EXPLORING THE ROLES OF DIFFERENT ARTEFACTS IN ENTERPRISE ARCHITECTURE PRACTICE

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DECLARATION

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of this thesis is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed. I acknowledge the support I have received for my research through the provision of an Australian Government Research Training Program Scholarship.

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ABSTRACT

Enterprise architecture (EA) is a coherent whole of principles, standards and models for designing business processes, information systems and IT infrastructure in large organizations. Enterprise architecture consists of multiple EA artefacts that describe and/or model various aspects of an organization including high-level abstract principles, business processes and technical specifications to be used by both IT and business stakeholders for the purposes ranging from strategic planning to IT systems implementation. Using EA artefacts is expected to bring numerous benefits to organizations including improved strategic alignment, increased returns on IT investments and reduced costs of IT operations.

The development of EA artefacts requires significant investments of time and money. However, the organizational investments in developing EA artefacts often do not bring the expected benefits because of the usability issues associated with these EA artefacts. For instance, the U.S. Federal Government invested hundreds of millions of dollars in developing EA, but the resulting EA artefacts were largely unable to facilitate better decision-making. These common failures of EA efforts call for an investigation into the specific roles of different types of EA artefacts in an EA practice. The role of an EA artefact can be specified based on its informational contents, regular users, typical use cases and resulting organizational benefits. Despite the theoretical and practical importance of studying EA artefacts, the current EA literature offers no comprehensive theories explaining the practical roles of EA artefacts. In order to address this problem, this thesis develops a descriptive theory that explicates the roles of different types of EA artefacts in the context of an EA practice and explains the influence of various organizational and environmental factors on these roles.

This exploratory study followed a "case studies-based grounded theory" approach to develop an inductive theory of the roles of EA artefacts. The theory-building process is accomplished via analysing five in-depth case studies of large organizations with established EA practices. In the five cases, 31 semi-structured interviews were undertaken with different EA practitioners and stakeholders, and samples of 39 different types of EA artefacts were studied. The data were analysed using the iterative grounded theory methodology. The practical aspects of the resulting theory were then discussed with ten additional EA experts,

including EA practitioners and EA academics, who confirmed its validity and practical utility.

The resulting theory articulates six primary roles fulfilled by EA artefacts metaphorically titled as Context Setters, Instrument Providers, Knowledge Repositories, Project Implementers, Strategic Aligners and Value Estimators. Each of these roles is further explained in terms of supporting artefacts, informational contents, involved users, associated use cases and resulting benefits. For example, Context Setters include EA artefacts such as principles, maxims and policies that senior business leaders and architects use to lay out the basic rules, values and aims governing information systems planning for the whole enterprise to ensure consistency of decision-making. Similarly, Value Estimators include EA artefacts such as solution overviews and conceptual architectures used by architects and business leaders to assess the business value of proposed IT initiatives, make informed funding decisions and thereby improve efficiency of IT investments. These six highly EA-specific roles provide a comprehensive explanatory view of the practical roles of EA artefacts and offer an in-depth, detailed and context-specific theoretical understanding that advances the common view of EA artefacts as boundary objects between business and IT communities and elements of an actor-network representing an EA practice. Moreover, the resulting theory explains the relationships between the six identified roles of EA artefacts as well as the impact of internal and external environmental factors on these roles.

The results of this exploratory study contribute to the EA discipline a theory describing the roles of EA artefacts that helps refocus future EA research from studying EA as a whole to studying specific types of EA artefacts. The results of this study also provide evidence-based conceptual solutions to the most typical practical problems associated with using EA and can help organizations get more value from EA artefacts. Additionally, this study makes an empirical contribution to the EA discipline by demonstrating important empirical facts that question established theories, assumptions and beliefs existing in the EA discipline.

LIST OF PUBLICATIONS

Published Articles and Proceedings

1) Kotusev, S. (2018) "The TOGAF-Based Enterprise Architecture Practice: An Exploratory Case Study", *Communications of the Association for Information Systems*, Accepted for publication in March 2018.

2) Kotusev, S. (2017) "Enterprise Architecture: What Did We Study?", *International Journal of Cooperative Information Systems*, Vol. 26, No. 4, pp. 1-84.

3) Kotusev, S. (2017) "Conceptual Model of Enterprise Architecture Management", *International Journal of Cooperative Information Systems*, Vol. 26, No. 3, pp. 1-36.

4) Kotusev, S. (2017) "Critical Questions in Enterprise Architecture Research", *International Journal of Enterprise Information Systems*, Vol. 13, No. 2, pp. 50-62.

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8) Kotusev, S. (2016) "The History of Enterprise Architecture: An Evidence-Based Review", *Journal of Enterprise Architecture*, Vol. 12, No. 1, pp. 29-37.

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In-Progress Publications

1) Kotusev, S. "Exploring the Roles of Different Artefacts in Enterprise Architecture Practice", *European Journal of Information Systems*, Revise and resubmit.

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3) Kotusev, S. “Enterprise Architecture Artefacts: An Empirical Investigation”, *Journal of Information Technology*, Submitted for review.

4) Kotusev, S. “How to Organize Your Enterprise Architecture Practice with the CSVLOD Taxonomy”, *MIS Quarterly Executive*, Submitted for review.

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
ADM	Architecture Development Method
ANT	Actor-Network Theory
ARIS	Architecture of Integrated Information Systems
ARF	Architecture Review Forum
BCM	Business Capability Model
BPMN	Business Process Model and Notation
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CIO	Chief Information Officer
CMDB	Configuration Management Database
COO	Chief Operating Officer
CTO	Chief Technology Officer
DoDAF	Department of Defence Architecture Framework
EA	Enterprise Architecture
FEAF	Federal Enterprise Architecture Frameworks
GTM	Grounded Theory Method
IDEF	Integration DEFinition
IS	Information Systems
IT	Information Technology
ITIL	Information Technology Infrastructure Library

MODAF	Ministry of Defence Architecture Framework
PMO	Project Management Office
PRISM	Partnership for Research in Information Systems Management
ROI	Return on Investment
SLA	Service Level Agreement
SOA	Service Oriented Architecture
TAFIM	Technical Architecture Framework for Information Management
TEAF	Treasury Enterprise Architecture Framework
TOGAF	The Open Group Architecture Framework
TRM	Technology Reference Model
UML	Unified Modelling Language

CHAPTER 1: INTRODUCTION

This study focuses on enterprise architecture (EA) as an instrument for organization-wide information systems planning in general and on the roles of EA artefacts in particular. The study is motivated, on the one hand, by the need for advancing the theoretical foundation of EA artefacts research and, on the other hand, by the practical problems organizations face in using and benefiting from EA artefacts. The study addresses the existing uncertainty around the roles of specific types of EA artefacts by establishing a strong theoretical basis for further research on EA artefacts. To achieve this goal, this study follows the case studies-based grounded theory approach and builds a grounded theory explaining the roles of different types of EA artefacts in an EA practice.

This chapter provides an introduction to the thesis. Firstly, this chapter describes the overall background of this research and explains its theoretical and practical motivation. Then, this chapter describes the research aims, objectives, question, approach and design. Finally, this chapter explains the key outcomes of this study and outlines the general structure of the whole thesis.

1.1. The Concept of Enterprise Architecture

The term enterprise architecture (EA) has been defined in multiple various ways (Saint-Louis et al., 2017; Schoenherr, 2008). One of the first definitions was provided by Richardson et al. (1990), who defined EA as an architecture that defines and links data, hardware, software and communication resources of an organization. Later, Spewak and Hill (1992) described EA as a high-level blueprint for data, applications and technology used in an organization. Wagter et al. (2005) considered EA as a consistent set of models and rules that guide the design and implementation of processes, organizational structures, information flows and technical infrastructure in enterprises. Bernard (2012) defined EA as the analysis of an organization and documentation of its current and future states from an integrated strategy, business and technology perspective. Lankhorst (2013) argued that EA is a coherent whole of principles, methods and models that are used in the design and realization of organizational business processes, information systems and infrastructure.

Despite the existence of multiple slightly different definitions provided above, EA can be generally considered as a holistic description of an enterprise depicting the relationship between its business and IT components at various levels of granularity, which facilitates information systems planning and helps improve business and IT alignment. EA consists of multiple diverse EA artefacts ranging from high-level abstract principles to low-level technical diagrams (Bernard, 2012; Boar, 1999a) providing specific views of an organization and its IT landscape from different perspectives and viewpoints (Abraham, 2013; Winter and Fischer, 2006). For example, a business process model is an EA artefact describing the structure of organizational business processes, while an applications model is an EA artefact explaining the structure of the underlying IT systems landscape. A broad overview of proposed EA artefacts can be found in Appendix A.

Enterprise architecture artefacts can be organized according to logical structures typically called as EA frameworks (Sowa and Zachman, 1992; TEAF, 2000; van't Wout et al., 2010). These frameworks structure EA artefacts according to their domains, e.g. business, data, applications and technology (Bernard, 2012; FEAF, 1999; TOGAF, 2018), interrogatives, e.g. what, how and why (Schekkerman, 2006; van't Wout et al., 2010), abstraction levels, e.g. owner, designer and builder (Pulkkinen, 2006; Zachman, 1987), views, e.g. operational, systems and technical (DoDAF, 2007; MODAF, 2005), or segments, e.g. business units and lines of business (Bernard, 2012; FEAF, 1999). Most EA artefacts are represented graphically with flowcharts, models, blueprints or diagrams often using specific modelling notations, e.g. ArchiMate (Lankhorst, 2013), UML (Holt and Perry, 2010) or ARIS (Scheer, 1992).

Organizations spend considerable amounts of money on EA and EA artefacts. For instance, the U.S. Federal Government has invested more than $600 million in the development of EA artefacts for all governmental bureaus and agencies (GAO, 2006; GAO, 2015). European companies also invested multimillion-dollar amounts in developing EA artefacts (Ahlemann et al., 2012). EA artefacts are expected to be used by both business stakeholders (e.g. board of directors, business executives, strategic planners, etc.) and IT stakeholders (e.g. senior IT managers, enterprise architects, project managers, software developers, etc.) for the purposes of decision-making relevant to their responsibilities (Lankhorst, 2013). Using EA artefacts is expected to facilitate management decision-making (Ross et al., 2006), guide corporate strategic planning and management (Simon et al., 2014), translate the business strategy into specific IT solutions (Radeke and Legner, 2012), enable strategic change (Radeke, 2011), guide IS implementation (Bernard, 2012) and support effective organizational analysis to alleviate potential problems and inefficiencies (Narman et al., 2012a).

Despite these promises of EA benefits, the overall success rate of EA initiatives is considered to be unsatisfactory (Bloomberg, 2014; Holst and Steensen, 2011; Kemp and McManus, 2009). For instance, the U.S. Department of Defence invested significant amounts of money in developing EA artefacts, but hardly realized the anticipated benefits. It was reported that "even though [the Department of Defence] has spent more than ten years and at least $379 million on its business enterprise architecture, its ability to use the architecture to guide and constrain investments has been limited" (GAO, 2013, p. ii). Later it was confirmed that "the architecture does not enable [the Department of Defence] to produce reliable and timely information for decision-making purposes" (GAO, 2015, p. 28) and that "[the architecture] was generally not effective in achieving its intended outcomes and that its usefulness in achieving benefits, such as reducing the number of applications, was limited" (GAO, 2015, p. 16). Various authors also report that as much as 40% (Zink, 2009), 66% (Roeleven, 2010), 80% (DiGirolamo, 2009) or even more than 90% (Jacobson, 2007) of all EA programs fail to deliver expected business value and result in significant overspendings.

Although there has been some attention to EA artefacts in the existing EA literature, as discussed in detail later in Chapter 2, research into the practical roles of EA artefacts remains rather limited and still lacks a strong theoretical foundation. Firstly, most EA researchers (Alaeddini and Salekfard, 2013; Schmidt and Buxmann, 2011; Shanks et al., 2018; Tamm et al., 2011; Weiss et al., 2013) consider enterprise architecture largely as a useful "black box" without discussing its internal structure from the perspective of the roles of constituting EA artefacts. Secondly, the few researchers who intentionally investigated the roles of EA artefacts drawn from the perspectives of the boundary objects theory (Abraham, 2013; Abraham et al., 2013) and actor-network theory (Sidorova and Kappelman, 2010; Sidorova and Kappelman, 2011), but these theories provide only a very high-level view of EA artefacts and hardly explain the differences between the roles of different types of EA artefacts that can be used as part of an EA practice. Thirdly, the existing EA literature also focuses on studying in detail the roles of several narrow types of EA artefacts including principles (Greefhorst and Proper, 2011b; Haki and Legner, 2012; Hugoson et al., 2010), standards (Boh and Yellin, 2007) and core diagrams (Ross et al., 2006), but these studies hardly provide a complete and generalized picture of the roles of EA artefacts.

Consequently, the phenomenon of EA artefacts still remains under-researched and insufficiently understood, while a sound theorization of EA artefacts and their roles in an EA practice is currently missing in the EA literature. For this reason, more research on EA artefacts is needed to enhance our theoretical understanding of the roles of different types of

EA artefacts, mitigate common EA-related practical problems and maximise the business value of organizational investments in EA. Due to the need for a stronger theoretical foundation for EA artefacts and their roles in an EA practice, a grounded theory approach should be followed to develop a new theory explaining the roles of different types of EA artefacts and helping address the most typical practical problems with EA discussed in detail in the next section.

1.2. Problems with Enterprise Architecture

EA initiatives in organizations often face a number of typical problems (Bussells, 2006; Chuang and van Loggerenberg, 2010; Hauder et al., 2013; Hylving and Bygstad, 2018). These problems can be summarized into three key areas (Lohe and Legner, 2012; Lohe and Legner, 2014):

- Considerable efforts are needed to develop and maintain EA artefacts
- Low quality and usability of created EA artefacts
- Insufficient integration of EA programs into other organizational processes

1.2.1. Enterprise Architecture Artefacts Are Hard to Develop and Maintain

Substantial financial, human and time resources are necessary to develop EA artefacts (Gaver, 2010; Seppanen et al., 2009). The significant effort required to collect data and develop all the recommended EA artefacts is recognized as one of the topmost challenges of an EA practice (Kim and Everest, 1994; Roth et al., 2013; Segars and Grover, 1996). In order to develop a comprehensive set of EA artefacts, organizations have to overcome significant challenges caused by their large scope, high organizational complexity and significant number of people involved in the process (Lohe and Legner, 2014). Unsurprisingly, EA is highly criticized by practitioners for its “heaviness” since it is usually associated with the development of an unreasonable number of descriptive models (Lagerstrom et al., 2011). Moreover, the external business environment and internal IS context are constantly changing (Beeson et al., 2002; Sauer and Willcocks, 2002). This instability leads to the necessity of additional efforts to maintain a considerable volume of EA artefacts keeping them accurate and up-to-date (Gaver, 2010; Kim and Everest, 1994; Lohe and Legner, 2014; Segars and Grover, 1996). As Trionfi (2016, p. 40) indicated, “standard EA products become too complicated as the scope expands, requiring too many resources to produce or maintain as well as taking too long to create. By the time the products are complete, they are already outdated and have cost the organization too much". Unsurprisingly, 71.4% of companies recognize a quickly changing environment as a challenge for an EA practice (Hauder et al., 2013).

This practical problem can be attributed to the fact that the relative value of different types of EA artefacts in an EA practice is largely unclear. Although the EA literature describes many EA artefacts that can be used as part of an EA practice (Bernard, 2012; Spewak and Hill, 1992; TOGAF, 2018; van't Wout et al., 2010), it does not offer a theory capable of explaining which of these EA artefacts can be most valuable in practice and are worth being developed and maintained.

1.2.2. Quality and Usability of Enterprise Architecture Artefacts

The second problem is that after developing a comprehensive set of EA artefacts, these EA artefacts are often not used actively or even found to be essentially useless for decision-making purposes (Carvalho and Sousa, 2014; Kappelman, 2010). For instance, Hobbs (2012, p. 85) wrote that "[a commercial] organization that shall remain nameless established a large, award-winning architecture, which it documented in minute detail [...]. There was just one problem: It was so involved and complicated that no one attempting to use it had any idea where to start. The teams that did attempt to use the elaborate architecture ended up significantly over-engineering the solution, which led to major scope, time and cost overruns. [...] After several well-publicised project failures, with multimillion dollar consequences, the organization eventually reorganized its EA efforts".

An overly conceptual nature, inflexibility, obsolescence, incomprehensibility for people untrained in modelling, wrong level of detail and mismatch with the real information needs of EA stakeholders are recognized as common problems that undermine the usability of EA artefacts (Gaver, 2010; Kim and Everest, 1994; Lohe and Legner, 2014; Segars and Grover, 1996). For instance, Trionfi (2016, p. 40) indicated that "creating and reading most EA products require special skill sets, not commonly held throughout the enterprise. Consequently, the information captured in EA products cannot be conveyed quickly, especially to executive-level decision-makers". Trionfi's observation is similar to the one of Blumenthal (2007, p. 63), who asserted that "the problem is EA information often is unintelligible. The necessary data might be there, but the presentation is so poor that the decision-maker's ability to use it is impaired. If information is not understandable, accessible and easily navigable, then it quickly becomes “shelfware,” meaning it sits on a shelf collecting dust”.

A survey of 140 companies by Roth et al. (2013) shows that the unsatisfactory quality of EA artefacts is one of the key challenges of an EA practice troubling 55.0% of companies. The survey of 105 companies by Hauder et al. (2013) demonstrates that 67.7% of companies find EA artefacts too technical and IT-specific, 37.6% of companies find them out-dated, 33.7% of companies find them too complex and 27.1% of companies find them improperly detailed. These findings echo the criticism of EA efforts by Ross et al. (2006, p. vii) for “their remoteness from the reality of the business and their heavy reliance on mind-numbing detail represented in charts that look more like circuit diagrams than business descriptions and that are useful as little more than doorstops”.

This problem suggests that the theories on EA artefacts need to offer appropriate conceptualizations for reflecting the intended audience and appropriate presentation formats of specific types of EA artefacts. Although the EA literature discusses various EA artefacts (Bernard, 2012; Spewak and Hill, 1992; TOGAF, 2018; van't Wout et al., 2010) and various EA stakeholders (Niemi, 2007; Thornton, 2007; van der Raadt et al., 2010), it does not theorize on which EA artefacts are intended for these EA stakeholders, what information these EA artefacts provide to them and how this information is presented.

1.2.3. Organizational Integration of Enterprise Architecture Programs

EA programs in some organizations are also criticized for “living” in a separate reality from the rest of the organization and eventually ending up in “ivory towers” (Ambler, 2010; Burton, 2009; Hauder et al., 2013; Hobbs, 2012; Jacobson, 2007; Levy, 2014; van der Raadt et al., 2010; van der Raadt and van Vliet, 2008). EA programs often lead to the creation of “paper tigers” instead of working architectures if they are not sufficiently integrated into organizations (Wagter et al., 2005). The lack of benefits for employees from using EA artefacts, unclear goals of EA initiatives, perceived technical focus of EA, limited participation of enterprise architects in decision-making committees and the existence of a parallel EA management cycle are the major symptoms of insufficient integration of EA programs (Lohe and Legner, 2014). “The prevailing belief was that if one built the architecture, the owners and operators would come. History has shown, however, that few organizations actually “operationalized” the architecture—and the owners and operators did not come. The inherent flaw from the beginning was the lack of a standard framework or methodology that allows the architecture to be inserted into the decision making process" (Thomas et al., 2000, p. 2).

Focus on paper-ware (Jacobson, 2007), lack of interest in EA artefacts among non-IT stakeholders (Kim and Everest, 1994; Segars and Grover, 1996), descriptive emphasis (Bloomberg, 2014), unclearly defined roles and responsibilities (Lucke et al., 2010), poor EA governance structures (Seppanen et al., 2009), absence of adequate EA compliance processes (Zink, 2009) and the lack of integration into a regular enterprise life cycle (Kaisler et al., 2005) lead to the alienation of EA programs and ultimately confine them into their "ivory towers". "The paradox is that EA efforts are aimed at integrating the various organizational elements, whereas the architecture efforts are not integrated in the organization", comments this problem an e-government interviewee (Janssen, 2012, p. 32). Similarly, a practicing chief enterprise architect of a large telecommunication company comments that "architectures, like fondue sets and sandwich makers, are rarely used. We occasionally dig them out and wonder why we ever spent the money on them. [Our] experience resonates with that of many other large corporations: architectures have emerged as erudite, elegant abstractions of the world, but they gain no momentum, unable to find traction in a world they profess to model" (Fonstad and Robertson, 2004, pp. 1-2). Therefore, the development of EA artefacts often becomes an end unto itself (Gaver, 2010). Unsurprisingly, the establishment of an adequate engagement between business activities and EA activities is found to be the critical success factor of EA initiatives able to turn an isolated EA program into a profitable one (Levy, 2014).

This practical problem suggests that the theories on EA artefacts should pay significant attention to the questions related to the practical usage and expected benefits resulting from specific types of EA artefacts. Although the EA literature lists various EA artefacts (Bernard, 2012; Spewak and Hill, 1992; TOGAF, 2018; van't Wout et al., 2010) and various ways to use EA to benefit organizations (Lankhorst, 2013; Narman et al., 2012a; Simon et al., 2014), it does not theorize on how specific types of EA artefacts are used, when they are used and how they benefit organizations.

1.3. Research Aims, Objectives and Questions

The analysis provided above demonstrates that all the three typical practical problems with EA can be, to a large extent, attributed to the common underlying root cause: current understanding of the practical roles of different EA artefacts in the context of an EA practice is insufficient. Since the term and concept of "role" in relation to EA artefacts has no commonly accepted definition and is often used loosely in the EA literature, the role of an EA artefact in the context of this thesis can be defined and understood specifically as the set of its key properties primarily including its informational contents, regular users, typical use cases and corresponding organizational benefits. These four properties, or facets, represent the most prominent "orthogonal" dimensions of the phenomenon of EA widely acknowledged and discussed in literature. For instance, numerous publications discuss what information EA should contain and present (Iyer and Gottlieb, 2004; Pulkkinen, 2006; Schekkerman, 2006; Sowa and Zachman, 1992), who key users and stakeholders of EA are (Niemi, 2007; van der Raadt et al., 2010; van der Raadt et al., 2008; Verley, 2007), how EA can be applied and used (Narman et al., 2012b; Niemi and Pekkola, 2017; Rahimi et al., 2017; Simon et al., 2014) and what organizational benefits using EA leads to (Lange et al., 2012; Plessius et al., 2014; Shanks et al., 2018; van Steenbergen et al., 2011). From this perspective, understanding of the practical roles of different EA artefacts requires an understanding of what useful information they provide, who the key users of this information are, how this information is used and what benefits result from this usage.

Improving our conceptual understanding of the practical roles of different EA artefacts, including their role-specific informational contents, users, usage and benefits, can help alleviate the three most significant practical problems with EA described above and, thereby, increase the success rate of EA initiatives. Consequently, the practical roles of EA artefacts remain the question of significant theoretical and practical importance for the entire EA discipline. In order to address the existing theoretical gaps and practical problems related to EA artefacts, this study aims to explore the roles of different types of EA artefacts in established EA practices. In particular, the main goal of this study is to develop a theory of the roles of EA artefacts explaining what different types of EA artefacts describe, who uses these EA artefacts, how exactly these EA artefacts are used and what benefits are typically associated with using these EA artefacts.

The general research question of this study is:

- What are the roles of different types of EA artefacts in an EA practice?

Due to the evident presence of both the theoretical and practical motives behind the research question, as explained above, objectives of this study are twofold. On the one hand, this study implies developing a full-fledged theory explaining the roles of EA artefacts. On the other hand, this study implies providing some actionable guidance for solving typical practical problems with EA and, if possible, creating a convenient practical tool for guiding EA practices based on the developed theoretical foundations.

1.4. Research Approach and Design

As the key aim of this study is to develop a new inductive theory of the roles of EA artefacts, a grounded theory method is used as the general research strategy to conduct the study (Corbin and Strauss, 1990; Strauss and Corbin, 1998). In particular, the study adopted the case studies-based grounded theory method (Fernandez, 2004; Fernandez and Lehmann, 2011). This method implies using the fundamental canons of the grounded theory method, however, based on the data collected via case studies.

As part of the theory-building procedure, five diverse organizations with established EA practices working in different industry sectors were studied. Data from the five case organizations were collected from 31 face-to-face semi-structured interviews with participants of EA practices and from 39 organizational EA artefacts. The practical aspects of the resulting grounded theory were then discussed with ten additional EA experts (including EA practitioners and academics) where the validity and practical value of the theory were confirmed.

1.5. Outcomes of the Study

The resulting descriptive theory developed in this study articulates six primary roles fulfilled by EA artefacts metaphorically titled as Context Setters, Instrument Providers, Knowledge Repositories, Project Implementers, Strategic Aligners and Value Estimators. Specifically, Context Setters include EA artefacts such as principles, maxims and policies that senior business leaders and architects use to lay out the basic rules, values and aims governing information systems planning for the whole organization to ensure consistency of decision-making. Instrument Providers are represented by EA artefacts such as technology reference models, guidelines and patterns that are created by architects within the IT department to establish a set of proven and reusable tools for implementing new IT projects with a maximum speed, minimal risks and costs. Knowledge Repositories include EA artefacts such as platform architectures, one-page diagrams and inventories that are maintained up-to-date by architects to provide an accurate baseline view of the existing IT landscape, allow its global optimization and facilitate project planning. Project Implementers are represented by EA artefacts such as solution designs and detailed designs that are developed collaboratively by architects and project teams to deliver specific IT projects, ensure their alignment to business and architectural requirements and improve the overall quality of project delivery. Strategic Aligners include EA artefacts such as business capability models, business reference architectures and roadmaps that are used together by architects and senior business leaders to focus future IT investments, prioritize proposed IT initiatives, initiate new IT projects and eventually improve the long-term strategic effectiveness of IT investments. Finally, Value Estimators are represented by EA artefacts such as solution overviews and conceptual architectures used by architects and business leaders to assess the business value of proposed IT initiatives, make informed funding decisions and thereby improve efficiency of IT investments. These six highly EA-specific roles provide a comprehensive explanatory view of the practical roles of EA artefacts and offer an in-depth, detailed and context-specific theoretical understanding that advances the common view of EA artefacts as boundary objects between business and IT communities and elements of an actor-network representing an EA practice.

The resulting theory also explains the logical interrelationships existing between these six roles of EA artefacts. For example, Instrument Providers offer practical guidelines for creating Value Estimators and Project Implementers for new IT initiatives, while Strategic Aligners initiate the development of Value Estimators according to the established strategic direction. Moreover, the resulting theory explains the influence of internal and external environmental factors on these roles of EA artefacts. For example, the role of Strategic Aligners is negatively impacted by high strategic uncertainty of the business environment impeding long-term business and IT alignment, while the role of Instrument Providers is negatively impacted by the significant dependence on a few key vendors essentially dictating the choices of particular technologies and products for IT solutions.

The results of this study contribute to the EA discipline arguably the first full-fledged theory describing the roles of EA artefacts. This theory offers a comprehensive view of the practical roles of different types of EA artefacts used in an EA practice, which is currently missing in the EA literature. The resulting theory developed in this study has three significant implications for the EA discipline. Firstly, the resulting theory establishes the link between different types of EA artefacts, their users, usage and resulting benefits and, thereby, connects various aspects of an EA practice into a consolidated logical picture. Secondly, the resulting theory allows re-conceptualizing EA as a set of six non-overlapping general types of EA artefacts describing combinations of typical EA domains (business, data, applications and technology). Thirdly, the resulting theory suggests that all the various types of EA artefacts can hardly be "lumped" together under the single title of EA, but should be studied separately instead due to the variety of their roles, purposes and other critical properties. Thereby, it helps refocus future EA research from studying the phenomenon of EA in general to studying specific types of EA artefacts and their type-specific roles.

The resulting theory of the roles of EA artefacts also has significant implications for practice and helps address the typical practical problems with EA described earlier. Firstly, the theory shows that EA practitioners should focus on mastering a reasonable number of pragmatic EA artefacts fulfilling necessary roles instead of producing and maintaining heaps of EA artefacts to holistically describe their organizations. Secondly, the theory shows that EA practitioners should choose appropriate representation formats for EA artefacts intended for different audiences and provides general guidelines regarding the selection of these formats. Thirdly, the theory shows that EA practitioners should integrate the processes associated with particular roles of EA artefacts with strategic management and project management processes. Additionally, this study makes an empirical contribution to the EA discipline by demonstrating important empirical facts that question established theories, assumptions and beliefs existing in the EA discipline.

1.6. Thesis Outline

Chapter 1 (Introduction) provides an introduction to the thesis. Firstly, Chapter 1 describes the overall background of this research and explains its theoretical and practical motivation. Then, Chapter 1 describes the research aims, objectives, question, approach and design. Finally, Chapter 1 explains the key outcomes of this study and outlines the general structure of the whole thesis.

Chapter 2 (Literature Review) provides a review of the literature relevant to this research. Firstly, Chapter 2 offers a broad overview of the existing EA research and explains the literature search methodology. Then, Chapter 2 analyses the scope and depth of the existing EA research with an in-depth focus specifically on the studies addressing the phenomenon of EA artefacts in general as well as specific types of EA artefacts in particular. Finally, Chapter 2 summarizes the current research on EA artefacts and positions this study in the overall context of the existing EA literature.

Chapter 3 (Research Design) describes the overall design of this research. Firstly, Chapter 3 describes the general research approach, adopted paradigm and case studies-based grounded theory research strategy. Then, Chapter 3 describes the data collection and data analysis procedures. Finally, Chapter 3 describes the overall process of grounded theory building and theory discussion followed in this study.

Chapter 4 (Theory Building via Case Studies) describes the overall iterative process of constructing a grounded theory of the roles of EA artefacts based on the analysis of five case studies. For each of the five studied organizations Chapter 4 provides a brief overview of this organization, describes the structure of an EA function in this organization, EA artefacts used in this organization, EA processes followed in this organization and finally the applied grounded theory analysis procedure addressing the roles of different EA artefacts identified in this organization.

Chapter 5 (Resulting Grounded Theory) provides an end-to-end description of the resulting grounded theory of the roles of EA artefacts and its various aspects. Firstly, Chapter 5 provides a detailed comprehensive description of the resulting conceptual framework, six roles of EA artefacts and their interrelationships. Then, Chapter 5 explains the influence of internal and external environmental factors on these roles of EA artefacts. Finally, Chapter 5 discussed the EA benefits realization through the analytical lenses of the identified roles of EA artefacts.

Chapter 6 (Practical Implications of the Resulting Theory) describes the practical side and implications of the developed grounded theory of the roles of EA artefacts. Firstly, Chapter 6 explains how the resulting theory helps address the typical practical problems with EA in organizations. Then, Chapter 6 proposes a convenient practical taxonomy for organizing EA artefacts based on the core ideas of the resulting theory. Finally, Chapter 6 presents the results of the evaluation of the proposed taxonomy for EA artefacts based on in-depth discussions with EA experts confirming its potential practical usefulness, descriptive power and validity.

Chapter 7 (Discussion and Literature Comparison) discusses the main findings of this research and their implications. Firstly, Chapter 7 discusses the resulting theory in the broader context of the IS discipline and relates the theory back to the existing studies on the roles of EA artefacts, environmental factors and EA benefits. Then, Chapter 7 discusses the implications of the resulting grounded theory for the EA discipline. Finally, Chapter 7 describes important empirical observations of this study and explains their potential consequences for the EA discipline

Chapter 8 (Conclusion) provides a general conclusion to the thesis. Firstly, Chapter 8 reviews the conducted research, summarizes its key findings and revisits the original research question and initial expectations. Then, Chapter 8 describes the overall contribution of this research to the EA discipline and discusses its main limitations. Finally, Chapter 8 outlines the directions for future research and concludes the thesis.

1.7. Chapter Summary

This chapter provided an introduction to the thesis. Firstly, this chapter described the overall background of this research and explained its theoretical and practical motivation. Then, this chapter described the research aims, objectives, question, approach and design. Finally, this chapter explained the key outcomes of this study and outlined the general structure of the whole thesis.

CHAPTER 2: LITERATURE REVIEW

This chapter provides a review of the literature relevant to this research. Firstly, this chapter offers a broad overview of the existing EA research and explains the literature search methodology. Then, this chapter analyses the scope and depth of the existing EA research with an in-depth focus specifically on the studies addressing the phenomenon of EA artefacts in general as well as specific types of EA artefacts in particular. Finally, this chapter summarizes the current research on EA artefacts and positions this study in the overall context of the existing EA literature.

2.1. Overview of Enterprise Architecture and EA Research

Enterprise architecture is a rather complex and multifaceted concept. EA practices in organizations involve different people, documents, processes, software tools and other related elements. Although active academic research on EA commenced in 2003 (Simon et al., 2013), the earliest origins of EA can be traced back to the information systems planning methodology called Business Systems Planning (BSP), which was initiated by IBM in the end of the 1960s (Harrell and Sage, 2010; Spewak and Hill, 1992; Zachman and Sessions, 2007). BSP used the notion of architecture to describe the relationship between business processes, information systems and data classes in a formal manner through flowcharts, relationship matrices and information systems networks diagrams (BSP, 1975; BSP, 1984).

However, most authors agree that the contemporary concept of EA originates either from the Partnership for Research in Information Systems Management (PRISM) framework (Greefhorst and Proper, 2011a; Harrell and Sage, 2010; Rivera, 2013) or from the Zachman Framework (Bernard, 2012; Finkelstein, 2006; Lohe and Legner, 2014; Sessions, 2007; Tamm et al., 2011). These seminal EA frameworks provided "a logical structure for classifying and organizing the descriptive representations of an Enterprise that are significant to the management of the Enterprise as well as to the development of the Enterprise's systems" (Zachman, 1996, p. 2) based on two-dimensional taxonomies. On the one hand, the PRISM framework (PRISM, 1986) structures EA into 16 components according to four domains (infrastructure, data, application and organization) and four types (inventory, principles, models and standards). On the other hand, the Zachman Framework (Zachman, 1987) structures EA into 15 components according to five abstraction levels (planner, owner, designer, builder and subcontractor) and three perspectives (data, function and network). Essentially, both these EA frameworks organize and structure EA into a number of subcomponents systematically describing various aspects of an enterprise. These subcomponents of EA are physically represented as EA artefacts, i.e. special documents describing particular aspects of EA. EA artefacts can describe the current (as-is) state of an organization as well as its planned future (to-be) state (Bernard, 2012; Bischoff et al., 2014; TOGAF, 2018).

Since the emergence of the two seminal EA frameworks described above, the EA discipline has evolved into a diverse and complex research stream forming an independent subfield of IS research. For instance, Simon et al. (2013) identified 608 papers belonging to the EA research stream published in different sources. In order to examine the scope and depth of available EA research and thereby identify the existing theories relevant to EA artefacts and their roles in an EA practice, a systematic literature review has been conducted as part of this study. Initially, the search was aimed specifically at identifying all publications relevant to EA (containing the words “enterprise architecture” in their titles) which appeared during the last ten years before the start of this study, i.e. since 2004, in the eight AIS senior scholars’ basket of journals (AIS, 2011). The search was conducted primarily via Google Scholar, however, AIS Electronic Library and SpringerLink were also used later to double-check the findings.

This search produced only six publications relevant to EA (Boh and Yellin, 2007; Bradley et al., 2012; Lange et al., 2016; Narman et al., 2012a; Schmidt and Buxmann, 2011; Shanks et al., 2018). As a result, the search criteria have been extended to include all 13 A* IS journals in the Australian Business Deans Council journal ranking (ABDC, 2013; ACPHIS, 2013). However, no additional publications meeting the search criteria have been found. Therefore, the search has been further extended to include all 40 A-rank journals as well as the proceedings of the International Conference on Information Systems (ICIS) as the leading IS conference. This search has identified 55 additional papers (61 papers in total) related to EA and published in the leading IS outlets since 2004.

The analysis of the 61 identified EA publications has demonstrated that, with the notable exception of two publications (Boh and Yellin, 2007; Niemi and Pekkola, 2017), research focused specifically on EA artefacts has not been published in the leading IS outlets and the phenomenon of EA artefacts received only a very limited attention in literature. For this reason, an additional literature search has been undertaken to cover the broader range of outlets and identify more EA research related to EA artefacts. As part of this extended literature search, relevant references from the primary set of 61 publications have been examined. Moreover, popular EA-specific outlets, including the Journal of Enterprise Architecture (JEA) and the Trends in Enterprise Architecture Research (TEAR) workshop, have been searched for publications relevant to EA artefacts. Additionally, relevant EA publications from various sources have been searched via Google and Google Scholar, including both academic and practitioner literature. As a result of this additional search, another 24 publications directly relevant to EA artefacts have been identified[1].

Overall, the analysis of the EA literature collected through the process described above suggests that the current EA research, with a few limited exceptions discussed further, does not address directly the questions related to the roles of EA artefacts and largely revolves around six major themes having different degrees of relationship to EA artefacts and their roles. These six themes are summarized in Table 2.1 and discussed in detail later in Sections 2.2-2.7. Further discussion of the EA literature intends specifically to examine the extent of research from the perspective of EA artefacts and their roles in an EA practice.

Table 2.1. Major themes identified in the EA research stream

Theme	Description	References	Relationship to the roles of EA artefacts
EA artefacts	This research theme studies the phenomenon of EA artefacts in general as well as specific types of EA artefacts in particular	Abraham (2013), Abraham et al. (2013) and Abraham et al. (2015), Aier (2014), Bischoff et al. (2014), Boh and Yellin (2007), Greefhorst and Proper (2011b), Greefhorst et al. (2013), Haki and Legner (2012), Haki and Legner (2013), Hugoson et al. (2010), Khosroshahi et al. (2018), Mueller et al. (2015), Niemi and Pekkola (2017), Peels et al. (2016), Proper and Greefhorst (2010), Proper and Greefhorst (2011), Ross et al. (2006), Sandkuhl et al. (2015), Sidorova and Kappelman (2010),	Study the phenomenon of EA artefacts, but still with a limited focus on their practical roles

[1] Actually, more than a thousand EA publications have been studied as part of this literature review (see Kotusev (2017)), but no other publications of theoretical significance relevant specifically to EA artefacts have been identified beyond the publications discussed in this chapter

		Sidorova and Kappelman (2011), Stelzer (2009), Tallberg et al. (2015), Winter and Aier (2011), Winter and Fischer (2006), Winter and Fischer (2007)	
EA frameworks and the structure of EA	This research theme analyses EA frameworks as well as the structure of EA in general	Bruls et al. (2010), Bui (2017), Hoogervorst (2004), Iyer and Gottlieb (2004), Jallow et al. (2017), Jonkers et al. (2006), Kappelman and Zachman (2013), Lindstrom et al. (2006), Nogueira et al. (2013), Tao et al. (2017)	Discuss EA artefacts, but only from the perspective of their informational contents
Modelling and analysis of EA	This research theme focuses on EA modelling techniques as well as on various ways to analyse EA	Balabko and Wegmann (2006), Dam et al. (2016), Engelsman et al. (2011), Gill (2015b), Johnson et al. (2007), Jonkers et al. (2004), Narman et al. (2011), Narman et al. (2012a), Narman et al. (2014), Narman et al. (2016), Quartel et al. (2012)	Discuss EA artefacts, but only from the perspective of their formal modelling and analysis
Adoption and use of EA in organizations	This research theme addresses the questions related to the adoption, acceptance and practical usage of EA in different types of organization	Bui (2015), Bui et al. (2015), Gregor et al. (2007), Rahimi et al. (2017), Smith and Watson (2015), Smith et al. (2012), Tamm et al. (2015), Toppenberg et al. (2015), Weiss (2010)	Discuss the phenomenon of EA in general with little or no focus specifically on EA artefacts
EA maturity and evolution	This research theme investigates the maturity of an EA practice and its evolution in organizations	Alwadain et al. (2014), Bradley et al. (2011), Bradley et al. (2012), Kettinger et al. (2010), Rai et al. (2010), Ross and Beath (2006), Trieu (2013), Vallerand et al. (2017), Venkatesh et al. (2007)	Discuss the maturity of an EA practice and its evolution with little or no focus specifically on EA artefacts
Benefits and success factors of EA	This research theme explores the organizational benefits resulting from the use of EA and associated critical success factors	Alaeddini and Salekfard (2013), Foorthuis et al. (2010), Foorthuis et al. (2016), Lange et al. (2016), Park et al. (2013), Schmidt and Buxmann (2011), Shanks et al. (2018), Tamm et al. (2011), Weiss et al. (2013)	Discuss the benefits of EA in general with little or no focus specifically on EA artefacts

2.2. Enterprise Architecture Artefacts

The stream of EA research focused specifically on EA artefacts includes 26 publications. These publications can be separated into two significantly different groups. On the one hand, the first group of these publications is focused on studying the phenomenon of EA artefacts in general without distinguishing between different types of EA artefacts. On the other hand, the second group of these publications is focused on studying specific narrow types of EA artefacts and their unique type-specific properties. These two groups of EA publications are discussed in detail below with a focus on the roles of EA artefacts in an EA practice.

