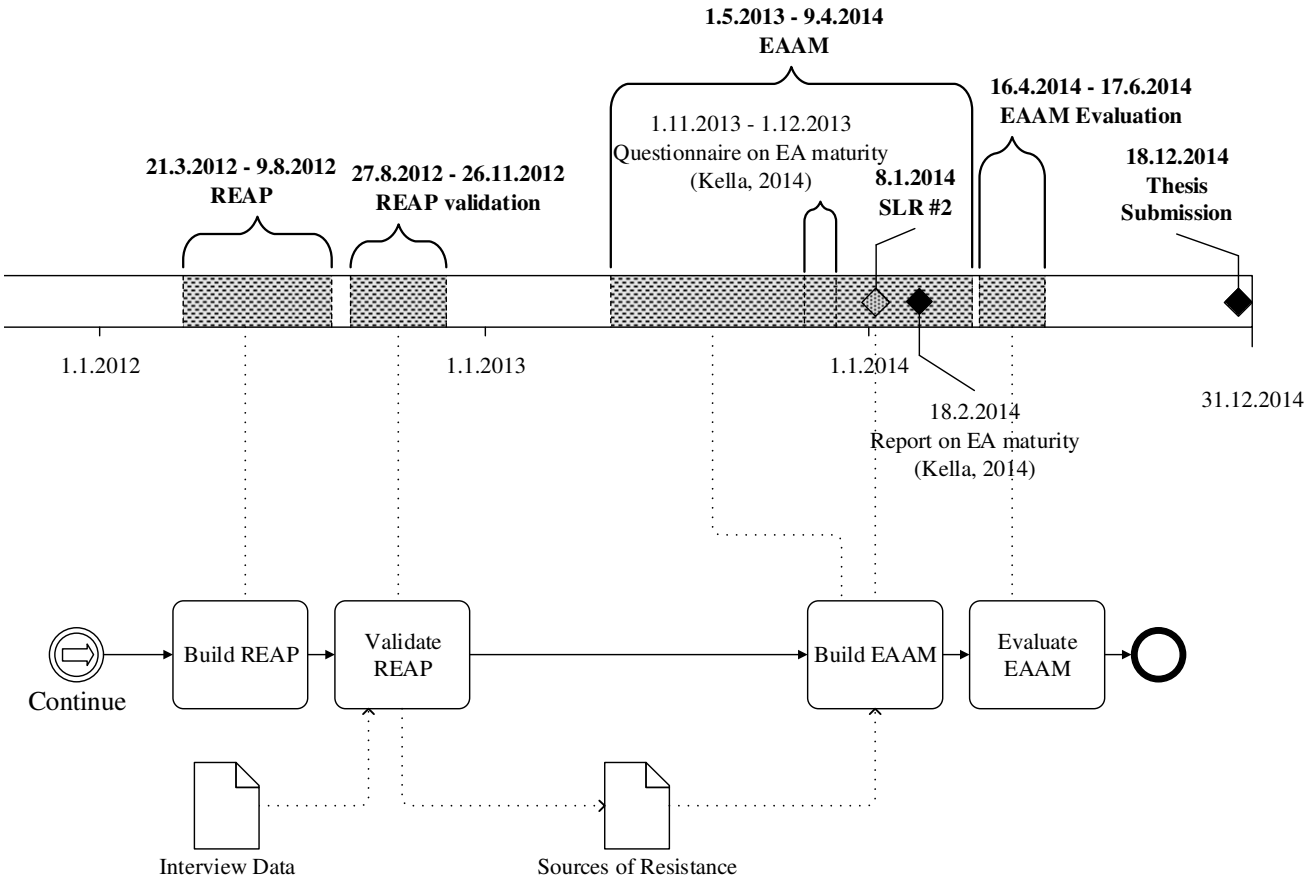
Zachman, J. A. (1997). Enterprise architecture: The issue of the century. *Database Programming and Design, 10*(3), 44-53.

Appendices

Appendix I Research Timeline and Process



Research Timeline and Process Part I



Research Timeline and Process Part II

Appendix II SLR: Digital Libraries and top Journals & Conferences on IS

This appendix contains list of digital libraries used in Systematic Literature Review (SLR) and their mapping to top journals and conferences on IS.

Digital libraries used in SLR

Database	*Address*	*Abbreviation*
Science Direct (Elsevier)	http://www.sciencedirect.com/	SD
ABI/Inform (ProQuest)	http://proquest.umi.com/login	AB
Web of Science (ISI)	http://www.isiknowledge.com	WS
ACM	http://portal.acm.org	AC
CSA	http://www.csa.com	CS
EBSCOhost	http://search.ebscohost.com	EB
Emerald	http://www.emeraldinsight.com	EM
IEEEXplore	http://ieeexplore.ieee.org	IE
JSTOR	http://www.jstor.org	JS
Sage Premier	http://online.sagepub.com	SP
Wiley InterScience	http://www.interscience.wiley.com	WI
Google Scholar	http://scholar.google.com	GO
CiteSeer	http://www.citeseer.com	CI

Mapping of digital libraries and top journals & conferences on IS

Name	*Libraries*
Journals	
ACM Transactions on Computer - Human Interaction	AB,WS,AC,CS,EB,GO
ACM Transactions on Information Systems	AB,WS,AC,CS,EB,GO
Communications of the Association for Information Systems	AB,EB,GO,CI
Electronic Commerce Research	AB,AC,CS,GO,CI
European Journal of Information Systems	AB,WS,AC,CS,EB,GO
Information Processing and Management	SD,AB,AC,CS,EB,GO
Information Systems	SD,WS,AC,CS,GO
Information Systems Journal	WS,CS,EB,WI,GO
Information Systems Research	AB,WS,AC,CS,GO
Information Technology and People	AB,CS,EB,EM,GO
International Journal of Electronic Commerce	AB,WS,AC,EB,GO
International Journal of Geographical Information Science	WS,AC,CS,EB,GO
Journal of Behavioral Decision Making	AB,WS,CS,GO
Journal of Computer Information Systems	AB,WS,EB,GO
Journal of Information Technology	AB,WS,CS,EB,GO
Journal of Management Information Systems	AB,WS,AC,CS,EB,GO
Journal of Organizational Computing and Electronic Commerce	AB,WS,AC,CS,EB,GO
Journal of the Association of Information Systems	AC,EB,GO

Name	*Libraries*
Management Science	AB,WS,AC,CS,GO
MIS Quarterly	AB,WS,AC,EB,GO
MIS Quarterly Executive	WS,GO
Scandinavian Journal of Information Systems	AC,GO
The Journal of Strategic Information Systems	AB,WS,AC,EB,GO
Conferences	
ACM Conference on Computer Supported Cooperative Work	WS,AC,CS,EB,GO
ACM International Conference on Information and Knowledge Management	AC,CS,GO
ACM International Conference on Research and Development in Information Retrieval	AC,GO
ACM Symposium on User Interface Software and Technology	WS,AC,CS,EB,GO
Americas Conference on Information Systems	WS,CS,EB,EM,GO
AoM Organizational Communication and Information Systems	EB
Australasian Conference on Information Systems	WS,CS,EB,EM,GO
British Computer Society Conference on Human-Computer Interaction	AC,GO
Computer Supported Collaborative Learning	WS,GO
Conference on Innovative Data Systems Research	GO
European Conference on Information Systems	WS,CS,EB,GO
Hawaii International Conference on System Sciences	WS,CS,EB,IE,GO
IEEE International Conference on Services Computing	WS,CS,IE,GO
IEEE International Conference on Web Services	WS,CS,EB,IE,GO
IEEE International Symposium on Wearable Computing	EM,IE,GO
IEEE Symposium on Visual Languages and Human-Centric Computing (was VL)	WS,IE,GO
International Conference in Business Process Management	WS,EB
International Conference on Advanced Information Systems Engineering	WS,CS,GO
International Conference on Cooperative Information Systems	WS,CS,EB,IE,GO
International Conference on Design Science Research in Information Systems and Technology	CS,GO
International Conference on Formal Ontology in Information Systems	WS,AC,CS,EB,GO
International Conference on Human Factors in Computing Systems	AC,GO
International Conference on Information Systems	WS,AC,CS,EB,GO
International Conference on Information Systems Development	WS,CS,EB,GO
International Conference on Intelligent User Interfaces	WS,AC,CS,EB,GO
International Conference on Security in Pervasive Computing	WS,GO
Internet Measurement Conference	WS,AC,CS,IE,GO
Network and OS Support for Digital A/V	AC,GO

Name	*Libraries*
Pacific Asia Conference on Information Systems	WS,CS,EB,GO
Tangible, Embedded, and Embodied Interaction	AC,CS,EB,GO

Appendix III SLR: Conducting SLR

Summary of the conducted SLR search can be seen in table below. Total number of studies found in 2010 and 2014 were, respectively, 949 and 546. All the citations, including abstracts, were imported to EndNote X3, which was used as a citation manager software during the research.

Summary of Systematic Literature Review results

Database	*Number of hits*	
	-2010	*2010-2014*
SciVerse Science direct[8]	376	6
ProQuest[9]	163	65
Web of Science (ISI)	44	11
ACM	144	146
CSA[10]	20	-
EBSCOhost	35	46
Emerald	87	39
IEEEXplore	22	44
JSTOR	0	18
Sage Premier	0	30
Wiley Online Library[11]	0	127
Google Scholar	55	14
CiteSeerX[12]	0	0
Total	*949*	*546*

Duplicates were first removed by using EndNote's *Find Duplicates* command. Some imported citations used different formats for instance in author fields, so not all of them were correctly identified by EndNote. Remaining duplicates were removed manually. After removing duplicates, 849 and 514 results remained. Next the results that were not scientific publications were removed. These results were for example indexes of conference proceedings, non-scientific books and book chapters, press releases, manuals, user guides, etc. After this phase, 597 and 450 publications remained. Next the metadata was search for "enterprise architecture", which gave 176 and 171 hits.

[8] In 2010: Science Direct (Elsevier)
[9] In 2010: ABI/Inform (ProQuest)
[10] In 2014: Part of ProQuest results
[11] In 2010: Wiley InterScience
[12] In 2010: CiteSeer

Next the abstracts of remained documents were read to identify candidates for *primary studies*. Candidates in a sense that it was not always possible to identify the type of the research based barely on metadata. If there was no abstract available, citation was manually fetched again. Abstracts were briefly reviewed and short notes about the contents of each publication were made. Some duplicates were found and those were removed. 154 and 156 documents were identified as candidates for primary studies.

Next the inclusion criteria (see Box 3.1) were applied. Based on the metadata and research notes made in previous phase, the document was included if it was clear that it would contribute to EA adoption or for research method, and if the language was English. In 2014, the 2nd inclusion criteria was not applied as the interest was purely in EA adoption. It should be noted that studies that only introduced a new or extension to previous EA *frameworks* were not included. After this, 35 and 31 papers, respectively were left. List of the included studies can be seen in Appendix II.

Next the full texts of the studies were fetched and reviewed. Research notes were made and bibliographic information was corrected. For rigour scientific basis, after quality evaluation, some studies were not included in synthesis. A list of rejected studies and the reason for rejection can be seen in following table.

Papers Rejected in Quality Assessment

ID	*Reason for rejection*
2.	Not peer reviewed, but an opinion article
5.	Not peer reviewed, but a report.
16.	Not peer reviewed, but a sponsored article
21.	Publication is peer reviewed, but this particular paper is not. A report of NAPA conference.

Papers excluded from EA adoption synthesis

ID	*Reason for exclusion*
1.	Paper is about ERP systems integration on construction industry.
4.	Paper is about Dell's adoption and design of an ERP system.
13.	Paper introduces a E-GOV EA framework, and is not about adoption
19.	Paper documents the implementation of a commercial logistics service deployment in Singapore airport.
28.	Introduces a mathematical model to be used as a decision model to decide whether SOA implementation should use integration or migration approach.
34.	Paper is not about adoption of EA, but a conceptual analysis of current literature in terms of e-government challenges.

ID	*Reason for exclusion*
35.	Paper is about EA's applicability to be adapted on an existing method in the context of small EA projects.
37.	Paper is about creating a mapping of ArchiMate and healthcare EA.
38.	Paper provides an overview of healthcare processes in the context of EA.
39.	Conceptual study proposing a method to guide strategic planning by combining 11 strategy models, EA, and business case method.
41.	Paper is not from a scientific publication
43.	Paper is a report of developing Integrating Healthcare Enterprise (IHE) supplement profile by using "EA interoperability process"
59.	Paper presents patterns of using EA descriptions as a basis for business process analysis in the ArchiMate language.
62.	Paper is author's publication from the same data than used in this thesis.

Appendix IV SLR: Publications Included in Systematic Literature Review

Publications included in Systematic Literature Review (SLR) conducted on March 29th 2010 and on January 8th 2014 are listed in the following tables. The column titled *Rank* refers to the ranking of Australian Research Council (2010a; 2010b). Additionally, T stands for Thesis.