2.2.1. Research Focused on Enterprise Architecture Artefacts in General

The sub-stream of EA research focused on studying EA artefacts in general includes nine publications (Abraham, 2013; Abraham et al., 2015; Abraham et al., 2013; Bischoff et al., 2014; Niemi and Pekkola, 2017; Sidorova and Kappelman, 2010; Sidorova and Kappelman, 2011; Winter and Fischer, 2006; Winter and Fischer, 2007). These publications discuss the phenomenon of EA artefacts as a whole without distinguishing between their different types. As summarized in Table 2.2 and discussed in detail further, the existing EA literature focused on EA artefacts in general identifies several generic roles of EA artefacts including boundary objects and elements of an actor-network, as well as the metaphorical roles inspired by their potential similarity with software architecture: blueprint, literature, language and decision.

Table 2.2. Summary of EA publications focused on EA artefacts in general

Author(s)	Research method	Underlying theory	Identified roles of EA artefacts
Abraham (2013)	Literature review and focus groups	Boundary objects theory	EA artefacts are boundary objects for bridging knowledge boundaries
Abraham et al. (2013)	Expert interviews	Boundary objects theory	EA artefacts are boundary objects for mitigating communication problems during enterprise transformations
Abraham et al. (2015)	Survey of 111 EA practitioners and academics	Boundary objects theory	EA artefacts are boundary objects for mitigating communication problems during enterprise transformations

Bischoff et al. (2014)	Survey of 60 European enterprise architects	No theory	EA artefacts can be superstars, shelf-warmers, annoyances or pressure beneficiaries
Niemi and Pekkola (2017)	In-depth case study	IS use theory (Burton-Jones and Straub, 2006)	Identify 15 use situations of EA artefacts and map them to four general roles: blueprint, literature, language and decision
Sidorova and Kappelman (2010)	Conceptual study	Actor-network theory	EA artefacts are elements of an actor-network representing EA practice
Sidorova and Kappelman (2011)	Conceptual study	Actor-network theory	EA artefacts are elements of an actor-network into which the achieved agreements between actors are inscribed
Winter and Fischer (2006)	Literature review and four case studies	No theory	No specific roles identified
Winter and Fischer (2007)	Literature review and four case studies	No theory	No specific roles identified

Generally, the studies focused on EA artefacts in general are diverse in nature, while the most important theories used in these studies include boundary objects theory and actor-network theory. These studies provide only high-level suggestions regarding the roles o EA artefacts.

Abraham (2013), Abraham et al. (2013) and Abraham et al. (2015) leverage the boundary objects theory and consider EA artefacts as boundary objects between different stakeholders in enterprise transformations. Firstly, Abraham (2013) based on a literature review identify eleven properties of boundary objects and then based on a focus groups with EA practitioners extend the original set to twelve properties: modularity, abstraction, concreteness, annotation, versioning, shared syntax, accessibility, up-to-dateness, malleability, stability, visualization and participation. Moreover, he links the resulting set of identified boundary object properties to the three key types of EA artefacts distinguished in TOGAF (repositories, matrices and diagrams) and formulates three hypotheses for EA artefacts to become effective boundary objects capable of bridging different knowledge boundaries. Abraham (2013, p. 1) argues that "boundary objects are a useful concept to understand the coordinative role of [EA] artefacts in practice". Secondly, Abraham et al. (2013) based on the previous findings and new empirical data collected from twelve expert interviews explain how EA artefacts can become boundary objects spanning core knowledge boundaries and, thereby, mitigate communication problems existing between diverse groups of participants of enterprise transformations. As a result, they develop the framework that links six main communication problems to three key knowledge boundaries and to the twelve corresponding properties of boundary objects identified in the previous study (Abraham, 2013). Abraham et al. (2013, p. 1) conclude that “EA models alone are not sufficient for overcoming communication defects, but that facilitators like architects are needed in addition”. Finally, leveraging their findings from the previous studies, Abraham et al. (2015) analyse which exactly properties of EA artefacts contribute to syntactic, semantic and pragmatic boundary spanning capacities helping achieve a mutual understanding between all stakeholders of enterprise transformations. They develop a research model explaining which properties of boundary objects are required to overcome the three key knowledge boundaries, i.e. syntactic, semantic and pragmatic, between various stakeholders and test the resulting model via surveying 111 EA practitioners and academics. As a result, Abraham et al. (2015, p. 3) conclude that their findings “show which boundary object properties contribute to a respective capacity needed to overcome each of the three knowledge boundaries”.

Bischoff et al. (2014) based on a survey of 60 enterprise architects in Europe explore the relationship between the use intensity of EA artefacts, the pressure to use these EA artefacts and the benefits resulting from the usage of these EA artefacts. From the perspective of the use intensity and pressure, they identify four types of EA artefacts: EA superstars, EA shelf-warmers, EA annoyances and EA pressure beneficiaries. Superstars are EA artefacts that are intensively used even without pressure to use them. Shelf-warmers are EA artefacts that are not intensively used even if pressure is applied. Annoyances are EA artefacts that are not intensively used without pressure, but intensively used when appropriate pressure is applied. Pressure beneficiaries are EA artefacts that are used rather intensively, but may be used even more intensively if additional pressure is applied. Bischoff et al. (2014) also articulate three main groups of benefits associated with the usage of different EA artefacts: (1) flexibility and consistency, (2) future readiness and (3) cost reduction and simplification.

Niemi and Pekkola (2017) based on an in-depth case study of a large Finnish public sector organization identify and describe various use situations of EA artefacts. Leveraging the theory of IS use developed by Burton-Jones and Straub (2006), the twelve-cell EA Grid framework for organizing EA artefacts proposed by Pulkkinen (2006) and the four roles of software architecture identified by Smolander et al. (2008) (blueprint, literature, language and decision), they classified the 15 identified use situations of EA artefacts according to the proposed conceptual framework. Specifically, the 15 use situations described by the interviewees have been classified according to their motives, primary and secondary stakeholders, product domain, product level, service and project development phase. Niemi and Pekkola (2017) conclude that adequate conceptual models explaining the usage of EA artefacts are missing in the existing EA literature and call for further research to explore the practical usage of EA artefacts.

Sidorova and Kappelman (2010) and Sidorova and Kappelman (2011) based on conceptual arguments interpret an EA practice and EA artefacts from the perspective of the actor-network theory (Hanseth et al., 2004; Walsham, 1997). Sidorova and Kappelman (2010) argue that EA artefacts can be considered as elements of an actor-network representing an EA practice as a complex activity involving multiple interacting people and artefacts. At the same time, the process of architectural planning can be considered as a continuous negotiation around specific EA artefacts. They identify three key conceptual implications for an EA practice from the perspective of the actor-network theory. Firstly, different EA artefacts represent inscriptions of different steps of architectural negotiations and therefore belong to different actor-networks, which may eventually lead to the distortion of higher-level inscriptions in "downstream" EA artefacts. Secondly, plans reflected in different EA artefacts may highly depend on the relative power of actors in the actor-networks that created them. Thirdly, along the architectural planning process the relative power of business owners and sponsors in the actor-networks diminishes, while the relative power of IT specialists in the actor-networks increases. Sidorova and Kappelman (2011) further theorize on an EA practice and EA artefacts through the lenses of the actor network theory. Specifically, Sidorova and Kappelman (2011, p. 39) argue that "enterprise architecture work helps to achieve agreement and thus alignment of the interests of internal actors within the context of enterprise interests and inscribes such agreement into architectural artefacts". The interests of business management, once inscribed in corresponding EA artefacts, help protect the interests of the whole organization during early vendor negotiations and further implementation of new IT solutions. Sidorova and Kappelman (2011) argue that the mechanism of the interest inscription in EA artefacts can reduce the negative influence of external third parties on an organization and eventually achieve better business and IT alignment.

Winter and Fischer (2006) and Winter and Fischer (2007) based on the review of popular EA frameworks, including TOGAF, FEAF and ARIS, and subsequent analysis of four case organizations identify six core groups of EA artefacts based on the EA domains they describe: strategy specifications, organization/process specifications, application specifications, software specifications, technical infrastructure specifications and specifications of dependencies between layers. Strategy specifications include all descriptions of organizational goals, success factors, targeted market segments and core competencies. Organization and process specifications include all descriptions of organizational structure, roles, behaviour, business processes and information flows. Application specifications include all descriptions of applications and their components as well as enterprise services and their service components. Software specifications include all descriptions of software components, functional hierarchy, event hierarchy and data resources, i.e. conceptual, logical and physical data models. Technical infrastructure specifications include all descriptions of underlying IT components, hardware units, platforms, networks and network nodes. Specifications of dependencies between layers include all descriptions of relationships between the entities from the five domains described above, e.g. goals vs. process metrics, services vs. processes, business units vs. applications, activities vs. applications, data entities vs. enterprise services, applications vs. conceptual data entities, applications services vs. software components, etc. However, Winter and Fischer (2007) do not identify any roles of EA artefacts beyond describing various aspects of organizations.

To summarize, the research focused on EA artefacts in general identifies several roles fulfilled by EA artefacts including boundary objects for bridging communication boundaries between diverse stakeholders (Abraham, 2013; Abraham et al., 2015; Abraham et al., 2013), elements of an actor-network for inscribing the agreements between actors and standing for their interests (Sidorova and Kappelman, 2010; Sidorova and Kappelman, 2011) as well as the roles similar to the typical roles of software architecture: “blueprint”, “literature”, “language” and “decision” (Niemi and Pekkola, 2017). However, both boundary objects theory and actor-network theory used in these studies address the phenomenon of EA artefacts primarily from the perspective of their stakeholders, but provide little explanation regarding other critical aspects of the roles of EA artefacts, e.g. their actual practical usage or the value of their informational contents for planning purposes. Moreover, EA artefacts can be very diverse and range from abstract architectural principles to detailed technical diagrams (Bernard, 2012; Spewak and Hill, 1992; TOGAF, 2011; TOGAF, 2018; van't Wout et al., 2010), but the roles identified above are very general and broad in nature. They either relate to all EA artefacts (e.g. consider all EA artefacts as boundary objects), or to broad groups of EA artefacts (e.g. consider all current-state EA artefacts as “literature”). These roles hardly explain potential type-specific differences between EA artefacts, e.g. how different types of EA artefacts might be different from the perspective of their roles in an EA practice, as if all

EA artefacts are homogeneous, equivalent or interchangeable. Therefore, a more detailed analysis of the practical usage of different types of EA artefacts is required to establish their type-specific roles in the context of an EA practice.

2.2.2. Research Focused on Specific Types of Enterprise Architecture Artefacts

The sub-stream of EA research focused on studying specific EA artefacts includes 17 publications. These publications discuss particular narrow types of EA artefacts in depth as well as their highly type-specific properties. As summarized in Table 2.3 and discussed in detail further, the existing EA literature analyses in detail and specifically focuses on the roles of five different types of EA artefacts: business capability maps, core diagrams, enterprise data models, principles and standards. However, only principles have been extensively studied, while other types of EA artefacts received much less attention in the EA literature.

Table 2.3. Summary of EA publications focused on specific types of EA artefacts

EA artefact	Author(s)	Research method	Underlying theory	Identified roles of EA artefacts
Business capability maps	Khosroshahi et al. (2018)	Interviews with 25 EA experts from Germany and Switzerland	No theory	Business capability maps fulfil strategic roles and, to a lesser extent, operational roles, including 14 different use cases
Core diagrams	Ross et al. (2006)	Multiple case studies of large international organizations	No theory	Core diagrams are communication instruments between senior business and IT stakeholders helping align IT investments to the operating model
Enterprise data models	Peels et al. (2016)	In-depth case study of a large oil and gas company	No theory	Enterprise data models are enablers of operational, managerial, strategic, organizational and infrastructural benefits
Principles	Aier (2014)	Survey of 68 German enterprise architects	No theory	Principles are the drivers of EA consistency
	Greefhorst and Proper (2011b)	Conceptual study	No theory	No specific roles identified
	Greefhorst et al.	Survey of 35 Dutch	No theory	Principles are the instruments for

	(2013)	EA practitioners		strategic, tactical and operational decision-making
	Haki and Legner (2012)	Literature review	No theory	Principles are the means to realize the regulative nature of EA
	Haki and Legner (2013)	Literature review, expert interviews and survey	No theory	Principles are the means for guiding EA evolution, maintaining consistency and restraining complexity
	Hugoson et al. (2010)	Two case studies	No theory	Principles are the drivers of IT investments and business and IT alignment
	Proper and Greefhorst (2010)	Conceptual study	No theory	Principles are bridges between architecture and design
	Proper and Greefhorst (2011)	Conceptual study	No theory	Principles are bridges between architecture and design
	Sandkuhl et al. (2015)	Expert interviews	No theory	No specific roles identified
	Stelzer (2009)	Literature review	No theory	No specific roles identified
	Tallberg et al. (2015)	Case study of a large Swedish insurance company	No theory	Principles are enablers of infological and functional dimensions of alignment
	Winter and Aier (2011)	Survey of 70 Swiss and German companies	No theory	Principles are restrictors of the future state of EA and transformation projects
Standards	Boh and Yellin (2007)	Survey of 108 organizations	No theory	Standards are enablers of application and data integration
	Mueller et al. (2015)	Interviews with nine experts	Technology acceptance theory (TAM)	No specific roles identified

Generally, the studies focused on specific EA artefacts are diverse from the perspective of their research approaches and almost completely atheoretical in their attitude. These studies identify some relevant roles of respective EA artefacts, though most of these studies focus specifically on principals, while other types of EA artefacts received little or no attention.

The vast majority of identified EA publications focused on specific types of EA artefacts study in detail architectural principles (Aier, 2014; Greefhorst et al., 2013; Greefhorst and Proper, 2011b; Haki and Legner, 2012; Haki and Legner, 2013; Hugoson et al., 2010; Proper and Greefhorst, 2010; Proper and Greefhorst, 2011; Sandkuhl et al., 2015; Stelzer, 2009; Tallberg et al., 2015; Winter and Aier, 2011).

Proper and Greefhorst (2010) and Proper and Greefhorst (2011) based on the analysis of conceptual and historical arguments develop a meta-model explaining the relationship between EA principles and other similar concepts including credos, norms, normative principles, instructions, requirements and scientific principles. They explain the existing interrelationships between these concepts based on their differences and similarities as well as the general impact of principles on EA-related planning decisions. Proper and Greefhorst (2010) and Proper and Greefhorst (2011) discuss the general role of EA principles as the bridges between architecture and design connecting the strategy and implementation.

Stelzer (2009) and Haki and Legner (2012) conduct EA literature reviews specifically focused on EA principles. Stelzer (2009) based on a broad review of available EA literature conclude that: (1) EA principles are lacking a common and widely accepted definition, (2) a detailed common framework for EA principles is absent, (3) business principles, IT principles and EA principles are often confused and (4) generic design principles are generally under-researched. However, he does not identify specific practical roles of EA principles. Haki and Legner (2012) based on a literature review to assess the current status of research on EA principles and determine potential gaps to be addressed in the future. Specifically, they focus on the nature, adoption, practices and impact of EA principles and identify the desirable future research directions in these areas. Haki and Legner (2012) conclude that one of the key roles of EA principles is providing the means to realize the regulative nature of EA

Hugoson et al. (2010) and Tallberg et al. (2015) study the practical usage of EA principles in organizational settings. Hugoson et al. (2010) based on two case studies explore how EA principles influence the management of IT investments in large organizations. They focus specifically on the relationship between IT investment decision-making and two types of EA principles: delineation (differentiation) principles and interoperability (integration) principles. Hugoson et al. (2010) demonstrate that EA principles have a significant influence on the management of IT investments as well as on business and IT alignment. They conclude that EA principles have four types of impact: the responsibility for IT investments, time-to-value, long-term alignment and the coordination between information systems and business process changes. Tallberg et al. (2015) based on an in-depth case study of a large Swedish insurance company investigate how different dimensions of business and IT alignment are addressed via EA principles. Specifically, they articulate infological, functional, socio-cultural and structural dimensions of alignment and explore how the EA principles established in the case organization addressed each of these dimensions. Tallberg et al. (2015) conclude that design principles focus predominantly on the functional dimension of alignment and to some extent on the infological dimension of alignment, whole the socio-cultural and structural dimensions remain unaddressed.

Winter and Aier (2011), Greefhorst et al. (2013), Haki and Legner (2013) and Aier (2014) explore the properties of EA principles by means of surveys. Winter and Aier (2011) based on the survey of 70 Swiss and German companies identified three key drivers for the improved quality of EA principles: (1) EA principles are observed, (2) EA principles are regularly updated and (3) EA principles are based on the business strategy. Moreover, they also identified three key drivers facilitating the conformance to EA principles: (1) EA principles are defined for business architecture, (2) EA principles are defined centrally and approved by management and (3) EA principles are checked for usefulness. Winter and Aier (2011) consider EA principles as the restrictors of the future state of EA and corresponding transformation projects. Greefhorst et al. (2013) based on a survey of 35 Dutch EA practitioners explore the industry situation regarding the usage of EA principles, including their specification, application, stakeholders and some other aspects of principles. They provide exhaustive statistical information on the aspects documented in EA principles, key drivers for principles, stakeholders of principles, common usage of EA principles and application areas of principles. Greefhorst et al. (2013) conclude that the practical role of principles is considered mostly as the instrument for strategic, tactical and operational decision-making. Haki and Legner (2013) based on an initial literature review, two exploratory expert interviews and subsequent survey of 26 EA practitioners analyse the state-of-the-art in EA principles from the perspective of their influence on EA design, their value for practitioners and their practical application. Specifically, they surveyed EA experts and practitioners to determine their perceptions of the roles, application and usefulness of EA principles. Haki and Legner (2013) conclude that EA principles are considered largely as a means for guiding EA evolution, maintaining consistency and restraining complexity. Additionally, they identified eleven meta-principles (standardization, compliance, data consistency, modularity, reusability, interoperability, integration, usability, simplicity, portability and centralization) from the existing EA literature and then analysed the relative importance of these meta-principles. Aier (2014) based on a survey of 68 German enterprise architects analyse the grounding, management and guidance mechanisms of EA principles and their influence on the utility of EA. He investigates the role and influence of the organizational culture on the effects of EA principles. Aier (2014) concludes that principles are the drivers of EA consistency, but the implications of architectural principles are significantly impacted by the organizational culture.

Greefhorst and Proper (2011b) and Sandkuhl et al. (2015) propose the development processes for principles without discussing their roles. Greefhorst and Proper (2011b) based on conceptual considerations propose an approach for developing and using principles. Specifically, they articulate eight steps to formulate and use EA principles: determine drivers, determine principles, specify principles, classify principles, validate and accept principles, apply principles, manage compliance and handle changes. Sandkuhl et al. (2015) explore the nature of EA principles, propose a development process for principles and then validate this process based on two expert interviews. They identify five critical qualities of EA principles (goal orientation, meaningful description, proper communication, process anchoring and regular control) and then articulate the four-step principles development process including the following phases: preparation, driver analysis, generation of principles, and implementation and governance.

Standards, as a specific type of EA artefacts, have been studied by Boh and Yellin (2007) and Mueller et al. (2015). Boh and Yellin (2007) study in detail the usage of EA standards. Specifically, based on the survey of 108 organizations they investigate which governance mechanisms are effective for enforcing different types of EA standards and which benefits are associated with different types of EA standards. Boh and Yellin (2007) demonstrate that institutionalized conformance monitoring processes, centralized IT infrastructure management, centralized application development and clearly defined architectural roles statistically correlate with the use of and conformance to EA standards, while EA standards for integrating business applications and EA standards enterprise data integration statistically correlate with improved business application integration and enterprise data integration correspondingly. Mueller et al. (2015) study in detail the factors influencing the acceptance of architectural standards in organizations. Specifically, based on nine interviews they identify five different factors positively influencing on the initial intention to use and subsequent actual usage of standards: (1) individual benefits, (2) organizational benefits, (3) peer group social influence, (4) supervisor social influence and

(5) perceived behavioural control. Moreover, Mueller et al. (2015) show that the factors of the “big five” factor model (openness, agreeableness, conscientiousness, level of command and experience) mediate the influence of the five key acceptance factors described above. However, they do not identify any specific practical roles associated with EA standards.

Khosroshahi et al. (2018) investigated the practical usage of business capability maps. Based on 25 interviews with EA practitioners from diverse German and Swiss organizations, they found out that in 92% of cases business capability maps were used for strategic purposes, e.g. investment decision-making, and in 76% of cases they were used for the purposes of operational decision-making, e.g. analysis of dependencies between applications in each capability. Khosroshahi et al. (2018) also evaluated 14 specific use cases of business capability maps (application lifecycle management, identification of capability spanning applications, application extended support, cost vs. user count ratio estimation, identification of cloud candidates, compliance issues, capability dependencies, assessment of the harmonization potential, IT costs, projects, business impact, agile team organization, infrastructure components and infrastructure components extended support) and then ranged respective usage scenarios based on their estimated benefit/feasibility ratio.

Ross et al. (2006) focus in detail on EA artefacts called core diagrams. Specifically, Ross et al. (2006) based on multiple case studies of large international organizations argue that companies can benefit from depicting the structure of an entire organization from the business and IT perspective on a single page (core diagram) to facilitate the constructive dialog between senior business and IT executives. This core diagram can help understand the general role of IT in an organization, recognize the need for change and understand the overall organizational impact of specific IT projects. Ross et al. (2006) further explain that core diagrams should reflect the integration and standardization requirements of the adopted operating model and describe four key elements: (1) core business processes, (2) shared data used by these processes, (3) key integration and automation technologies and (4) key customer groups. They argue that core diagrams should drive IT investment processes and help organizations build digitized platforms boosting organizational agility.

Peels et al. (2016) based on a single case study explored the benefits resulting from the usage of enterprise data models. Specifically, they identified five types of benefits associated with enterprise data models: operational, managerial, strategic, organizational and IT infrastructural. Operational benefits include productivity and quality improvements as well as the cycle time reduction. Managerial benefits include improved data management, resource management, decision-making, planning and performance. Strategic benefits include the enablement of sustainable competitive advantage, global expansion and business alliances. Organizational benefits include empowerment, support of common visions and improved employee satisfaction. IT infrastructural benefits include identification and removal of redundancy, reduced complexity and increased reusability.

To summarize, the research focused on specific types of EA artefacts identifies a number of highly type-specific roles including the role of core diagrams as communication instruments between senior business and IT stakeholders (Ross et al., 2006), the role of business capability maps as strategic and operational decision-making tools (Khosroshahi et al., 2018), the role of standards as enablers of application and data integration (Boh and Yellin, 2007) and multiple roles of architectural principles as bridges between architecture and design (Proper and Greefhorst, 2010; Proper and Greefhorst, 2011), drivers of increased consistency (Aier, 2014) and reduced complexity (Haki and Legner, 2013), instruments of strategic, tactical and operational decision-making (Greefhorst et al., 2013) and means to realize the regulative nature of EA (Haki and Legner, 2012). However, various EA methodologies provide lists of ~30-80 diverse EA artefacts that can be used as part of an EA practice (Bernard, 2012; Spewak and Hill, 1992; TOGAF, 2011; TOGAF, 2018; van't Wout et al., 2010), while the current EA literature analyses in detail the type-specific roles of only five different types of EA artefacts, i.e. business capability maps, core diagrams, enterprise data models, principles and standards. This fact suggests that the type-specific roles of all other types of EA artefacts still remain unexplored and largely unclear. Therefore, a more detailed analysis of the practical usage of EA artefacts is required to provide a comprehensive view of the type-specific roles of key types of EA artefacts.

2.3. EA Frameworks and the Structure of Enterprise Architecture

The stream of EA research on EA frameworks and the structure of EA includes ten publications (Bruls et al., 2010; Bui, 2017; Hoogervorst, 2004; Iyer and Gottlieb, 2004; Jallow et al., 2017; Jonkers et al., 2006; Kappelman and Zachman, 2013; Lindstrom et al., 2006; Nogueira et al., 2013; Tao et al., 2017). These publications discuss the properties and features of EA frameworks as well as the overall structure of EA in general. As summarized in Table 2.4 and discussed in detail further, many of these authors (Hoogervorst, 2004; Iyer and Gottlieb, 2004; Kappelman and Zachman, 2013; Nogueira et al., 2013; Tao et al., 2017) discuss EA artefacts as the key elements constituting EA. However, these publications focus only on the informational aspects of EA artefacts, i.e. what views of an organization these EA artefacts should provide, but do not discuss other critical aspects of their roles, e.g. how exactly these EA artefacts should be used to benefit organizations.

Table 2.4. Existing EA research related to EA frameworks and the structure of EA

Author(s)	Research method	Underlying theory	Findings	Reference to EA artefacts
Hoogervorst (2004)	Conceptual study	No theory	EA should consist of four key elements: business architecture, organizational architecture, information architecture and technology architecture	Specify what EA artefacts should describe for each of the four elements
Iyer and Gottlieb (2004)	Conceptual study	No theory	Propose to organize EA into four key domains (process, information and knowledge, infrastructure, and organization) and explain the mapping of these domains to the Zachman Framework	Explain what objects should be described in EA artefacts for each domain
Jonkers et al. (2006)	N/A	N/A	Introduce the concept of EA in the special issue on EA in Information Systems Frontiers	Little or no reference to EA artefacts
Lindstrom et al. (2006)	Survey of 62 Swedish CIOs	No theory	Identify an inconsistency between the priorities of CIOs and the focus of popular EA frameworks	Little or no reference to EA artefacts
Bruls et al. (2010)	Four case studies of large companies	No theory	Formulate a set of criteria for well-formed domains and corresponding architectures of two types: business usage domain architecture and solution construction domain architecture	Little or no reference to EA artefacts
Kappelman and Zachman (2013)	Conceptual study	No theory	Emphasize the importance of the Zachman Framework as the fundamental organizing structure for describing all complex engineering objects	Argue that EA artefacts ideally should fill all the cells
Nogueira et al. (2013)	Action research	No theory	Propose a new methodology for the implementation of the Zachman framework to assist its adoption	Discuss EA artefacts to fill the cells of the framework
Bui (2017)	Conceptual study	No theory	EA frameworks can be categorized based on their essential elements into technical	Little or no reference to EA

			EA, operational EA and strategic EA	artefacts
Jallow et al. (2017)	Expert interviews	No theory	Develop the electronic Requirements Information Management (eRIM) Framework defining a lifecycle approach to managing information in a process-oriented and service-oriented manner	Little or no reference to EA artefacts
Tao et al. (2017)	Case study of a large Chinese company	No theory	Develop an EA framework oriented towards architectures based on service-oriented architecting and cloud computing	Provide the mapping of EA artefacts between TOGAF and DoDAF

Generally, the studies focused on EA frameworks and the structure of EA are diverse from the perspective of their research approaches, though many of these studied are purely conceptual, and all these studies are atheoretical in nature. These studies discuss EA artefacts exclusively from the perspective of their informational contents, e.g. what domains or abstraction levels these EA artefacts should cover.

Hoogervorst (2004), Iyer and Gottlieb (2004), Jonkers et al. (2006) and Kappelman and Zachman (2013) focus on discussing the basic structure of EA. Hoogervorst (2004) based on conceptual arguments suggests that EA is intended to bridge the gap between the functional perspective and constructional perspective. He argues that EA generally consists of four key elements: business architecture, organizational architecture, information architecture and technology architecture. Business architecture and corresponding EA artefacts focus on describing the strategy, mission, market, competitors, products, services, key resources, customers, operating method, economic and revenue model, environment and stakeholders. Organizational architecture and corresponding EA artefacts focus on describing enterprise processes, events, structures, systems, learning, human resources, employee behaviour, competences, performance, culture and management. Information architecture and corresponding EA artefacts deal with the presentation, operation, structure, cognition, exploitation, exploration and quality of information. Similarly, Iyer and Gottlieb (2004) based on conceptual arguments propose to organize EA into four key domains: process, information/knowledge, infrastructure and organization. The process domain and corresponding EA artefacts deal with business context engines, planning engine, visualization engine and business tools. The information and knowledge domain and corresponding EA artefacts deal with business data, business profiles, business models and data models. The infrastructure domain and corresponding EA artefacts deal with computers, operating systems, display devices and networks. The organization domain and corresponding EA artefacts deal with people, roles, organizational structures and alliances. Iyer and Gottlieb (2004) also explain the relationship and provide the mapping between their four-domain view and the Zachman Framework (Sowa and Zachman, 1992; Zachman, 1987). Jonkers et al. (2006) in their introduction to the special issue on EA offer the general discussion of the concept of EA and its structure without focusing on specific EA artefacts. Kappelman and Zachman (2013) based on conceptual arguments and comparisons with construction and industrial engineering emphasize the importance of the Zachman Framework as the fundamental organizing structure for describing all complex objects. They also emphasize the importance of a comprehensive architectural planning that requires creating explicit descriptions covering all the 30 cells of the Zachman Framework with corresponding EA artefacts. Therefore, Kappelman and Zachman (2013) define the informational contents of all EA artefacts that can be used to describe EA.

Lindstrom et al. (2006), Bruls et al. (2010), Nogueira et al. (2013), Bui (2017), Jallow et al. (2017) and Tao et al. (2017) focus on more advanced aspects of EA and EA frameworks. Lindstrom et al. (2006) surveyed 62 CIOs in Sweden in order to explore the relevancy of the existing EA frameworks to the key concerns of CIOs. They find an inconsistency between the top priorities of CIOs and the focus of most EA frameworks. Bruls et al. (2010) explore the relationship between EA and domain architectures. Specifically, they follow the design science approach, formulate a number of criteria to be met by domain architectures and then validate these criteria based on four case studies. Although Bruls et al. (2010) argue that domain architecture artefacts should be derived from the corresponding EA artefacts, they do not discuss this process in detail. Nogueira et al. (2013) based on an action research propose a new methodology for the creation of business, systems and technology EA models leveraging the Zachman Framework. As part of their methodology they suggest a number of EA artefacts that might be developed to fill the top rows of the Zachman Framework. Bui (2017) analyse existing EA frameworks from the perspective of their essential elements. Firstly, he identifies eight essential elements of EA frameworks: EA principles, technical EA layers, business EA layers, EA methodology, EA organizing structure, EA operations and monitoring, EA enforcement and strategic integration. Then, based on these essential elements, Bui (2017) classify EA frameworks into three different "ideal types" (technical, operational and strategic EA), however, without analysing the relationship between these types and EA artefacts. Jallow et al. (2017) develop the integrated electronic Requirements Information Management Framework (eRIM), a specific new EA framework for managing electronic requirements, and confirm the potential practical utility of this framework via expert interviews. The proposed framework focuses mostly on the project lifecycle, but does not discuss specific EA artefacts. Tao et al. (2017) also propose a new framework for the EA development intended to support service-oriented architecture and cloud computing and then demonstrate the practical application of this method in a case study. As part of the proposed EA development method, they develop a unified set of EA artefacts based on the EA deliverables recommended by two popular EA frameworks: TOGAF and DoDAF.

To summarize, the research on EA frameworks and the structure of EA generally discusses EA artefacts (Hoogervorst, 2004; Iyer and Gottlieb, 2004; Kappelman and Zachman, 2013; Nogueira et al., 2013; Tao et al., 2017), but only from the perspective of their descriptive viewpoints, i.e. what organizational aspects these artefacts should describe to provide a comprehensive view of an organization. Beyond focusing on their descriptive role, these publications do not theorize on any other practical roles of EA artefacts and do not explain how exactly these EA artefacts providing different views can be used.

2.4. Modelling and Analysis of Enterprise Architecture

The stream of EA research on modelling and analysis of EA includes eleven publications (Balabko and Wegmann, 2006; Dam et al., 2016; Engelsman et al., 2011; Gill, 2015b; Johnson et al., 2007; Jonkers et al., 2004; Narman et al., 2014; Narman et al., 2012a; Narman et al., 2011; Narman et al., 2016; Quartel et al., 2012). These publications discuss and propose various notations, languages and techniques for modelling and analysing EA artefacts. As summarized in Table 2.5 and discussed in detail further, all the analysed publications on modelling and analysis of EA directly discuss EA artefacts. However, these publications focus only on the purely "technical" side of EA artefacts, e.g. proper format of EA artefacts or formal analysis of EA artefacts, but do not discuss the roles of EA artefacts in the organizational context of an EA practice, e.g. who uses EA artefacts, how, when and for what purpose.

Table 2.5. Existing EA research related to modelling and analysis of EA

Author(s)	Research method	Underlying theory	Findings	Reference to EA artefacts
Jonkers et al.	Conceptual	No theory	Propose a comprehensive graphical	Offer

(2004)	study		modelling notation (currently known as ArchiMate) for describing EA artefacts with their business, application and technology aspects	modelling notation for EA artefacts
Balabko and Wegmann (2006)	Conceptual study / literature review	No theory	Classify 20 identified concern-based design methods (CBDMs) in the context of an EA practice and discuss the existing development trends in the field of CBDMs	Discuss the modelling approaches for graphical EA artefacts
Johnson et al. (2007)	Conceptual study	No theory	Develop a new formal modelling notation and analytical technique to support the formal analysis of the information contained in EA artefacts	Discuss analysis of EA artefacts
Engelsman et al. (2011)	Conceptual study	No theory	Develop an extension for ArchiMate EA modelling language to support the description of motivational aspects including business goals and requirements	Extend the modelling notation for EA artefacts
Narman et al. (2011)	Conceptual study	No theory	Propose a method for architectural analysis of ArchiMate diagrams focusing on data accuracy aspects	Discuss analysis of EA artefacts
Narman et al. (2012a)	Case study	No theory	Develop a new method for the analysis of EA diagrams and interview data to determine estimated service response time	Discuss analysis of EA artefacts
Quartel et al. (2012)	Conceptual study	No theory	Develop a novel technique for application and project portfolio valuation based on the analysis of ArchiMate-based EA artefacts	Discuss analysis of EA artefacts
Narman et al. (2014)	Case studies	No theory	Propose a methodology for analysing EA diagrams from the perspective of availability based on fault trees and interviews	Discuss analysis of EA artefacts
Gill (2015b)	Conceptual study	No theory	Evaluate the applicability of common modelling languages including ArchiMate, BPMN, UML, FAML, SoaML and BMM in the context of agile EA modelling	Compare modelling languages for EA artefacts
Narman et al. (2016)	Case study	Mintzberg's theory on	Develop a framework for analysing the effects of an organizational structure on	Discuss analysis of EA

		organizational structure	the organization performance through employee learning and motivation	artefacts
Dam et al. (2016)	Conceptual study	No theory	Develop a new language for EA description that supports effective change impact analysis and change propagation through architectural models	Propose a modelling approach for EA diagrams

Generally, the vast majority of the studies focused on modelling and analysis of EA are purely conceptual and atheoretical. These studies discuss EA artefacts exclusively from the perspective of their modelling and analysis, e.g. how specific types of diagrams should be created and how these diagrams can be analysed.

Jonkers et al. (2004), Balabko and Wegmann (2006), Engelsman et al. (2011) and Gill (2015b) propose new and analyse existing modelling notations or languages suitable for graphical EA artefacts. Jonkers et al. (2004) argue that EA and underlying EA artefacts should be structured according to two-dimensional taxonomy. The first dimension classifies EA artefacts into informational, behavioural and structural aspects. The second dimension classifies EA artefacts according to business, application and technology layers. The business layer includes descriptions of organizational services, products, business objects, actors, roles, events and other business elements. The application layer includes descriptions of application services, interfaces, components, interactions, data objects and other elements related to applications. The technology layer includes descriptions of infrastructure services, interfaces, nodes, devices, networks, system software and other elements related to applications. Moreover, Jonkers et al. (2004) also offer specific modelling meta-models and graphical diagramming notations to describe EA artefacts related to each of these layers currently known as ArchiMate. Balabko and Wegmann (2006) discuss, analyse and classify the available concern-based design methods (CBDMs) appropriate for modelling graphical EA artefacts. Engelsman et al. (2011) propose an extension to the existing ArchiMate standard to enable the modelling of motivational aspects of EA-related decisions including corresponding business goals and requirements. Gill (2015b) analyses the integration of the ArchiMate modelling standard with other modelling languages including BPMN, UML, FAML, SoaML and BMM in the context of agile EA practices.

Johnson et al. (2007), Narman et al. (2011), Narman et al. (2012a), Narman et al. (2014), Narman et al. (2016), Quartel et al. (2012) and Dam et al. (2016) develop formal analysis methods and supporting modelling techniques to enable the effective extraction of information from graphical EA artefacts. Johnson et al. (2007) propose a new formal language and corresponding analysis approach based on extended influence diagrams for describing EA artefacts and enabling their effective analysis. Narman et al. (2011) develop a new method based on the probabilistic relational model formalism for analysing ArchiMate diagrams from the perspective of data accuracy. Narman et al. (2012a) develop an analytical method for analysing EA diagrams and determining the expected service response time based on provided interview data. Narman et al. (2014) propose a methodology for analysing graphical EA diagrams based on fault trees and stakeholder interviews to estimate the system availability. Narman et al. (2016) develop a model-based analysis framework for analysing the effects of an organizational structure on the business performance from the perspective of employee learning and motivation through the lenses of the corresponding Mintzberg's theory of organizational structures. Quartel et al. (2012) propose an analytical methodology for application and project portfolio valuation based on ArchiMate diagrams and business requirements modelling. Dam et al. (2016) propose a modelling language for describing EA diagrams called ChangeAwareHierarchicalEA and a corresponding analytical method to facilitate change impact analysis and change propagation in EA models.