Publications included in SLR 2010

ID	*Reference*	*Rank*
1.*	Acikalin, U., et al. (2008), 'Evaluating the integrative function of ERP systems used within the construction industry', in Alain Zarli and Raimar Scherer (eds.), *ECPPM 2008, 7th European conference on product and process modelling* (Sophia Antipolis, France: Taylor & Francis Group), 245-254.	-
2.*	Ambler, Scott W. (2003), 'Enterprise agility', *Computing Canada,* 29 (2), 9.	-
3.	Bellman, B. (2003), 'The role & function of enterprise architecture in e-Government', *International Conference on Politics and Information Systems: Technologies and Applications, Proceedings*, 1-16.	-
4.*	Fan, M., Stallaert, J., and Whinston, A. B. (2000), 'The adoption and design methodologies of component-based enterprise systems', *European Journal of Information Systems,* 9, 25-35.	A*
5.*	GAO (2003), 'Information Technology: Architecture Needed to Guide NASA's Financial Management Modernization: GAO-04-43', *Report to Congressional Committees* (Washington: United States General Accounting Office).	-
6.	Gregor, Shirley, Hart, Dennis, and Martin, Nigel (2007), 'Enterprise architectures: enablers of business strategy and IS/IT alignment in government', *Information Technology & People,* 20 (2), 96-120.	A
7.	Hjort-Madsen, Kristian (2006), 'Enterprise Architecture Implementation and Management: A Case Study on Interoperability', *HICSS-39. Proceedings of the 39th Annual Hawaii International Conference on System Sciences* (Kauai, Hawaii, USA).	A
8.	Hjort-Madsen, Kristian (2007), 'Institutional patterns of enterprise architecture adoption in government', *Transforming Government: People, Process and Policy,* 1 (4), 333-349.	-
9.	Iyamu, T. (2009), 'Strategic Approach for the Implementation of Enterprise Architecture: A Case Study of Two Organizations in South Africa', in X Feng, K Liu, and G Jiang (eds.), *ICISO. 11th International Conference on Informatics and Semiotics in Organisations* (Beijing University of Technology, Beijing, China), 375-381.	B
10.	Kaisler, H., Armour, Frank, and Valivullah, Michael (2005), 'Enterprise Architecting: Critical Problems', *HICSS-38. Proceedings of the 38th Annual Hawaii International Conference on System Sciences* (Waikoloa, Hawaii, USA).	A

ID	*Reference*	*Rank*
11.	Liimatainen, Katja, Heikkilä, Jukka, and Seppänen, Ville (2008), 'A Framework for Evaluating Compliance of Public Service Development Programs with Government Enterprise Architecture', *ECIME 2008. Proceedings of the 2nd European Conference on Information Management and Evaluation* (London, UK), 269-276.	C
12.	Liu, Jianxun, Zhang, Shensheng, and Hu, Jinming (2005), 'A case study of an inter-enterprise workflow-supported supply chain management system', *Information & Management,* 42 (3), 441-454.	A*
13.*	Liu, Yinbin and Li, Hongbo (2009), 'Applying Enterprise Architecture in China E-Government: A Case of Implementing Government-Led Credit Information System of Yiwu', *WHICEB2009. Eighth Wuhan International Conference on E-Business* (Wuhan, China), 538-545.	-
14.	Martin Nigel, Gregor, Shirley, and Hart, Dennis (2004), 'Using a common architecture in Australian e-Government: The Case of Smart Service Queensland', *ICEC'04. Proceedings of the 6th International Conference on Electronic Commerce* (Delft, The Netherlands: ACM), 516-525.	B
15.	Matthee, M. C., Tobin, P. K. J., and van der Merwe, P. (2007), 'The status quo of enterprise architecture implementation in South African financial services companies', *South African Journal of Business Management,* 38 (1), 11-23.	-
16.*	McKinnon, Cheryl (2005), 'Challenges Facing the Public Sector. An Infrastructure for 21st Century Government.', *KM World,* 14 (6), S3-S4.	-
17.	McNabb, David E. and Barnowe, J. Thad (2009), 'Trends Shaping Public Sector Transformation: Knowledge Management, E-Government and Enterprise Architecture', *Journal of Information & Knowledge Management,* 8 (1), 25-34.	C
18.	Miller, Philip Charles (2003), 'Enterprise architecture implementation in a state government', Doctoral Dissertation (University of Phoenix).	T
19.*	Møller, Charles, Chaudhry, Sohail S, and Jørgensen, Bent (2008), 'Complex service design: A virtual enterprise architecture for logistics service', *Information Systems Frontiers,* 10 (5), 503-518.	B
20.	North, Ernest, North, John, and Benade, Siebert (2004), 'Information Management and Enterprise Architecture Planning--A Juxtaposition', *Problems and Perspectives in Management,* (4), 166-179.	C
21.*	Pandy, Susan M. (2002), 'Expanding Electronic Government: The Challenges', *Public Manager,* 31 (3), 17-21.	C
22.	Rafidah, Abd Razak, et al. (2007), 'Enterprise Information Architecture (EIA): Assessment of Current Practices in Malaysian Organizations', *HICSS-40. 40th Annual Hawaii International Conference on System Sciences* (Waikoloa, Hawaii, USA).	A
23.	Ramnath, Rajiv and Ramanathan, Jay (2008), 'Integrating goal modeling and execution in adaptive complex enterprises', *Proceedings of the 2008 ACM symposium on Applied computing* (Fortaleza, Ceara, Brazil: ACM), 532-539.	B
24.	Richardson, Gary L., Jackson, Brad M., and Dickson, Gary W. (1990), 'A Principles-Based Enterprise Architecture: Lessons from Texaco and Star Enterprise', *MIS Quarterly,* 14 (4), 385-403.	A*

ID	*Reference*	*Rank*
25.	Saha, Pallab (2009), 'Architecting the connected government: practices and innovations in Singapore', *Proceedings of the 3rd International Conference on Theory and Practice of Electronic Governance* (Bogota, Colombia: ACM), 11-17.	-
26.	Shupe, Colleen and Behling, Robert (2006), 'Developing and Implementing a Strategy for Technology Deployment', *Information Management Journal,* 40 (4), 52-57.	B
27.	Themistocleous, Marinos and Irani, Zahir (2002), 'Evaluating and Adopting Application Integration: The Case of a Multinational Petroleum Company', *HICSS-35. Proceedings of the 35th Annual Hawaii International Conference on System Sciences* (Waikoloa, Hawaii, USA), 3715-3723.	A
28.*	Umar, Amjad and Zordan, Adalberto (2009), 'Reengineering for service oriented architectures: A strategic decision model for integration versus migration', *Journal of Systems and Software,* 82 (3), 448-462.	A
29.	Van der Raadt, Bas, Schouten, Sander, and van Vliet, Hans (2008), 'Stakeholder perception of enterprise architecture', *ECSA 2008, Second European Conference on Software Architecture* (Lecture Notes in Computer Science, 5292; Paphos, Cyprus: Springer), 19-34.	-
30.	Van der Raadt, Bas and van Vliet, Hans (2009), 'Assessing the Efficiency of the Enterprise Architecture Function', in Erik Proper, Frank Harmsen, and Jan L.G.Dietz (eds.), *Advances in Enterprise Engineering II. First NAF Academy Working Conference on Practice-Driven Research on Enterprise Transformation, PRET 2009, held at CAiSE 2009, Amsterdam, The Netherlands, June 11, 2009. Proceedings* (Lecture Notes in Business Information Processing, 28; Amsterdam, The Netherlands: Springer Berlin Heidelberg), 63-83.	-
31.	Van Steenbergen, Marlies, van den Berg, Martin, and Brinkkemper, Sjaak (2007), 'A Balanced Approach to Developing the Enterprise Architecture Practice', in Joaquim Filipe, José Corderio, and Jorge Cardoso (eds.), *ICEIS 2007, 9th International Conference on Enterprise Information Systems* (Funchal, Madeira, Portugal), 240-253.	C
32.	Van Veenstra, A. F. and Zuurmond, A. (2009), 'Opening the Black Box: Exploring the Effect of Transformation on Online Service Delivery in Local Governments', *Electronic Government, Proceedings,* 5693, 234-244.	-
33.	Weerakkody, Vishanth, Janssen, Marijn, and Hjort-Madsen, Kristian (2007), 'Integration and Enterprise Architecture Challenges in E-Government: A European Perspective', *International Journal of Cases on Electronic Commerce,* 3 (2), 13-35.	-
34.*	Wu, Raymond Cheng-Yi (2007), 'Enterprise integration in e-government', *Transforming Government: People, Process and Policy,* 1 (1), 89 - 99.	-
35.*	Ylimäki, Tanja and Halttunen, Veikko (2006), 'Method engineering in practice: A case of applying the Zachman framework in the context of small enterprise architecture oriented projects', *Information, Knowledge, Systems Management,* 5 (3), 189-209.	C