To summarize, the research on modelling and analysis of EA offers valuable modelling notations for creating EA artefacts and corresponding analysis techniques for "extracting" the information from these EA artefacts. However, this research stream does not provide any theories addressing the practical roles of EA artefacts and essentially considers all EA artefacts as homogeneous and interchangeable graphical diagrams that might be modelled with strict notations and then analysed with formal methods.

2.5. Adoption and Use of Enterprise Architecture in Organizations

The stream of EA research on the adoption and use of EA in organizations includes nine publications (Bui, 2015; Bui et al., 2015; Gregor et al., 2007; Rahimi et al., 2017; Smith and Watson, 2015; Smith et al., 2012; Tamm et al., 2015; Toppenberg et al., 2015; Weiss, 2010). These publications analyse the initiation of EA practices and subsequent usage of EA in organizations. As summarized in Table 2.6 and discussed in detail further, research on the adoption and use of EA in organizations generally focuses on an EA practice, EA management, EA function or EA capability in general without relating to the specific roles of EA artefacts.

Table 2.6. Existing EA research related to the adoption and use of EA in organizations

Author(s)	Research method	Underlying theory	Object of study	Findings	Reference to EA artefacts
Bui (2015)	Analysis of websites and interviews	No theory	EA practice in general	Identify three approaches to EA adoption: maturing, refreshing and bundling	Little or no reference to EA artefacts
Bui et al. (2015)	Case studies and analysis of websites	Diffusion of innovations	EA practice in general	Adopted innovation design may depend on the organizational structure and on the popular design at the time of adoption	Little or no reference to EA artefacts
Gregor et al. (2007)	In-depth case study	No theory	EA-driven alignment mechanisms	EA is holistic, focuses on business operations, includes IT governance and reuse of IT components	Little or no reference to EA artefacts
Rahimi et al. (2017)	Literature review and eight case studies	No theory	EA management	EA can have three different applications depending on its scope: IT management, business capability management and business strategy management	Little or no reference to EA artefacts
Smith and Watson (2015)	In-depth case study	No theory	EA function	Identify the loss of dedicated staff and fuzzy lines of responsibility as the key challenges of the EA adoption, while effective demand management, education, coaching and mentoring are considered to be the success factors of the EA adoption	Little or no reference to EA artefacts
Smith et al. (2012)	In-depth case study	No theory	EA function and culture	Formulate a set of recommendations for adopting EA: apply the EA framework to support the business logic and fit the culture, avoid bureaucracy, hire architects with both business and	Little or no reference to EA artefacts

				technical skills, ensure every EA-related activity adds value, educate senior leaders about EA	
Tamm et al. (2015)	In-depth case study	No theory	EA capability and best practices	Formulate a set of recommendations for adopting EA: build the capability for EA early, establish the strong mandate for EA, adopt a flexible approach, build constructive relationships with project teams and adopt a service mindset	Little or no reference to EA artefacts
Toppenberg et al. (2015)	In-depth case study	No theory	EA capability	Formulate a set of recommendations for adopting EA for supporting corporate acquisitions: treat EA as a dynamic process, minimize integration problems, use pairs of business and IT architects integrate acquisitions with business transformation and look for digital traces to pave the way	Little or no reference to EA artefacts
Weiss (2010)	Case study	No theory	EA practice in general	Identify five key EA-related processes: architecture strategy, architecture definition, architecture governance, business unit project implementations and enterprise shared assets	Little or no reference to EA artefacts

Generally, the studies focused on the adoption and use of EA are mostly based on single or multiple case studies and the vast majority of them are completely atheoretical. These studies discuss various questions related to EA, but none of these studies provides significant findings specifically regarding EA artefacts and their practical roles.

On the one hand, Gregor et al. (2007), Bui (2015) and Bui et al. (2015) study the adoption and use of EA specifically in governmental organizations. Gregor et al. (2007)

analyse in detail the adoption and use of EA at the Australian Bureau of Statistics (ABS). They analyse various aspects of an EA practice including the overall approach to EA, specific business and IT alignment mechanisms and other aspects. Bui (2015) analyses the EA adoption approaches taken by 50 U.S. state governments and identifies two additional approaches leveraging “crisitunities” (mix of “crises” and “opportunities”) to start or improve an EA practice: refreshing approach and bundling approach. Bui et al. (2015) further analyse the adoption of EA in 50 U.S. state governments specifically from the perspective of the diffusion of innovations theory and conclude that the adopted innovation design may depend on the organizational structure and on the popular design at the time of adoption.

On the other hand, other authors (Smith and Watson, 2015; Smith et al., 2012; Tamm et al., 2015; Toppenberg et al., 2015; Weiss, 2010) study the initiation and successful usage of EA in various commercial organizations. Tamm et al. (2015) study in detail the EA-enabled business transformation at a large Australian retailer. They report that EA principles helped the retailer to lay the foundation for transformation, agree on the most significant imperatives and develop a number of more specific transformation guidelines, while architectural vision helped the organization to agree on the overall strategic direction and outcome of the transformation. Toppenberg et al. (2015) focus on analysing the EA-enabled acquisition practices at Cisco. Besides discussing the Cisco’s four-phase acquisition process and specialized BOST (business, operations, systems and technology) reference model for facilitating acquisitions, they describe the roles of several EA artefacts in accomplishing corporate acquisitions. Firstly, they report that the enterprise reference model is used by architects to compare Cisco’s systems and technologies with the ones of acquired companies. This analysis helps determine which components are critical to the integration planning as well as prioritize the most critical components for the future state of the integrated business. Secondly, they report that the capability “heatmaps” are used by architects to understand particular capabilities that need to be integrated during the merger and identify new capabilities that might need to be developed. Thirdly, they report that the capability roadmaps are used by architects to sequence the integration of the acquired organizations into the core systems, enable the ability to sequence the integration planning and provide a powerful communication tool for identifying what activities are necessary, in what order and when.

Weiss (2010), Smith et al. (2012) and Smith and Watson (2015) study an EA practice at Chubb Group (a large U.S. insurance company) at different time periods. Weiss (2010) identify five key EA-related processes (architecture strategy, architecture definition, architecture governance, business unit project implementations and enterprise shared assets) and three competency centres (shared service, knowledge community and centres of excellence) supporting an EA practice at Chubb Group. Smith et al. (2012) report that business capability models are used at Chubb Group to enable effective communication between business and IT stakeholders and focus IT investments into the most important business areas. Roadmaps also enable transparency of IT investments and show where the money is spent and how they uplift the required business capabilities. Smith and Watson (2015) study the further progress of an EA practice at Chubb Group and identify four major components of the Chubb's target EA: architecture principles, architecture governance, conceptual reference architectures and emerging technology.

Finally, Rahimi et al. (2017) analysed various applications of EA management in organizations. Based on an extensive EA literature review and subsequent case studies of eight Danish organizations, they identified three different applications of EA management which depend on its organizational scope: IT management, business capability management and business strategy management. However, Rahimi et al. (2017) did not analyse the relationship between these applications of EA management and the roles of EA artefacts.

To summarize, the research on the adoption and use of EA in organizations generally focuses on studying "high-level" objects including EA practice, EA management, EA function and EA capability. With some exceptions (Smith et al., 2012; Tamm et al., 2015; Toppenberg et al., 2015), these publications consider EA as a generic set of useful descriptions without distinguishing specific EA artefacts and their practical roles. Essentially, this research stream discusses the adoption and usage of EA in general, rather than the adoption and usage of specific EA artefacts constituting EA.

2.6. Enterprise Architecture Maturity and Evolution

The stream of EA research on EA maturity and evolution includes nine publications (Alwadain et al., 2014; Bradley et al., 2012; Bradley et al., 2011; Kettinger et al., 2010; Rai et al., 2010; Ross and Beath, 2006; Trieu, 2013; Vallerand et al., 2017; Venkatesh et al., 2007). These publications discuss different aspects of the process of maturation and evolution of EA practices in organizations. As summarized in Table 2.7 and discussed in detail further, all these publications focus either on EA maturity models (Vallerand et al., 2017) or on an EA practice in general (all other publications) with little or no reference to specific EA artefacts and their practical roles, as if they are completely irrelevant from the perspective of EA maturity.

Table 2.7. Existing EA research related to EA maturity and evolution

Author(s)	Research method	Underlying theory	Object of study	Findings	Reference to EA artefacts
Alwadain et al. (2014)	Interviews with 20 EA experts	Archer's Morphogenetic theory	EA practice in general	Articulate five levels of the outcomes from the SOA and EA integration, and identify a mature EA, flexible EA framework and comprehensive objectives to be the main drives of these integration outcomes	Little or no reference to EA artefacts
Bradley et al. (2011)	Survey of 140 CIOs of U.S. hospitals	No theory	EA practice in general	The maturity of EA positively correlates with business and IT alignment, technical and social risk mitigation and general IT value	Little or no reference to EA artefacts
Bradley et al. (2012)	Survey of 164 U.S. hospitals	No theory	EA practice in general	The maturity of EA positively correlates with business and IT alignment, operational IT effectiveness and enterprise agility	Little or no reference to EA artefacts
Kettinger et al. (2010)	Six case studies of international companies	Globalization theory of Bartlett and Ghoshal (2002)	EA practice in general	Identify the conceptual relationship between the EA maturity stage and the business globalization stage, and articulate nine key success factors for using EA in globalizing companies	Little or no reference to EA artefacts
Rai et al. (2010)	Two case studies of large companies	No theory	EA practice in general	Identify the drivers, actions and constraints for achieving EA maturity from the experience of two organizations with mature EA practices	Little or no reference to EA artefacts
Ross and Beath	Multiple case studies	No theory	EA practice in	Identify the conceptual relationship between the	Little or no reference to EA

(2006)	and surveys		general	stages of EA maturity and appropriate types of outsourcing arrangements	artefacts
Trieu (2013)	Research-in-progress, no data collected	Theory of effective use	EA practice in general	Develop the research model explaining the conceptual relationship between the stages of EA maturity and representational fidelity of business intelligence (BI)	Little or no reference to EA artefacts
Vallerand et al. (2017)	Literature review	No theory	Existing EA maturity models	Identify the underlying assumptions of the available EA maturity models and demonstrate the usefulness of organizational learning as a theoretical lens for studying EA maturity	Little or no reference to EA artefacts
Venkatesh et al. (2007)	In-depth case study of a healthcare organization	No theory	EA practice in general	Articulate six catalysts for achieving EA maturity including strategic vision, evolutionary approach, local accountability for global objectives and effective performance management	Little or no reference to EA artefacts

Generally, the studies focused on EA maturity and evolution use diverse research approaches, though many of them are based on case studies, and are largely atheoretical in nature. These studies discuss various aspects related to EA maturity, but none of these studies provides significant findings specifically regarding EA artefacts and their practical roles.

Bradley et al. (2011) and Bradley et al. (2012) analyse the effects of EA maturity via using statistical instruments. Bradley et al. (2011) based on the survey of 140 CIOs of U.S. hospitals explore the relationship between the maturity of EA and the realization of EA benefits. They demonstrate statistically that having more mature EA practices leads to better business and IT alignment, facilitates risk management and increases the overall value of IT. Bradley et al. (2012) based on the survey of 164 U.S. hospitals study the relationship between EA maturity stages, business and IT alignment, operational IT effectiveness and enterprise agility. They demonstrate statistically that the maturity of EA directly improves enterprise agility, IT alignment and operational IT effectiveness, which in their turn, also improve enterprise agility.

Venkatesh et al. (2007) and Rai et al. (2010) analyse the maturation and evolution of EA practices qualitatively. Venkatesh et al. (2007) analyse the journey to EA maturity in the U.S. Veterans Health Administration (VHA). They identify six key catalysts for success: having strategic vision, involving both global and local groups, taking evolutionary approach, having a strategy for supporting business and IT, local accountability for global objectives and effective performance management. Rai et al. (2010) analyse the experience of two large companies in achieving modular EA, i.e. one of the highest stages of EA maturity. They identify the key drivers for modular EA as well as the key actions and constraints on the way to EA maturity.

Ross and Beath (2006), Kettinger et al. (2010), Alwadain et al. (2014) and Trieu (2013) focus on studying the relationship between the maturity of EA and other organizational practices. Ross and Beath (2006) based on a multi-method research including both case studies and surveys analyse the relationship between the maturity of an EA practice and outsourcing arrangements. They identify a strong link between the EA maturity and corresponding outsourcing practices. Moreover, they articulate three types of outsourcing arrangements (strategic partnership, co-sourcing alliance and transaction exchange) appropriate for companies at different stages of EA maturity. Kettinger et al. (2010) analyse the relationship between the maturity stages of an EA practice and the business globalization stages defined by Bartlett and Ghoshal (2002). They identify the conceptual relationship between the corresponding EA and globalization maturity stages. Moreover, they articulate nine critical success factors for using EA in globalizing organizations. Alwadain et al. (2014) analyse the EA evolution from the critical realist perspective. Based on 20 interviews with EA practitioners and consultants they study the co-evolution of service-oriented architecture (SOA) and EA practices, however, without discussing specific EA artefacts and their roles. Trieu (2013) in a research-in-progress paper based on the theory of effective use (Burton-Jones and Grange, 2012) develops a theoretical model explaining the potential relationship between the EA maturity stages and representational fidelity of business intelligence (BI). Vallerand et al. (2017) analyse and compare the EA maturity models available in literature from the perspective of organizational learning. They provide novel analytical insights on the key assumptions implied by the existing EA maturity models.

To summarize, the research on EA maturity and evolution studies the maturity of an EA practice in general without discussing the concept of maturity through the lenses of specific EA artefacts, their practical usage and roles. This research stream essentially considers EA as some "black box" which gradually matures in organizations, but does not try to explain these processes at the more detailed level of underlying EA artefacts.

2.7. Benefits and Success Factors of Enterprise Architecture

The stream of EA research on benefits and success factors includes nine publications (Alaeddini and Salekfard, 2013; Foorthuis et al., 2016; Foorthuis et al., 2010; Lange et al., 2016; Park et al., 2013; Schmidt and Buxmann, 2011; Shanks et al., 2018; Tamm et al., 2011; Weiss et al., 2013). These publications analyse how EA benefits organizations and what critical success factors facilitate the realization of these benefits. As summarized in Table 2.8 and discussed in detail further, all these publications focus on EA practice, EA management, EA services, EA projects or even on the concept of EA in general, but do not refer to particular EA artefacts or artefact-specific benefits. Generally, the existing research on the benefits and success factors of EA offers little or no discussion of the roles of specific EA artefacts in the realization of anticipated benefits from EA.

Table 2.8. Existing EA research related to benefits and success factors of EA

Author(s)	Research method	Underlying theory	Object of study	Findings	Reference to EA artefacts
Alaeddini and Salekfard (2013)	Survey of 31 organizations in Iran	Alignment assessment model of Luftman (2000)	EA project	EA projects improve business and IT alignment through six maturity components (scope and architecture, partnership, governance, competency and value measurements, skills and communications)	Little or no reference to EA artefacts
Foorthuis et al. (2010)	Survey of 293 Dutch respondents	No theory	EA in general	Establish the statistical relationship between the three techniques for achieving project conformance to EA (compliance assessments, management propagation and project assistance) and	Little or no reference to EA artefacts

				resulting benefits from EA	
Foorthuis et al. (2016)	Survey of 293 Dutch respondents	No theory	EA in general	Establish the statistical relationship between the six characteristics of an EA approach, project compliance with EA, architectural insight and resulting benefits from EA	Little or no reference to EA artefacts
Lange et al. (2016)	Survey of 133 EA practitioners	No theory	EA management	Establish the statistical relationship between EA success factors (product quality, infrastructure quality and service delivery quality) and success measures (intention to use EA, organizational and project benefits)	Little or no reference to EA artefacts
Park et al. (2013)	Research-in-progress, no data collected	No theory	EA practice	Theorization of the possible relationship between EA design factors, strategy types, business environments and organizational performance	Little or no reference to EA artefacts
Schmidt and Buxmann (2011)	Survey of 85 EA professionals	No theory	EA management	Establish the statistical relationship between several success factors of an EA practice and resulting organizational outcomes of using EA	Little or no reference to EA artefacts
Shanks et al. (2018)	Survey of 192 U.S. CIOs	Resource-based view and dynamic capabilities	EA services	Establish the statistical relationship between the EA service capability, EA governance, the use of EA services, project benefits and resulting organizational benefits	Little or no reference to EA artefacts
Tamm et al. (2011)	Literature review	No theory	EA in general	Develop a theoretical model explaining the mechanisms	Little or no reference to EA

				of translation between EA quality and organizational benefits	artefacts
Weiss et al. (2013)	Survey of 112 enterprise architects	Institutional theory	EA management	Establish the statistical relationship between the institutionalization of an EA practice and resulting benefits	Little or no reference to EA artefacts

Generally, the studies focused on benefits and success factors of EA for the most part are based on surveys and atheoretical in nature. These studies discuss various aspects related to EA benefits and their realization, but none of these studies analyses the achievement of benefits through the roles of underlying EA artefacts.

The research stream on the benefits and success factors of EA includes both conceptual and empirical studies. Tamm et al. (2011) based on the EA literature review identify four benefit enablers (organizational alignment, information availability, resource portfolio optimization and resource complementarity) which facilitate the realization of organizational benefits from using EA. Park et al. (2013) proposed a conceptual framework explaining the influence of four EA design factors (centralization, modularity, standardization and open platform), strategy types (differentiation and cost efficiency), organizational size and industry characteristics on the organizational performance including both financial and perceived performance.

All other authors (Alaeddini and Salekfard, 2013; Foorthuis et al., 2016; Foorthuis et al., 2010; Lange et al., 2016; Schmidt and Buxmann, 2011; Shanks et al., 2018; Weiss et al., 2013) conduct empirical, survey-based studies to demonstrate the positive business value of EA. Alaeddini and Salekfard (2013) based on the survey of 31 private and governmental Iranian organizations investigate the benefits of EA projects. They identify the positive impact of EA on business and IT alignment through the six components of the Luftman's alignment maturity assessment model, i.e. scope and architecture, partnership, governance, competency and value measurements, skills and communications (Luftman, 2000). Weiss et al. (2013) based on the survey of 112 enterprise architects investigate the relationship between the institutionalization and effectiveness of EA management. They demonstrate that seven institutionalization factors (social legitimacy, efficiency, organizational grounding, trust, governance, goal alignment and enforcement) facilitate the realization of benefits from using EA.

Lange et al. (2016) based on the survey of 133 EA practitioners study the factors and measures of EA management success. They identify product quality, infrastructure quality and service delivery quality to be the critical success factors of an EA practice, while the intention to use EA and subsequent organizational and project-level benefits are found to be the most significant measures of success. Schmidt and Buxmann (2011) based on the survey of 85 EA professionals from the financial industry sector analyse the relationship between the outcomes and success factors of an EA practice. They find out that multiple factors including EA governance and stakeholder participation lead to the realization of EA benefits such as IT efficiency and flexibility.

Foorthuis et al. (2010) and Foorthuis et al. (2016) based on a survey of 293 Dutch respondents from 119 organizations establish the relationship between the techniques for achieving conformance to EA and resulting benefits. One of their conclusions suggests that the usage of EA artefacts called project-start architectures (PSAs) helps achieve the compliance of specific IT projects with the organization-wide EA rules, guidelines and models. In other words, project-start architectures enable the traceability between global architectural requirements and local implementation-level activities. Finally, Shanks et al. (2018) demonstrate that EA can be considered as a set of advisory services and explain the realization EA benefits through the lenses of EA service capability. Leveraging the resource-based view of a firm and the dynamic capabilities theory, they theorize on the relationships between the EA service capability, EA governance, the use of EA services in both business-driven and IT-driven change, resulting project and organizational benefits from EA. Shanks et al. (2018) proof the statistical significance of these relationships based on the survey of 192 CIOs from the United States.

To summarize, the research on benefits and success factors studies the benefits and success factors of EA projects, EA management, EA services or even EA in general, but does not focus on the benefits of using specific EA artefacts and does not explain how exactly these benefits are operationalized through the practical use of EA artefacts. Moreover, this research stream considers EA merely as a collection of multiple indistinguishable EA artefacts which can be used together to benefit organizations, but does not theorize on the potential differences between the benefits resulting from the usage of different types of EA artefacts.

2.8. Conclusions of the Enterprise Architecture Literature Analysis

The literature review conducted as part of this study and described in detail above shows that the current EA research is very diverse from the perspective of its outlets (published in leading IS journals as well as in highly EA-specific sources and local conferences), methodologies (uses surveys, case studies, focus groups, action research, literature reviews and even many purely conceptual studies) and research questions (addresses disparate and loosely related themes summarized in Table 2.1). The majority of available EA publications are atheoretical, or largely atheoretical, and many of them are purely prescriptive in nature, i.e. propose new approaches or techniques for structuring, describing and analysing EA.

This literature review suggests several important conclusions on the status of research on EA artefacts relevant to the aims of this study. Firstly, EA publications focused on the phenomenon of EA artefacts in general (see Table 2.2) either provide some descriptive views of different use situations of EA artefacts (Niemi and Pekkola, 2017) or offer only very high-level theoretical interpretations of their practical roles from the perspective of the actor-network theory (Sidorova and Kappelman, 2010; Sidorova and Kappelman, 2011) and boundary objects theory (Abraham, 2013; Abraham et al., 2015; Abraham et al., 2013). However, these publications do not develop any comprehensive EA-specific theories addressing the roles of EA artefacts and do not provide a sound theoretical basis for understanding these roles.

Secondly, EA publications focused on specific types of EA artefacts (see Table 2.3) address in detail the practical roles of only a limited number of EA artefacts. Moreover, the vast majority of these publications focus specifically on EA principles, while other types of EA artefacts received insufficient attention in the existing EA research. Therefore, these publications do not offer any comprehensive theories addressing the roles of EA artefacts either.

Thirdly, other streams of EA research that appeared in the leading IS outlets (see Table 2.1) generally pay little or no attention to the practical roles of EA artefacts. For instance, the EA publications on EA frameworks and the structure of EA (see Table 2.4) discuss EA artefacts, but only from the perspective of their informational contents, i.e. what aspects of organizations these EA artefacts should describe. The EA publications on the modelling and analysis of EA (see Table 2.5) discuss EA artefacts, but only from the perspective of their modelling and formal analysis, i.e. what notations can be used for drawing graphical diagrams and how these diagrams can be formally analysed. The EA publications on the adoption and use of EA in organizations (see Table 2.6) generally focus on EA practice, EA function or EA capability. With some rare exceptions, they do not discuss the adoption and use of EA from the perspective of specific EA artefacts and their roles. The EA publications on the EA maturity and evolution (see Table 2.7) do not mention specific EA artefacts altogether, as if they are completely irrelevant to the maturity of EA practices. Finally, the EA publications on the benefits and success factors of EA (see Table 2.8) generally do not discuss the roles of EA artefacts in achieving these benefits, as if the very existence of EA somehow "automatically" benefits organizations. Essentially, the vast majority of publications from these EA research streams consider EA merely as a "black box" with some important information that helps organizations in numerous ways, but do not consider the internal structure of this "black box" from the perspective of the practical roles of constituting EA artefacts.

Additionally, the popular literature for EA practitioners (Bernard, 2012; Spewak and Hill, 1992; TOGAF, 2018; van't Wout et al., 2010), though provides comprehensive lists of EA artefacts that can be used in EA practices, does not explain how exactly specific EA artefacts should be used. At the same time, popular taxonomical EA frameworks (Schekkerman, 2006; Sowa and Zachman, 1992; TEAF, 2000; van't Wout et al., 2010) distinguish EA artefacts only from the perspective of their informational contents, e.g. domains, views, abstraction levels or interrogatives, but without clarifying their practical roles. Moreover, the EA literature for practitioners (Bernard, 2012; Spewak and Hill, 1992; TOGAF, 2011; TOGAF, 2018; van't Wout et al., 2010) offers differing lists of ~30-80 diverse EA artefacts, but these recommendations are largely unverified and limited empirical studies (Smith et al., 2012; Toppenberg et al., 2015) demonstrate that some other EA artefacts missing in these lists, e.g. business capability models, are widely used in practice. These observations suggest that even simple empirically substantiated lists of useful EA artefacts that can be taken as the basis for further research are missing in the current EA literature.

Consequently, the literature review conducted as part of this study suggests that the very phenomenon of EA artefacts for the most part is undeservingly "unnoticed" in literature, i.e. research focuses predominantly on the phenomenon of EA in general, rather than on underlying EA artefacts constituting the essence of EA. The roles of specific EA artefacts in an EA practice received little attention in the existing EA literature, lack a strong theoretical foundation and can be considered as an important under-researched area of the EA discipline. The scope and depth of theorization on the roles of EA artefacts leaves much to be desired.

Moreover, even simple qualitative descriptive accounts of the practice usage of EA artefacts remain rather limited and which of all recommended EA artefacts are actually used in practice is still largely unclear. With the notable exception of the recent study of Niemi and Pekkola (2017), which contributes to our understanding of the practical usage of various EA artefacts, any deliberate efforts towards theorizing the roles of EA artefacts in the current EA literature are missing. Essentially, the available EA literature is largely unable to explain how most EA artefacts can be used in practice and what roles they fulfil. Unsurprisingly, Niemi and Pekkola (2017, p. 326) "call for further research in these respects".

Taking into account the significant practical importance of the advanced understanding of the roles of EA artefacts, as demonstrated earlier in Chapter 1, the research question of this study formulated earlier (What are the roles of different types of EA artefacts in an EA practice?) seems timely and worthwhile. At the same time, the paucity of existing theories on EA artefacts and their roles in the available EA literature suggests that the use of the grounded theory approach may be especially appropriate to develop a new theory on the roles of EA artefacts in an EA practice from scratch, i.e. directly from empirical data. Moreover, the lack of clear answers even on the most basic questions related to EA artefacts, e.g. what EA artefacts are actually used in established EA practices, inevitably makes this study highly exploratory in nature.

In order to provide an adequate answer to the intended research question and address the existing problems in our understanding of the practical roles of EA artefacts, the resulting grounded theory of the roles of EA artefacts should satisfy the following criteria:

- Be comprehensive and encompass the key roles of all EA artefacts useful in practice, e.g. business capability maps (Khosroshahi et al., 2018), enterprise data models (Peels et al., 2016) and standards (Boh and Yellin, 2007)
- Be very EA-specific, highly sensitive to "native" EA-related issues and articulate the roles closely aligned to the unique context of EA (as opposed to generic and widely applicable roles, e.g. decision-making, analysis and planning (Lankhorst, 2013))
- Be generic and organization-neutral to address the roles of EA artefacts in all organizations with established EA practices, however, taking into account various organizational and environmental factors that might significantly influence these roles where appropriate (Buckl et al., 2012; Park et al., 2013; Saha, 2009)

- Establish a clear connection between individual EA artefacts and their typical roles (as opposed to identifying the roles of EA in general or the common roles of all EA artefacts, e.g. boundary objects (Abraham, 2013; Abraham et al., 2013) and elements of an actor-network (Sidorova and Kappelman, 2010; Sidorova and Kappelman, 2011))
- Distinguish the roles of different types of EA artefacts where appropriate, but still be abstracted from highly specific narrow types of EA artefacts, e.g. business capability maps or core diagrams. To achieve this goal, the resulting theory should introduce some new "middle" abstraction layer between (1) the very high-level concept of EA embracing all imaginable EA artefacts (Lange et al., 2016; Shanks et al., 2018; Tamm et al., 2011) and (2) very specific exact types of EA artefacts (Boh and Yellin, 2007; Khosroshahi et al., 2018; Peels et al., 2016; Proper and Greefhorst, 2011). Essentially, the resulting theory should articulate some distinct components of EA from the perspective of their practical usage and roles (as opposed to the existing EA frameworks articulating these components based only on their distinct informational contents, e.g. business, data, applications and technology)

An important distinguishing feature of this study is that it intends to plunge to the next level down and explore the very "nut and bolts" of an EA practice, rather than study EA at a high level of abstraction. While most available EA publications discuss EA in general or EA artefacts as an aggregating umbrella term for all possible types of EA artefacts (see Table 2.2, Table 2.5, Table 2.6, Table 2.7 and Table 2.8), this study intends to explicitly distinguish different types of EA artefacts and identify their type-specific usage and roles. In other words, unlike most of the existing EA studies, this study focuses specifically on EA artefacts and considers different types of EA artefacts as full-fledged distinct concepts of inquiry, rather than as some secondary components of the general overarching first-class concept of EA.

2.9. Chapter Summary

This chapter provided a review of the literature relevant to this research. Firstly, this chapter offered a broad overview of the existing EA research and explained the literature search methodology. Then, this chapter analysed the scope and depth of the existing EA research with an in-depth focus specifically on the studies addressing the phenomenon of EA artefacts in general as well as specific types of EA artefacts in particular. Finally, this chapter summarized the current research on EA artefacts and positioned this study in the overall context of the existing EA literature.

CHAPTER 3: RESEARCH DESIGN

This chapter describes the overall design of this research. Firstly, this chapter describes the general research approach, adopted paradigm and case studies-based grounded theory research strategy. Then, this chapter describes the data collection and data analysis procedures. Finally, this chapter describes the overall process of grounded theory building and theory discussion followed in this study.

3.1. Research Approach

This study aims to address the roles of EA artefacts in an EA practice. However, the practical usage of EA artefacts is insufficiently described in the existing literature. As discussed in Chapter 2, most existing EA publications discuss EA in general as a collection of EA artefacts, but provide little or no information regarding the practical roles of specific EA artefacts. As fairly noticed earlier by Niemi and Pekkola (2017), the available qualitative descriptions of the use cases of EA artefacts are limited in both scope and depth, while any comprehensive conceptual models explaining the usage of EA artefacts are missing in the current EA literature altogether. This paucity of knowledge on the roles of EA artefacts does not allow constructing reasonable conceptual frameworks or deductive propositions to guide this study. Consequently, this study is exploratory in nature and intends to build a new theory on the roles of EA artefacts in a purely inductive manner, rather than deductively extend any existing theories in the EA discipline.

The roles of EA artefacts and various aspects of their usage can be multifaceted, complex and highly context-specific. They can hardly be reduced to a limited number of universal quantifiable attributes and measured quantitatively, especially when different sets of EA artefacts are recommended by different authors (Bernard, 2012; Spewak and Hill, 1992; TOGAF, 2018; van't Wout et al., 2010). Moreover, conceptually similar or even same EA artefacts can be used under different titles in different organizations. For these reasons, a qualitative approach is selected for the exploratory purposes of this study. This research is purely qualitative in nature.

3.2. Research Paradigm

A paradigm can be defined as "a set of basic beliefs (or metaphysics) that deals with ultimates or first principles" (Guba and Lincoln, 1994, p. 107). Paradigms provide ways of examining a social phenomenon from which an explanation of this phenomenon can be attempted and a particular understanding of the phenomenon can be gained (Saunders et al., 2009). Guba and Lincoln (1994, p. 107) explain that a specific paradigm "represents a worldview that defines, for its holder, the nature of the "world", the individual's place in it, and the range of possible relationships to that world and its parts, as, for example, cosmologies and theologies do". The questions of research paradigm are more fundamental than the questions of research methodology since they define not only the research method, but also the ontological and epistemological stances adopted by a researcher (Guba and Lincoln, 1994; Saunders et al., 2009).

There is no single widely accepted set of established research paradigms in social science. For instance, Orlikowski and Baroudi (1991) suggest positivist, interpretive and critical research paradigms as dominating paradigms in information systems research. Guba and Lincoln (1994) consider positivism, postpositivism, critical theory and constructivism as main research paradigms in social sciences. Saunders et al. (2009) discuss positivism, realism, interpretivism and pragmatism as key social science research philosophies.

Regardless of the variety of research paradigms identified by different authors, positivism and interpretivism are widely considered as two dominant "opposing" research philosophies embraced in the information systems discipline (Lee, 1991). On the one hand, positivism is the "classic" research philosophy rooted in natural sciences, which considers reality as objective and independent of any social actors (Dube and Pare, 2003; Pare, 2004; Straub et al., 2004). On the other hand, interpretivism is a newer research philosophy originating in social science, which considers reality as a highly subjective and socially constructed phenomenon (Klein and Myers, 1999; Walsham, 1995a; Walsham, 1995b). The comparison between positivist and interpretivist philosophies (Guba and Lincoln, 1994; Orlikowski and Baroudi, 1991) is summarized in Table 3.1.

Table 3.1. The comparison between positivist and interpretivist philosophies

Aspect	Positivism	Interpretivism
Nature	Scientific	Social
Logics	Reality is objective and therefore can be	Reality is subjective and therefore can be

	measured objectively	perceived only through meanings assigned to it
Assumptions	Objective world exists independently of people and functions according to universal, though undiscovered, rules	Reality is created and maintained by people with their thoughts, values and actions
Applications	Natural, technical, social and humanitarian sciences	Only social and humanitarian sciences
Limitations	Ignores people as creators of reality, ignores contextual and historical conditions	Ignores structural conflicts among people in groups or societies, ignores unintended consequences of their actions

This study tends to be closer to the positivist philosophy, even though qualitative and inductive inquiry is more prevalent in interpretive studies (Orlikowski and Baroudi, 1991; Saunders et al., 2009). Despite that the roles of different EA artefacts might be perceived or described slightly differently by different people, this study still implies that the practical roles of conceptually similar EA artefacts are expected to be generally similar in different organizations reflecting established industry best practices shaped by rather objective organizational realities (this assumption was actually confirmed later during the data analysis).

Although this study admits a certain subjective bias in understanding the roles of different EA artefacts, their roles in general are still considered to be largely free from subjective individual-specific interpretations of particular participants of EA practices. In other words, this study expects that the roles of EA artefacts form more or less objective, consistent, generalizable and organization-independent conceptual patterns. From this perspective, this study can be considered as a postpositivist study which implies objective reality, but “only imperfectly and probabilistically apprehendable” (Guba and Lincoln, 1994, p. 109).

3.3. Research Strategy

Since this study intends to build a new inductive theory directly from empirical data, the grounded theory method (GTM) has been selected as the key research strategy (Corbin and Strauss, 1990; Strauss and Corbin, 1998). Due to the inherent qualitative nature of this study, case studies have been selected as a subsidiary data collection method to complement the primary grounded theory approach (Fernandez, 2004; Fernandez and Lehmann, 2011).

3.3.1. Grounded Theory Research Approach

The grounded theory approach can be defined as "an inductive theory discovery methodology that allows the researcher to develop a theoretical account of the general features of the topic while simultaneously grounding the account in empirical observations of data" (Martin and Turner, 1986, p. 141). Grounded theory is considered as one of the most appropriate methods for building theories in an inductive manner suitable for research areas with little or no established theories (Jaccard and Jacoby, 2010; Langley, 1999; Miles and Huberman, 1994; Wiesche et al., 2017).

Importantly, the grounded theory method is largely unrelated to any specific scientific philosophy or paradigm (Matavire and Brown, 2013). For instance, Urquhart and Fernandez (2006) argue that it can be considered as both positivist and interpretivist approach at the same time. The grounded theory method is "orthogonal not only to the type of data used; it can be appropriated by researchers with different assumptions about knowledge and how it can be obtained. [...] GTM is in many ways neutral and should be seen as a container into which any content can be poured" (Urquhart and Fernandez, 2013, p. 229). Consequently, the grounded theory approach is completely consistent with the postpositivist paradigm adopted in this study.

Birks et al. (2013) identify six essential features of the grounded theory approach. Firstly, the grounded theory method is always focused on theory development. The purpose of a grounded theory study is developing new theories or descriptive models. The grounded theory method provides a flexible approach to theory building that can be used for producing both low-level theories and high-level theories (Urquhart and Fernandez, 2006; Urquhart and Fernandez, 2013). Different types of theories can result from the grounded theory method, e.g. descriptive, predictive and explanatory, all of which are equally important for the normal progression of research and knowledge (Gregor, 2006; Wiesche et al., 2017). Secondly, the grounded theory method always relies on the constant comparison technique. As Fernandez (2004, p. 45) puts it, "regardless of the particular approach one might adopt, without the concept of constant comparison grounded theory cannot be developed". As part of the grounded theory method, data is analysed from different perspectives and constantly compared with each other. Thirdly, the grounded theory method always requires iterative coding. The grounded theory-style data analysis is carried out in an iterative and adaptive manner. Fourthly, the grounded theory method is always based on theoretical sampling. Data collection aims to cover theoretically significant cases, rather than merely statistically representative ones. Fifthly, the grounded theory method always deals with the management of preconceptions. Grounded theory-driven research is not guided by existing theories and literature. As Fernandez (2004, p. 45) puts it, "the critical point here is that the research does not start with a theory to prove or disprove". Sixthly, the grounded theory method always implies inextricable link between data collection and analysis. Data collection and data analysis are closely interrelated and carried out in parallel simultaneously as an intertwined recursive process.

3.3.2. Straussian Version of the Grounded Theory Method

Despite the six essential features of the grounded theory method discussed above, two different versions of the grounded theory are widely used in research: so-called "Glaserian" and "Straussian" grounded theories (Duchscher and Morgan, 2004; Heath and Cowley, 2004; Kendall, 1999; Melia, 1996; Seidel and Urquhart, 2013). The Glaserian version of the grounded theory originates from the seminal work of Glaser and Strauss (1967), while the Straussian version of the grounded theory represents a newer "updated" approach advocated by Strauss and Corbin (1998). The key difference between the two main versions of the grounded theory method is that the Glaserian version is considered to be more conceptual, whereas the Straussian version tends to be more descriptive (Birks et al., 2013; Duchscher and Morgan, 2004; Seidel and Urquhart, 2013). Unlike the Glaserian version of the grounded theory method, the Straussian version is considered as suitable for developing "rich and rigorous descriptions of a phenomenon" (Birks et al., 2013, p. 2).

Matavire and Brown (2013) found four variations of the grounded theory method commonly used in the leading IS research:

- Classic – an end-to-end grounded theory method based on the original guidelines of Glaser and Strauss (1967)
- Evolved – an end-to-end grounded theory method based on the newer guidelines of Strauss and Corbin (1998)
- Analytical – the use of some elements of the grounded theory method, e.g. coding, for data analysis only
- Mixed method – the use of "custom" research methodologies based on, or derived from, the grounded theory method

Although each of these four approaches is considered as an acceptable way to use grounded theory in IS research and has numerous examples of its successful application in the IS literature, the evolved Straussian variation of the grounded theory method is specifically selected as the preferred research method for this study. In other words, this study represents an end-to-end grounded theory driven by the recommendations of Strauss and Corbin (1998), though backed by underlying case studies (Fernandez, 2004; Fernandez and Lehmann, 2011), as discussed later in the subsequent sections.

As noticed by Niemi and Pekkola (2017, p. 327) and completely supported by the conclusions of the EA literature review discussed in Chapter 2, “currently a theoretical model of EA artefact use does not exist”. Moreover, “the coverage of the [EA artefact use] situations identified in the literature is limited in both extent and level of detail” (Niemi and Pekkola, 2017, p. 327). As discussed earlier, even the elementary understanding of what EA artefacts are actually used in organizations remains largely missing. These facts suggest that at this moment the practical usage of EA artefacts, which is essential for understanding their roles, is still poorly understood even at the most basic descriptive level, though with the exception of a limited number of specific EA artefacts, e.g. principles and core diagrams (see Table 2.3).