Publications included in SLR 2014

ID	*Reference*	*Rank*
36.	Adhikari, G. P. (2011). National ID project of Nepal: future challenges. *Proceedings of the 5th International Conference on Theory and Practice of Electronic Governance.* Tallinn, Estonia: ACM.	-
37.*	Ahsan, K., Shah, H. & Kingston, P. (2010). Healthcare Modelling through Enterprise Architecture: A Hospital Case. *In:* Information Technology: New Generations (ITNG), 2010 Seventh International Conference on, 12-14 April 2010 2010. 460-465.	-
38.*	Ahsan, K., Shah, H. & Kingston, P. (2010). Patients' Processes in Healthcare: an Abstract View Through Enterprise Architecture. *Proceedings of the International Conference on Information Management & Evaluation*, 459-466.	-
39.*	Aldea, A., Iacob, M.-E., Quartel, D. & Franken, H. (2013). Strategic planning and enterprise architecture. *In:* Enterprise Systems Conference (ES), 2013, 7-8 Nov. 2013 2013. 1-8.	-
40.	AlSoufi, A. (2012). Bahrain National Enterprise Architecture Framework: a Platform towards a GCC EA Initiative. *GSTF Journal on Computing,* **2**, 73-80.	-
41.*	Bruckner, J. (2010). Capturing Value From Business Process Improvement. *Baseline*, 53-53.	-
42.	Carrillo, J., Cabrera, A., Román, C., Abad, M. & Jaramillo, D. (2010). Roadmap for the implementation of an enterprise architecture framework oriented to institutions of higher education in Ecuador. *In:* Software Technology and Engineering (ICSTE), 2010 2nd International Conference on, 2010. IEEE, V2-7-V2-11.	-
43.*	DePalo, P. & Song, Y.-T. (2012). Healthcare interoperability through enterprise architecture. *Proceedings of the 6th International Conference on Ubiquitous Information Management and Communication.* Kuala Lumpur, Malaysia: ACM.	-
44.	Espinosa, J. A., Armour, F. & Boh, W. F. (2011). The Role of Group Cognition in Enterprise Architecting. *In:* System Sciences (HICSS), 2011 44th Hawaii International Conference on, 4-7 Jan. 2011 2011. 1-10.	A
45.	Hazen, B. T., Kung, L., Cegielski, C. G. & Jones-Farmer, L. A. (2014). Performance expectancy and use of enterprise architecture: training as an intervention. *Journal of Enterprise Information Management,* **27**, 6-6.	C
46.	Hiekkanen, K., Korhonen, J. J., Collin, J., Patricio, E., Helenius, M. & Mykkänen, J. (2013). Architects' Perceptions on EA Use -- An Empirical Study. *In:* Business Informatics (CBI), 2013 IEEE 15th Conference on, 15-18 July 2013 2013. 292-297.	-
47.	Iyamu, T. (2011). Engineering Change Through the Domains of Enterprise Architecture. *Proceedings of the European Conference on Information Management & Evaluation*, 222-230.	C
48.	Iyamu, T. (2011). Enterprise Architecture as Information Technology Strategy. *In:* Commerce and Enterprise Computing (CEC), 2011 IEEE 13th Conference on, 5-7 Sept. 2011 2011. 82-88.	-

ID	*Reference*	*Rank*
49.	Lemmetti, J. & Pekkola, S. (2012). Understanding Enterprise Architecture: Perceptions by the Finnish Public Sector. *In:* Scholl, H., Janssen, M., Wimmer, M., Moe, C. & Flak, L. (eds.) *Electronic Government.* Berlin: Springer.	-
50.	Makiya, G. K. (2012). *A multi-level investigation into the antecedents of Enterprise Architecture (EA) assimilation in the U.S. federal government: a longitudinal mixed methods research study.* 3530104 Ph.D., Case Western Reserve University.	T
51.	Medini, K. & Bourey, J. P. (2012). SCOR-based enterprise architecture methodology. *International Journal of Computer Integrated Manufacturing,* **25**, 594-607.	B
52.	Mezzanotte, D. M., Dehlinger, J. & Chakraborty, S. (2010). On Applying the Theory of Structuration in Enterprise Architecture Design. *In:* Computer and Information Science (ICIS), 2010 IEEE/ACIS 9th International Conference on, 18-20 Aug. 2010 2010. 859-863.	C
53.	Nassiff, E. (2012). *Understanding the Value of Enterprise Architecture for Organizations: A Grounded Theory Approach.* 3523496 Ph.D., Nova Southeastern University.	T
54.	Nogueira, J. M., Romero, D., Espadas, J. & Molina, A. (2013). Leveraging the Zachman framework implementation using action – research methodology – a case study: aligning the enterprise architecture and the business goals. *Enterprise Information Systems,* **7**, 100-132.	C
55.	Närman, P. & Ericsson, E. (2011). Case study: Merging technology management methods. *In:* Technology Management in the Energy Smart World (PICMET), 2011 Proceedings of PICMET '11:, Jul 31 - Aug 4 2011. 1-11.	A
56.	Pascot, D., Bouslama, F. & Mellouli, S. (2011). Architecturing large integrated complex information systems: an application to healthcare. *Knowledge and Information Systems,* **27**, 115-140.	B
57.	Rai, A., Venkatesh, V., Bala, H. & Lewis, M. (2010). Transitioning to a Modular Enterprises Architecture: Drivers, Constraints, and Actions. *MIS Quarterly Executive,* **9**, 83-94.	A
58.	Razak, R. A., Dahalin, Z. M., Ibrahim, H., Yusop, N. I. & Kasiran, M. K. (2011). Investigation on the importance of enterprise architecture in addressing business issues. *In:* Research and Innovation in Information Systems (ICRIIS), 2011 International Conference on, 23-24 Nov. 2011 2011. 1-4.	-
59.*	Šaša, A. & Krisper, M. (2011). Enterprise architecture patterns for business process support analysis. *Journal of Systems and Software,* **84**, 1480-1506.	A
60.	Sembiring, J., Nuryatno, E. T. & Gondokaryono, Y. S. (2011). Analyzing the Indicators and Requirements in Main Components Of Enterprise Architecture Methodology Development Using Grounded Theory in Qualitative Methods. *Society of Interdisciplinary Business Research Conference.* Bangkok.	-
61.	Struijs, P., Camstra, A., Renssen, R. & Braaksma, B. (2013). Redesign of Statistics Production within an Architectural Framework: The Dutch Experience. *Journal of Official Statistics,* **29**, 49-71.	-