However, the critical need for having accurate descriptive theories as a prerequisite to conducting more advanced studies had been long recognised by leading management scholars, for instance by Henry Mintzberg (Mintzberg, 1973; Mintzberg, 1979). Likewise, Gregor (2006, p. 629) argues that solid descriptive theories providing basic analytical descriptions of the studied phenomena are “necessary for the development of all of the other [more advanced] types of theory” since “the components of [descriptive] theory are necessary before theory of other types can be expressed clearly” (Gregor, 2006, p. 633). Earlier Fawcett and Downs (1986, p. 4) also emphasized that “descriptive theories are needed when nothing or very little is known about the phenomenon in question”.

Therefore, the resulting grounded theory expected from this study should necessarily include a considerable descriptive element to initially identify and describe in detail all typical use cases of EA artefacts, which currently remain an unexplored “terra incognita” in the existing EA literature. For this reason specifically the Straussian version of the grounded theory is selected as a more suitable approach for highly descriptive research (Birks et al., 2013; Strauss and Corbin, 1998), which this early exploratory study unavoidably represents. From this perspective, this study is very similar conceptually to the previous descriptive research of Smolander et al. (2008), who successfully used the Straussian version of the grounded theory method to identify and qualitatively describe different practical roles of software architecture.

Moreover, the Straussian version of the grounded theory is considered to be easier to use without prior grounded theory experience (Hughes and Jones, 2003), while the "classic [Glaserian grounded theory method] is often perceived as difficult to execute, especially for novice researchers" (Matavire and Brown, 2013, p. 126). Consequently, the choice of the Straussian version of the grounded theory seems especially appropriate for the overall context and aims of this research. Besides that, the Straussian version is identified as the dominant grounded theory approach used in the leading IS research (Wiesche et al., 2017).

3.3.3. Case Studies as a Data Source

Since this study is qualitative and exploratory in nature, the most appropriate data collection method is case studies (Benbasat et al., 1987; Eisenhardt, 1989; Lee, 1989; Yin, 2003). Benbasat et al. (1987, p. 369) argues that case studies research is especially appropriate when "research and theory are at their early, formative stages", as in the case of the roles of EA artefacts addressed in this exploratory study. The case studies data collection method implies that one or several contemporary objects of interest are intensively studied in their full complexity and in their natural settings via multiple means of data collection without any experimental control or manipulation (Benbasat et al., 1987; Miles and Huberman, 1994). Case studies help investigate a contemporary insufficiently studied phenomenon within its real-life context, even when the boundaries between the phenomenon and its context are unclear (Darke et al., 1998; Yin, 2003). Due to these reasons the case studies approach has been selected as a preferable data collection method for this research to complement the core grounded theory research strategy.

Moreover, an EA practice with the set of associated EA artefacts represents an inherently organization-specific, not individual-specific, phenomenon. Therefore, this study implies organizations practicing EA as independent units of analysis. In other words, the units of analysis in the context of this research are complete organizational cases of EA practices, rather than separate interviews of their individual participants. From this perspective, the choice of organizational case studies as an approach to data collection seems especially appropriate.

Eisenhardt (1989) argues that the case studies-based research approaches generally provide two major advantages. Firstly, case studies potentially facilitate the development of novel theories. They help "unfreeze" thinking and "generate theory with less researcher bias than theory built from incremental studies or armchair, axiomatic deduction" (Eisenhardt, 1989, pp. 546-547). Secondly, case studies tend to produce empirically valid theories because in the case studies-based approaches "the theory-building process is so intimately tied with evidence that it is very likely that the resultant theory will be consistent with empirical observation. [...] This intimate interaction with actual evidence often produces theory which closely mirrors reality" (Eisenhardt, 1989, p. 547).

3.3.4. Grounded Theory Method Based on Case Studies

Fernandez (2004, p. 47) warns that "when combining methods like case study and grounded theory, utmost care must be exercised to ensure that the canons of case study research do not distort true emergence for theory generation". For instance, unlike the full-fledged "classical" case study research method (Yin, 2003), which implies constructing an upfront theoretical framework for guiding the research, the case studies-based grounded theory method requires no upfront conceptualization (Fernandez, 2004; Fernandez and Lehmann, 2011). For this reason Fernandez (2004, p. 47) argues that as part of a combined grounded theory and case study research "the researcher must clearly specify which methodology is driving the investigation seeking to generate theory grounded in case study data".

This study intends to develop a new inductive theory directly from empirical data and, therefore, is driven predominantly by the canons of the grounded theory method, while cases studies are used only as a supplementary method of data collection to provide the necessary input data for grounded theory analysis procedures. Despite the possible tension between the canons of the grounded theory and case studies approaches, the case studies-based grounded theory method is considered as "one of the preferred ways of doing grounded theory in IS research" (Fernandez, 2004, p. 47). Moreover, Fernandez (2004, p. 48) argues that "the combination of case studies and grounded theory has been rewarding for IS researchers". Fernandez and Lehmann (2011, p. 8) conclude that "an amalgam of GTM and case research offers a significant potential to IS researchers interested in studying socio-technical systems". Consequently, the case studies-based grounded theory approach was selected as the most appropriate research strategy for this study.

3.4. Data Collection

Grounded theory requires collecting data based on theoretical sampling considerations (Charmaz, 2006; Eisenhardt, 1989; Glaser and Strauss, 1967). The theoretical sampling technique requires focusing primarily on theoretically interesting samples that are likely to extend the emerging theory or provide new and unique insights into the question under investigation, rather than merely on statistically representative samples of the overall population. Moreover, in the case studies-based grounded theory approach "theoretical sampling first ranges within-case to maximize theoretical depth in the case story, and secondly is applied between-cases to move the overall theory forward" (Fernandez and Lehmann, 2011, p. 7). In this study, both the case selection process and the data collection process within each case were driven by theoretical sampling considerations aligned to the overall grounded theory research strategy.

3.4.1. Selection of Case Organizations

Two general common criteria have been applied to all organizations to establish a minimal set of basic requirements for case selection and "weed out" inappropriate cases. Firstly, case organizations must actively practice EA for the period of at least three years, have permanent EA teams and consistent EA-related processes. Secondly, case organizations must be relatively large in order to be using complex IT systems and have a real need for a full-scale EA practice supported by various EA artefacts. In line with the previous study of Ambler (2010), organizations employing at least 100 IT specialists, or a comparable number of full-time equivalents, were considered as large for the purposes of this research.

According to the canons of the adopted grounded theory research strategy, the inter-case sampling has been guided by the sampling recommendations of Fernandez and Lehmann (2011, p. 9), who argue that as part of the inter-case theoretical sampling "the status of the theoretical framework, which is the result of all the previous cases' categories and constructs is assessed for 'saturation' of theorems and propositions. Theoretical sampling then selects the next case such that unsaturated theorems and propositions can be enhanced and strengthened in their explanatory and predictive qualities".

Guided by theoretical sampling considerations, as well as by the minimal basic requirements described above, five organizations working in different industries have been studied as part of this research. All the five cases were large organizations with well-established EA practices. In order to ensure confidentiality, these organizations will be called here and further as Educational Institution, Financial Institution, Telecom Institution, Delivery Institution and Retail Institution reflecting their respective industry sectors. A brief overview of the five studied organizations is provided in Table 3.2.

Table 3.2. Overview of the five studied organizations

Case Organization	Description	Size	EA experience	Theoretical sampling
Educational Institution	One of the largest Australian teaching and research universities providing various educational services to undergraduate, postgraduate and vocational students across multiple specialities	>7000 employees including >500 IT specialists	>3 years of full-fledged EA practice	"Average" mid-size organization, "typical" case to start from
Financial Institution	Large international bank with multibillion dollar revenues providing retail, corporate, insurance, wealth management and other financial services primarily in the Asia-Pacific (APAC) region	>40000 employees including >3000 IT specialists, plus outsourced IT staff	>8 years of full-fledged EA practice	Larger organization with more extensive EA experience from a more IT-dependent industry sector
Telecom Institution	One of the prominent Australian telecommunication companies providing various communication services to millions of customers across Australia	>4000 employees including >500 IT specialists, plus vendor IT staff	>6 years of full-fledged EA practice	More centralized organizational structure with consolidated IT governance
Delivery Institution	One of the prominent goods delivery companies operating on the Australian market and providing a wide range delivery services to individuals and organizations	>30000 employees including >500 IT specialists, plus contractor IT staff	>5 years of full-fledged EA practice	More decentralized organizational structure with significant local decision-making autonomy
Retail Institution	Major player in the fast-moving consumer goods retail market in Australia which operates several hundred retail outlets and has multibillion dollar revenues	>80000 employees including >1000 IT specialists	>4 years of full-fledged EA practice	More dynamic and unpredictable industry and business environment

3.4.2. Selection of Data Sources for Case Studies

One of the key characteristics of data collection through case studies is the collection of data from different sources (Benbasat et al., 1987; Yin, 2003). For each case, data were collected from two main sources:

- Interviews – interviews is the most important data source for this study because the answer to the research question can be obtained only from the people involved in EA practices in organizations
- EA documentation – specific documents, i.e. EA artefacts, is an inherent and critical element of an EA practice that should necessarily be studied in order to understand the roles of these documents

3.4.3. Semi-Structured Interviews within Case Studies

As the first part of within-case data collection, semi-structured interviews with architects, architecture managers and other participants of EA practices have been conducted. Interviewees within case studies have been selected using the theoretical sampling technique (Charmaz, 2006; Eisenhardt, 1989; Glaser and Strauss, 1967). As recommended by Fernandez and Lehmann (2011, p. 9), in within-case sampling the theoretical focus was "on selecting more 'slices-of-data' from within each case so that their incidents can saturate categories and maximize their conceptual yield. Once such new data does not add more properties and/or begins to repeat existing ones, then no more useful data can come out of the current case".

As described earlier in Chapter 2, the resulting grounded theory is intended to be comprehensive and cover all types of EA artefacts used in organizations. From this perspective, one of the critical goals of the theoretical sampling was to study the usage of all types of EA artefacts, rather than of some limited subsets of EA artefacts. For this purpose the key intent of within-case theoretical sampling was to interview all key representatives of architecture functions (e.g. enterprise architects, domain architects, lead architects, solution architects, etc.) and cover all relevant organizational levels of planning (e.g. enterprise level, business unit level and project level) to ensure that all types of EA artefacts used in the studied organizations are discussed and their practical roles understood. Accordingly, interviews in each organization were conducted until the theoretical saturation has been achieved (Charmaz, 2006; Glaser and Strauss, 1967; Strauss and Corbin, 1998).

In total 31 one-hour interviews were conducted between October 2014 and March 2016. The semi-structured interview questionary used in this study for the primary data collection can be found in Appendix B. The full list of interviews taken in this research for the primary data collection in each of the five studied organizations is presented in Table 3.3.

Table 3.3. List of participants interviewed in each organization

Organization	Interviewee position	Tenure in organization
Educational Institution	Director of Architecture	13 years
	Project Manager	2 years
	Director of Architecture	13 years
	Engagement Manager	2.5 years
	Solution Architect	9 years
	Business Analyst	1 year
	Two Solution Consultants	7 months and 15 months
	Communication Systems Engineer	5 years
	Director of Architecture	13 years
	Total: Nine interviews	
Financial Institution	Enterprise Architect	10 years
	Solution Architect	4 years
	Enterprise Architect	8 years
	Technical Architect	3 years
	Enterprise Architect	10 years
	Solution Architect	6 months
	General Manager for Architecture and Strategy	30 years
	Total: Seven interviews	
Telecom Institution	Lead Architect	2 years
	Lead Data Architect	5 years
	Enterprise Architect	2 years
	Enterprise Architect	5.5 years
	Solution Architect	1.5 years

	Data Architect	1 year
	Lead Architect	2 years
	Total: Seven interviews	
Delivery Institution	Principal Architect	3 years
	Solution Architect	2.5 years
	Enterprise Architect	17 years
	Principal Architect	3 years
	Solution Architect	2.5 years
	Total: Five interviews	
Retail Institution	Solution Architect	3 months
	Manager of Architecture	2 years
	Enterprise Architect	8 months
	Total: Three interviews	
Total: 31 interviews		

All the interviewees were guaranteed full confidentiality of the data they provided. Each interviewee has been also explicitly asked to provide a permission to record a conversation before any recording started. All interviews have been recorded with the permission of the interviewees and then transcribed for grounded theory analysis.

3.4.4. Documentation Analysis within Case Studies

As the second part of within-case data collection, samples of EA artefacts provided by the interviewees have been studied in order to triangulate the collected interview data. Triangulation is "the use of two or more independent sources of data or data-collection methods within one study in order to help ensure that the data are telling you what you think they are telling you" (Saunders et al., 2009, p. 602). Triangulation implies studying "different data sources of information by examining evidence from the sources and using it to build a coherent justification for themes" (Creswell, 2003, p. 191). Accordingly, the examination of EA artefacts used in the studied organizations helped understand the informational contents of these EA artefacts and cross-check these contents against the typical use cases described by the interviewees.

Due to the commercially sensitive nature of the information contained in EA artefacts, most EA artefacts were available only for a visual examination and in some cases sketches of EA artefacts have been taken for further analysis. However, in Educational Institution full access to the organizational EA repository has been granted to the researcher. In total, samples of 39 different types of EA artefacts have been studied via analysis of original copies, visual examination or visual examination with sketching. An example of a typical sketch of an EA artefact taken from a real EA artefact as part of the EA documentation analysis can be found in Appendix C. The full list of EA artefacts studied in each of the five studied organizations is presented in Table 3.4.

Table 3.4. List of EA artefacts studied in each organization

Organization	EA artefact(s)	Examination type
Educational Institution	Maxims	Original copies studied
	Principles	Original copies studied
	Standards	Original copies studied
	Technology Reference Model	Original copy studied
	Business Capability Model	Original copy studied
	Roadmaps	Original copies studied
	One-Page Diagrams	Original copies studied
	Program of Work	Original copies studied
	Conceptual Architectures	Original copies studied
	Solution Designs	Original copies studied
Financial Institution	Capability Model	Visually examined
	Process Model	Visually examined
	Divisional Roadmap	Visually examined
	Platform Roadmap	Visually examined and sketched
	Blueprint	Visually examined and sketched
	Solution Architecture	Visually examined and sketched
	High-Level Design	Visually examined
Telecom Institution	Data Model	Visually examined
	Patterns	Visually examined

	Data Schema	Visually examined and sketched
	Business Capability Model	Visually examined
	Function Roadmap	Visually examined and sketched
	Reference Architecture Model	Original copy studied
	Solutions on a Page	Visually examined
	Solution Blueprint	Visually examined
Delivery Institution	Principles	Visually examined
	Reference Architecture	Visually examined
	Blueprint	Visually examined and sketched
	Roadmap	Original copy studied
	Technology Blueprint	Visually examined and sketched
	Technology Roadmap	Visually examined
	Idea Brief	Visually examined
	Preliminary Solution Architecture	Visually examined
Retail Institution	Business Capability Model	Visually examined and sketched
	Business Reference Architecture	Visually examined
	Roadmap	Visually examined and sketched
	Technical Reference Architecture	Original copy studied
	Key Design Decisions of SO	Visually examined
	Solution Overview	Visually examined

3.5. Data Analysis

Due to an inevitable highly descriptive nature of this early exploratory study of the roles of EA artefacts, the data collected from the five case organizations have been analysed according the canons of the grounded theory approach recommended by Strauss and Corbin (1998), as explained earlier in this chapter.

3.5.1. Grounded Theory Approach to Data Analysis

Before data analysis with the grounded theory method, all the interview recordings have been manually transcribed verbatim from audio into textual representations. Then, the data analysis in this study generally progressed according to the standard three-step grounded theory process recommended by Strauss and Corbin (1998): open coding, axial coding and selective coding. Firstly, during the open coding phase the transcripts were analysed and coded in order to identify narrow codes, more general concepts and overarching categories (Corbin and Strauss, 1990; Strauss and Corbin, 1998). Secondly, during the axial coding phase, after the concepts have been joined into categories, connections and interrelationships between these concepts have been established (Corbin and Strauss, 1990; Strauss and Corbin, 1998). Finally, during the selective coding phase the usage of EA artefacts has been chosen to be the core category, all other categories have been related to usage and a single storyline around the roles of EA artefacts has been developed binding all the categories into a consistent logical picture (Corbin and Strauss, 1990; Strauss and Corbin, 1998). The overall analytical process based on the grounded theory method followed in this study is shown in Figure 3.1.

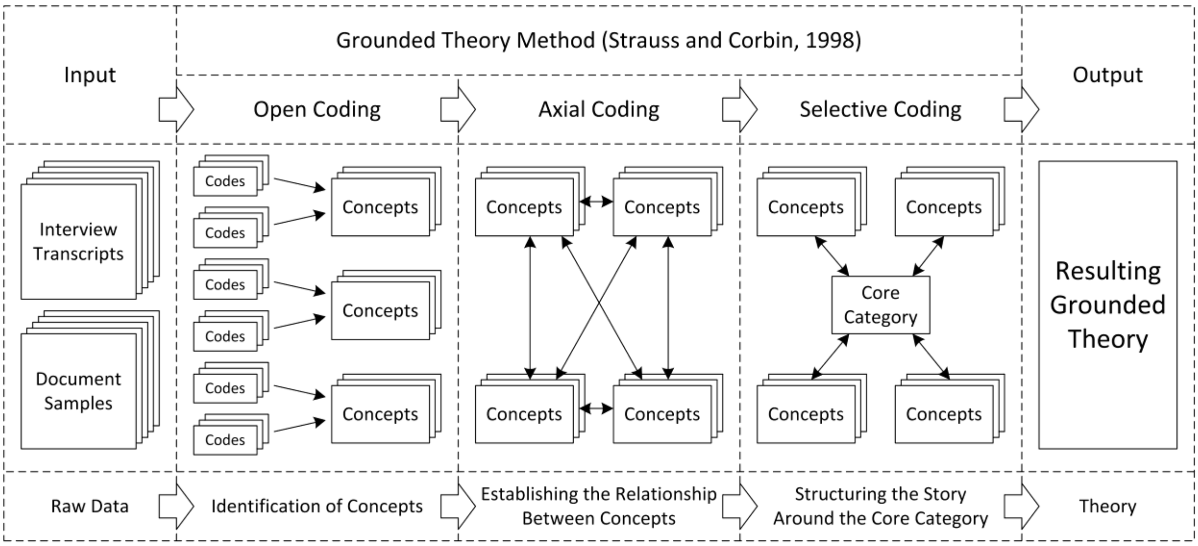

Figure 3.1. Analytical process according to the grounded theory method

Open coding is "the interpretive process by which data are broken down analytically" (Corbin and Strauss, 1990, p. 12). As part of the open coding phase I read and reread the transcribed text line-by-line, identified the fragments of text containing relevant information from the perspective of the roles of different EA artefacts and then associated these fragments with corresponding codes. However, the analysis during the open coding phase was based largely on key points instead of individual words since a word-by-word and line-by-line microanalysis can be very time consuming, often leads to over-conceptualization and, most importantly, may divert the focus of research away from the essential issues (Allan, 2003). Following the constant comparative method (Charmaz, 2006; Glaser and Strauss, 1967), all identified codes were continuously compared with other codes to form higher-order concepts and then all concepts were continuously compared with other concepts to form broader categories.

Axial coding is the interpretive process during which "categories are related to their subcategories, and the relationships tested against data" (Corbin and Strauss, 1990, p. 13). Axial coding "looks at how categories crosscut and link" (Strauss and Corbin, 1998, p. 124). As part of the axial coding phase I read and reread the transcribed text, as well as the codes and concepts identified earlier during the open coding phase, and then established logical relationships between these concepts grounded in data (Creswell, 2007). As recommended by Corbin and Strauss (1990, p. 13), single incidents were not taken as a sufficient basis for establishing or rejecting the potential relationship between different concepts. Instead, only systematic relationships have been taken into account "that were indicated by the data over and over again" (Corbin and Strauss, 1990, p. 13). Axial coding helped "reassemble" the data that has been previously fractured during the open coding phase into a cohesive picture (Charmaz, 2006). Axial coding resulted in a set of established relationships between the concepts and main categories previously identified during the open coding phase.

Selective coding is the interpretive process "by which all categories are unified around a "core" category" (Corbin and Strauss, 1990, p. 14). The selective coding phase implies the identification of the core category, which "represents the central phenomenon of the study" (Corbin and Strauss, 1990, p. 14). Since this study is intended to explore the practical roles of different EA artefacts, the usage of EA artefacts was naturally selected to be the core category serving as a pivot for the emerging grounded theory and as a key theme for the resulting storyline on the roles of EA artefacts. Selective coding is the final step of the grounded theory method in which the researcher "assembles a story that describes the interrelationship of categories in the model" (Creswell, 2007, p. 65). During the selective coding phase I combined all the previously identified concepts, categories and relationships between them into a consistent storyline explaining the roles of different EA artefacts in an EA practice answering the intended research question of this study.

However, the case studies-based grounded theory method used in this research implies two different levels of iterations: within-case iterations and inter-case iterations

(Fernandez, 2004; Fernandez and Lehmann, 2011). On the one hand, within-case iterations imply collecting a portion of new raw data, analysing this data, updating established conceptual framework and then organizing the next interview to collect additional data until the theoretical saturation for a single organization is not achieved. On the other hand, inter-case iterations imply collecting and analysing the data for a single organization, updating established conceptual framework and then switching the focus to the new case organization until the theoretical saturation for the whole study is not achieved.

Consequently, the grounded theory research process in this study consisted of two iterative loops at within-case and inter-case levels. Each of these loops included collecting and analysing new data, refining codes, concepts and relationships between them, updating the resulting conceptual framework and then selecting new interviewees (for within-case loops) or new case organizations (for inter-case loops) for further data collection based on the theoretical sampling and saturation considerations described earlier. The two-level iterative grounded theory process followed in this study is shown in Figure 3.2.

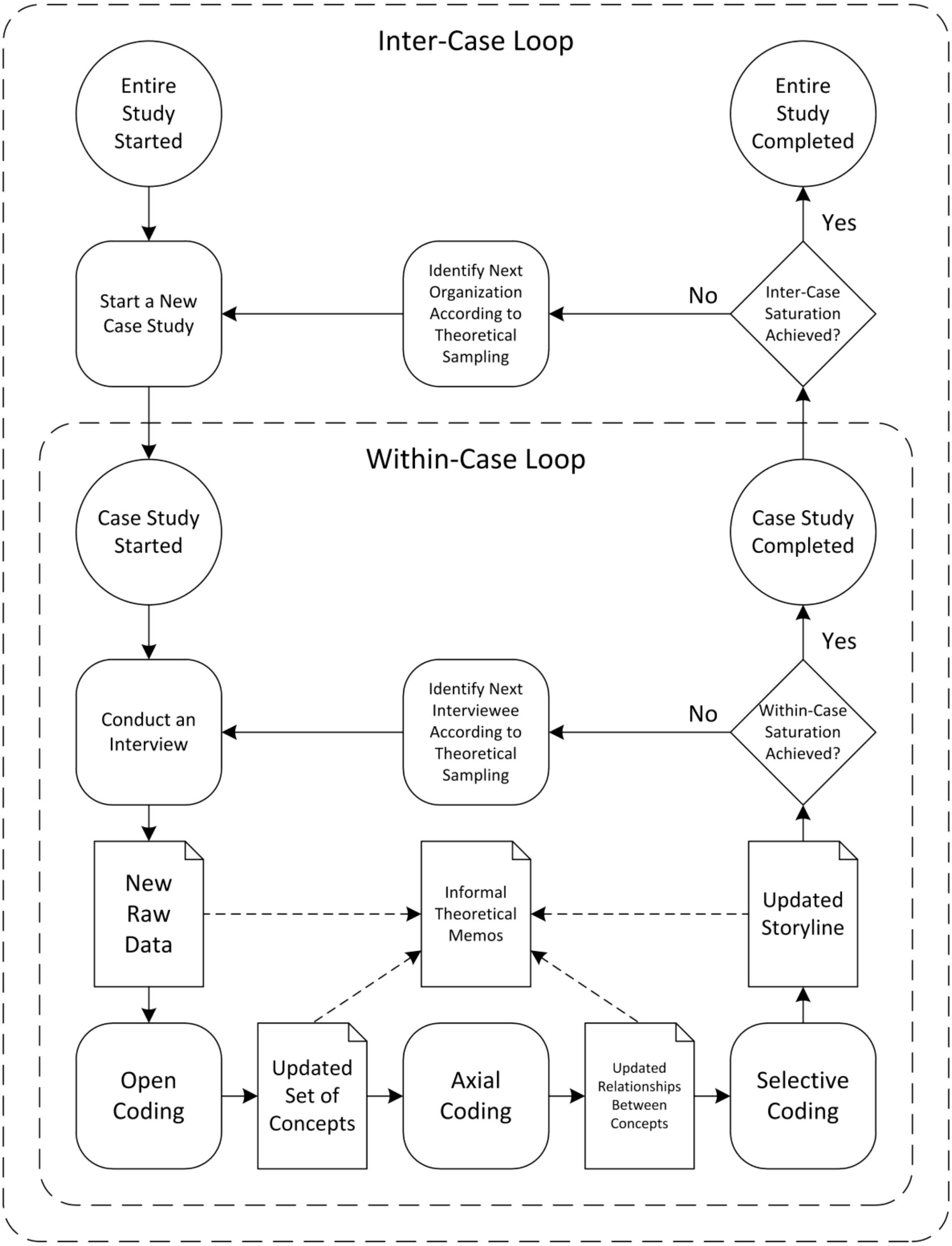

Figure 3.2. The two-level iterative grounded theory process followed in this study

Writing theoretical memos along the whole process of data analysis is an integral part of the grounded theory approach (Charmaz, 2006; Corbin and Strauss, 1990; Glaser and Strauss, 1967; Strauss and Corbin, 1998). Theoretical memos help "keep track of all the categories, properties, hypotheses, and generative questions that evolve from the analytical process" (Corbin and Strauss, 1990, p. 10). Writing theoretical memos also "prompts you to analyse your data and codes early in the research process" (Charmaz, 2006, p. 72). I started to write informal theoretical memos at the early stage of the data collection process in order to systematize my preliminary conceptualizations and immature reflections on the discovered roles of EA artefacts. These theoretical memos were continuously updated after each step of the ongoing research process to reflect the latest understanding of the studied phenomenon of EA artefacts. During the later stages of this study these theoretical memos naturally converged into the ultimate storyline produced as a result of the grounded theory process. Eventually theoretical memos provided "a firm base for reporting on the research and its implications" (Corbin and Strauss, 1990, p. 10).

3.5.2. Manual Approach to Data Analysis

Many data analysis software tools are available to support the grounded theory research including NVivo and ATLAS.ti. However, Glaser (1998) argues that the grounded theory analysis may suffer from the excessive reliance on software analysis tools, which can impose unnecessary restrictions, impair the development of researchers' analytical skills and stifle their creativity. Webb (1999) argues that the creative and thinking parts of any research belong to the researcher, while software tools can "alienate researchers from their data" (Webb, 1999, p. 325). "The intellectual work of actually conceptualizing can only be done by the brain of the researcher. The computer may be able to assist, but there is a risk of becoming so concerned with the technical aspects that this interferes with the "artistic" aspects [of the research]" (Webb, 1999, p. 329). This is why Webb (1999, p. 329) argues that "it is preferable for beginning qualitative researchers to use "manual" methods for their first project because the resulting learning process will then form a firm basis for any subsequent use of [data analysis software tools]".

Thompson (2002, p. 3) argues that computers cannot do the data analysis instead of researchers because mindlessly "coding data using computer programs is *not* analysis". Data analysis software tools can facilitate only some "mechanical" aspects of research, while "the most difficult task for the researcher is the conceptual part of data analysis: identifying meaningful segments of data, organizing these segments into categories, and finally describing the relationship among these categories" (Thompson, 2002, p. 5).

Moreover, Thompson (2002, p. 2) argues that manual analysis may be preferable because "physically handling the data, by marking text or cutting and pasting the transcripts of interviews, seems to give the process a more human touch by connecting the researcher to the researched". Similarly, Webb (1999, p. 329) argues that "the intimacy gained by [the manual data analysis] process gives such a close "feeling" for and familiarity with what participants have said that it leads to a process of analysis that could appear almost to be automatic and even to have physical elements. It is as if the ideas almost literally flow up one's arm as one annotates transcripts and makes notes, enter one's brain, and then flow back to the paper on which the analysis is written". At the same time, "there are no easy short cuts in undertaking a quality controlled and rigorous analysis of research data. The consequences of trying to cut corners [with software tools] are more likely to result in research that lacks credibility and is difficult to defend [...] because the process of analysis involves a dynamic relationship between researcher and data" (Thompson, 2002, p. 4). Unsurprisingly, even many experienced qualitative researchers (Chakraborty et al., 2010; Day et al., 2009; Hekkala and Urquhart, 2013; Kumar and Stylianou, 2014; Levina and Ross, 2003; Levina and Su, 2008; Olsson et al., 2008; Orlikowski, 1993; Urquhart, 1999; Vannoy and Salam, 2010) do not report on using any specific software tools for data analysis in their studies. Therefore, in line with the recommendation of Webb (1999) to use manual data analysis in the first qualitative research project, the manual approach to data analysis have been used in this study.

3.5.3. Specifics of the Coding Approach

This research is highly exploratory in nature. Due to its focus specifically on different EA artefacts as first-class objects of inquiry, this study has no direct analogues in the existing EA literature, which, with the exception of in-depth studies of specific types of EA artefacts (see Table 2.3), focuses on EA in general as a collection of all types of EA artefacts (see Table 2.2, Table 2.4, Table 2.5, Table 2.6, Table 2.7 and Table 2.8).

Since this study intends to develop a theory that articulates type-specific roles of EA artefacts, as discussed earlier in Chapter 2, different types of EA artefacts fulfilling these roles must be distinguished as separate theoretically significant concepts by the resulting theory as well. Unlike other studies that often consider EA artefacts as a single umbrella concept representing all the "products" of an EA practice largely as homogeneous documents (Lange et al., 2016; Niemi and Pekkola, 2009), this research intentionally distinguishes different types of EA artefacts as separate theoretical constructs to be able to study and understand the corresponding differences in their practical usage, roles and value. For example, at a high abstraction level both principles (Aier, 2014; Greefhorst et al., 2013;

Tallberg et al., 2015) and core diagrams (Ross et al., 2006) can be considered simply as "EA artefacts" with some properties. However, for the purposes of this exploratory study such intuitive high-level generalizations are inappropriate because these artefacts represent significantly different concepts from the perspective of their informational contents, practical usage and roles in the context of an EA practice.

In other words, this study focuses on type-specific roles of EA artefacts and, therefore, identifying different theoretically significant types of EA artefacts is an integral part of this research. For this reason this study intentionally uses a somewhat unusual, more detailed and fine-grained coding approach to distinguish all significant types of EA artefacts, their users and use cases as separate first-class concepts important for theoretical understanding of their type-specific roles. In order to initially investigate the usage of different types of EA artefacts, which is currently insufficiently understood even at the most basic descriptive level (Niemi and Pekkola, 2017), this study uses "direct" rather than "tangential" approach to coding, i.e. the coding procedures are focused largely on the primary aspects of the phenomenon of EA artefacts including their types, use cases and stakeholders, rather than on some more subtle "secondary" aspects, e.g. qualities, properties or motives. In the current situation, when neither different types of EA artefacts nor their regular use situations are sufficiently studied, this direct focus is critically necessary for identifying theoretically significant types of EA artefacts, understanding their type-specific use cases and eventually developing a comprehensive theory explaining their type-specific practical roles.

3.5.4. Examples of Applied Coding Procedures

Guided by the suggestions of the "direct" coding approach described above required to initially explore the practical usage of EA artefacts, this study followed the three different types of coding procedures recommended by Strauss and Corbin (1998): open coding, axial coding and selective coding (see Figure 3.1). Firstly, the transcripts of all recorded interviews have been read line by line and coded to identify all notions relevant to the roles of EA artefacts. Specific codes have been assigned to individual words or phrases conveying important meaning in the context of the studied phenomenon. Examples of this open coding procedure for the first studied organization (Educational Institution) with source quotes and identified low-level codes are shown in Table 3.5.

Table 3.5. Examples of the initial open coding procedure

Original quotes	Identified low-level codes
"They are roadmaps [1], drafts that you see behind you on the walls. They are basically saying "this piece of work or this capability will be developed [2] in this timeframe [3]", and they link to investment plans that say "in order to establish this capability we need to make this much investment". [...] That's about prioritizing investments [4]"	[1] Roadmaps, [2] Planned Work, [3] Timeframe, [4] Investments Prioritization
"These are the proposed [conceptual] designs [1] that will support those [demanded projects] and that enables us to cost out what the solution looks like [2]. So, then it [conceptual design [3]] goes to the [top management] committee [4] as a view of how much those projects are gonna cost [5], how long they gonna take [6], what benefits are associated with that and how that strategically supports where the university is trying to go [7]"	[1] Conceptual Designs, [2] Estimation, [3] Conceptual Designs, [4] Committee, [5] Project Cost, [6] Project Duration, [7] Project Benefits
"We have the technology reference model [1], which we use to say "this is all of the technologies that we have right now [2]". So, everything we do should line out with the TRM [3]"	[1] Technology Reference Model, [2] Available Technologies, [3] Technologies Selection
"[Our EA practice is] TOGAF-based. So, TOGAF is the key framework that we use [1], but I wouldn't say that we adopted it very fully at this point in time. There are a few other frameworks that push into the enterprise architecture space. From a service perspective we are very much an ITIL-based shop [2] and that impacts on some of the architecture work that we do as well. And I guess emerging from an enterprise perspective is COBIT. So, COBIT is very much the future of where we are going at [3]"	[1] TOGAF, [2] ITIL, [3] COBIT
"What we are looking for is a good roadmapping tool, but since we haven't found anything that really meets our needs at this point in time we still fall back to Visio [1]. [...] We have an extensive repository of architecture documents within Google Drive [2] which [proved] to be a good collaboration platform, but we don't have any specific architecture tools implemented"	[1] MS Office, [2] Google Drive

Secondly, the transcripts of all recorded interviews have been reread again and all the initial fine-grained codes have been consolidated and harmonized to form broader, logically related, non-overlapping and coherent concepts. As explained earlier, for the purposes of this exploratory study different types of EA artefacts, their use cases and different groups of their users have been considered as separate full-fledged concepts required to explicate type-specific roles of EA artefacts and achieve the intended research objectives. As a result of this procedure the initial sets of fine-grained codes have been consolidated into broader concepts with consistent meaning. Examples of this procedure for the first studied organization (Educational Institution) with the initial codes, resulting concepts and relevant explanations are shown in Table 3.6.

Table 3.6. Examples of the codes harmonization procedure

Codes in alphabetical order	Resulting concept	Explanation
Chancellors, Top Managers, Vice-Chancellors	Global Executives	All these codes refer to individual executives of the entire university
Detailed Designs, Solution Designs, Technical Designs	Solution Designs	All these codes refer to the type of EA artefacts most often called as solution designs
Consistency, Fitness, Organizational Alignment	Organizational Fitness	All these codes refer to the general appropriateness of IT-related planning decisions in the organizational context
Project Cost, Project Benefits, Project Duration, Project Structure	Project Overviews	All these codes refer to high-level overviews of specific IT projects with preliminary estimations of their timelines, costs and business value
COBIT, ITIL, TOGAF	Frameworks	All these codes refer to EA or EA-related frameworks potentially shaping an EA practice
Google Drive, MS Office	Tools	All these codes refer to software tools used for various EA-related purposes and supporting an EA practice

Thirdly, the resulting consolidated concepts have been grouped into broader categories relevant in the context of the studied phenomenon. As a result of this procedure, identified concepts have been organized into a small number of overarching categories representing their key logical meaning. Examples of this procedure for the first studied organization (Educational Institution) with the original concepts, resulting categories and relevant explanations are shown in Table 3.7.

Table 3.7. Examples of the categories identification procedure

Concepts in alphabetical order	Resulting category	Explanation
Business Capability Models, Conceptual Architectures, Global Roadmaps, IT Principles, Landscape Diagrams, Local Roadmaps, Principles, Solution Designs, Standards, Technology Reference Models	Artefacts	All these concepts refer to specific types of EA artefacts used in Educational Institution
Improved Project Quality, Increased Agility, Investments Effectiveness, Investments Efficiency, Organizational Fitness, Reduced Complexity, Reduced Cost, Reduced Duplication	Benefits	All these concepts refer to the benefits resulting from the usage of different EA artefacts
Accelerating Change	External Factors	This single concept refers to the factors of external business environment influencing an EA practice
Business Capabilities, Business Imperatives, Implementation Plans, Landscape Snapshots, List of Technologies, Planned Projects, Project Overviews, Solution Components, Technical Imperatives	Information	All these concepts refer to the informational contents of different types of EA artefacts
Frameworks, Size and Tools	Internal Factors	All these concepts refer to the factors of internal organizational environment influencing an EA practice
Approaches Selection, Decisions Assessment, Investments Focusing, Investments Prioritization, Knowledge Sharing, Project Approval, Project Implementation, Project Planning, Project Shaping, Technologies Selection	Usage	All these concepts refer to different use situations of EA artefacts in the context of an EA practice
Enterprise Architects, Global Executives, Liaisons, Local Executives, Project Managers, Project Team Members, Solution Architects, Steering Committee	Users	All these concepts refer to different groups of users and stakeholders of EA artefacts

Fourthly, the transcripts of all recorded interviews have been reread once again to discover consistent relationships between the identified concepts. As a result of this axial coding procedure the connections between concepts have been established. Examples of this procedure for the first studied organization (Educational Institution) with source quotes and identified relationships between the corresponding concepts are shown in Table 3.8.

Table 3.8. Examples of the axial coding procedure

Original quotes	Concepts	Relationships
"What we're really trying to get to is this business architecture space where we have a business capability model [1]. We know that the capabilities [of the university] that we describe in that model [2] are aligned with the objectives that the university has in its strategic plan [3] and then we decide how to invest to build those particular capabilities [4]. We're at least a year off really having those conversations, but the turnaround that we expect from that is the fact that we will be talking to the business [5] about how do we enable a capability [6] rather than talking to them about how do we deploy an application"	[1] Business Capability Models, [2] Business Capabilities, [3] Investments Effectiveness, [4] Investments Focusing, [5] Global Executives, [6] Investments Focusing	Business Capability Models provide information on Business Capabilities which supports Global Executives who perform Investments Focusing to improve Investments Effectiveness
"Typically within the architecture engagement what happens is first we take the captured requirements and turn those into the conceptual architecture [1] to describe [proposed] solution at a high level [2]. That's basically enough, so we can size up the piece of work, decide roughly where the solution space is and figure out how big it is [3] to be able to give the business stakeholders [4] an idea of how much you gonna need to invest in order get all of this [5]. And that then causes a notification process for the project, so that gets it passed through the first gate"	[1] Conceptual Architectures, [2] Project Overviews, [3] Project Shaping, [4] Local Executives, [5] Investments Efficiency	Conceptual Architectures provide Project Overviews which support Local Executives who perform Project Shaping leading to Investments Efficiency

Finally, the existing relationships between concepts have been analysed to identify consistent usage patterns of EA artefacts (Usage was selected to be the core category of this study) and then group them into a number of top-level themes representing the resulting roles of EA artefacts. As a result of this selective coding procedure a consistent "story" around the roles of EA artefacts has been produced. Examples of this procedure for the first studied organization (Educational Institution) with the identified patterns of usage and resulting roles of EA artefacts are shown in Table 3.9.