ID	*Reference*	*Rank*
62.*	Syynimaa, Nestori (2012), 'The art of Shooting the Moving Goal - Explorative Study of EA Pilot', *Proceedings of the European Conference on Information Management & Evaluation*, 302-306.	C
63.	Unhelkar, B. & Ginige, A. (2010). A framework to derive holistic business transformation processes. *In:* e-Business (ICE-B), Proceedings of the 2010 International Conference on, 26-28 July 2010 2010. 1-7.	B
64.	Valtonen, K., Mäntynen, S., Leppänen, M. & Pulkkinen, M. (2011). Enterprise Architecture Descriptions for Enhancing Local Government Transformation and Coherency Management: Case Study. *In:* Enterprise Distributed Object Computing Conference Workshops (EDOCW), 2011 15th IEEE International, Aug 29-Sep 2 2011. 360-369.	-
65.	Van der Merwe, A., Gerber, A. & van der Linde, J. (2013). The Impact of managerial Enterprise Architecture decisions on software development employees. *In:* Enterprise Systems Conference (ES), 2013, 7-8 Nov 2013. 1-7.	-
66.	Vasilescu, C. (2012). General Enterprise Architecture Concepts and the Benefits for an Organization. *7th International Scientific Conference, Defence Resources Management in the 21st Century.* Braşov: Romanian National Defence University, Regional Department of Defence Resources Management Studies.	-

Appendix V Mapping EA Adoption Factors to Theory and Intellectual Questions

#	*Organisation related factors*
F1	Organisation structure
F2	Change management capability
F3	Need of change in organisational culture
F4	Organisation's capability to adopt changes
F5	IT portfolio management
F6	Strategy driven change
F7	Structured decision making process
F8	Conformance in change
F9	EA frameworks' lack of focus on social perspective
F10	EA adoption brings cultural clash to surface
F11	Social perspective is important
F12	EA is more about people than technology
F13	Resistance to change
F14	Importance of leadership
F15	Support of top management
F16	Organisational position of EA function
F17	Communication
F18	Clear goal set for the EA adoption set by the organisation

#	*EA related factors*
F19	Selection of the EA framework
F20	Vague definition of EA
F21	Use of principles
F22	Experience and skills of EA staff

#	*Environment related factors*
F23	Initiator of EA adoption
F24	Interoperability issues of related EAs
F25	Steering power of external parties

#	*Organisation related questions*
TR1	What is organisation's capability to adopt changes?
TR2	What is the level of organisation's change management capability?
TR3	What is the level of change resistance in the organisation?
TR4	What is the level of organisation IT portfolio management?
TR5	Is there a champion that drives EA or similar initiatives?
TR6	Does top management provide adequate support to EA or similar initiatives?
TR7	Where is EA positioned in an organisation?
TR8	Who is responsible for EA?
TR9	Is organisation wide communication in place?
TR10	What is the level of inter-stakeholder communication?
TR11	How is new initiatives communicated in organisation?
TR12	Is there a clear goal set for the EA pilot?
TR13	Is there a business case to be solved with EA?
TR14	Is EA related to organisations strategy?
TR15	What are stakeholders' expectations and are they conflicting?
TR16	Are expectations in line with stakeholders' formal role?

#	*Environment related questions*
TR17	Is EA adopted to satisfy external pressure?
TR18	How is EA related to government or similar EAs?
TR19	How EA is coordinated in government level?
TR20	Can EA be forced to be used by government?

#	*Enterprise Architecture related questions*
TR21	How is EA framework selected?
TR22	Could selected EA framework used as is?
TR23	Is EA definition too vague?
TR24	Are principles used?
TR25	Is there enough EA skills?

#	*Organisation related questions*
IQ1	Think about some major change(s) your organisation have faced during the past few years. Describe such a change and how it was conducted. Which challenges, if any, the change faced.
IQ2	Describe the process how new information systems are defined, acquired or implemented, and introduced in your organisation.
IQ3	Describe how new development initiatives are introduced in your organisation. Who or which party is driving such initiatives? How important this is for the success of the initiative?
IQ4	Describe on what basis are development initiatives given resources in your organisation.
IQ5	Describe how EA is organised in your organisation.
IQ6	Describe how communication is organised in your organisation. How about between external stakeholders?
IQ7	About EA pilot, explain what are your or your organisation's expectations for the pilot. How are they related to your organisation's strategy?
IQ8	Which kind of expectations from other stakeholders have you faced/know?

#	*Environment related questions*
IQ9	Explain how EA pilot or similar initiatives are related to the government level programs. How are such programs coordinated? What are the power relationships in such coordination?

#	*Enterprise Architecture related questions*
IQ10	Tell me about EA pilot, explain how was the used framework selected? Does the framework require any modification to suit your purposes? Explain. On which kind of principles is the EA pilot based on? Explain in your own words EA and related terms.
IQ11	Explain your and your organisation's EA experience. Has there been any training during the pilot? Which parts of EA, if any, you think your organisation has most challenges? Have you used contracted specialists/consultants during the pilot?