Table 3.9. Examples of the selective coding procedure

Consistent usage patterns	Resulting themes (roles)
Technology Reference Models (Artefacts) provide the List of Technologies	Technology Providers

(Information) to Enterprise Architects and Solution Architects (Users) for Technologies Selection (Usage) purposes to achieve Reduced Cost and Reduced Complexity (Benefits) of the IT landscape	
Business Capability Models (Artefacts) provide a view of all organizational Business Capabilities (Information) to Enterprise Architects, Global Executives and Steering Committee (Users) for Investments Focusing (Usage) to improve strategic Investments Effectiveness (Benefits)	Investment Guides
Solution Designs (Artefacts) provide project Implementation Plans (Information) to Solution Architects, Project Managers and Project Team Members (Users) for Project Implementation (Usage) purposes to achieve Improved Project Quality (Benefits)	Project Implementers

The consistent application of these coding procedures to all collected data eventually produced the resulting grounded theory of the roles of EA artefacts.

3.6. Theory-Building Process

The theory building in this study progressed according to the high-level iterative process described in Figure 3.2. As discussed earlier in Chapter 2, the resulting grounded theory was intended to be generic, organization-neutral and reflect the essential commonalities in the roles of EA artefacts found in different organizations. For this reason, the generalizations of concepts made during the theory-building process in this study have been made based on the uncovered similarities between EA artefacts and their practical usage across the five case organizations. The underlying conceptual framework evolved accordingly from very narrow and organizations-specific concepts to broader and organization-neutral concepts.

Specifically, as a result of the first analysed case study the initial conceptual framework has been developed based on the concepts identified in the first organization and the initial list of corresponding roles has been composed accordingly. After each of the four subsequent case studies the conceptual framework was gradually enriched with new concepts identified in corresponding organizations and generalized from organization-specific to organization-independent notions. The list of the roles of EA artefacts was updated accordingly after each case study and eventually converged into the final set of general, organization-independent roles. As noted by Suddaby (2006, p. 636), in the grounded theory method “the movement from relatively superficial observations to more abstract theoretical categories is achieved by the constant interplay between data collection and analysis that constitutes the constant comparative method". Importantly, the analysis of each case study initially produced some unique concepts unidentified in the previous cases, but eventually after comparing these new concepts with the existing ones all such case-specific concepts have been generalized into more abstract concepts relevant for all the studied organizations. The overall logic driving the process of concepts generalization aligned to the goals of this study is shown in Figure 3.3. The gradual evolution of the conceptual framework after each case study is described in detail in Appendix D.

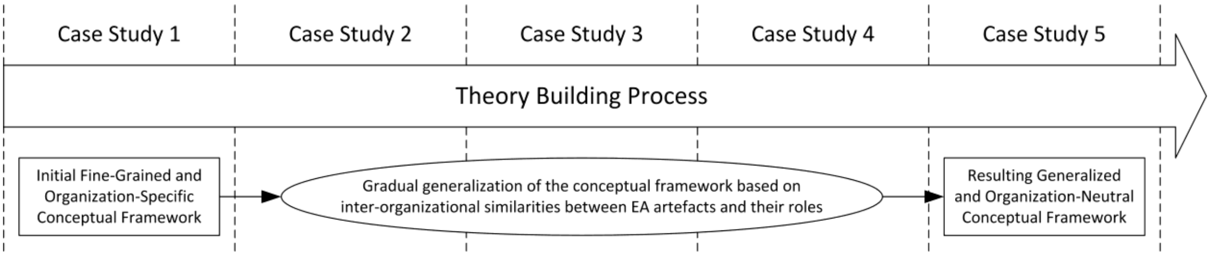

Figure 3.3. The overall logic of the concepts generalization process

After completion of each case study the theory saturation assessment has been conducted to evaluate the emerging grounded theory and decide whether additional data is required to achieve theoretical saturation. The progression of this study from the perspective of concepts related to the roles of EA artefacts is shown in Table 3.10.

Table 3.10. The progression of research from the perspective of relevant concepts

Aspect	Educational Institution	Financial Institution	Telecom Institution	Delivery Institution	Retail Institution
Codes (all low-level codes assigned as part of the analysis of each case)	161	190	176	165	111
Concepts Found (all abstract concepts identified as part of the analysis of each case)	49	67	56	55	49
New Concepts Found (new concepts unidentified in the previous cases)	49	28	17	7	4
Generalized Concepts (concepts extended by merging and "consuming"	0	16	6	16	8

other similar concepts)					
Added Concepts (new concepts added to the resulting conceptual framework after appropriate generalizations)	49	13	12	4	2
Resulting Concepts (the total number of concepts in the resulting conceptual framework)	49	56	65	54	48
Resulting Roles (the total number of resulting highest-level theoretical themes)	10	12	11	8	6
Theory Status (theory saturation assessment)	Unsaturated	Unsaturated	Somewhat saturated	Largely saturated	Fully saturated

Eventually, after the analysis of all the five case organizations has been completed, six generic roles fulfilled by EA artefacts in the context of an EA practice (six highest-level themes) have been articulated and the corresponding theory has been developed. As the next step of this study, the practical implications of the resulting grounded theory have been discussed with a number of EA experts.

3.7. Concluding Theory Evaluation and Discussion

In line with the similar study of the roles of software architecture by Smolander et al. (2008), this study also included the discussion of the practical aspects of the resulting grounded theory with industry experts. In order to discuss the potential practical value of the developed theory, as well as to confirm its key propositions, a number of additional face-to-face and Skype interviews with different EA experts have been conducted. As part of these interviews the practical aspects of the resulting grounded theory have been presented to the interviewees and then the interviewees have been asked to provide their feedback, opinions and comments regarding the theory, its validity and potential practical value.

To achieve the maximum degree of objectivity and minimize potential biases, EA experts from different countries with diverse backgrounds have been interviewed as part of theory discussion, including EA practitioners from the organizations studied previously as part of theory building, experienced EA practitioners from other organizations and EA academics. In total ten ~40 minute interviews have been conducted between July 2016 and October 2016. The full list of EA experts interviewed in this study as part of theory discussion is presented in Table 3.11.

Table 3.11. List of EA experts interviewed as part of theory discussion

#	EA expert	Organization	Country	EA experience
1	EA practitioner	University	Australia	10 years
2	EA practitioner	Road operator	Australia	8 years
3	EA practitioner	Telecom Institution	Australia	12 years
4	EA practitioner	Superannuation fund	Australia	6 years
5	EA practitioner	Delivery Institution	Australia	13 years
6	EA practitioner	Insurance provider	Australia	18 years
7	EA practitioner	Food manufacturer	Australia	7 years
8	EA academic with practical experience	University (as EA academic) and government agency (as EA practitioner)	Netherlands	6 years
9	EA academic with practical experience	University (as EA academic) and bank (as EA practitioner)	Netherlands	20 years
10	EA academic with practical experience	University (as EA academic) and government agency (as EA practitioner)	Finland	8 years

As the final step of this study, the confirmed grounded theory of the roles of EA artefacts has been related back to the existing theories in the EA discipline (Corbin and Strauss, 1990; Creswell, 2007; Glaser and Strauss, 1967; Strauss and Corbin, 1998).

3.8. Measures Taken to Ensure Validity and Reliability

Yin (2003) argues that the quality of a case studies research design can be assessed based on four main quality criteria: construct validity, internal validity, external validity and reliability. A number of special measures have been taken in this study to ensure high quality of the research design and satisfy these quality criteria. The four quality criteria suggested by Yin (2003), their descriptions and the measures undertaken in this study to address these criteria are presented in Table 3.12.

Table 3.12. Quality criteria and the respective measures taken to address these criteria

Quality criteria	Description	How the criteria is addressed
Construct validity	Making sure that operational measures address the studied concepts	Multiple data sources have been analysed including interviews (see Table 3.3) and documents (see Table 3.4), interviewees have been asked to provide specific examples of the actual activities and behaviour, interview questions have been formulated in "real organizational terms", rather than in abstract notions
Internal validity	Establishing cause-effect relationships between the studied concepts	Clarifying questions have been asked in order to understand the actual relationship between different concepts as well as the roles of these concepts in the broader organizational context
External validity	Understanding the limits of the domain where the findings of the study can be analytically generalized	Analytical generalizability of the findings from each case organization is logically replicated to other cases (see Figure 3.3) and also supported via the subsequent theory evaluation and discussion with other EA experts (see Table 3.11)
Reliability	Ensuring that the operations of the study can be repeated and the same outcomes obtained	All interviews have been conducted according to the standardized semi-structured questionary (see Appendix B), established and rigid grounded theory procedures have been followed for data analysis (see Table 3.10)

3.9. Chapter Summary

This chapter described the overall design of this research. Firstly, this chapter described the general research approach, adopted paradigm and case studies-based grounded theory research strategy. Then, this chapter described the data collection and data analysis procedures. Finally, this chapter described the overall process of grounded theory building and theory discussion followed in this study.

CHAPTER 4: THEORY BUILDING VIA CASE STUDIES

This chapter describes in great detail the long, complex and "boring" process of constructing a case studies-based grounded theory of the roles of EA artefacts based on the consecutive analysis of five case organizations with established EA practices. As discussed earlier, this study followed an iterative theory-building process where five different organizations have been subsequently studied until the theoretical saturation has been achieved (see Figure 3.2), while the corresponding conceptual framework and the identified roles of EA artefacts gradually matured and evolved from organization-specific to organization-independent notions accordingly (see Figure 3.3). The goal of this chapter is to describe in detail the "technical" step-wise process of theory building as well as the evolution and convergence of the resulting conceptual framework.

In particular, this chapter describes five consecutive iterations of grounded theory building representing the analysis of five different organizations studied as part of this research. For each of the five studied organizations this chapter (1) provides a brief overview of this organization, (2) describes the structure of an EA function in the organization, EA artefacts used in the organization and EA-related processes followed in the organization, (3) discusses concepts identified in the organization as a result of the grounded theory analysis, (4) describes the identified roles of EA artefacts and environmental factors influencing these roles, (5) assesses the degree of theoretical saturation achieved after the analysis of the organization and (6) justifies the selection of the next case organization to be studied. The five case studies, their interpretation and respective stages of the theory-building process are described in great detail in Sections 4.1-4.5.

4.1. Case Study One: Educational Institution

Educational Institution is one of the largest Australian teaching and research universities providing educational services to undergraduate, postgraduate and vocational students across a wide spectrum of specialisations. It has several academic campuses in Australia and overseas serving more than 38,000 students from different countries. Educational Institution is structured on several faculties consisting of multiple academic schools. Totally, it employs more than 7000 people including administrators, permanent academic staff, casual teachers and invited researchers.

Educational Institution has a centralized IT department providing planning, delivery and support services to all faculties and schools. The IT department employs more than 500 IT specialists including system administrators, developers and architects and consists of the following subunits: engagement, application delivery, infrastructure delivery, client computing, service management and enterprise architecture.

Although the educational business is not very dynamic compared to many other businesses, its speed of change is constantly accelerating. In order to attract the research funding and collaborate on an international basis it is now essential to have supporting network and infrastructure technologies in place. The emergence of a free online education, where people can get the information of comparable quality at no cost, makes universities look for new and innovative value propositions. The ongoing deregulation of education in Australia allows many private education providers to compete with established public universities. All these changes in the business environment make universities struggle to keep up with the required rate of change.

> *"In the business environment there is acceleration, there is an accelerating speed of change. So, there is a challenge for us. [...] I would say that [Educational Institution] struggles as a large organization to keep up with the rate of change that is required. [...] The university really has to stay technologically relevant and also offer a new value proposition"* (Director of Architecture)

This accelerating pace of the educational business forced Educational Institution to improve the planning of its IT systems with EA. In order to uplift its IT planning capability, Educational Institution made a deliberate commitment to establish a mature EA practice. For this purpose, the university recruited architects who had previous experience with EA in the public sector instead of relying on internal staff. The inflow of experienced enterprise architects helped the university establish its EA capability and organize a permanent EA function with consistent EA-related processes.

> *"[Our EA practice] was set up as a very defined effort to enter into enterprise architecture. So, the organization brought in somebody who had experience in doing that in a public sector arena and also invested the time in bringing on board a lot of external skills to raise, to uplift our skills base. Rather than*

> *trying to rely on people who are very senior internal people, we started to get some external perspective into that"* (Director of Architecture)

Therefore, the consistent value-adding EA practice in its present form was established at Educational Institution during 2011-2012, but it is still evolving towards greater maturity.

4.1.1. Enterprise Architecture Function

The EA function at Educational Institution is centralized and responsible for information systems planning for all units of the university. The EA department is headed by the deputy director of architecture, who is focused on maturing the EA practice and describes himself as a manager of architects, not a chief architect.

> *"My role is to lead and mature that practice to ensure that it's established as a permanent capability within the organization"* (Director of Architecture)

The EA function employs 20 architects including four enterprise architects and 16 solution architects.

> *"We have a team of twenty architects and four of those are EAs [enterprise architects], so we've got about sixteen solution architects"* (Director of Architecture)

Enterprise architects work at the enterprise level and constitute the core of the architecture team. Each of the four enterprise architects is responsible for one major domain (business, applications, integration and data, and infrastructure) enterprise-wide.

> *"We have an alignment to those [EA] domains. Conceptually, we have an enterprise architect in infrastructure, one in applications, one in data and integration and one in business"* (Director of Architecture)

Enterprise architects develop global principles, standards, roadmaps and other architectural artefacts described further relevant to their domains. Solution architects work at the project level in project teams and spend most of their time developing architectural artefacts for their individual IT projects. Solution architects closely collaborate with enterprise architects in order to ensure that the project architectures they produce conform to established maxims, principles and standards for the corresponding domains.

> *"We have a set of them: maxims, principles, patterns and standards. [...] We reference back to all of those EA artefacts [in our solutions]"* (Solution Architect)

Many of the solution architects are contractors hired specifically to work on particular types of projects. TOGAF certification is encouraged among all architects and many of them are already TOGAF-certified. The director of architecture considers TOGAF as the main EA framework used in Educational Institution, but admits that its recommendations are followed loosely.

> *"[Our EA practice] is TOGAF-based. TOGAF is the key framework that we use, but I wouldn't say that we adopted it very fully at this point in time"* (Director of Architecture)

The organization of the EA function at the university is shown in Figure 4.1.

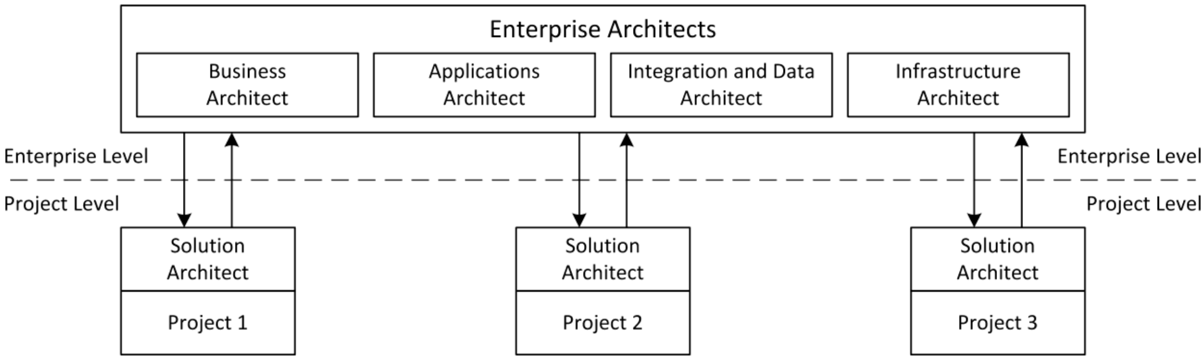

Figure 4.1. EA function in Educational Institution

Apart from enterprise and solution architects, the EA practice at Educational Institution has several other participants collaborating with architects on various EA-related activities: ICT steering committee, business customers, engagement managers, solution consultants, business analysts, project managers and project implementers. ICT (Information and Communications Technology) steering committee is the top-level governance body of the university consisting of the most senior executives and responsible for approving, prioritizing and funding IT projects.

> *"The ICT steering committee [...] is the most senior operational group in the university, and the same group of stakeholders, senior stakeholders, also meets as the ICT steering committee in order to prioritize IT projects"* (Director of Architecture)

Business customers are typically the heads or representatives of various business units of the university responsible for running and managing their units. Engagement managers are the "front door" to the IT department for business customers of the university. They are responsible for communicating with business customers from different units of the university and discovering their demand for new IT projects.

> *"As engagement managers we're the front door into IT services. If anybody in the university wants to get any IT work done, at a project level, at a strategic project level, then that is logged with an engagement manager and we work with a customer to flesh out that piece of work"* (Engagement Manager)

Solution consultants are responsible for collecting high-level business requirements for IT projects from business customers. Business analysts are responsible for eliciting and collecting detailed business requirements for IT projects from their future users. Project managers are responsible for managing project implementation activities as well as for communicating with users and other business stakeholders of IT projects. Project implementers include software developers, team leads, technical designers, testers, database administrators, infrastructure experts and other IT specialists responsible for the actual implementation of projects.

4.1.2. Enterprise Architecture Artefacts

The EA practice at Educational Institution is supported by a well-defined set of ten EA artefacts. Main EA artefacts used at the university are briefly described in Table 4.1. Schematic samples of all the different types of EA artefacts used at Educational Institution can be found in Appendix G.

Table 4.1. EA artefacts in Educational Institution

Owners	Artefacts	Description
Enterprise architects	Program of work	The program of work contains the list, or mini-roadmap, of all projects chosen for implementation in the upcoming year and approved for funding
	Business capability model (BCM)	The business capability model provides a high-level holistic view of the whole university. It shows all the organizational capabilities and sub-capabilities as well as the organizational goals, customers, suppliers, partners and stakeholders in a simple structured manner
	Roadmaps	Each business unit of the university has its own roadmap showing all the

		information systems and technologies relevant to this unit. Roadmaps show the systems of four different types: (1) implemented systems currently used by the business unit, (2) systems being implemented now, (3) planned systems approved for implementation in the future and (4) systems needed by the business unit, but not yet approved for implementation. They also show expected beginning and completion dates for planned systems and systems at the implementation stage
	Technology reference model (TRM)	The technology reference model lists all the available technologies that should be used in IT projects including programming languages, application servers, operating systems, database management systems, integration buses and many other technologies
	One-page diagrams	One-page diagrams show the relationship and interaction between various information systems depicting different parts of the organizational IT landscape in their current states and less often in their planned future states
	Maxims	Maxims are very high-level business and IT imperatives applicable to all projects
	Principles	Principles are brief reusable implementation-level rules applicable to broad categories of IT projects
	Standards	Standards are reusable low-level technical rules and patterns applicable in narrow and specific situations
Solution architects	Conceptual architectures	Conceptual architectures describe goals, objectives, high-level designs and major design options for individual IT projects detailed enough to estimate their size, time and cost
	Solution designs	Solution designs describe detailed designs of individual IT projects actionable for project teams implementing them

Educational Institution takes a simplistic approach towards creating, storing and distributing the EA documentation and does not use any specific EA software tools, though some of them have been tried in the past.

> *"We've tried a number of different tools in that space but haven't found any to be really suitable to our environment yet and so the debate rages on"* (Director of Architecture)

Google Drive serves as a central repository for all EA artefacts at the university. The architectural website is based on Google Sites and provides a convenient interface for navigating the catalogue and accessing the EA artefacts stored in Google Drive. Most EA artefacts are either MS Word documents or graphical diagrams. MS Visio is the key tool used for drawing architectural diagrams, no specific formal modelling notations are used for that purpose. For presentation purposes EA artefacts are typically wrapped in MS PowerPoint files.

4.1.3. Enterprise Architecture Processes[2]

Architects and other participants of the EA practice at Educational Institution work according to established processes enabling business and IT alignment. All alignment processes start from the activities of engagement managers. Five engagement managers visit different business units of the university and communicate with the corresponding business customers in order to understand what new IT projects are needed by their business units and which existing IT systems are not used anymore and can be decommissioned.

> *"Engagement managers speak directly with areas of the business to understand the demand for projects we have coming in. They will be engaged with a solution consulting team, who will engage with the business stakeholders to sort of understand what the project is that is required, and the solution consulting team internally engage the architecture team. Typically within the architecture engagement what happens is first we take the captured requirements and turn those into the conceptual architecture [to describe proposed solution at a high level]. That is basically enough, so we can size up the piece of work, decide roughly where the solution space is, figure out how big it is and give the business stakeholders an idea of how much do they need to invest in order get this"* (Director of Architecture)

Roadmaps are used to facilitate these discussions between engagement managers and business customers by showing what IT systems their business units have now, what IT systems they will have in the short-term future and what IT systems are envisioned for the long-term future.

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[2] Studying in detail EA-related processes is not the goal of this research and is not implied by the research question of this study. Therefore, the descriptions of EA-related processes provided here and in all the subsequent case studies are rather approximate and simply reconstructed from the descriptions of EA artefacts and their usage. These descriptions are provided for illustrative purposes only in order to demonstrate the usage of specific EA artefacts in a wider organizational context, but they cannot be considered as perfectly accurate descriptions

> *"We do all the groundwork around the edges in terms of talking to customers to understand what they are trying to do, and we use various tools to do that, like I will use roadmaps around these systems"* (Engagement Manager)

After the needs for new IT projects have been identified by engagement managers, for each proposed project a solution consultant gathers high-level business requirements and then a solution architect uses them to develop a conceptual architecture for the project.

> *"Once we have extracted from a customer what they're trying to do, then a [solution] architect and a solution consultant are the next people that I will bring in behind me to flesh that piece of work out"* (Engagement Manager)

Solution architects use the technology reference model (TRM) and one-page diagrams in order to identify the most reasonable technologies and high-level implementation options for proposed IT projects. Additionally, solution architects use the business capability model (BCM) to specify which capabilities projects contribute to. After being developed by solution architects, all conceptual architectures are approved by enterprise architects responsible for the corresponding domains in order to ensure their alignment and conformance to the overall architecture. The resultant conceptual architectures help estimate the scope, value, cost and timelines of all proposed IT projects. After these estimates are agreed with the corresponding business customers, they make formal business cases for the projects.

> *"Once architecture can say "right, this is the conceptual design for that project", then that enables me to cost out [the project]. I can pick up an architectural design and I can go "for this I will need system changes, I will need infrastructure changes, I will need a PM [project manager], I will need a BA [business analyst], I will need an architect, I will need a process analyst, I will need someone from AD [application delivery], ID [infrastructure delivery]", and it enables us to cost out everything it would take to reach that solution that architecture has given us. [...] Those costings then feed into the decision-making committee, executives across the organization, for them to be able to make decisions about what they want to do or what they do not want to do"* (Solution Consultant)

Based on these time, cost and value estimates, once a year the ICT steering committee prioritizes all proposed IT projects, selects which projects will be implemented during the upcoming year and allocates funding for them.

> *"I pull my picture together for all my customers that says "this is the list of projects that all my customers want to do". [...] All that comes together into a big university bucket of everything that everybody wants to do across the university. What the architects do then is help feed into that a view of all these things that the university wants to do. These are the proposed designs that will support projects and enable us to cost out what that looks like. Then it goes to the committee as a view of how much those projects will cost, how long they will take, what the benefits are associated with that and how that strategically supports where the university is trying to go"* (Engagement Manager)

However, each business unit also has its own small pool of funding to sponsor the projects critical to it. Typically 80-90% of all projects to be implemented in the following year are selected by the ICT steering committee as a result of the prioritization process and funded from the centralized IT funding pool, while other 10-20% of projects, predominantly small ones, are funded directly by business units and avoid the global prioritization process. The business capability model (BCM) and maxims are used by the ICT steering committee during the prioritization process to assess the alignment of proposed IT projects to the organizational strategic goals, capabilities and philosophy.

> *"There are a number of different prioritization aspects that occurs. [...] Stuff like maxims fit is an input into that process. [...] We have certain custody of projects within there they are prioritized. The vast majority of demand keeps below that. But essentially what happens is we decide what gets above the line, what gets done. That goes to seniors stakeholders within the university and there is a governance process that goes up to the ICT steering committee and they approve what projects will go ahead"* (Director of Architecture)

> *"We have a business capability model, we know that the capabilities that we describe in that model aligned with the objectives that the university has in its strategic plan and then we decide how to invest to build those particular capabilities"* (Director of Architecture)

As a result of these activities the program of work for the next year is produced and roadmaps for all business units are updated to reflect the newly scheduled projects. Then, after all proposed IT projects have been prioritized and the program of work for the upcoming year has been produced, business analysts collect detailed requirements for all IT projects included in the program of work and solution architects develop corresponding solution designs based on these requirements. The conceptual architectures previously developed for these projects serve as a basis for these activities.

> *"The conceptual architecture really sets out the goals of the project, what it is trying to achieve, what problem it is trying to solve and the reason for doing the project, of course. [All that] feeds into the creation of requirements for the solution architecture that we do"* (Business Analyst)

> *"Conceptual architecture document will say "the business case of the project is we want to do this, this and this, and this is what it all looks like conceptually". Then to go to the next stage we actually do a very detailed solution design document. This is actually the next document that we produce architecturally [...]. The architect do the actual solution design and this is what we are going to implement specifically as part of that project"* (Project Manager)

Solution architects use maxims, principles and standards in order to ensure that their solution designs are compliant with established architectural guidelines and reuse standardized solution components.

> *"There are standards that the enterprise architecture team produces and maintains [...]. We have to make sure that we are adhering to those standards and not going outside of the boundaries to reinvent wheels"* (Solution Architect)

Typically one solution design is developed for each project based on its conceptual architecture. However, in rare cases of large projects their conceptual architectures are split up into several solution designs to support their step-by-step implementation. All solution designs are formally reviewed and approved by enterprise architects responsible for the corresponding domains.

> *"The solution design then goes throughout a formal governance process where we make an assessment that the correct architectural approaches are applied to that. This is a peer review process that generally includes a number of solution architects and an enterprise architect, at least one, are reviewing the deliverables to see that it aligns"* (Director of Architecture)

Finally, approved solution designs are transferred to project managers and project implementers to implement the projects according to their designs. Solution designs are communicated to all project participants and used as cornerstones guiding the implementation activities for all projects.

> *"We got this solution design document, which is done by an architect and that is the cornerstone that really designs a project. But from that document [solution design] we then get what is called the technical design document and that is done by a technical designer, not in the architecture team. [...] So this is what we can implement"* (Technical Expert)

During all the alignment processes described above, enterprise architects are responsible for producing, maintaining and providing all the supporting enterprise-level EA artefacts including the business capability model, technology reference model, roadmaps, one-page diagrams, maxims, principles and standards. At the same time, other participants of the EA practice also contribute to enterprise-level EA artefacts. Specifically, senior executives from the ICT steering committee contribute to the business capability model and review maxims, which are updated according to the organizational strategy after it has been approved. Solution architects contribute to technical EA artefacts including the technology reference model, one-page diagrams, principles and standards. The alignment processes constituting the EA practice at the university, their main actors and supporting EA artefacts described above are shown in Figure 4.2.

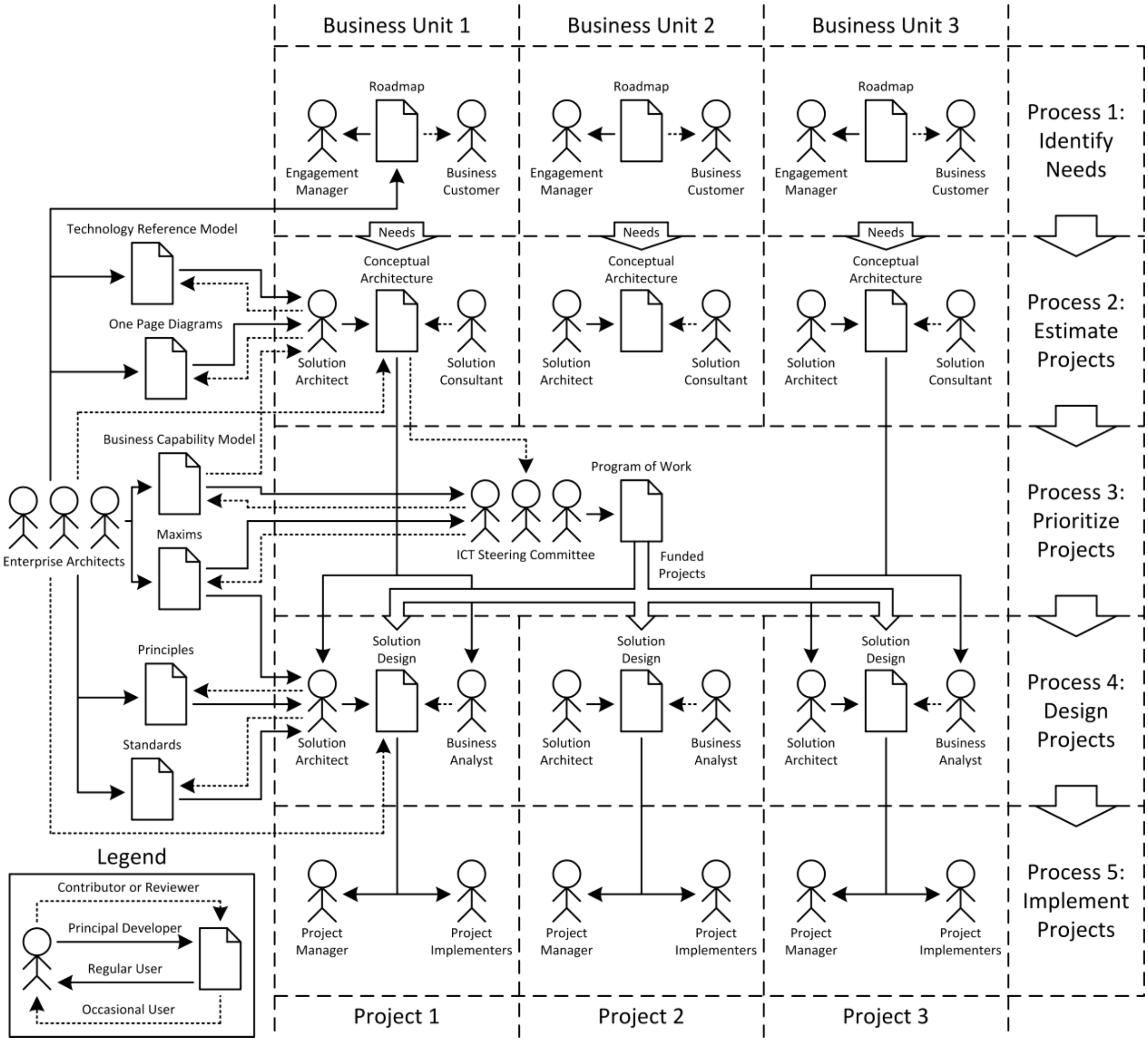

Figure 4.2. EA processes in Educational Institution

4.1.4. Grounded Theory Analysis

In order to analyse the collected interview data for Educational Institution and theorize on the roles of EA artefacts, the three-step grounded theory procedure described in detail earlier in Section 3.5.4 has been applied (see Table 3.5, Table 3.6, Table 3.7, Table 3.8 and Table 3.9). Samples of the grounded theory analysis process and the detailed list of all identified concepts and categories for Educational Institution can be found in Appendix D.1.

As explained earlier in Chapter 3, the usage of EA artefacts in practice still remains largely unexplored even at the very basic descriptive level and this in-depth exploratory study, therefore, intends to investigate rather basic, but important and insufficiently understood questions related to EA artefacts, e.g. what is actually used, by whom, how and why. Accordingly, the resulting concepts have been identified with an intention to comprehensively cover these "simple" questions distinguishing all theoretically significant types of EA artefacts, their use cases and groups of related users as separate first-class theoretical constructs required for articulating type-specific roles of EA artefacts. Due to an insufficient understanding of the differences between various EA artefacts from the perspective of their practical usage, this direct and fine-grained coding approach, though somewhat unusual, is appropriate and even necessary for "untangling" and systematizing the complex mix of diverse artefacts, processes and actors constituting an EA practice (see Figure 4.2) and then articulating the practical roles of EA artefacts.

As a result of the applied coding procedure 161 different codes have been assigned, which were subsequently consolidated into 49 consistent concepts and ten crosscutting dimensions. These 49 concepts and related dimensions have been further consolidated into seven broad categories: Artefacts (ten concepts and three dimensions), Benefits (eight concepts), External Factors (one concept), Information (nine concepts and three dimensions), Internal Factors (three concepts), Usage (ten concepts and two dimensions) and Users (eight concepts and two dimensions).

In their turn, Artefacts, Benefits, External Factors, Information, Internal Factors, Usage and Users categories have been grouped into four key domains reflecting the degree of coupling and relationships between these categories: environment (Internal Factors and External Factors), artefacts (Artefacts and Information), use (Users and Usage) and benefits (Benefits). The environment domain covers all environmental Internal Factors and External Factors influencing the usage of EA artefacts in an organization. The environment domain essentially addresses the question "What factors influence usage?" The artefacts domain embraces the closely related categories of Artefacts, as physical documents, and Information, as valuable informational contents of these artefacts. The artefacts domain answers the question "What is used?" The use domain covers Usage, as use cases of these EA artefacts, and Users, as organizational actors involved in this usage. The use domain addresses the question "How is it used?" The benefits domain includes only Benefits category, as positive organizational outcomes resulting from the usage of EA artefacts. The use domain answers the question "Why is it used?"

These four domains can be organized into a comprehensive theoretical framework which is inspired by and loosely resembles the framework used earlier by Orlikowski (1993) for studying the usage of CASE tools and then successfully adapted to the context of information systems planning as well (Shanks, 1997; Shanks and Swatman, 1997). The proposed four-domain framework for grouping the seven categories and ten related dimensions relevant to the roles of EA artefacts is shown in Figure 4.3.

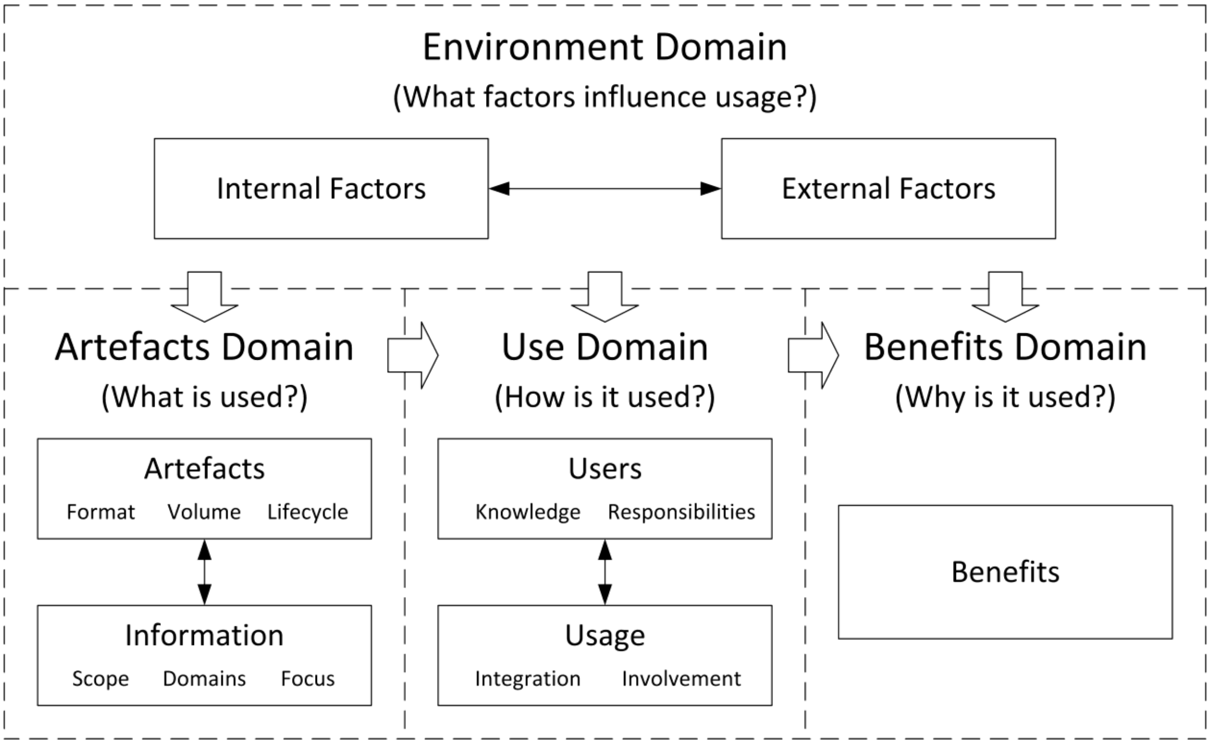

Figure 4.3. Four-domain theoretical framework for grouping the seven categories

Each of the four core domains with the underlying concepts and their dimensions is discussed in detail in the following sections.

4.1.5. The Environment Domain

The environment domain includes two related categories: Internal Factors and External Factors. Internal Factors represent relevant factors of the internal organizational context influencing the usage and roles of EA artefacts, while External Factors represent significant factors of the external business environment potentially impacting the roles of EA artefacts.

Internal Factors category includes three distinct concepts: Frameworks, Size and Tools. Frameworks represent EA frameworks, e.g. TOGAF or Zachman, that an organization used as the basis for establishing its EA practice. Size stands for the size of an organization from the perspective of IT including the effective full-time equivalent (FTE) number of its IT staff and the overall size of the IT landscape supporting its business processes. Tools represent software tools deployed and used in an organization to create, store, manage and distribute its EA artefacts among architects and other stakeholders including both standard general-purpose tools, e.g. MS Office suite and Google Drive, and specialized software tools for EA, e.g. Enterprise Architect (Sparx Systems) or Troux (Planview) (McGregor, 2016; Searle and Kerremans, 2017).

External Factors category includes only one distinct concept of Accelerating Change which represents the increased pace of change in the external business environment of an organization.

4.1.6. The Artefacts Domain

The artefacts domain includes two tightly coupled categories: Artefacts and Information. Artefacts represent EA artefacts as tangible physical documents of certain volume and format created and used at particular moments, while Information represents the semantic meaning of the informational contents of corresponding EA artefacts. Artefacts differ from Information essentially in the same way in which data differs from information in the knowledge management theory (Alavi and Leidner, 1999; Alavi and Leidner, 2001), i.e. data can be defined as “simple observations of states of the world”, but information is “data endowed with relevance and purpose” (Davenport, 1997, p. 9).