Appendix VI REAP Validation: Interview form

Appendix VIIREAP Validation: Codes and References

Category	*Sources*	*References*
Strategic Level of EA	19	23
Glue between business and IT	9	10
Link between strategy and execution	10	10
Means for organizational innovation and sustainability	3	3
Changes	20	29
Changes in functions	7	7
Changes in power within the organisation	6	6
Changes in processes	13	16
Changes in values	0	0
Change resistance	**21**	**63**
During execution	*14*	*21*
Other	11	13
Capabilities gap	6	7
Collective action problems	0	0
Cynicism	1	1
Embedded routines	5	5
Leadership inaction	0	0
Political and cultural deadlocks	8	8
Deep rooted values	1	1
Departmental politics	6	6
Forgetfulness of the social dimensions of changes	0	0
Implementation climate and relation between change values and organisational values	1	1
Incommensurable beliefs	0	0
During planning	*19*	*42*
Lack of creative response	7	7
Fast and complex environmental changes	2	2
Inadequate strategic vision	5	5
Resignation	0	0
Low motivation	5	5
Cannibalisation costs	1	1
Cross subsidy comforts	0	0
Different interest among employees and management	4	4
Direct costs of change	0	0
Past failures	0	0
Perception, Interpretation	18	30
Communication barriers	14	22
Denial	0	0
Implicit assumptions	0	0
Myopia	0	0
Organisational silence	6	6
Perpetuation of ideas	2	2

Appendix VIII REAP Validation: Interview Excerpts in Finnish

Tavoitteet:
"Tälle pilotille sinällään niin tärkein tavote että me ens vuoden puolella jo käytettäs niinku työskentelyssä tämmöstä kartturimallia, eli koko korkeakoulujen kokonaisarkkitehtuurimallia et se on se ensisijainen tavoite..". **Pilotti on ensimmäinen missä kokeillaan ja harjoitellaan, sekä kehitetään käyttöönotettua mallia.**

Strategia:
Keskeisiä on perustoimintojen ja IT-toimintojen liittäminen tiiviimmin toisiinsa, että IT voi paremmin perustoimintoja (opetus ja TK) ja prosesseja tukea. Toinen keskeinen on ajasta ja paikasta riippumaton työskentely, kolmas kehitystyön nopeuttaminen.

Coding of answer ID26 to IQ 7

Päivitetyssä strategiassa on mainittu, että yliopisto osallistuu RAKETTI hankkeeseen. **Käsittää liittyvän enemmän tietojärjestelmiin.**

Coding of answer ID54 to IQ 7

Muutos:
".. itse asiassa tää on ollu pelkkää suurta muutosta..", viimeisin suuri muutos kansainvälistyminen.

Toteutus:
..
Meillä tarkoitti sitä, että useamman vuoden aikana syntyi päätökset, jossa aloitettiin kuusi vieraskielistä koulutusohjelmaa. Suunnitelmien mukaan toteutuessaan päästään tavoitteeseen, jossa 7% opiskelijoista on ulkomaalaisperäisiä. Tämä on muuttanut kulttuuria siten, että seitsemässä koulutusohjelmassa (yksi Master tason ko.) opetus annetaan englanninkielellä.
..
Haasteet:
..
Sisäisten tulosneuvotteluiden perusteella on tullut tunne, että ainakin osittain on voitu vastata näihin haasteisiin. ***"..mut tää oli ihan selvästi, hypättiin suolle ja toivottiin että selvitään."*****, kyllä ollaan varsin kohtuullisesti selvitty ja palaute opiskelijoiltakin on kohtuullista.**
..

Coding of answer ID10 to IQ1

Muutos:
Viimeinen 13 vuotta on ollut jatkuvaa muutosta kokonaisuuden osalta. Ammattikorkeakouluun tuli mukaan uusia oppilaitoksia, toiminnan jakautuminen ammattikorkea- ja toisen asteen koulutukseen, sekä aikuiskoulutuksen liikelaitoksen perustaminen. Pari vuotta on ollut "sulatteluaikaa", viimeisimmät muutokset ovat olleet toisella asteella. Fuusioita ja sisäisiä järjestelyitä, kuten toimialajaon muuttuminen ja yhteisten palveluiden perustaminen.
..
Haasteet:
Tietohallinnon toiminta on jäänyt näkymättömäksi, kun kaikki on sujunut "liian hyvin".
Systemaattinen projektinhallinta ja dokumentaatio on haaste. Projektimainen yhteistoiminta siten, että kaikki siihen sitoutuisivat. ***"..kokonaisuuden hanskassa pitäminen on jossain määrin haasteellista, mutta ei se mikään iso ongelmaa oo ollu.."***

Coding of answer ID22 to IQ1

Muutos:
Tietohallinto kun tuli taloon, mutta yksittäinen suuri muutos on amkin verkosto/liittymä.
..
Haasteita:
..
Haasteena oli "..että miten saadaan niinkun IT tukemaan tämmöstä verkostomaista työskentelyä.".
Pilottiin liittyvänä haasteena myös, että ***"..miten muu kuin IT-väki saadaan oikeesti niinkun tekemään käytännön työtä .."***

Coding of answer ID26 to IQ1

On kolmenlaisia järjestelmiä, yleiset toimistotyön perussovellukset, koulutustehtävän toimeenpanoon liittyvät järjestelmät (satoja) ja amkin hallinnon operatiiviset järjestelmät.

Perussovellusten hankinta kustannustehokkaasti IT puolelta. Koulutustehtävän järjestelmät opettajilta ja toiminnoilta. Hallinnon järjestelmät ko. alueen johtajilta, tietohallinto hoitaa integroinnin. Muutosvaiheessa hallinnon järjestelmät ovat olleet suurin haaste näistä kolmesta.

Operatiivisissa järjestelmissä *"..ihmisille tuppaa oleen vaikee tyytyä siihen et ne määrittelee tarvetta. Ne määrittelee sitä minkä nimisen ohjelman ne haluaa."*

Coding of answer ID05 to IQ 2

"Tuota noin, tuo on paha. Itteasias mä en ees tiedä kaikkee mitä täällä tapahtuu.". Kehitysasiat ovat kt-keskusten johtajien, rehtorin ja prosessinjohtajien välistä kommunikointia. Jos siis on tuon kuvion ulkopuolella, niin ei välttämättä tiedä asioista mitä amkissa käynnistellään.

Vetäjä:
2003 oli vakava tarkoitus, että suunnitellaan tietohallinnon sovelluksia omiin tarpeisiin. Siihen tarkoitukseen mallinnettiin prosesseja hyvin tarkkaan. Asia lähti liikkeelle tietohallinnossa toimivan projektin vetäjän toimesta, itse oli mukana viemässä laatujuttuja eteenpäin. ***"..ilmeisesti se tapa miten me se asia hoidettiin ei ollu hyvä, koska se ei niinkun, me ei saatu oikeestaan tätä niinku täyttä johdon tukee sinne taakse."*. Olimme asiassa itse ehkä liiankin aloitteellisia.**
..

Coding of answer ID46 to IQ 3

Enimmäkseen kehityshankkeet kuuluu peruspalkkaukseen, eli virkatyönä. Suunnittelu ja projektointi tavassa olisi kyllä kehitettävää, että voitaisiin aidosti resursoida.

Coding of answer ID46 to IQ 4

Kokonaisarkkitehtuurityötä ei ole tehty sillä nimellä aiemmin,
"..kokonaisarkkitehtuurityötähän olisi pitänyt tehdä silloin kun tätä yhdistymistä tota suunniteltiin."
"..sit varmaan jossain vaiheessa näin iso talo tarvis myös kokonaisarkkitehdin."

Coding of answer ID32 to IQ 5

Pilotin tuntemus muussa on johdossa on hyvin vähäistä. Tietohallintojohtaja ei ole ehtinyt pitää esitystä johtoryhmälle aloituksen jälkeen. Hallitus ei ilmeisesti tiedä hankkeesta mitään. Viestintä jää aika paljon projektipäällikön harteille. Tavallaan viestiminen johdolle myös tuloskorttiajattelun kautta, jossa eri johtajilla on kuvattuna päämäärät ja vuosittaiset toimenpidesuunnitelmat.

Coding of answer ID32 to IQ 6

Intranet on keskeisessä osassa, sähköpostin käyttöä on pyritty minimoimaan. Intrassa tiedotteita voidaan luokitella ja roolipohjaisesti niitä näytetään käyttäjille.
..
Johtamisjärjestelmässä on systemaattinen koneisto, jossa viestintä nousee alemmilta tasoilta ylemmäs. Vetäjät kuuluvat aina seuraavan tason johtoryhmään. Viestintä myös ylhäältä-alas. Esimiesten kautta liikkuvaan perinteiseen viestintään, eikä uuteen sähköiseenkään, luoteta 100%:sti. Siksi kummatkin käytössä.

Coding of answer ID05 to IQ 6

Appendix IX EAAM Evaluation: Expert Evaluation of EA Adoption Method

Appendix X EAAM Evaluation: Round I Translated Answers

#	*Cause*	*Target*	*Consequence(s)*
A1	Positively to the creation of basic documentation.	Documentation, QA system	Enhanced documentation
A2	Positively to the big picture	IM departments estimates of change targets	Anticipation and visualisation of change targets is improved
A3	Negatively, because it's broad and unfamiliar concept to management	Resistance and threshold of adoption may increase	Systematisation for instance in evaluation of changes is not achieved
A4	Method recognises the meaning of communicating the benefits to help in the formation of positive endeavour and in acquiring the mandate.	Method affects the central parameters of situational management, which is the organisation's individuals' willingness to change.	Likely shifts the distribution of willingness (to change) so that the mean would be more willing. On the other hand, the deviation may increase as part of the target group is not capable to digest the benefits in any form.
A5	Method recognises the creation of readiness by know-how to avoid failure caused by lack of knowledge.	Method affects the central parameters of situational management, which is the organisation's individuals' capability to change.	Among individuals with a good willingness to change, very high probability to have positive effect to knowledge distribution of EA practice and methods.
A6	Method recognises goal setting, implementation tracking and corrective actions in a phase, where prerequisites for the adoption are in place.	To assimilation of more persistent change to organisation by utilising reactive transactional leadership.	Limited affect to the assimilation of EA practice as a permanent part of organisation's activities. Top management's utilisation of cultural change management and experts' continuous practical and tool support has greater impact.
A7	Method includes previously mentioned phases to so called traditional adoption phases while taking functional dependency order into account to maximise the effect.	Correct phasing affects the motivation.	Correct phasing increases the relevancy and cohesion of tasks related to the adoption, and thus increases the motivation.

#	*Cause*	*Target*	*Consequence(s)*
A8	Architecting is still relatively new and therefore there are gaps in knowledge. There is a need for assessing and increasing the level of knowledge, as is the transformational leadership. However, in order to success in the assimilation of architecture practice the transactional leadership is needed.	Method increases management's and actors' prerequisites of adopting EA in organisation.	More realistic understanding of the scope and changes in knowledge needs required by EA adoption.
A9	The reason for the change is often well known, but the benefits caused by the change seldom. If the benefits can be communicated to target groups by using their understanding and viewpoint, the attitude towards the extra work caused by the change would be positive, as the extra work would be understood to be just temporary. Positive view to the future would courage over the difficult times.	Understanding of EA is typically very narrow and the holistic perception is not often in a good level. By training and familiarisation it is possible to create an understanding to handling complexity and multi-dimensional dependencies. Responsibility in organisation is created by understanding. Results oriented behaviour is achieved by using incentives and sharing responsibility to organisation.	When organisation have a capability to understand multi-dimensional dependencies, actions and related change components as well as related costs can be better anticipated. The extra time used to planning, training, and familiarisation can then be saved multiple times during the execution phase and mistakes having remarkable consequences can be minimised.
A10	Adoption is based strongly to the commitment of top-management and to communication of EA	Operations management, experts, IT-management, IT-experts and project managers, staff responsible for communications	Ensuring the commitment of top-management also in adoption of other similar concepts
A11	Benefits of EA are broadly bring out	The whole organisation, stakeholders	Awareness of benefits of EA; reduction of change resistance.
A12	Method describes the EA adoption in chronologically and logically, in project-like manner	Top-management, process improvers, QA organisation	Well-structured adoption can be used as a best-practice in other similar projects.
A13	Besides the top-management, the method takes into account the improvement of EA knowledge of other actors	The whole organisation, knowledge development in general	An example how to comprehensive develop knowledge

#	*Cause*	*Target*	*Consequence(s)*
A14	Via top-management commitment EA adoption is made obligatory to the rest of the organisation	The whole organisation	Top-management realises the effect of their own example
A15	It helps the user to understand or at least to ask from self the question of why EA should be adopted and why it is done. In the other words, adoption is not proceeded in the sake of adoption itself.	Affects the understanding of reasons and goals behind EA.	Creates motivation and commitment from reasons.
A16	Method affects, because it helps the responsible for the adoption to consider target groups and proper ways to influence and approach them.	Affects communication, its content and focus.	With better and more focused communication the required mandate and commitment is achieved.
A17	Method affects, because it brings out the importance of improving knowledge and forces to assess the organisation's capability to perform EA work.	Affects the identifying of organisational capabilities and assessing its improvement targets	By assessing organisational capability it's possible to identify the right and more influencing development targets and this way improve results of the adoption.
A18	Affects because it brings out the change management view point of EA adoption, e.g. it's all about changing the habits to perform development and should be regarded as change initiative.	Affects the change management and in choosing the appropriate leadership style	Considered and appropriate leadership styles help during the execution of change (adoption). A proper view point and approach in execution of change.
A19			Method assures that the reasons for actions are communicated
A20			Helps to shape the communication in proper way according to target group - a proper leadership view point