Artefacts category includes ten distinct concepts: Business Capability Models, Conceptual Architectures, Global Roadmaps, IT Principles, Landscape Diagrams, Local Roadmaps, Principles, Solution Designs, Standards and Technology Reference Models (in this initial case study these concepts naturally resemble specific EA artefacts listed earlier in Table 4.1, however, reflecting the commonly accepted titles of these EA artefacts where they exist in order to avoid idiosyncratic organization-specific titles, e.g. one-page diagrams or maxims. After subsequent case studies these concepts will be broadened into generic organization-neutral concepts). These concepts can be organized across three different dimensions: Format, Volume and Lifecycle. Format dimension represents the physical representation format of Artefacts. From the perspective of their Format, all Artefacts can be classified into textual, graphical and mixed. Textual Artefacts are represented as structured plain text, graphical Artefacts are represented as graphical diagrams or models, while mixed Artefacts are represented as a combination of both textual and graphical formats. Volume dimension represents the physical volume of Artefacts. From the perspective of their Volume, all Artefacts can be loosely classified into one-page, brief and voluminous. One-page Artefacts consist of only a single page (though often a large one, e.g. A3 size), brief Artefacts consist of a few or several pages, while voluminous Artefacts consist of tens of pages.

Lifecycle dimension represents the lifecycle of Artefacts as physical documents. From the perspective of their Lifecycle, all Artefacts can be classified into permanent and temporary. On the one hand, permanent Artefacts have essentially unlimited lifespans, developed once and then continuously updated to stay relevant. On the other hand, temporary Artefacts are short-lived, created for specific purposes and then archived after these purposes are fulfilled.

Information category includes nine distinct concepts: Business Capabilities, Business Imperatives, Implementation Plans, Landscape Snapshots, List of Technologies, Planned Projects, Project Overviews, Solution Components and Technical Imperatives. These concepts can be organized across three different dimensions: Scope, Domains and Focus. Scope dimension represents the organizational scope encompassed by Information. From the perspective of its Scope, Information can be related to an enterprise, business unit or project. Enterprise-wide Information is relevant for an entire organization and all its business units, business unit-wide Information is relevant for a single business unit or functional area, while project-wide Information is relevant only for a separate IT project. Domains dimension represents organizational aspects, or viewpoints, covered by Information. From the perspective of its Domains, Information can describe business, systems, data and technology aspects of an organization, as well as any combinations of these aspects. Business Information often focuses on business capabilities, processes and requirements, systems Information typically covers IT systems and applications, data Information focuses on databases, data structures and entities, while technology Information describes platforms, hardware, networks and also relevant security aspects. Focus dimension represents the time focus of Information. From the perspective of its Focus, Information can be focused on the present, focused on the future or have no explicit time focus. Information focused on the present describes the current as-is situation existing now. Information focused on the future describes the planned to-be situation that should be achieved sometime in the future. Information having no explicit time focus typically describes some rules which cannot be related to any particular time point and stay active until modified or cancelled. Artefacts and closely associated Information concepts are described in detail from the perspective of their dimensions in the following paragraphs in an alphabetical order.

Business Capability Model is a single large one-page graphical EA artefact of an intuitively understandable format typically called as business capability model, business capability map or simply BCM. Semantically, it provides executive-level information on all organizational Business Capabilities, i.e. capacity of an organization to accomplish some valuable activities, e.g. manage students or attract sponsors, including people, process and system aspects of these activities. Business Capability Model covers an entire organization, however, only in terms of very high-level abstractions, i.e. organizational capabilities, and does not contain any information on its systems, data or technology dimensions. Although Business Capabilities themselves are rather stable in nature and change rarely, Business Capability Model highlights the capabilities which ought to be uplifted with IT and therefore focuses on the future.

Conceptual Architectures are rather high-level EA artefacts of 20-40 pages long usually called conceptual architectures or more rarely conceptual designs. They are created on a per-project basis at the early stages of specific IT projects and typically consist of both textual descriptions and simple graphical diagrams. Semantically these EA artefacts provide abstract Project Overviews of proposed IT solutions intended for their business sponsors typically explaining the overall structure of these solutions, their benefits, costs, risks and timelines. While Conceptual Architectures often describe the expected changes in business processes, high-level underlying system architectures and the sources of necessary data for these systems, they rarely focus on purely technical aspects of IT projects. Since Conceptual Architectures describe only proposed IT solutions, they naturally focus on the short-term or mid-term future merely "by definition".

Global Roadmaps are EA artefacts of a mixed textual and graphical format developed on a yearly basis for the whole organization and called programs of work. They provide descriptions of all Planned Projects with their scheduled commencement and completion dates. Global Roadmaps cover an entire organization and show only the IT projects planned for implementation during the upcoming financial year. These Planned Projects are aligned to the corresponding Business Capabilities they are intended to uplift.

IT Principles are textual EA artefacts of a purely technical nature often called simply as principles. Semantically they provide mandatory Technical Imperatives with recommended organization-wide approaches to particular IT-related problems, e.g. organizing web access and addressing security issues. The prescriptions captured as Technical Imperatives in corresponding IT Principles are relevant to all IT solutions in an organization dealing with respective technologies or areas. IT Principles are irrelevant to business aspects and cover predominantly the technology domain. The implementation approaches recommended by IT Principles are not related to any specific state, i.e. current or future, but rather apply as long as the corresponding principles are not cancelled.

Landscape Diagrams represent a family of ~200 similar graphical EA artefacts using complex, often ad hoc modelling notations usually called simply as one-page diagrams. They provide technical one-page Landscape Snapshots covering different areas of the organizational IT landscape with varying scopes and granularity. Landscape Snapshots typically show cohesive groups of related IT assets fulfilling a particular business function, e.g. customer relationship management or student information management, as well as interconnections between these assets. Landscape Diagrams primarily focus on the current structure of the IT landscape and only rarely reflect the planned changes in the covered areas. Usually they describe only relevant systems, data and technology dimensions, rarely also the business dimension, e.g. business processes supported by these IT assets.

Local Roadmaps represent ~30 slightly different roadmaps related to separate business units or functional areas of the university. They are intuitive one-page graphical diagrams providing rather simple structured views of all Planned Projects for the next 3-4 years in corresponding business areas with their anticipated start and completion dates. Essentially, Local Roadmaps provide the basis for compiling Global Roadmaps aggregating major IT projects from all business units approved for implementation during the next financial year.

Principles are brief textual EA artefacts widely known in literature as architecture principles (Greefhorst and Proper, 2011a; Greefhorst et al., 2013; Haki and Legner, 2012), but specifically in Educational Institution called as maxims (principles used in Educational Institution are coded as IT Principles due to their IT-specific nature). Principles offer a global set of C-level guiding statements or Business Imperatives defining the overall attitude towards using IT in an organization, e.g. “common use of systems and technology”. Essentially, these EA artefacts document some global decisions regarding IT, e.g. to standardize IT systems and processes across all business units and locations. Business Imperatives are overarching in nature and apply to all projects and architecture-related planning decisions in an organization. They are very abstract, never mention specific technical details and can be interpreted differently in different situations. The set of Principles is very stable and changes very rarely, normally together with the respective changes in the business strategy.

Solution Designs are pretty detailed EA artefacts of 40-80 pages long consisting of extensive textual descriptions and complex technical diagrams typically called as solution designs, detailed designs or sometimes technical designs. They are developed for specific IT projects at their later stages, i.e. right before their actual implementation. Essentially, Solution Designs provide actionable Implementation Plans for separate IT solutions containing rather specific prescriptions regarding their internal technical structure. Although they contain separate sections with descriptions of functional business requirements, these EA artefacts generally provide highly technical views of IT solutions focusing specifically on their "nuts and bolts", i.e. separate application components, database tables, physical servers and network equipment. Since Solution Designs are created right before the project implementation takes place, corresponding Implementation Plans are naturally focused on the short-term, immediately actionable future.

Standards are technical EA artefacts of a mixed textual and graphical format typically called as standards, sometimes as patterns and more rarely as building blocks. The meaning of Standards is to provide preferred end-to-end Solution Components addressing some commonly occurring technical problems in the design of IT systems, e.g. implementation of a single sign-on authentication mechanism. Essentially, these EA artefacts provide reusable components or proven "building blocks" for creating new IT solutions applicable to all IT projects in an organization facing standard problems. Solution Components are technical in nature, focus predominantly on the technology and systems domains, more rarely on the data domain and almost never on the business domain. Similarly to Technical Imperatives reflected in IT Principles, Solution Components documented in Standards do not refer to any particular points in time, e.g. current state or future state, but rather stay relevant until revised sometime in the indefinite future.

Technology Reference Model is a single complex graphical one-page EA artefact typically called as technology reference model, technical reference model or simply TRM. Semantically it provides a comprehensive List of Technologies that are used and supported in an organization including programming languages, databases, network platforms, security products and other types of technology. This List of Technologies is relevant for the whole organization and all business units. All IT projects are expected to comply with its prescriptions and use only the recommended technologies. Technology Reference Model naturally covers only the technology domain.

The analysis of ten identified Artefacts concepts and nine identified Information concepts from the perspective of their dimensions is summarized in Table 4.2 and Table 4.3 respectively.

Table 4.2. Analysis of Artefacts concepts from the perspective of their dimensions

Artefacts	Format	Volume	Lifecycle
Business Capability Models	Graphical	One-page	Permanent

Conceptual Architectures	Mixed	Voluminous	Temporary
Global Roadmaps	Mixed	Voluminous	Temporary
IT Principles	Textual	Brief	Permanent
Landscape Diagrams	Graphical	One-page	Permanent
Local Roadmaps	Graphical	One-page	Permanent
Principles	Textual	Brief	Permanent
Solution Designs	Mixed	Voluminous	Temporary
Standards	Mixed	Brief	Permanent
Technology Reference Models	Graphical	One-page	Permanent

Table 4.3. Analysis of Information concepts from the perspective of their dimensions

Information	Scope	Domains	Focus
Business Capabilities	Enterprise	Only business	Future
Business Imperatives	Enterprise	Only business	No explicit focus
Implementation Plans	Project	Business, systems, data and technology	Future
Landscape Snapshots	Business unit	Mostly systems, data and technology	Present
List of Technologies	Enterprise	Only technology	No explicit focus
Planned Projects	Business unit or enterprise	Business and systems	Future
Project Overviews	Project	Business, systems and data	Future
Solution Components	Enterprise	Mostly technology	No explicit focus
Technical Imperatives	Enterprise	Mostly technology	No explicit focus

4.1.7. The Use Domain

The use domain includes two tightly coupled categories: Users and Usage. Users represent consistent groups of organizational actors working directly with EA artefacts as part of their responsibilities, while Usage represents specific use cases of EA artefacts or situations when particular EA artefacts are used by their Users.

Users category includes eight distinct concepts: Enterprise Architects, Global Executives, Liaisons, Local Executives, Project Managers, Project Team Members, Solution Architects and Steering Committee (similarly to Artefacts, after this single opening case study these concepts naturally highly correlate with specific actors involved in an EA practice in Educational Institution, but they will be broadened later into generic organization-neutral concepts after subsequent case studies). These concepts can be organized across two different dimensions: Knowledge and Responsibilities. Knowledge dimension represents the expertise possessed by Users. From the perspective of their Knowledge, all Users can be classified into users knowledgeable only in business, only in IT or knowledgeable in both business and IT. Users knowledgeable only in business understand the relative business value of IT solutions, but consider IT-specific discussions and terminology as meaningless “IT-babble”. Users with an expertise only in IT, on the contrary, understand complex IT-related questions, but are unable to appreciate the business value of IT projects. Users knowledgeable in both business and IT are capable of understanding both “worlds” and translating abstract business requirements into specific IT actions. Responsibilities dimension represents typical organizational responsibilities fulfilled by Users. From the perspective of their Responsibilities, all Users can be classified into users responsible for decision-making, IT planning, implementing or intermediating. Users responsible for decision-making make various IT investment decisions on behalf of the whole organization based on its strategic and tactical needs. Users responsible for IT planning are the primary creators of IT-related plans taking into account relevant business needs and decisions. Users responsible for implementing carry out IT-related plans and turn them into working IT systems. Finally, intermediating Users are responsible for “translating” between the disparate business and IT worlds without making any significant planning or investment decisions on their own. Users concepts are described in the following paragraphs in an alphabetical order.

Enterprise Architects are all architects responsible for various aspects of organization-wide IT planning including business architects, application architects, data architects and infrastructure architects.

Global Executives are all senior business executives of the university, including its chancellors and vice-chancellors, responsible for organization-wide strategic planning, budget allocation and approval of all major IT projects.

Liaisons represent all engagement managers and solution consultants serving essentially as intermediaries or “translators” between architects and their business customers.

Liaisons do not have their own interests in any IT-related planning decisions, but intend only to facilitate effective communication between other actors having these interests.

Local Executives are all local business leaders responsible for managing separate business units of the university and aware of the strategic IT-related needs of their business units. Local Executives include formal heads of business units as well as their authorized representatives acting as business customers and sponsors of specific IT projects from the perspective of an EA practice.

Project Managers are typical project managers responsible for the technical delivery of separate IT projects on time and budget via controlling their project teams.

Project Team Members represent all rank-and-file IT specialists, e.g. software developers, infrastructure engineers and database administrators, as well as business analysts working on specific IT projects. They are responsible for discussing detailed requirements for their projects and then for implementing these requirements with IT.

Solution Architects are architects specialized in different technologies and responsible for the technical planning of separate IT projects according to their high-level business requirements provided by their business sponsors.

Steering Committee represents a global decision-making committee of senior executives responsible for making collective IT investment decisions on behalf of the whole organization including prioritization, selection and funding of appropriate IT projects. The analysis of eight identified Users concepts from the perspective of their dimensions is summarized in Table 4.4.

Table 4.4. Analysis of Users concepts from the perspective of their dimensions

Users	Knowledge	Responsibilities
Enterprise Architects	Business and IT	IT planning
Global Executives	Only business	Decision-making
Liaisons	Business and IT	Intermediating
Local Executives	Only business	Decision-making
Project Managers	Only IT	Implementing
Project Team Members	Only IT	Implementing
Solution Architects	Business and IT	IT planning
Steering Committee	Only business	Decision-making

Usage category includes ten different concepts: Approaches Selection, Decisions Assessment, Investments Focusing, Investments Prioritization, Knowledge Sharing, Project Approval, Project Implementation, Project Planning, Project Shaping and Technologies Selection. These concepts can be organized across two different dimensions: Integration and Involvement. Integration dimension represents the integration between Usage of EA artefacts and other organizational activities or processes. From the perspective of Integration, all Usage can be integrated with strategic management, project lifecycle or be not integrated explicitly with other activities. Usage integrated with strategic management is intertwined with regular strategic planning activities, e.g. deciding on the long-term business goals, objectives and needs. Usage integrated into the project lifecycle happens at different stages, or gates, of the established project delivery methodology, e.g. initiate, evaluate, design, build and deploy. Usage not integrated with regular processes can be carried out largely in a standalone manner independently from other organizational activities. Involvement dimension represents the participation of stakeholders in Usage. From the perspective of Involvement, all Usage can be classified into unilateral and bilateral. On the one hand, unilateral Usage is carried out inside the IT department and involves only IT specialists. On the other hand, bilateral Usage is always collaborative in nature and requires active participation of both business and IT stakeholders. Usage concepts are described in the following paragraphs in an alphabetical order.

Approaches Selection is the use situation when EA artefacts help Solution Architects and Enterprise Architects select the most appropriate implementation approaches for specific IT projects. The preferred organization-wide technical approaches documented in corresponding EA artefacts provide the basis for making sound project-level planning decisions regarding the structure of separate IT solutions.

Decisions Assessment is the usage of EA artefacts when these artefacts help Enterprise Architects, Solution Architects and Steering Committee understand the overall appropriateness of specific portfolio-level or project-level planning decisions for the core needs of an organization. Decisions Assessment allows avoid making inappropriate planning decisions inconsistent with the general organization-wide business vision.

Investments Focusing represents the use situation of EA artefacts when they are used by Enterprise Architects, Global Executives and Steering Committee to discuss in which organizational areas further enhancements should be made in the future. Investments Focusing results in an improved understanding and mutual agreement on the most strategically important business areas for future IT investments.

Investments Prioritization is the use case when EA artefacts are used by Global Executives, Local Executives, Liaisons, Enterprise Architects and Steering Committee to determine the relative importance and priority of particular proposed IT investments for the business needs of an organization or its business units. Investments Prioritization helps align planned IT investments to corresponding business goals and plans as well as to capital budgeting and financial plans.

Knowledge Sharing is the usage of EA artefacts by Enterprise Architects and Solution Architects intended to understand the current structure of the organizational IT landscape or its key areas. Knowledge Sharing helps newly hired architects study the available IT assets as well as the overall information flow between existing IT systems.

Project Approval represents the use case of EA artefacts when these artefacts help Local Executives and then Steering Committee approve the implementation of specific IT projects. Conscious Project Approval ensures that all key project requirements are understood, agreed and taken into account, while anticipated business benefits of the project outweigh its estimated costs.

Project Implementation is the use situation where EA artefacts are used by Solution Architects, Project Managers and Project Team Members to implement corresponding IT projects. Essentially, in this use case EA artefacts provide cornerstones for all parties involved in the project implementation activates enabling their productive collaboration and partnership.

Project Planning represents the usage of EA artefacts when Enterprise Architects and Solution Architects plan the high-level structure of new IT solutions and discuss their external connections with the existing IT systems. Essentially, the use case of Project Planning helps architects seamlessly fit new IT systems into the existing IT landscape and integrate new systems with the current ones.

Project Shaping is the usage of EA artefacts by Solution Architects, Local Executives and Liaisons helping these parties agree on the high-level structure of requested IT solutions. Explicit Project Shaping ensures that all proposed IT projects are pre-approved by their business sponsors and address all the essential business needs they are intended for.

Technologies Selection is the use situation when EA artefacts help Solution Architects and Enterprise Architects select the most appropriate technologies for specific IT projects. The recommended technologies documented in corresponding EA artefacts provide the basis for making optimal project-level technology choices rationalizing the overall organization-wide technology portfolio. The analysis of ten identified Usage concepts from the perspective of their dimensions is summarized in Table 4.5.

Table 4.5. Analysis of Usage concepts from the perspective of their dimensions

Usage	Integration	Involvement
Approaches Selection	Project lifecycle	Unilateral
Decisions Assessment	Strategic management and project lifecycle	Bilateral
Investments Focusing	Strategic management	Bilateral
Investments Prioritization	Strategic management	Bilateral
Knowledge Sharing	Not integrated	Unilateral
Project Approval	Project lifecycle	Bilateral
Project Implementation	Project lifecycle	Unilateral
Project Planning	Project lifecycle	Unilateral
Project Shaping	Project lifecycle	Bilateral
Technologies Selection	Project lifecycle	Unilateral

4.1.8. The Benefits Domain

The benefits domain includes only Benefits category. This category includes eight distinct concepts: Improved Project Quality, Increased Agility, Investments Effectiveness, Investments Efficiency, Organizational Fitness, Reduced Complexity, Reduced Cost and Reduced Duplication. These concepts are described in the following paragraphs in an alphabetical order.

Improved Project Quality is the benefit resulting from the usage of EA artefacts when IT projects are delivered in a more smooth and predictable manner successfully addressing both business and architectural requirements.

Increased Agility is the increased planning speed of new IT projects. Possible implementation options for new IT solutions are explored more swiftly leading to the reduced planning time of all IT-related efforts.

Investments Effectiveness is the improved alignment between IT investments and the long-term strategic business objectives. Corresponding IT investments address the most strategically important business areas at the right time moments reflecting their temporal priority from the business perspective.

Investments Efficiency is the improved value-for-money ratio for new IT projects, or increased financial returns on IT investments (ROI). The tactical business value of all IT projects, as well as their overall worthiness, is explicitly evaluated and ensured.

Organizational Fitness is the increased consistency between all IT-related planning decisions and the most fundamental needs of the business. All architecturally significant planning decisions are aligned to the overall organizational philosophy towards using IT.

Reduced Complexity represents a lowered number of used implementation approaches leading to the overall simplification of the structure of the IT landscape. The diversity of followed technical approaches is restrained and controlled.

Reduced Cost is the minimized expenditures on vendor products, license agreements and contractor support resulting from the consolidation of technological diversity. Available technologies, products and vendors are reused without inflating the IT budget. Unnecessary purchases are reduced to minimum.

Reduced Duplication is the minimized proliferation of redundant IT assets enabling same or similar business functionality. Duplicated IT assets having no considerable added business value are consolidated or eliminated.

4.1.9. Theorizing on the Roles of Enterprise Architecture Artefacts

As discussed earlier in Chapter 1, the intention of this study is to explore the practical roles of different EA artefacts, while the role of an EA artefact in the context of this thesis is understood specifically as the set of its key properties including its valuable informational contents, typical practical usage and users as well as resulting benefits. In other words, roles of EA artefacts represent consistent and generalizable patterns of usage of similar artefacts for identical purposes by similar groups of actors.

The four-domain theoretical framework for grouping all the identified conceptual categories relevant to the roles of EA artefacts (see Figure 4.3) provides a sound basis for articulating these practical roles. From the perspective of this framework, a specific role is fulfilled by some Artefacts, supported by their Information, involves relevant Users, operationalized in specific Usage, results in particular Benefits and influenced by both Internal Factors and External Factors. The four-domain framework essentially defines two potentially testable hypotheses, or theoretical propositions, explaining the roles of EA artefacts in an EA practice. Firstly, the framework hypothesizes that specific types of EA artefacts with corresponding informational contents are likely to be used by certain actors for particular purposes. Secondly, the framework hypothesizes that specific usage of respective EA artefacts is likely to result in achieving particular types of benefits for an organization.

Essentially, the roles of EA artefacts are defined by the established connections between the concepts related to different categories forming consistent and repeatable patterns of usage of different types of EA artefacts. From the perspective of the grounded theory method (Corbin and Strauss, 1990; Strauss and Corbin, 1998), the roles of EA artefacts represent logical storylines, or themes, built around the core category, i.e. Usage, produced as a result of the final selective coding phase. Of all the categories identified in this study, e.g. Artefacts, Benefits, Information and Users, only Usage category can be considered as central to the roles of EA artefacts since this category essentially lies at the "intersection" of all other categories, has direct connections to each of these categories and, therefore, can be used to bind all categories together into consistent stories. Specifically, Usage requires some physical Artefacts and corresponding Information, involves particular Users and results in specific Benefits, while no other categories identified in this study relate directly to all the remaining categories. For this reason the selection of Usage as the core category for the resulting theory can be considered as the most natural, or even as the only possible, choice according the tenets of the grounded theory (Corbin and Strauss, 1990; Strauss and Corbin, 1998).

The first findings from Educational Institution suggest that different types of EA artefacts play significantly different, unique and highly type-specific roles in an EA practice, which is often not taken into account in the existing EA literature essentially treating all EA artefacts largely as homogeneous components of EA, as shown earlier in Chapter 2 (see Table 2.2, Table 2.4, Table 2.5, Table 2.6, Table 2.7 and Table 2.8). Each type of EA artefacts is very closely associated with one specific use case, or with a few related use cases. Moreover, most EA artefacts are intentionally created for specific purposes and even continuously optimized to better fit for these particular purposes. This strong connection between EA artefacts and their usage can be explained by two clear considerations. Firstly, each type of EA artefacts has its own type-specific informational contents enabling a certain usage based on the corresponding information. For example, the use case of Project Approval naturally requires executive-level information on the conceptual structure, benefits and costs of proposed IT projects contained in Conceptual Architectures in the form of high-level Project Overviews. However, this or similar information is not contained in any other types of EA artefacts used in Educational Institution making all these artefacts inappropriate for Project Approval purposes. Similarly, the information on available technologies is provided only by Technology Reference Models and therefore the Technologies Selection use situation can be supported only by Technology Reference Models.

Secondly, the evident connection between EA artefacts and corresponding use cases can be also explained from the perspective of the cognitive fit theory (Smelcer and Carmel, 1997; Vessey and Galletta, 1991), which suggests that a proper presentation of information is critically important for the performance of decision-making. As Vessey (1991, p. 221) explains, "matching representation to task leads to the use of similar, and therefore consistent, problem-solving processes [...]. Hence, problem solving with cognitive fit leads to effective and efficient problem-solving performance". For instance, for certain types of tasks significant differences in problem-solving performance have been empirically demonstrated for various information representation formats including tables, graphs and maps (Smelcer and Carmel, 1997; Vessey, 1991; Vessey and Galletta, 1991). Different approaches to information representation have different effects on problem-solving performance in the analysis of financial statements (Frownfelter-Lohrke, 1998), accounting information (Dull and Tegarden, 1999) and geographic information (Dennis and Carte, 1998; Mennecke et al., 2000) as well as in software maintenance (Shaft and Vessey, 2006) and diagrams-based communication (Hungerford and Eierman, 2005). These propositions of the cognitive fit theory can be easily extrapolated to EA artefacts as well. For example, the use case of Investments Focusing naturally requires some structured information on the key elements of business. Although this information can be found in some form in Local Roadmaps, the presentation format of this information in Local Roadmaps is inconvenient for Investments Focusing purposes. At the same time, Business Capability Models provide this information in a form convenient for Investments Focusing as a structured view of all organization-wide Business Capabilities. For this reason, despite some overlap in the information contained in Business Capability Models and Local Roadmaps, the use cases of these EA artefacts are still different due to different information presentation formats. Business Capability Models help decision-makers answer the question "where?" and focus IT investments in particular business areas, while Local Roadmaps are more appropriate for answering the question "when?", prioritizing and sequencing these investments. In other words, even if some relevant information is contained in different types of EA artefacts, only the types with the most appropriate presentation formats are likely to be used for respective purposes.

Another important observation from the case of Educational Institution suggests that different dimensions of Artefacts and Information categories, e.g. Format, Volume, Scope, Domains and Focus (see Figure 4.3), hardly explain and correlate with the practical roles of corresponding EA artefacts. For instance, Conceptual Architectures providing Project Overviews and Solution Designs providing Implementation Plans are almost equivalent from the perspective of their key dimensions. Specifically, both these types of EA artefacts and informational contents are expressed in similar mixed formats, focused on the future, have a comparable volume of tens of pages, cover the same scope (a single project) and similar domains (see Table 4.2 and Table 4.3). However, despite these apparent similarities the practical roles of Conceptual Architectures and Solution Designs are still disparate in nature. While Conceptual Architectures are intended for Local Executives and Steering Committee to be used for Project Shaping and then for Project Approval, Solution Designs are developed for Project Managers and Project Team Members to be used for Project Implementation (see Figure 4.2). Consequently, the practical roles of EA artefacts are defined essentially only by their logical and semantic meaning, but not by some of their "obvious" properties, e.g. format, scope or domains.

From the perspective of this study, this finding suggests that Artefacts and Information concepts cannot be grouped into higher-order concepts based on the evident similarities in their dimensions, but only based on the more subtle similarities in their practical meaning. For example, even though both Conceptual Architectures and Solution Designs describe separate projects to be implemented and can be intuitively grouped on this basis into a single higher-order concept, e.g. Project Architectures, for the purposes of this study these EA artefacts cannot be grouped in this way and should be considered as dissimilar objects due to their disparate usage in the context of an EA practice regardless of their deceptive "physical" similarity. This approach to grouping Artefacts and Information concepts is rather different from the approach taken previously, for instance, by Niemi and Pekkola (2017), who grouped EA artefacts based on their organizational levels (scopes) and domains. Although the identified dimensions of Artefacts and Information can help clarify some important differences between the corresponding concepts, these dimensions or their combinations cannot be considered as reliable and useful predictors of the practical roles of respective EA artefacts for the purposes of this exploratory study. In other words, the identified dimensions of Artefacts and Information concepts, though offer some descriptive value, are unfit as first-class concepts for theory building in the context of this study since the usage and roles of EA artefacts, as the initial findings clearly demonstrate, are determined predominantly by the semantic meaning of EA artefacts and their informational contents.

4.1.10. Identified Roles of Enterprise Architecture Artefacts

The data collected and analysed for Educational Institution allows articulating the initial set of specific roles fulfilled by EA artefacts in an EA practice. In line with the similar research of Smolander et al. (2008), the roles of EA artefacts here and further are titled with appropriate two-word metaphors reflecting the core meaning of these roles in the context of an EA practice derived from the corresponding usage. Specifically, the early findings from Educational Institution suggest ten distinct roles fulfilled by EA artefacts representing their different use situations (the Usage category was selected to be the core category around which the resulting theory is shaped): Approach Providers, Baseline Descriptors, Decision Assessors, Investment Guides, Investment Prioritizers, Project Implementers, Project Planners, Project Shapers, Project Tags and Technology Providers. These roles represent ten different logical "stories" around the usage of EA artefacts based on the five relevant categories (Artefacts, Benefits, Information, Usage and Users) and 45 underlying concepts developed via applying the Straussian grounded theory method to the collected empirical data. Each of these roles is described in detail below.

Approach Providers help reuse and select best implementation approaches for new IT projects. This role is fulfilled by Standards offering reusable Solution Components for new IT solutions and by IT Principles providing more abstract guiding Technical Imperatives reflecting proven best practices. These EA artefacts are used by Enterprise Architects and Solution Architects during implementation Approaches Selection, i.e. when deciding on the best way to implement a new IT project for addressing a particular business need. The usage of these EA artefacts helps achieve Reduced Complexity through following consistent implementation approaches in all projects across the entire organization.

Baseline Descriptors help understand the structure of the existing IT landscape. This role is fulfilled by Landscape Diagrams providing a set of rather high-level graphical Landscape Snapshots describing the connections between existing IT systems. Landscape Diagrams are used by Enterprise Architects and Solution Architects for Knowledge Sharing to communicate and learn the current landscape structure. The resulting good understanding of the IT landscape helps achieve Reduced Duplication of IT assets.

Decision Assessors help evaluate various planning decisions against core organizational needs and overarching business philosophy. This role is fulfilled by Principles providing Business Imperatives explaining how an organization needs to work from the IT perspective. Principles are used by Enterprise Architects, Solutions Architects and Steering Committee for Decisions Assessment to determine the appropriateness of particular IT-related planning decisions for an organization, which leads to better general Organizational Fitness of all IT projects.

Investment Guides help decide where future IT investment should go. This role is fulfilled by Business Capability Models providing high-level overarching views of all organizational Business Capabilities. Business Capability Models are used collaboratively by Enterprise Architects, Global Executives and Steering Committee for Investments Focusing, i.e. to focus IT investments in the most critical business areas needing improvements in the long run. This commonly agreed understanding of organizational investment priorities improves strategic Investments Effectiveness.

Investment Prioritizers help decide when and in which order future IT investments should be made. This role is fulfilled by organization-wide Global Roadmaps as well as by unit-specific Local Roadmaps providing structured views of all Planned Projects aligned to business functions or capabilities. These EA artefacts are used by Enterprise Architects, Global Executives, Local Executives, Liaisons and Steering Committee for Investments Prioritization to determine the desired priority and sequence of planned IT projects, which also allows improving overall Investments Effectiveness.

Project Implementers help deliver separate IT projects in a disciplined manner. This role is fulfilled by Solution Designs providing Implementation Plans for specific IT projects. Solution Designs are used by all parties involved in the Project Implementation activities including Solution Architects, Project Managers and Project Team Members to achieve a common view of what exactly needs to be done as part of the project. This common understanding helps achieve Improved Project Quality.

Project Planners help plan the high-level structure of new IT projects and their integration into the existing IT landscape. This role is fulfilled by Landscape Diagrams providing high-level Landscape Snapshots showing the relationship between the existing IT assets. Landscape Diagrams are used by Enterprise Architects and Solution Architects during the Project Planning to swiftly identify the best possible options for addressing requested business needs with the available IT assets, which leads to Increased Agility of IT planning.

Project Shapers help discuss and negotiate the conceptual structure of new IT projects. This role is fulfilled by Conceptual Architectures providing high-level Project Overviews understandable to their key business sponsors. Conceptual Architectures are used by Solution Architects, Local Executives and Liaisons for Project Shaping, i.e. to achieve an agreement on what needs to be done and how approximately it should be done as part of the project. These negotiations help ensure that new IT projects address business needs with appropriate means and costs and, thereby, improve tactical Investments Efficiency.

Project Tags help make final investment decisions regarding proposed IT projects. This role is also fulfilled by Conceptual Architectures providing Project Overviews with the estimates of their value, time and cost. As part of this role, Conceptual Architectures are used by senior business stakeholders including Local Executives and Steering Committee for the final Project Approval to decide whether the proposed IT solutions are worth to be implemented given their expected benefits, costs and timelines, which also helps improve overall Investments Efficiency.

Technology Providers help reuse and select appropriate technologies for new IT projects. This role is fulfilled by Technology Reference Models providing a comprehensive List of Technologies employed in an organization. Technology Reference Models are used for Technologies Selection purposes at the early stages of new IT projects by Enterprise Architects and Solution Architects. Reusing available technologies in new IT projects helps achieve Reduced Complexity of the IT landscape and also Reduced Cost due to consolidation of the technology portfolio.

The ten identified roles of EA artefacts in Educational Institution described above are highly interrelated and the logic of their relationship follows from the process view of an EA practice discussed in detail earlier and shown in Figure 4.2. The relationship between the identified roles of EA artefacts can be further clarified via organizing these roles according to the two dimensions of the underlying Usage core category, i.e. Integration and Involvement. The identified interrelationships between the roles of EA artefacts in Educational Institution are shown in Figure 4.4.

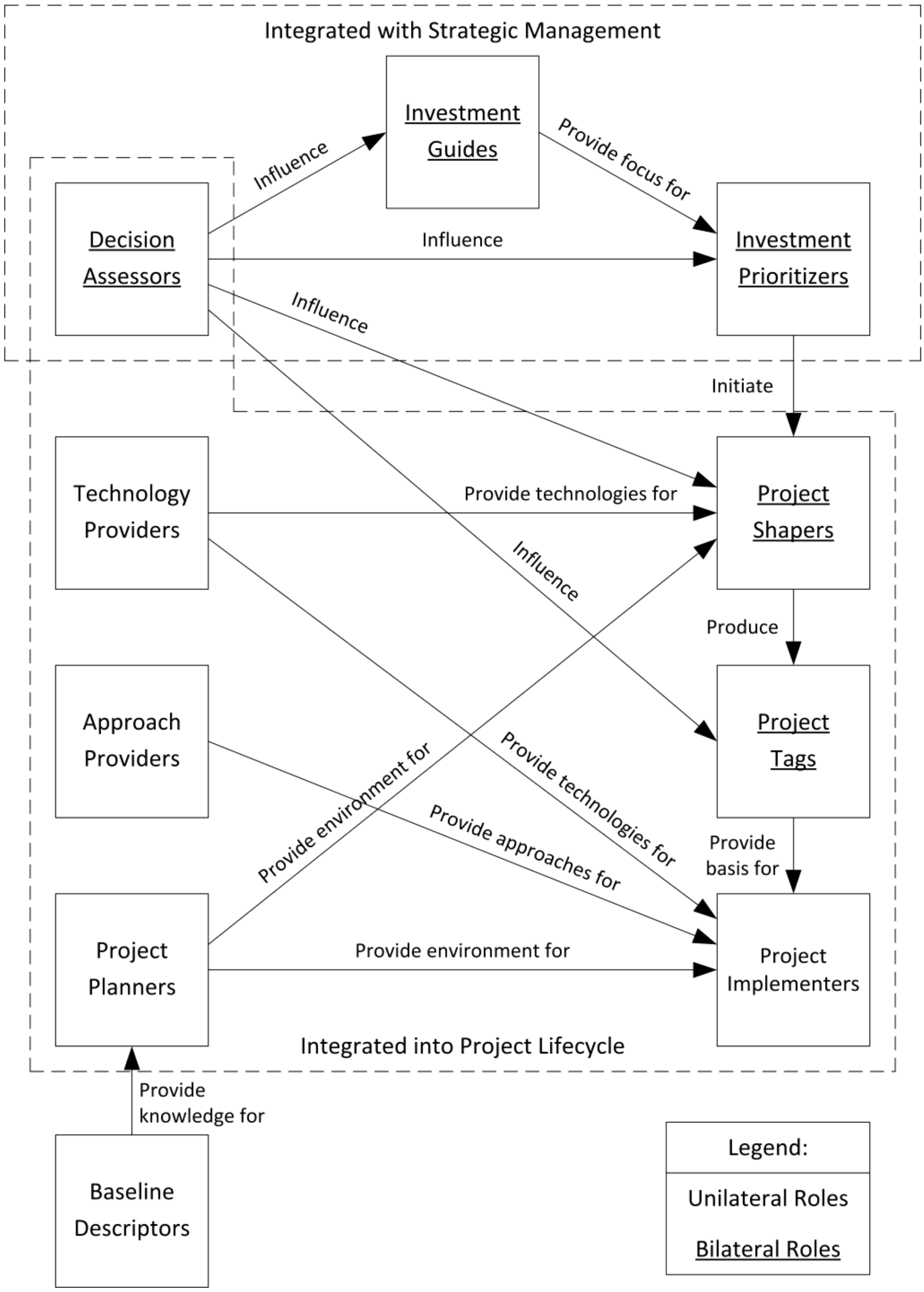

Figure 4.4. Identified interrelationships between the initial roles of EA artefacts

4.1.11. Summary of the Identified Roles

The list of ten roles and their relationships described above provide an initial conceptual answer to the research question of this study (What are the roles of different types of EA artefacts in an EA practice?) based on an in-depth analysis of only a single organization, i.e. Educational Institution. At this stage of data collection and analysis the developed roles and concepts are naturally rather low-level, fine-grained and highly organization-specific, while the influence of environmental factors on the roles of EA artefacts is impossible to establish based on the data from only a single studied case. However, these concepts and roles will be broadened and generalized later after more data from next case organizations is collected and analysed. The potential influence of environmental factors on these roles will be analysed after subsequent case studies accordingly.

A high-level initial summary of all the ten roles of EA artefacts identified in Educational Institution in terms of the underlying concepts structured according to the established four-domain theoretical framework (see Figure 4.3) is provided in Figure 4.5 (part 1) and Figure 4.6 (part 2).

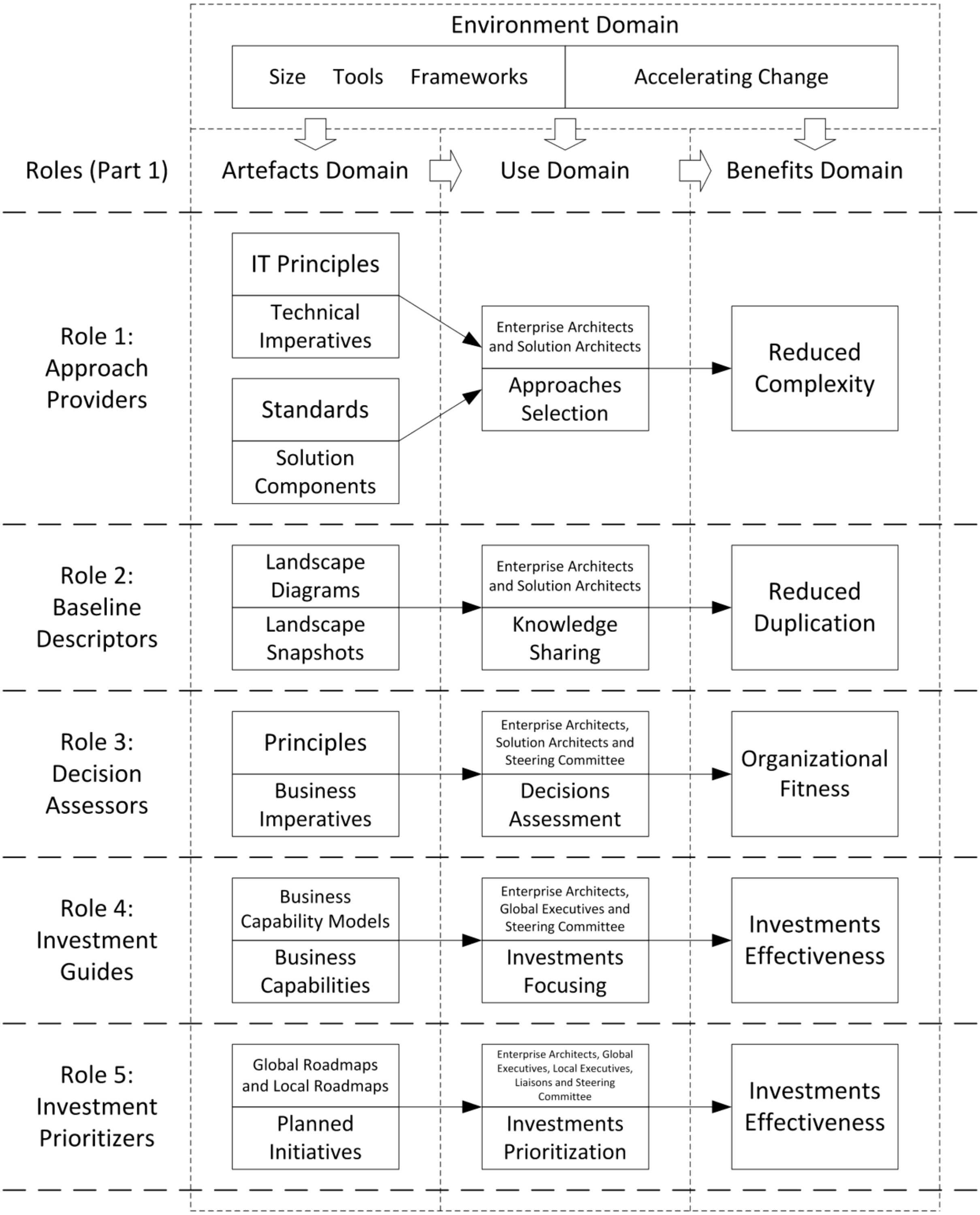

Figure 4.5. Summary of the roles of EA artefacts in Educational Institution (part 1)

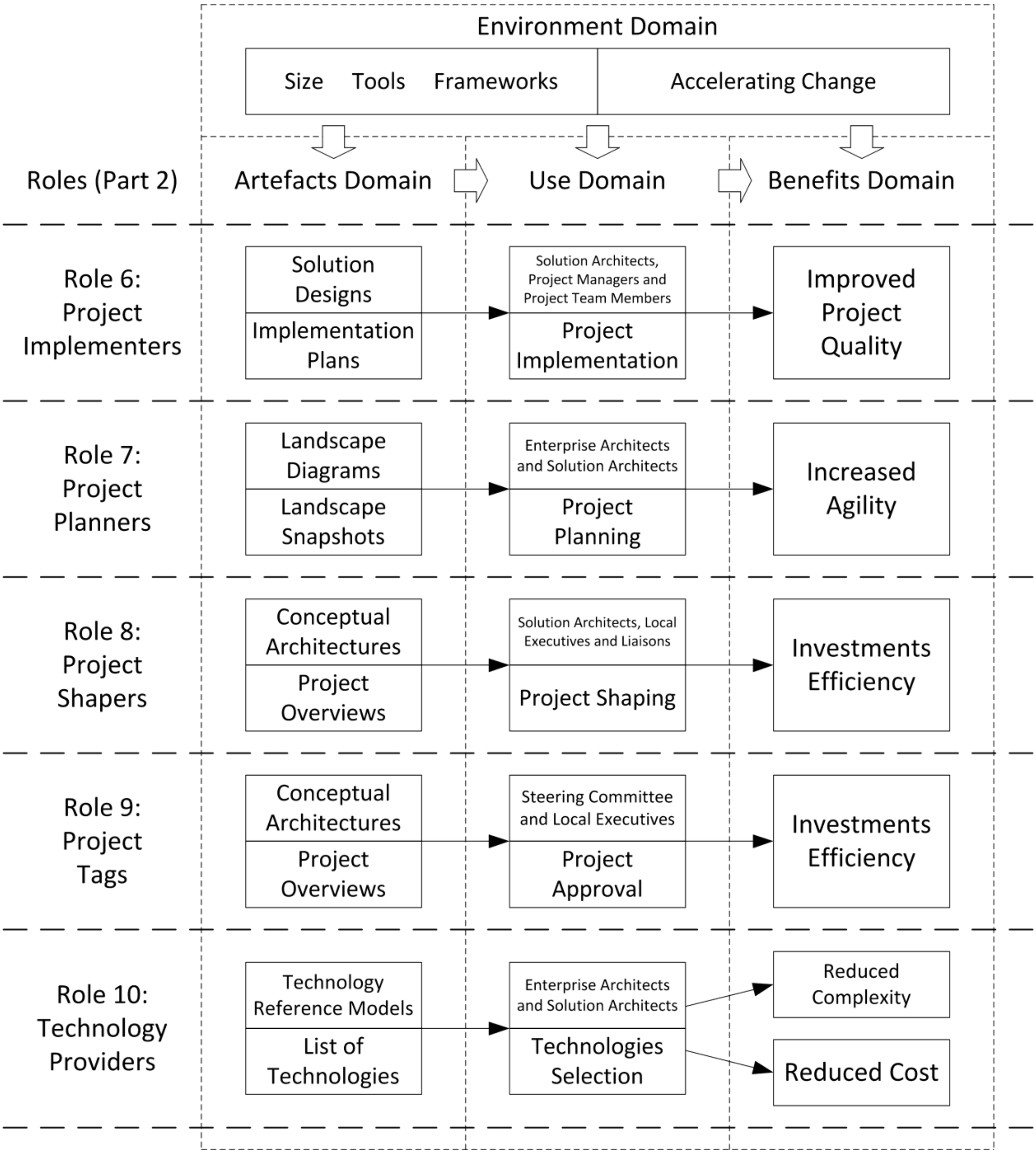

Figure 4.6. Summary of the roles of EA artefacts in Educational Institution (part 2)

4.1.12. Saturation Assessment

Since the initial conceptual framework is wholly based on the data from only a single studied organization, significant generalizations regarding the roles of EA artefacts can hardly be made at this stage of the theory-building process, especially when the lists of used EA artefacts are likely to vary significantly in different organizations. Unsurprisingly, resulting concepts of the initial conceptual framework are very specific, narrow and fine-grained. Many details of the current conceptual framework might be very organization-specific and ungeneralisable to an EA practice as a whole. Consequently, the emerging roles of EA artefacts cannot be considered comprehensive and far from being saturated. Additional analysis of other organizations is required to saturate the theory.

4.1.13. Selecting the Next Case

The selection of the next case organization for this study, in addition to the basic case selection criteria discussed in Chapter 3, was driven by three main considerations: size of an organization, experience with EA and industry differences. Firstly, the first studied organization, i.e. Educational Institution, is a mid-size organization (~7000 employees and ~500 IT specialists). Since the size of an organization may influence its EA practice and is generally considered as an important mediating factor in IS research (Goode and Gregor, 2009), exploring some larger organizations was required from the perspective of the theoretical saturation for developing high-quality grounded theories.

Educational Institution is also an organization with a moderate experience with EA (~3 years of full-fledged EA practice). Since the organizational experience with EA may also influence its EA practice, exploring some organizations with more extensive EA experience was desirable from the theoretical saturation perspective.

Furthermore, even though the available EA literature does not suggest any clear industry-specific differences in EA practices, a university might arguably be intuitively considered as an "untypical" case of an EA practice, while other more IT-dependent industries, e.g. banking or insurance, might be intuitively considered as more "typical" from the perspective of their EA practices.

4.2. Case Study Two: Financial Institution

The second case organization studied in this research is Financial Institution. Financial Institution is a larger organization (>40000 employees and >3000 IT specialists) with more extensive experience with EA (>8 years of full-fledged EA practice) representing intuitively more "typical" industry from the EA perspective.

Financial Institution is a large international financial institution with multibillion dollar revenues. This bank was listed in the Fortune Global 500 and is among the top 100 largest banks in the world. Currently, Financial Institution is one a prominent financial services provider in the Asia-Pacific (APAC) region and operates in nine countries: Japan, China, Hong Kong, Thailand, Vietnam, Singapore, Indonesia, Malaysia and Australia.

Products offered by Financial Institution include retail, business and corporate banking, insurance, wealth management and other financial services. The bank also owns and controls a number of subsidiary companies working under different brands but providing similar services across the globe. Totally, Financial Institution serves over 6.5 million personal and corporate customers globally and maintains an extensive network of more than 1,100 offices and 2,900 ATMs (automatic teller machines) worldwide. The bank employs more than 40,000 people including more than 3000 IT specialists, although a significant part of the Financial Institution's IT delivery function is outsourced to its offshore partners in the U.S.A., India and other countries.

Financial Institution operates in a highly regulated business environment. The financial services industry in Australia is legislatively controlled by the Australian Prudential Regulation Authority (APRA) – a statutory authority of the Australian Government responsible for monitoring the activities of financial organizations and ensuring stability of the entire Australian financial and banking industry. APRA imposes strict regulatory requirements governing the storage, use and sharing of sensitive financial information within and between organizations.

Financial Institution, as most organizations working in the financial industry sector, is the early adopter of IT and has been critically dependent on information systems in its daily operations for decades. The top management is committed to leveraging IT for introducing innovative banking products and providing cutting-edge digital services to the bank's customers. Unsurprisingly, rudimentary (pre-EA) architecture-based approaches to the disciplined IT planning have been practiced in Financial Institution in some or the other form for almost a quarter of the century.

> *"Architecture [in some form] has been practiced since about the late 80s, that's more than 25 years [...]. The origins [of our EA practice] are grounded in data architecture I think, data modelling and an element of applications architecture, and then it has grown across [other domains]. Process architecture was probably filled out in the 90s and data architecture, as I said, probably dates to the mid or late 80s. Business architecture has been the last thing to be developed and things like capability models probably date from the late 90s to the early 2000s"* (General Manager of Architecture)

However, a full-fledged EA practice in its current form has been established in Financial Institution since the mid-2000s.

> *"In terms of a [full] EA with the business architecture overlay I would date [our EA practice] from about 2005, but that's a rough estimate"* (General Manager of Architecture)

4.2.1. Enterprise Architecture Function

Due to its very large scope and its extensive use of information systems, the EA function at Financial Institution has a sophisticated structure. The EA function is headed by the general manager of architecture and consists of more than 120 architects of five different types: business architects, enterprise architects, program architects, solution architects and technical architects.

> *"We have program architects, we have solution architects, which is the biggest pool, and then we have enterprise architects and business architects"* (General Manager of Architecture)

Business architects work at the enterprise level and responsible for translating the business strategy for the whole organization into a set of particular business capabilities that should be uplifted and specific business processes that should be added, changed and removed. Enterprise architects are focused on multiple separate enterprise-wide domains (e.g. customer relationship management, customer mastering, payments processing, origination, etc.) and responsible for developing architecture strategies for their domains up to 3-5 years ahead.

> *"[Business and enterprise architects] work directly with the business in a shaping of initiatives, the development of roadmaps for investment planning purposes and the development of roadmaps for platform convergence purposes. They spend a fair bit of their time working through business strategy and translating that business strategy into realizable architectural goals"* (General Manager of Architecture)

Program architects and solution architects work at the solution level and responsible for a high-level architecture planning for individual IT programs or projects. Technical architects work at the delivery level and responsible for developing more detailed architectures for specific IT projects and assisting project teams with their implementation. The structure of the architecture function at Financial Institution is shown in Figure 4.7.

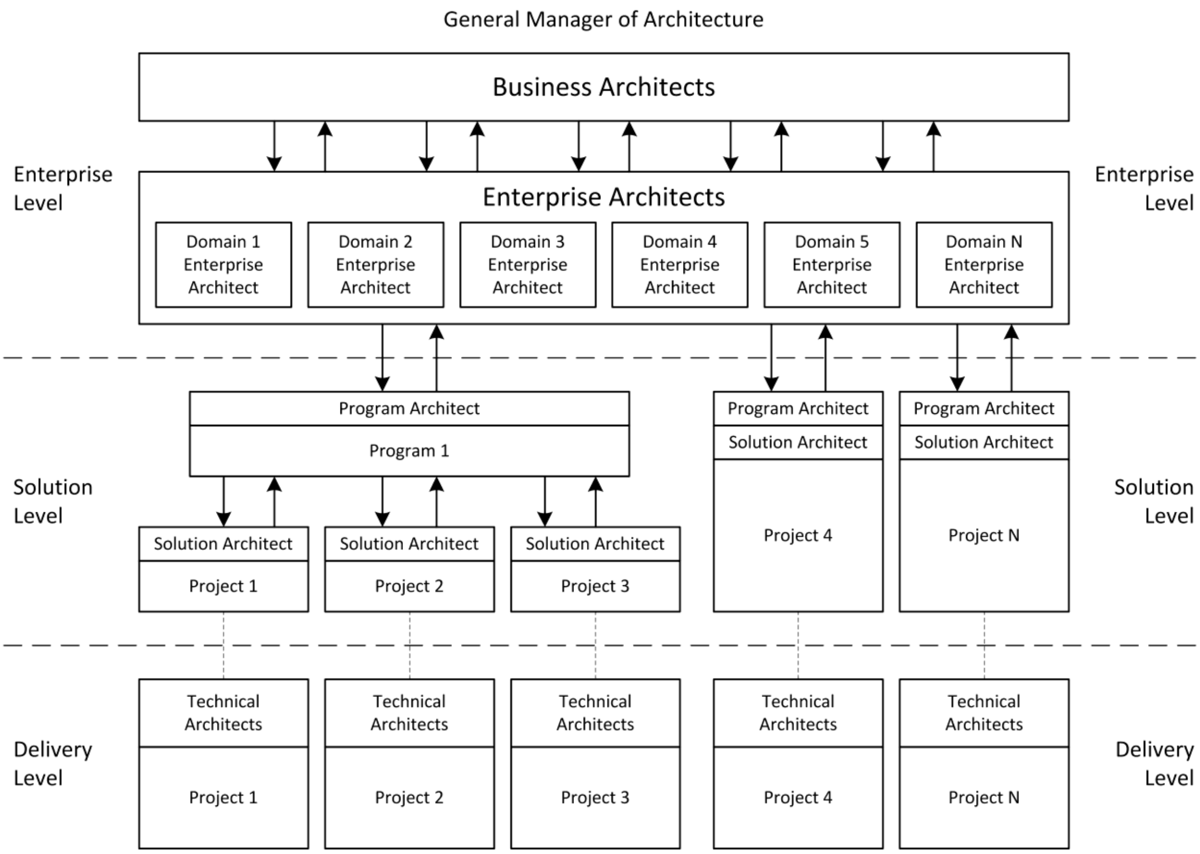

Figure 4.7. EA function in Financial Institution

4.2.2. Enterprise Architecture Artefacts

The EA practice at Financial Institution is based on 13 distinct types of EA artefacts produced by architects with the necessary involvement of other relevant stakeholders. EA artefacts used at Financial Institution with their brief description and meaning are described in Table 4.6.

Table 4.6. EA artefacts in Financial Institution

Owners	Artefacts	Description
Business architects	Core drivers	Core drivers describe several global abstract architecture guidelines relevant for all information systems in the organization
	Capability model	Capability model is a large one-page diagram describing business capabilities of the whole organization up to four or five nested levels of abstraction
	Process model	Process model is a large one-page diagram describing main business processes and roles of the whole organization up to four nested levels of abstraction
Enterprise architects	Principles	Principles describe various high-level architecture guidelines relevant for specific domains

	Policies	Policies are high-level guidelines regulating certain specific areas, for instance information security or data exchange, and relevant for all information systems in the organization
	Standards	Standards describe various best practices and technology standards relevant for specific domains
	Enterprise investment roadmap	Enterprise investment roadmap is a global business-focused document describing the allocation of all investment funding decisions in the organization planned for the next financial year
	Divisional roadmaps	Divisional roadmaps are business-oriented documents describing the desired evolution of individual business units on a horizon of 3-5 years. They describe where and when business units need to invest to uplift the required business capabilities and outline the necessary projects to be delivered to achieve these business goals
	Platform roadmaps	Platform roadmaps are technical documents describing the desired evolution of individual domains from the IT perspective on the horizon of 3-5 years
	Asset register	Asset register is an organization-wide repository describing all currently available IT assets. It includes all existing capabilities, processes, applications, infrastructure and technology components. Asset register describes the purposes and lifecycles of these IT assets as well as shows which IT assets are currently changing and which projects are modifying them
Program architects	Blueprints	Blueprints are high-level descriptions of individual IT projects or programs in a business language typically of 25-50 pages long. They describe the objectives, value, benefits, scope and risks of IT initiatives and provide approximate estimates of their time and cost with a 50% precision. They show the current state, future state, tentative solution and the necessary steps to implement it and explain which vendors or partners will be involved. Blueprints inform business cases for projects or programs
Solution architects	Solution architectures	Solution architectures are high-level technical documents describing the conceptual implementation of individual IT projects or groups of related projects. They are typically of 50-100 pages long, but may reference more detailed subdocuments. Solution architectures describe functional and non-functional requirements of the solution, logical components of the solution and their relationship from the business, information, application, infrastructure and security perspectives
Technical architects	High-level designs	High-level designs are detailed IT-specific descriptions of the physical implementation of individual IT projects. They are voluminous documents describing technical designs of all logical components outlined in solution

		architectures

For organizing and managing its asset register Financial Institution uses a specialized EA software tool called planningIT, which is distributed commercially by Software AG (formerly by Alfabet) and helps architects analyse the architecture repository, trace the connections between different IT assets and coordinate their modification. However, most other EA artefacts are still based on standard MS Office tools, e.g. PowerPoint, Word and Visio, and stored in a centralized MS SharePoint repository.

4.2.3. Enterprise Architecture Processes

Architecture processes constituting the EA practice at Financial Institution can be roughly separated into enterprise-level processes, domain-level processes and project-level processes. Business architects are the main actors of enterprise-level processes, domain-level processes are carried out largely by enterprise architects, while project-level processes are carried out by program architects, solution architects and technical architects.

Enterprise-level architecture processes at Financial Institution are largely unstructured and not formalized. They consist of four distinct activities of business architects and enterprise architects influencing the whole enterprise. These activities are largely independent of each other and carried out in parallel without any particular predefined order. Firstly, business architects, senior business and IT stakeholders collectively discuss the strategic role of IT for the whole organization and develop core drivers influencing all information systems.

> *"Every year, almost, there's not necessarily a completely new set of overall core business drivers for the whole bank, not just for technology, for the whole bank. [...] [One of these core drivers] right now is architecture simplicity, and that doesn't necessary mean IT architecture, architecture simplicity means anything you're constructing make it simple than make it complex"* (Solution Architect)

Secondly, enterprise architects communicate with relevant business stakeholder and establish enterprise-wide policies regulating certain aspects of information systems design. Thirdly, business architects communicate with the business strategy team and collaboratively decide which business capabilities should be uplifted in order to achieve the goals and objectives outlined in the organizational strategy. Fourthly, business architects communicate with relevant business stakeholders and identify which business processes should be added, modified or removed in order to improve the required business capabilities.

> *"Business architects produce things like capability maps, what capabilities are required to be uplifted. They produce high-level process maps, what processes are gonna added or changed. [...] Their predominant focus is around capability, process and to some extent roles because that's really about the change impact, change impact on the business associated with the initiative"* (General Manager of Architecture)

Enterprise-level architecture processes at Financial Institution are shown in Figure 4.8.

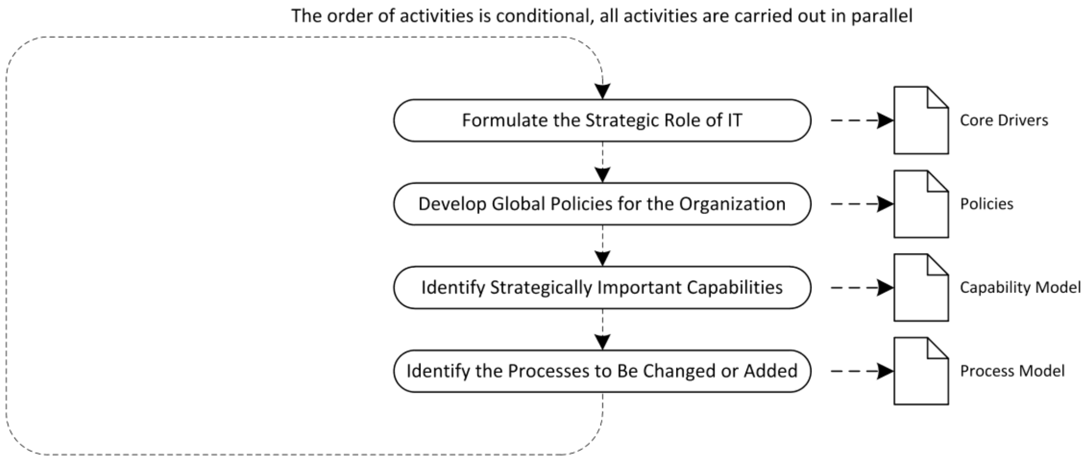

Figure 4.8. EA processes in Financial Institution at the enterprise level

Domain-level architecture processes at Financial Institution are largely unstructured and not formalized. They consist of six distinct activities of enterprise architects influencing the specific domains (e.g. customer relationship management, customer mastering, payments processing, origination, etc.). These activities are largely independent of each other and carried out in parallel without any particular predefined order, except that divisional roadmaps are typically developed after platform roadmaps for corresponding domains have been developed, but before the enterprise investment roadmap is composed. Firstly, enterprise architects collaborate with relevant business stakeholders and develop mutually agreed architecture principles guiding the design of all information systems in their domains consistent with core drivers and other established global policies. Secondly, enterprise architects develop and discuss in architecture forums technical standards for their domains reflecting established best practices and major technology choices. Thirdly, enterprise architects develop architecture strategies for their domains and produce platform roadmaps describing the desired technical evolution of these domains in order to simplify their IT landscapes, make them more flexible and agile.

> *"We might have a hundred applications that do that sort of thing, we understand what processes and capabilities those applications deliver and the platform roadmap which shows the convergence to two or three platforms. It will talk about the types of activities that we need to undertake to converge that into target state"* (General Manager of Architecture)

Fourthly, after the platform roadmaps have been developed, enterprise architects collaborate with relevant business stakeholders and develop divisional roadmaps describing the necessary IT initiatives to be implemented in business units in order to achieve the planned business objectives informed by the capability assessments, required business process changes and platform roadmaps.

> *"[Divisional roadmaps] are really grounded in the business goals and objectives, they are supported by the platform roadmaps [...]. They are much more about what are the capabilities that the company wants to deliver, what processes are impacted by that and what are the benefits that are driven out of that"* (General Manager of Architecture)

Fifthly, after the divisional roadmaps have been prepared, executive-level business stakeholders with a subgroup of enterprise architects aggregate, prioritize and sequence the divisional roadmaps to develop the enterprise investment roadmap describing all the IT investments to be made in the upcoming financial year.

> *"There is essentially a subgroup of architects who deal with that aggregation challenge, and they work with the other groups in the company who actually organize that enterprise-level roadmap"* (General Manager of Architecture)

Sixthly, enterprise architects maintain the register of existing IT assets in order to adequately reflect the presently available IT systems, application, components, products and platforms. Domain-level architecture processes at Financial Institution are shown in Figure 4.9.

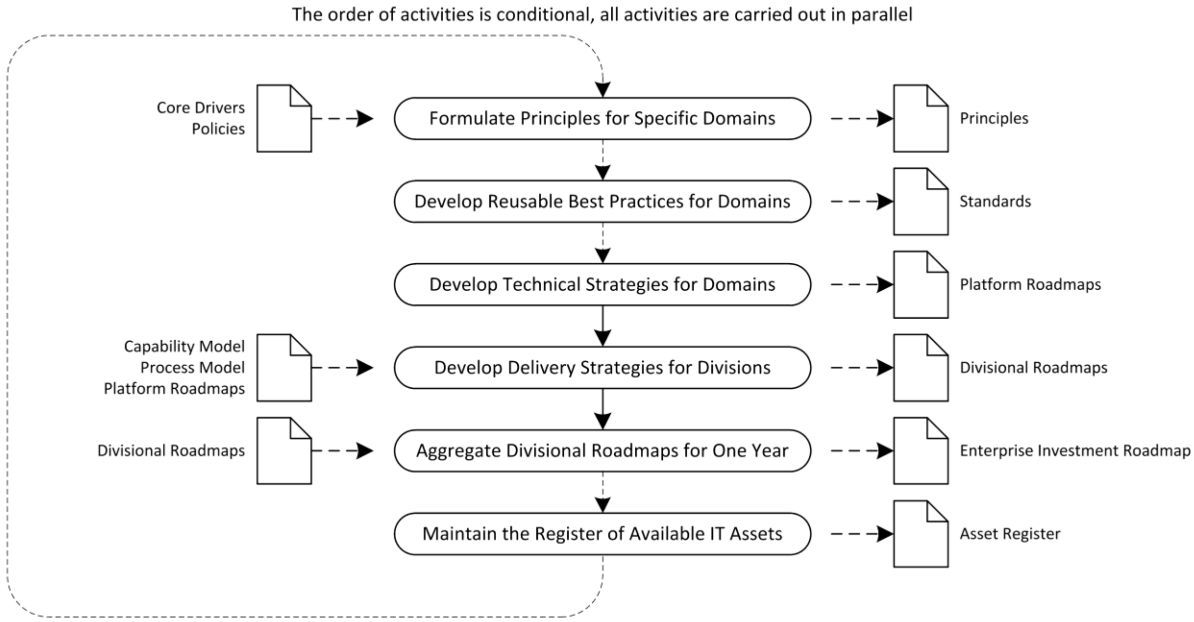

Figure 4.9. EA processes in Financial Institution at the domain level

Project-level architecture processes at Financial Institution are sequential, step-wise and well-structured. They consist of twelve separate steps carried out by program architects, solution architects and technical architects. Firstly, a project or program from the enterprise investment roadmap is initiated and a program architect is assigned to it. Then, the program architect shapes the initial high-level solution required to achieve the declared objectives of the project or program.

> *"Blueprint says "we want to do loan origination and this is what will happen". It will talk about some components, but it does not describe how exactly it is going to be done, it is about what needs to be done. [...] You need this for the funding"* (Enterprise Architect)

The program architect aligns the solution to core drivers, established global policies and existing domain-specific principles. The program architect also aligns the solution with existing platform roadmaps and divisional roadmaps for relevant domains. The program architect reuses the available IT assets, follows established domain-specific standards and finalized the blueprint providing an executive-level description of the solution.

> *"Let's say my domain was network, I've got a strategy [platform roadmap] for networks and the standards. If somebody is doing a project and they need to do use the network they gonna use the standards I defined. If they wanna to divert from the standard then they've got to fill an exception form"* (Enterprise Architect)

After the blueprint is completed, it provides the necessary estimates of time and cost to inform the formal business case for the project or program.

> *"Business case is informed by the blueprint, but the business case actually stands on its own. So, if we are building the business case, what we've got to be able to articulate fundamentally is how much am I gonna spend and what return am I gonna get"* (General Manager of Architecture)

Then, the blueprint and business case are formally approved by relevant business stakeholder as well as by the investment funding committee, if the solution is large.

> *"Blueprint also focuses on, that if you gonna spend a hundred million dollars these are the benefits you gonna get. We have a funding committee, for the whole [organization], so if it's more than ten million we have to go to them. The blueprint is used to tell them "okay, we know the solution, we know the steps and these are the benefits". So, it's used by multiple people, but the one I did for this project we used it quite well for the funding committee"* (Enterprise Architect)

Based on a high-level solution outline provided by the blueprint, solution architects start to develop more detailed technical solution architectures for the project or program, which are then formally reviewed and approved by the supervising enterprise and program architect as well as by relevant business stakeholders.

> *"Generally [in the approval process] there will be somebody from the enterprise architecture, there will be somebody from the business that requested the solution [...]. And then approval will be at the program level, so somebody like the program architect [...]. Approval of a SAD, solution architecture document, will result in an action for somebody to go and create a high-level design"* (Solution Architect)

Solution architectures are used by technical architects as an input for developing very detailed high-level designs for the project or program, which are then also formally reviewed and approved by the program architect and solution architects. Finally, after all the necessary reviews and approvals, high-level designs are transferred to projects team to actually implement the corresponding projects, or sets of projects included in the program.

"If they have to add anything, they have to add to the [solution architecture] first, then it has to be added into [high-level design], it has to be added to the detailed design and then it goes into implementation" (Technical Architect)

Project-level architecture processes at Financial Institution are shown in Figure 4.10.

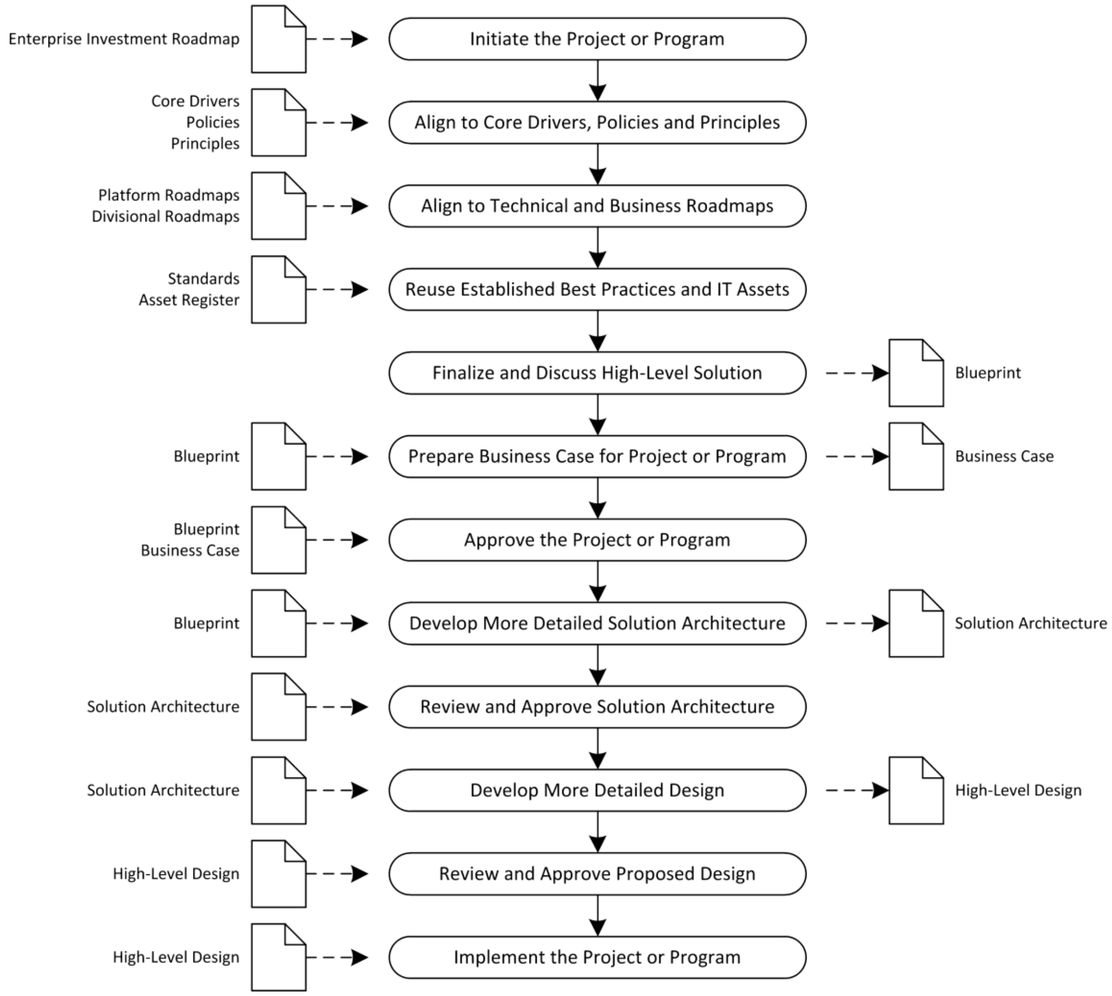

Figure 4.10. EA processes in Financial Institution at the project level

4.2.4. Grounded Theory Analysis

In order to analyse the collected interview data for Financial Institution the three-step grounded theory procedure identical to the one used for Educational Institution and described in detail earlier in Section 3.5.4 has been applied. Samples of the grounded theory analysis process and the detailed list of all identified concepts and categories for Financial Institution can be found in Appendix D.2.

As a result of the applied coding procedure 190 different codes have been assigned, which were subsequently consolidated into 67 consistent concepts. Of all 67 resulting concepts, 28 new and previously unrecognized concepts have been identified relevant to each of the seven high-level categories, i.e. Artefacts, Benefits, External Factors, Information, Internal Factors, Usage and Users. Each of the four theoretical domains (see Figure 4.3) has been updated accordingly.

In the environment domain one new concept has been identified related to Internal Factors category and one new concept has been identified related to External Factors category. Firstly, Industry has been added as a significant internal factor representing the industry-specific degree of dependence of corresponding organizations on IT and the overall maturity of the culture of the relationship between business and IT. Essentially, this factor reflects the general organization-wide “IT savvy”-ness (Weill and Aral, 2004; Weill and Aral, 2005), e.g. dependence on digital transactions, commitment of business executives to IT and widespread use of the Internet. Secondly, Legislative Regulation has been added as a significant factor of the external business environment representing governmental regulatory efforts intended to monitor and control the business of organizations. Legislative Regulation implies a strict set of compliance norms and mandatory restrictive requirements imposed on organizations working in particularly “sensitive” industries, e.g. finance and healthcare.

In the artefacts domain five new concepts have been identified related to Artefacts category and seven new concepts have been identified related to Information category. Firstly, Policies have been added as a new type of rather detailed textual EA artefacts providing overarching executive-level Mandatory Rules relevant for all information systems in an organization. Secondly, Process Models have been added as new graphical one-page EA artefacts showing the abstract structure of High-Level Processes existing in an entire organization. Thirdly, Landscape Roadmaps have been added as a special type of roadmaps providing technical Improvement Plans related specifically to the organizational IT landscape. Fourthly, Inventories have been added as new EA artefacts containing a comprehensive List of IT Assets currently existing in an organization. Fifthly, Solution Architectures have been added as a new type of solution-level EA artefacts providing preliminary High-Level Implementation Plans of technical nature for specific IT initiatives. Sixthly, since Financial Institution executes large IT initiatives as programs consisting of multiple related projects, corresponding Information concepts of Planned Programs and Program Overviews have been added to the existing Artefacts concepts of Global Roadmaps, Local Roadmaps and Conceptual Architectures, which may relate equally to both projects and programs.

Based on the constant comparative method (Glaser and Strauss, 1967; Strauss and Corbin, 1998), i.e. on the analysis of differences and similarities between the existing and newly identified concepts, nine concepts in the artefacts domain have been generalized to form more generic and higher-order concepts. Firstly, the concepts of IT Principles providing Technical Imperatives and Standards providing Solution Components have been merged to form a broader concept of Technical Standards providing all sorts of Technical Recommendations including both conceptual prescriptions and reusable components. Secondly, the concepts of Business Capability Models providing Business Capabilities and Process Models providing High-Level Processes have been merged to form a broader concept of Business Models describing at the executive level both Capabilities and Processes. Thirdly, the concepts of Landscape Diagrams providing Landscape Snapshots and Inventories providing the List of IT Assets have been merged to form a broader concept of Landscape Views providing all sorts of technical current-state Landscape Descriptions. Fourthly, due to their similarity Artefacts concepts of Global Roadmaps and Local Roadmaps have been merged into a broader concept of Roadmaps of any scope. Fifthly, due to their similarity Information concepts of Planned Projects and Planned Programs have been merged into a broader concept of Planned Initiatives embracing both projects and programs, as series of closely related projects. Analogously, Information concepts of Project Overviews and Program Overviews have been merged into a broader concept of Initiative Overviews covering both projects and programs.

In the use domain six new concepts have been identified related to Users category and five new concepts have been identified related to Usage category. Firstly, Business Architects, Program Architects and Technical Architects have been added as new actors of an EA practice responsible for planning the architecture changes at the corresponding organizational levels (see Figure 4.7). Secondly, Program Managers and PMO (project management office) have been added as new actors at the initiative level responsible for managing large initiatives and providing required resources correspondingly. Thirdly, Investment Committees have been added as new actors responsible for discussing, evaluating and approving all proposed IT initiatives. Fourthly, Program Planning, Program Shaping and Program Approval have been added as new use cases of EA artefacts representing the technical planning, business-shaping and final approval of IT programs respectively. Fifthly, Initiative Launch has been added as new usage of EA artefacts intended to articulate and start new IT initiatives based on higher-level strategic plans. Sixthly, Sequencing has been added as new usage of EA artefacts intended to determine the right sequence of IT initiatives feasible from the technical perspective, e.g. ensure that different initiatives do not plan to modify same IT systems at the same time.

Based on the analysis of differences and similarities between the existing and newly identified concepts, seven concepts in the use domain have been generalized to form more generic and higher-order concepts. Firstly, the corresponding pairs of Project Planning and Program Planning, Project Shaping and Program Shaping, Project Approval and Program Approval have been merged to form broader concepts of Initiative Planning, Initiative Shaping and Initiative Approval due to a conceptual equivalence of projects, programs or any other types of IT initiatives from the perspective of an EA practice and roles of EA artefacts. Secondly, due to their conceptual similarity and poor distinguishability the concepts of Global Executives and Local Executives have been merged into a broader concept of Business Executives representing all senior business decision-makers responsible for strategic planning. Thirdly, due to the similarity in their responsibilities and evident organization-specific “flavour” the concepts of Steering Committees and Investment Committees have been merged to form a broader concept of Decision-Making Committees responsible for evaluating and approving all IT investment proposals. Fourthly, particular architecture positions in different organizations are inherently organization-specific, all belong to architecture functions, imply similar responsibilities and often overlap and therefore the concepts of Business Architects, Enterprise Architects, Program Architects, Solution Architects and Technical Architects have been merged into an overarching concept of Architects responsible for IT planning at any organizational levels. Fifthly, the concepts of Project Managers, Program Managers and PMO have been merged to form a broader concept of Initiative Managers responsible for managing any IT initiatives, including both projects and programs, and procuring all the necessary resources.

In the benefits domain three new concepts have been identified related to Benefits category: Improved Compliance, Reduced Risk and Reduced Legacy. Improved Compliance stands for achieved compliance with relevant industry regulatory acts and requirements, e.g. controlling the handling and sharing of financial and personal data. Reduced Risk represents minimized risks of technical nature associated with using unproven technologies and implementation approaches. Reduced Legacy is the lowered number of legacy IT systems and minimized dependence on these systems. Based on the analysis of differences and similarities between the existing and newly identified concepts, no concepts in the benefits domain have been merged or generalized.