Appendix XI EAAM Evaluation: Round II Claims

#	*Claim*	*Src*
C1	Documentation of QA system is improved, because method has a positive effect in the creation of basic documentation	A1
C2	IM department's estimates of change targets are improved, because the anticipation of changes are improved and visualised.	A2
C3	Systemisation for instance in the estimation of changes is not achieved, because the resistance or threshold of adoption may increase.	A3
C4	The average of organisation's individuals' willingness to change will change to more positive, because the communication of benefits increases the formation of positive image and the acquirement the mandate from top-management.	A4
C5	Knowledge of EA practice and methods increases among organisation's individuals being willing to change, because the need for know-how readiness is recognised.	A5
C6	With reactive transactional leadership, a more persistent organisational change and assimilation of EA practice is achieved, because setting of the goals, tracking the implementation, and corrective actions are recognised after the prerequisites for the adoption are in place.	A6
C7	Motivation increases, because the phases added to the phasing of traditional adoption takes the functional dependencies into account and increases the relevancy and cohesion of tasks related to the adoption.	A7
C8	Top-management's and actors' understanding of the focus and required knowledge changes is more realistic, because the architecture work is still relatively new and there are gaps in the knowledge.	A8
C9	Top-management's and actors' prerequisites for adoption increases, because the assimilation of EA practice requires transactional leadership.	
C10	Benefits of the adoption and the temporal nature of the resulting extra work is understood better, because the benefits are communicated using the target group's comprehension and point of view.	A9
C11	Estimation of the operations and costs of the affecting change components increases, because by training and familiarisation it's possible to create an understanding to handle complexity and multi-dimensional dependencies.	
C12	Total costs of the adoption decreases, because the time used in planning, training, and familiarisation decreases errors during the execution phase.	
C13	Securing of top-management's commitment to adoption of EA and similar concepts increases, because the adoption is strongly based on top-management's commitment and communication of the adoption.	A10
C14	Understanding of the EA benefits increases and change resistance degreases in the whole organisation, because the benefits of EA are widely brought out.	A11
C15	Structural adoption serves as a best practice to the top-management, process developers, and QA-organisation also in other similar projects, because the adoption is described in project-like manner chronologically and logically.	A12
C16	The total development of organisational knowledge would be improved in general, because also other actors beside the top-management are taken into account.	A13
C17	The meaning of the top-management's own example for the organisation is becoming more aware, because by the commitment of the top-management also the rest of the organisation is obligated to the EA adoption.	A14

#	*Claim*	*Src*
C18	The commitment and motivation to the adoption increases, because the understanding of reasons and objectives of EA increases.	A15
C19	Improves commitments and possibilities to acquire the mandate, because the person responsible for adoption is helped to improve targeting and content of the communication, and to considering the appropriate influencing methods and approaches.	A16
C20	Results of the adoption are improved, because by assessing the organisational capabilities the appropriate and more effective development results can be identified.	A17
C21	Considered and appropriate leadership style helps in adoption because it is all about changing the way to perform development.	A18
C22	The reasons for actions will be communicated.	A19
C23	The leadership point of view is correct because the communication of EA is shaped according to the target group.	A20
C24	Eases management, because everybody has an equal level of knowledge.	A21
C25	Setting the target and objectives of the adoption can be performed faster and in managed manner because the participants has a common picture of concepts, objectives, and methods before the actual execution phase.	
C26	Definitions of the roles and tasks are naturally forming according to the target, because the communication using the language of the target group affects the understanding of the benefits of each group.	A22
C27	Utilisation of appropriate experts and assigning them to the appropriate task improves operations, because based on the assessment the most effective implementation group is found.	A23
C28	Top-managements support to EA as a continuous part of organisation's normal management and operational development increases, because the recognition of the purpose and justification of EA-work, and communication of benefits, builds the foundation to acquire the mandate of top-management.	A24
C29	Effects to the quality of results and to communicating them are positive, because the meaning of broad-enough knowledge is emphasised.	A25
C30	The probability of having results from the EA-work increases, because the proper leadership style, which fits to the organisation's culture, is used.	
C31	EA work might be done because forced and because of the pursued benefits, because the organisational pressure can be misused.	

Appendix XII Tiivistelmä (Finnish Abstract)

Viimevuosien aikana huomio kokonaisarkkitehtuuria kohtaan on kasvanut sekä tutkijoiden että alan toimijoiden keskuudessa. Kokonaisarkkitehtuuri (KA) voidaan määritellä (i) määrämuotoiseksi kuvaukseksi organisaation nyky- ja tavoitetiloista, sekä (ii) hallituksi muutokseksi näiden tilojen välillä sidosryhmien tavoitteisen saavuttamiseksi ja organisatorisen lisäarvon luomiseksi. Kokonaisarkkitehtuurin käyttöönotolla organisaatiot voivat saavuttaa useita hyötyjä, kuten päätöksenteon parantumisen, liikevaihdon lisääntymisen, kulujen vähentymisen, ja liiketoiminnan ja IT:n virtaviivaistamisen.

Vuonna 2011 Suomessa tuli voimaan laki julkisen hallinnon tietohallinnon ohjauksesta (ns. tietohallintolaki). Lain tarkoituksena on lisätä julkishallinnon tehokkuutta ja yhteentoimivuutta, sekä parantaa julkisten palveluiden saatavuutta. Laki edellytti julkishallinnon organisaatioiden aloittavan kokonaisarkkitehtuurin soveltamisen vuoteen 2014 mennessä. Myös korkeakoulut kuuluvat lain piiriin, joko suoraan tai epäsuorasti. Kokonaisarkkitehtuurin hyödyistä ja voimassa olevasta lainsäädännöstä huolimatta kokonaisarkkitehtuurin käyttöönotto- ja kypsyystasot ovat kuitenkin verrattain alhaisia. Tämä johtunee osin siitä, että kokonaisarkkitehtuurin käyttöönoton on havaittu olevan vaikeaa. Tästä syystä organisaatiot tarvitsevat käyttöönottoa helpottavia ratkaisuja.

Tässä väitöstutkimuksessa käytettiin suunnittelututkimusmenetelmää (Design Science) perinteisen kokonaisarkkitehtuurin käyttöönottomenetelmän parantamiseksi siten, että käyttöönoton onnistumisen todennäköisyys kasvaa. Tutkimuksessa kehitettiin aluksi käyttöönottoa selittävä malli, joka lähestyy käyttöönottoa muutosvastarinnan kautta. Käyttöönottoon liittyvien ongelmakohtien tunnistamiseksi mallin avulla analysoitiin kahtatoista vuonna 2010 KA-pilottiin osallistunutta suomalaista korkeakoulua. Tulosten perusteella suuri osa vastarinnasta aiheutui väärinymmärretystä kokonaisarkkitehtuurin käsitteistöstä, asenteista, sekä tarvittavien taitojen puutteesta. Niin sanottu perinteinen käyttöönottomenetelmä ei huomioi näitä haasteita.

Rajoitteiden poistamiseksi tutkimuksessa kehitettiin käyttöönottomenetelmästä parannettu versio. Menetelmän avulla organisaatiot voivat kasvattaa kokonaisarkkitehtuurin käyttöönoton onnistumisen todennäköisyyttä. Menetelmä auttaa organisaation ylimmän johdon tuen hankkimisessa, minkä on todettu olevan kriittisessä asemassa käyttöönoton onnistumisen kannalta. Lisäksi menetelmä auttaa tukemaan yksilöiden ja organisaation oppimista, minkä on myös todettu olevan tärkeä osa onnistunutta käyttöönottoa.