The updated set of concepts resulting from the analysis of the collected data from Financial Institution allows updating the identified roles of EA artefacts accordingly.

4.2.5. Updated Roles of Enterprise Architecture Artefacts

The data collected and analysed for Financial Institution confirms, generalizes and extends the initial set of roles of EA artefacts developed previously (see Figure 4.5 and Figure 4.6). The newly identified roles of EA artefacts in Financial Institution appear to be very similar in principle to the previously identified roles, but still highly different in numerous details most of which are likely to be organization-specific. Specifically, all the ten previously identified roles have been confirmed, but with appropriate generalizations reflecting natural organization-specific differences in EA practices. None of the existing roles has been contradicted with the new findings, while two completely new roles have been identified. The uncovered evident similarities between the roles of EA artefacts suggest that these roles are remarkably consistent even between disparate organizations. These roles seemingly reflect established industry best practices in EA and tend to be rather objective in nature. The status of all the identified roles of EA artefacts after the second case study is shown in Table 4.7.

Table 4.7. Status of the roles of EA artefacts after the second case study

Role	Status	Explanation
Approach Providers	Confirmed and generalized	New Benefits added, Artefacts, Information and Users generalized
Baseline Descriptors	Confirmed and generalized	New Benefits added, Artefacts, Information and Users generalized
Change Sequencers	Newly identified	Completely new role helping plan the timing of future changes in the IT landscape corresponding to the new Usage concept Sequencing
Decision Assessors	Confirmed and generalized	New Artefacts, Information and Benefits added, Users generalized
Initiative Launchers	Newly identified	Completely new role helping articulate and start the execution of new IT initiatives corresponding to the new Usage concept Initiative Launch
Initiative Planners (former Project Planners)	Confirmed, generalized and renamed	New Artefacts and Information added, Users and Usage generalized

Initiative Shapers (former Project Shapers)	Confirmed, generalized and renamed	Information, Users and Usage generalized
Initiative Tags (former Project Tags)	Confirmed, generalized and renamed	Information, Users and Usage generalized
Investment Guides	Confirmed and generalized	Artefacts, Information and Users generalized
Investment Prioritizers	Confirmed and generalized	Artefacts, Information and Users generalized
Project Implementers	Confirmed and generalized	New Artefacts and Information added, Users generalized
Technology Providers	Confirmed and generalized	New Benefits added, Users generalized

As summarized in Table 4.7, after the second case study the role of Approach Providers has been generalized to involve all denominations of Architects as potential Users since architecture positions can be very organization-specific (the same generalization has been also made to all other roles). Moreover, Reduced Risk has been also added as the typical resulting benefit of this role since reusing proven implementation approaches helps de-risk the delivery of new IT initiatives. Inventories has been added as a new type of EA artefacts fulfilling the role of Baseline Descriptors since they also provide descriptions of the current IT landscape suitable for knowledge sharing purposes similar to previously identified Landscape Diagrams, however, in a tabular form as a list of available IT assets.

Policies has been added as a new type of EA artefacts to the role of Decision Assessors since these EA artefacts are used in a manner very similar to the previously identified Principles for assessing the organizational fitness of all IT-related planning decisions. The resulting Improved Compliance has been added to ensuing Benefits accordingly. Process Models, as newly identified EA artefacts providing a global view of High-Level Processes, have been added to the role of Investment Guides. These artefacts are used in a very similar way to the previously identified Business Capability Models to focus future IT investments on the most critical areas and thereby improve the long-term Investments Effectiveness. The role of Investment Prioritizers has been generalized to embrace all possible types of business-oriented Roadmaps since these types can be very organization-specific, but are still used in a very similar manner to prioritize IT investments. The role of Project Implementers has been extended to also include newly identified Solution Architectures as High-Level Implementation Plans, which are used rather similarly to previously identified Solution Designs for planning the project implementation, but focus specifically on a high-level view.

The role of Project Planners has been extended to embrace the planning of all IT initiatives, including both separate projects and larger programs consisting of several related projects, due to their conceptual similarity from the perspective of technical planning. Accordingly, the role was renamed to Initiative Planners to reflect this fact. Due to the same reason the roles of Project Shapers and Project Tags have been also extended and renamed accordingly to embrace both projects and programs. These roles have been also generalized to involve all possible types of Decision-Making Committees since these committees are highly organization-specific. The role of Technology Providers has been extended to ensue also Reduced Risk and generalized to involve all denominations of Architects, as describe earlier.

Two new, previously unidentified roles of Change Sequencers and Initiative Launchers have been added. Change Sequencers help plan the timing of future changes in the IT landscape. This role is fulfilled by Inventories, or more general Landscape Views, providing Landscape Descriptions showing the timelines of planned changes affecting specific IT assets. Landscape Views are used by Architects for Sequencing IT initiatives to ensure that different initiatives do not try to modify the same IT asset at the same time, leading to Increased Agility of IT planning. Initiative Launchers help articulate and start the execution of new IT initiatives. This role is fulfilled by Roadmaps providing the structured view of all Planned Initiatives. As part of this role, Roadmaps are used by Business Executives and Architects to start the initial planning of right IT initiatives at right time moments to ensure better Investments Effectiveness.

4.2.6. Summary of the Identified Roles

A high-level summary of all the twelve roles of EA artefacts identified after the second case study in terms of the underlying concepts structured according to the established four-domain theoretical framework (see Figure 4.3) is provided in Figure 4.11 (part 1) and Figure 4.12 (part 2).

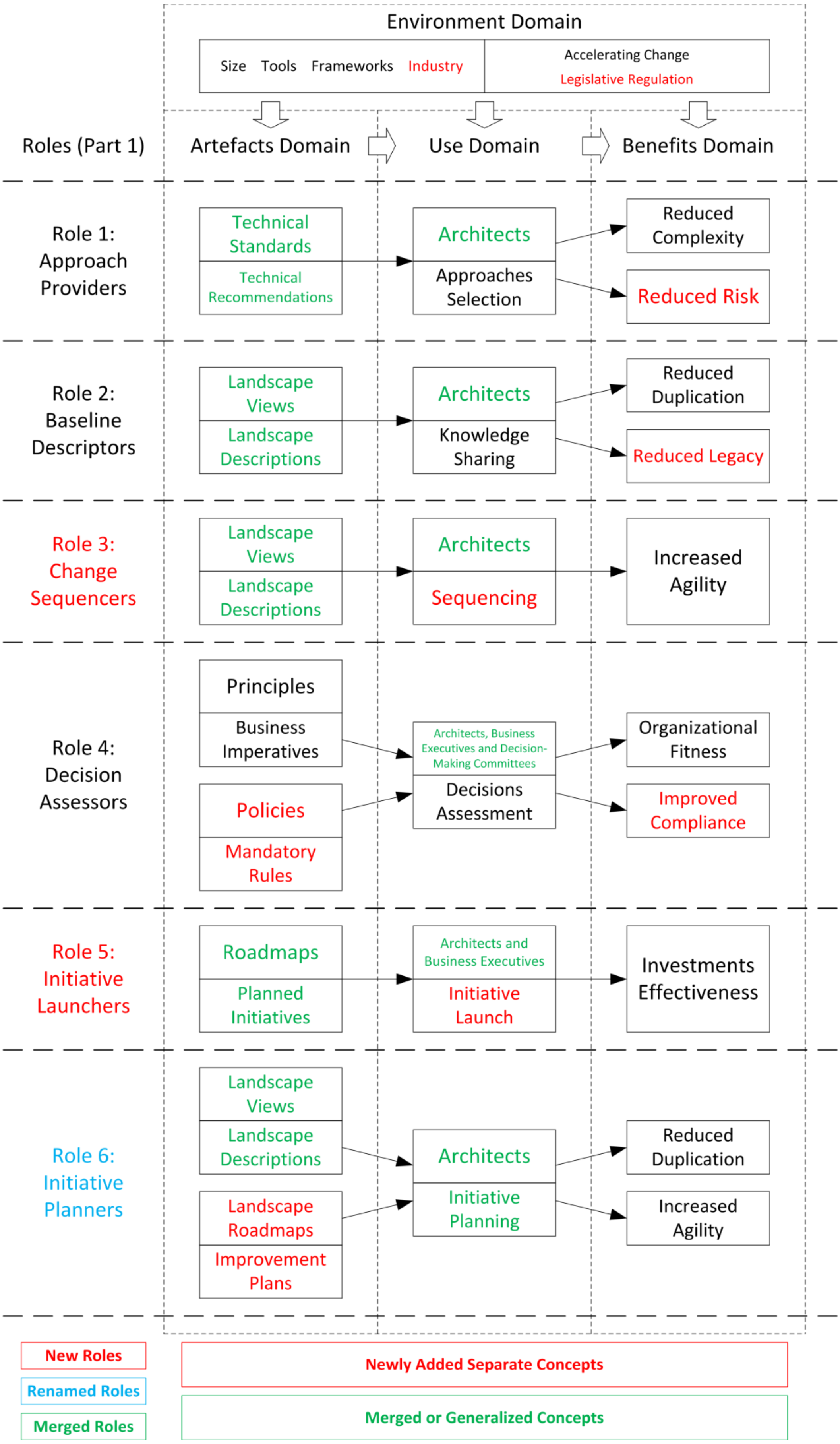

Figure 4.11. Summary of the roles of EA artefacts after the second case study (part 1)

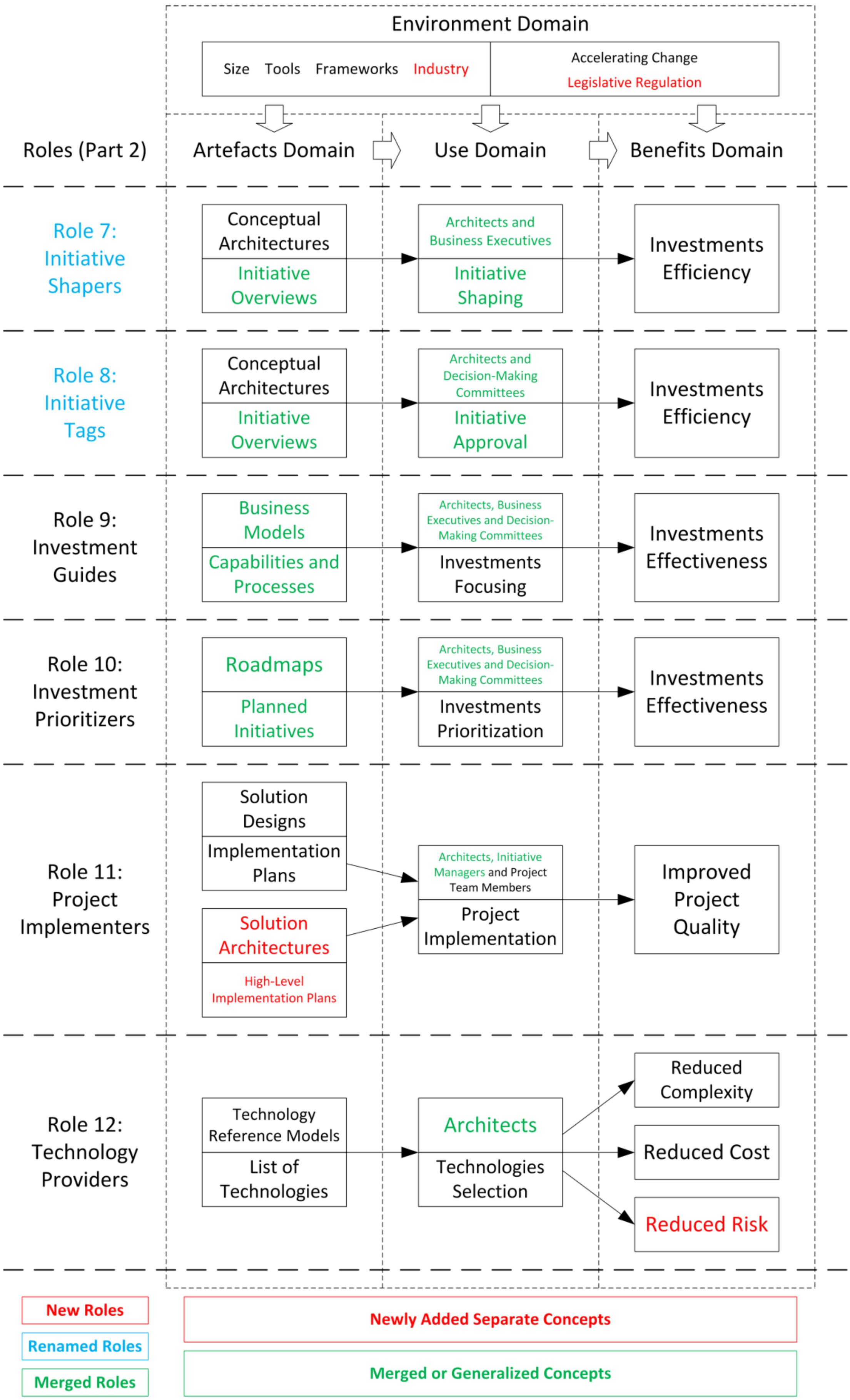

Figure 4.12. Summary of the roles of EA artefacts after the second case study (part 2)

4.2.7. Influence of Environmental Factors on the Roles of EA Artefacts

The comparison of the identified roles of EA artefacts and underlying concepts between Educational Institution and Financial Institution allows to initially theorize on the influence of various environmental factors on the roles of EA artefacts.

Firstly, the role of Decision Assessors is evidently influenced by the Legislative Regulation factor. A highly regulated business environment in which Financial Institution operates naturally imposes additional normative restrictions shaping all IT-related decision-making processes. Specifically, the role of Decision Assessors is impacted by Legislative Regulation in the artefacts and benefits domains. On the one hand, Policies providing Mandatory Rules are identified as new EA artefacts fulfilling the role of Decision Assessors in addition to the previously identified Principles providing much "softer" guidance for assessing the appropriateness of all planning decisions. On the other hand, Improved Compliance is identified as a new type of benefit enabled by the role of Decision Assessors.

Secondly, the roles of Baseline Descriptors and Initiative Planners are influenced by the use of specialized software Tools for EA. While Educational Institution does not use any specific software tools for an EA practice beyond the standard MS Office suite, e.g. Word and PowerPoint, and other general-purpose tools, e.g. Google Drive, a tool-based architecture repository employed in Financial Institution provides a convenient means for managing the descriptions of the IT landscape and constituting IT assets. Due to the use of a specialized software tool, Landscape Descriptions in Financial Institution are stored as an interrelated network of IT assets in the searchable architecture repository, rather than as a set of separate pictorial diagrams. Instead of using plain MS Visio diagrams for capturing the current state of the IT landscape, architects at Financial Institution are empowered by the capabilities of a specialized tool, e.g. analysis of the dependencies between IT assets and impact analysis, which helps them share knowledge, analyse the IT landscape and plan future IT initiatives. At the same time, most other types of EA artefacts used in Financial Institution, e.g. Business Models, Conceptual Architectures and Solution Designs, are still created and distributed using standard MS Office applications and their roles, therefore, are largely unaffected by the use of specialized software Tools.

Thirdly, the roles of Investment Prioritizers and Initiative Shapers are influenced by the Industry factor. Since the financial industry traditionally is among the earliest forefront adopters of IT, the overall IT "savvyness" and culture of the relationship between business and IT in Financial Institution is much higher than in Educational Institution. From the perspective of the roles of EA artefacts, this difference is clearly manifested in the use domain as the absence of Liaisons as users EA artefacts in Financial Institution, whose involvement in the roles of Investment Prioritizers and Initiative Shapers was essential in Educational Institution. Liaisons in Educational Institution are responsible for “translating” and facilitating the effective dialog between business and IT, but in Financial Institution the very need for Liaisons is essentially missing due to a more mature culture of the relationship between business and IT enabling direct communication between Architects and relevant business stakeholders.

Fourthly, the identification of the new roles of Change Sequencers and Initiative Launchers can be attributed to the larger Size of Financial Institution and its IT landscape. A more extensive scale of the IT landscape and a greater number of ongoing IT initiatives introduce more complex dependencies between IT assets, require better coordination of their modifications and thereby complicate the temporal planning of new IT initiatives. Change Sequencers help address this problem by providing a systematic means of sequencing the planned changes and ensuring that these changes do not overlap from the perspective of the IT assets they intend to modify. The large Size of Financial Institution also complicates the translation of abstract strategic plans into concrete implementable IT initiatives. In order to alleviate this problem, the newly identified role of Initiative Launchers intends to facilitate the transformation of strategy into action, i.e. helps derive actionable IT initiatives from highly conceptual strategic plans.

The large size of Financial Institution also impacts on the roles of Initiative Shapers, Initiative Planners, Initiative Tags and Project Implementers. A larger organizational size naturally implies larger-scope organizational changes, which are more often implemented not as separate IT projects, but as full-fledged change programs consisting of multiple related IT projects. For this reason, from the perspective of the use domain the roles of Initiative Shapers, Initiative Planners, Initiative Tags in Financial Institution often deal with shaping, planning and approving large change programs (i.e. groups of related projects), rather than individual IT projects. Because of the similar reasons related to the organizational Size, the role of Project Implementers in Financial Institution implies two-step project implementation firstly developing preliminary Solution Architectures providing broad High-Level Implementation plans and then subsequently elaborating them into more narrow and detailed Solution Designs. The influence of environmental factors on the roles of EA artefacts in Financial Institution analysed above is summarized in Figure 4.13.

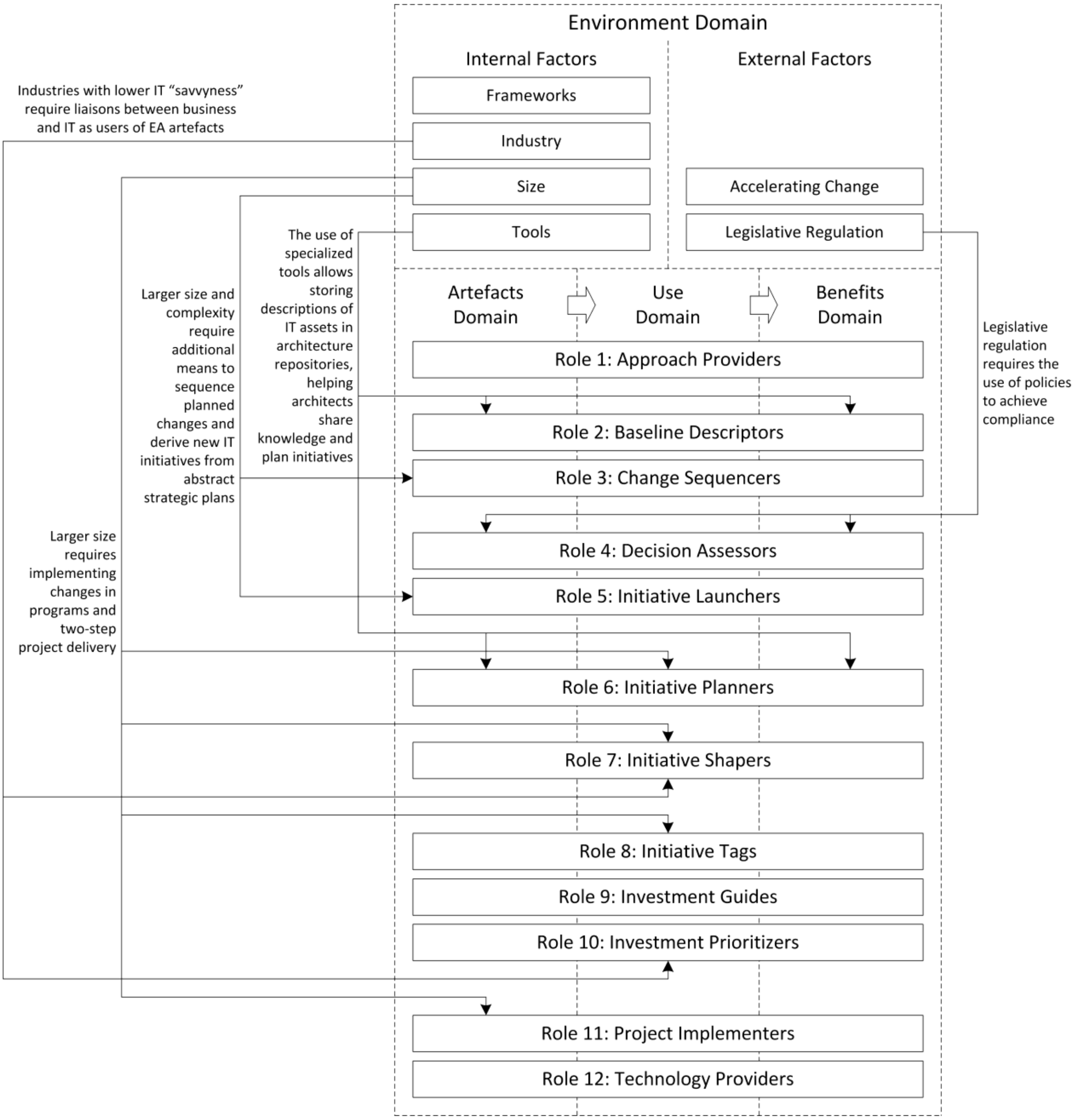

Figure 4.13. Influence of environmental factors on the roles in Financial Institution

4.2.8. Saturation Assessment

28 of 67 substantive concepts identified in the second case study were new and previously unidentified. Moreover, 13 of these concepts were significantly different from the existing concepts. These concepts could not have been merged with the existing concepts and, therefore, have been added to the resulting conceptual framework.

As a result of the second case study, the resulting conceptual framework has been significantly extended and generalized, while the tentative roles of EA artefacts have been refined accordingly. Even though the vast majority of the previously identified roles have been confirmed, numerous details of these roles have been modified. Many resulting concepts are still very fine-grained and highly organization-specific. Consequently, the emerging conceptual framework at this stage of the study does not show any signs of saturation and the identified roles of EA artefacts can still be considered only as tentative findings. Additional analysis of other organizations is required to saturate the theory.

4.2.9. Selecting the Next Case

Both the first and second studied organizations, i.e. Educational Institution and Financial Institution, are moderately decentralized organizations consisting of somewhat independent business units reporting to the central organization-wide head units. Since the organizational structure significantly impacts its IT governance arrangements (Weill and Ross, 2004), it may significantly influence the structure of its EA practice as well. From this perspective, exploring some organizations with significantly different organizational structures might be desirable for theoretical saturation to enrich the emerging conceptual framework. Consequently, the selection of the next case organization for this study was driven by the intention to study either a very centralized organization or, on the contrary, a very decentralized organization.

4.3. Case Study Three: Telecom Institution

The third case organization studied in this research is Telecom Institution. Telecom Institution satisfies the case selection criteria described above driven by the theoretical sampling considerations. Specifically, Telecom Institution is a very centralized organization essentially representing a single line of business and structured according to its key business functions. Telecom Institution also satisfies minimal case selection requirements since it employs more than 500 IT specialists and practices EA for more than six years.

Telecom Institution is one of the prominent telecommunication companies on the Australian market providing various communication services to millions of customers across Australia. It employs several thousand people, including ~500 in-house IT staff. Additionally, it has established partnerships and outsourcing arrangements with a number of IT service companies and other telecommunication companies involved in the delivery of new IT systems on behalf of Telecom Institution. Technologically, Telecom Institution relies on the telecommunication equipment, platforms and systems provided by a few major strategic vendors.

> *"Most of our applications that run our business are off-the-shelf type products. They are supplied and supported by vendors and we don't design them from scratch. They already come with a function, functionality and we just adapt them to how we want them to work. [...] They [IT specialists] do that within those projects that are implemented"* (Data Architect)

Organizationally Telecom Institution is structured into four different complementary functions: construct, operate, customer and enterprise. Construct function is responsible for building physical connectivity facilities necessary for providing telecommunication services to customers, such as building towers, laying cables and launching satellites. Operate function is focused on supporting the faultless operations of the entire corporate network, such as routing, network management and service delivery. Customer function is responsible for all customer-related activities, such as billing, analytics and order management. Enterprise function includes all the supporting departments necessary to maintain Telecom Institution as a commercial organization, such as human resources, procurement and finance.

> *"There are four business [functions]. There is a customer business function, there is our operate the network function, there is our build the network function and then there is the enterprise functions which just look after [the organization] as an entity itself"* (Enterprise Architect)

Telecom Institution implements the Coordination operating model (Ross, 2005; Ross et al., 2006; Weill and Ross, 2009) since all the functional divisions run different business processes, but rely on common information which is stored in a centralized manner in a corporate datacentre and shared across all business functions. Telecom Institution has an organization-wide IT function providing various IT services to these four major corporate functions. However, the delivery of IT solutions is almost entirely outsourced to partner companies.

> *"There is a lot of outsourcing partners which are coming, but not all the outsourcing partners work in the way we work. So, we have to change some of the practices to accommodate those outsourcing partners [...]. In some places [both solution architecture and implementation] is completely outsourced to partners"* (Lead Architect)

Telecom Institution practices EA starting from 2009, when many experienced architects have been hired from the job market to establish a permanent EA function.

4.3.1. Enterprise Architecture Function

Due to its large scope and extensive use of information systems, the EA function at Telecom Institution has a pretty sophisticated structure. The EA function is headed by the general manager of architecture and consists of around 100 architects of five different types: enterprise architects, lead architects, domain architects (including lead domain architects), solution architects and platform architects. Additionally, vendor architects allocated by partner organizations as part of outsourcing arrangements for design and delivery of IT solutions also play a significant role in the EA practice at Telecom Institution.

Enterprise architects represent the highest level of architecture at Telecom Institution. Their responsibilities include a strategic IT planning for the entire organization on a very long-term time horizon, typically 5-10 years.

> *"As an enterprise architect, [my responsibilities are] trying to look at disruptive influences on our company and trying to position IT to respond. So, it is sensing and responding"* (Enterprise Architect)

Lead architects are responsible for a long-term IT planning for the four corporate functions (construct, operate, customer and enterprise), typically up to five years ahead. Each corporate function has its own dedicated lead architect. Domain architects are responsible for an architectural planning for the four main domains enterprise-wide (data, security, integration and infrastructure). Each domain has its own dedicated lead domain architect responsible for directing and managing other domain architects working in this domain. Solution architects are responsible for a high-level solution architecture planning under the supervision of corresponding lead architects and domain architects.

> *"In consideration of our enterprise architecture, I need to work with business groups to identify their needs, see how to fit it to our roadmaps, work with them to identify opportunities and where solution potentially requires automation"* (Solution Architect)

Platform architects are similar to solution architects, but they are focused on specific IT platforms and primarily work on enhancements and maintenance of their platforms. Vendor architects are allocated and provided to Telecom Institution by its partner organizations to do a detailed solution architecture planning for specific IT projects as part of delivery outsourcing arrangements. The structure of the architecture function at Telecom Institution is shown in Figure 4.14.

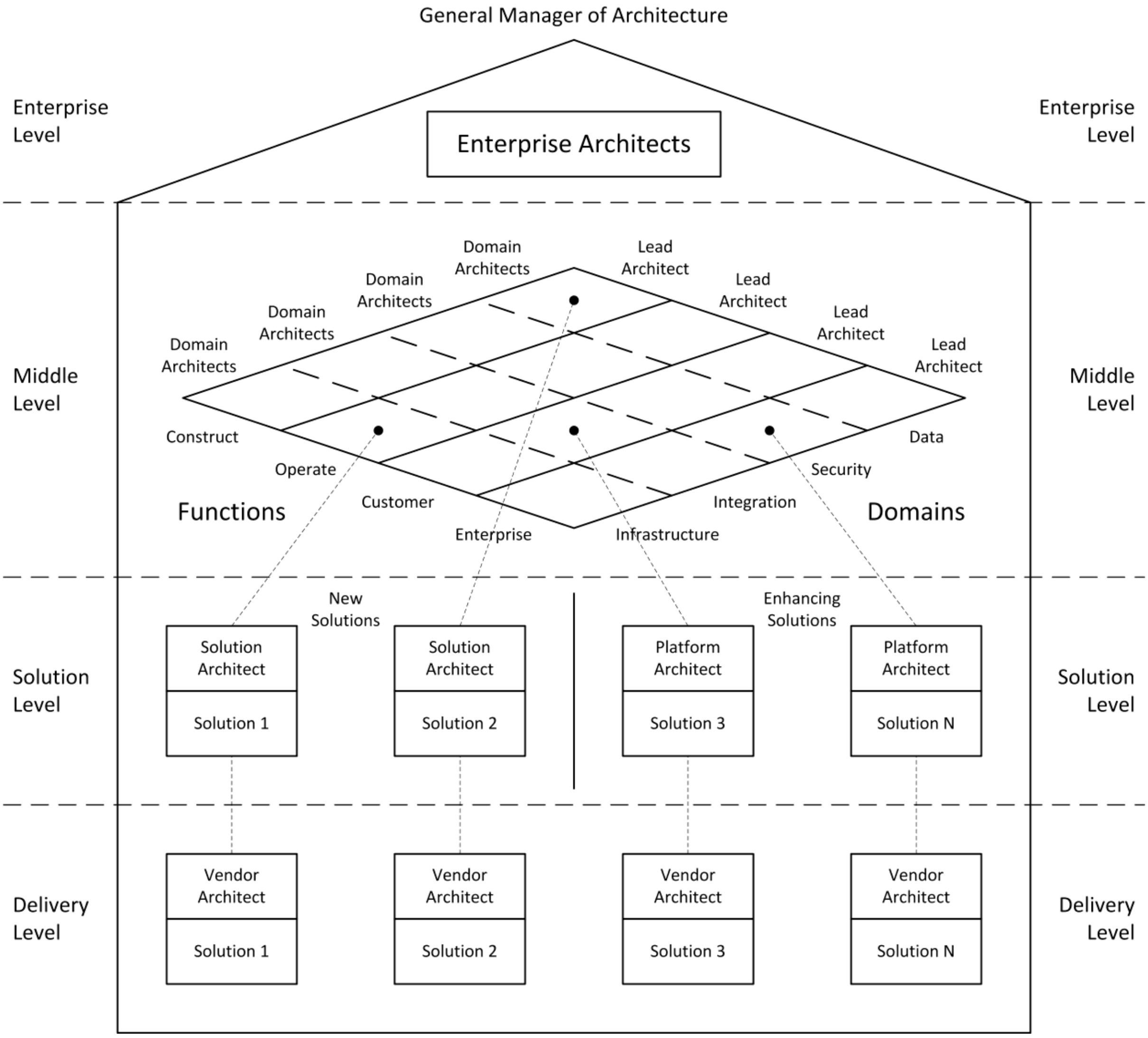

Figure 4.14. EA function in Telecom Institution

4.3.2. Enterprise Architecture Artefacts

The EA practice at Telecom Institution is based on 15 distinct types of EA artefacts produced by architects with the necessary involvement of other relevant stakeholders. EA artefacts used at Telecom Institution with their brief description and meaning are described in Table 4.8.

Table 4.8. EA artefacts in Telecom Institution

Owners	Artefacts	Description
Enterprise architects	Strategic papers	Strategic papers are conceptual documents describing recommended future directions for both business and IT typically on a horizon of 5-10 years
	IT principles	IT principles describe ten global high-level architecture guidelines relevant for all IT solutions in the organization
	Business capability models	Business capability models are one-page diagrams describing general business capabilities of the whole organization as well as more specific business capabilities of different organizational functions (construct, operate, customer and enterprise)
	Reference architecture model	Reference architecture model is a one-page diagram showing all business capabilities of the organization as well as all main information systems supporting these capabilities
Lead architects	Principles	Principles describe high-level architecture guidelines or concepts relevant for specific functions (construct, operate, customer and enterprise) or domains (data, security, integration and infrastructure)
	Function roadmaps	Function roadmaps describe tentative lists of IT initiatives to be implemented in different organizational functions (construct, operate, customer and enterprise) in the future up to five years ahead. However, short-term horizons describe more specific IT initiatives approved and funded to be implemented during the next financial year
Domain architects	Data models	Data models are abstract business-oriented descriptions defining the conceptual structure of core data types, e.g. customer, product, service and order, to be used in all organizational IT systems
	Data schemas	Data schemas are detailed technical documents defining the standardized formats to store and transfer main data entities on different platforms, for instance SQL definitions and XML schemas
	Patterns	Patterns describe reusable technical solutions to typical problems relevant for specific domains (data, security, integration and infrastructure)
	Domain roadmaps	Domain roadmaps describe the desired progression of different domains (data, security, integration and infrastructure) in the future from the technical or semi-technical perspective
	Inventories	Inventories are lists of systems, technologies, data entities, platforms and other entities existing in the organization. Each entity in an inventory is marked as to-be-decommissioned, current or to-be-implemented
Solution and	Solutions on	Solutions on a page are one-page diagrams schematically describing individual

platform architects	a page	IT solutions in an abstract manner
	Solution blueprints	Solution blueprints are high-level descriptions of individual IT solutions typically of 30-70 pages long
Vendor architects	Platform architectures	Platform architectures are detailed technical documents and diagrams describing different parts of the IT landscape (platforms) typically of 60-150 pages long
	Detailed designs	Detailed designs are voluminous detailed technical documents up to several hundred pages long describing a number of individual IT solutions relevant to a single platform included into a release

4.3.3. Enterprise Architecture Processes

Architecture processes constituting the EA practice at Telecom Institution can be roughly separated into enterprise-level processes, middle-level processes and solution-level processes. Enterprise architects are the main actors of enterprise-level processes, middle-level processes are carried out by lead architects and domain architects, while solution-level processes are carried out largely by solution architects and vendor architects.

Enterprise-level architecture processes at Telecom Institution are largely unstructured and not formalized. They consist of four distinct activities of enterprise architects influencing the whole enterprise. These activities are largely independent of each other and carried out in parallel without any particular predefined order. Firstly, enterprise architects monitor relevant technical, societal, economical and industrial global trends in the external environment, communicate with senior business stakeholders and periodically produce strategic papers describing how the organization should respond on these trends in the long-term period in order to successfully execute its business strategy.

> *"[Strategic papers] say this is what we got currently, these are some of the problems that we are seeing in the future. We went and talk to the business about what's happening in the future, this is where we think we should go"* (Enterprise Architect)

Secondly, enterprise architects formulate IT principles guiding the use of information systems in the organization, discuss and approve these principles.

> *"We have a set of architecture principles and the solutions that are being produced by the solution architects are now being assessed against these principles. [...] They are purely technical at this point. We did have a goal at*

a time to define some [global] guiding principles which would be coined by business stakeholders, but the organization is not mature enough for that" (Enterprise Architect)

Thirdly, enterprise architects maintain business capability models and use them for discussions with senior business stakeholders in order to understand which capabilities should be improved with IT in order to deliver the business strategy.

"We have business capability model, we go to business and say "what capability you need?" So, that's how the to-be state is made" (Enterprise Architect)

Fourthly, enterprise architects maintain the reference architecture model and use it for analysing the portfolio of information systems managed by the organization in order to optimize it, minimize the misuse of existing systems, facilitate reuse and reduce duplication. Enterprise-level architecture processes at Telecom Institution are shown in Figure 4.15.

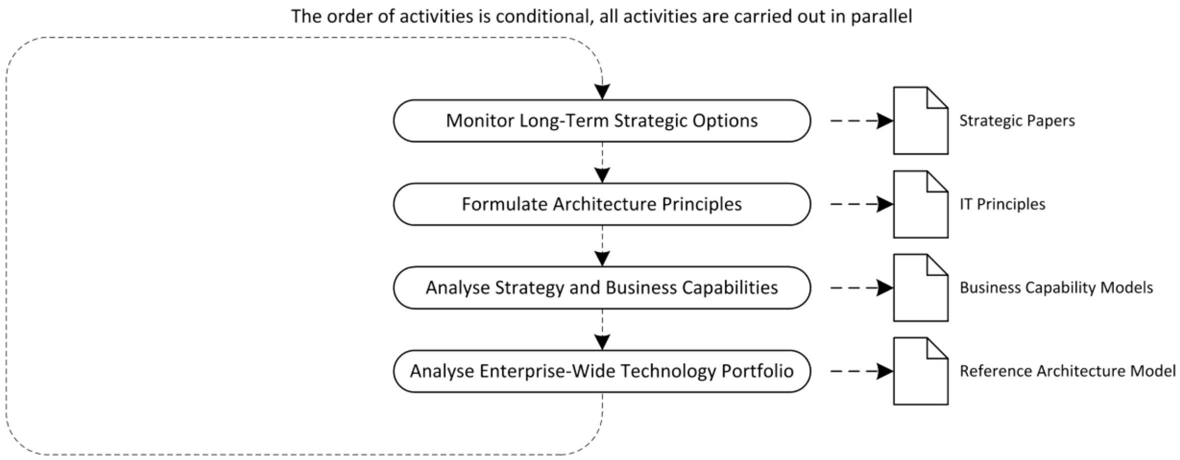

Figure 4.15. EA processes in Telecom Institution at the enterprise level

Middle-level architecture processes at Telecom Institution are largely unstructured and not formalized. They consist of seven distinct activities of lead architects and domain architects influencing the individual enterprise-wide functions (construct, operate, customer and enterprise) and domains (data, security, integration and infrastructure). These activities are largely independent of each other and carried out in parallel without any particular predefined order. Firstly, lead architects and domain architects communicate with relevant business stakeholders and formulate more specific architecture principles for their functions and domains consistent with enterprise-wide IT principles.

> *"Some of them [principles] are just like concepts, are just a more fully articulated idea. [...] They [lead architects] will sometimes come up with a concept paper that might say "What if we did it this way? What if we actually offered this kind of service to our users? What if we shift paradigm from having a push model to also having a pull model?""* (Solution Architect)

Secondly, lead architects communicate with business stakeholders, discuss the future development strategies for their functions and develop function roadmaps reflecting the shared business and IT plans on the next 4-5 years consistent with the directions outlined in strategic papers and strategic capabilities shown on business capability models.

> *"The [function] roadmaps really are controlled by the business on how they wanna spend the money. So, they can prioritize different activities on the roadmap. It's all intended to keep the business control and IT react to that"* (Lead Domain Architect)

Thirdly, data domain architects communicate with senior business stakeholders and develop data models describing the structure of information entities and assets managed by the organization in order to align them to the business visions.

> *"Data models will describe entities that the business is aware of, that operate like a concept of customer, product, order and then the attributes that they [business executives] need to describe each of those entities. How do you describe a product here at [the organization], how much information do you need?"* (Data Architect)

Fourthly, data domain architects translate abstract data models into specific data schemas describing desired representation, storage and transfer formats for different types of data, platforms or systems.

> *"[Data] schemas will be for a purpose, they are platform-dependent. So, I would generate a schema for an Oracle database or a DB2 database or a message schema in the XSD format"* (Data Architect)

Fifthly, domain architects develop and document established best practices to be reused in all IT solutions relevant to their domains and publish them as a set of patterns. Sixthly, domain architects develop domain roadmaps describing the desired future technical evolution of their domains consistent with the directions outlined in strategic papers and considerations resulting from the reference architecture model.

> *"Data architect might say "a roadmap for enterprise data integration capability says that we are currently using IBM and want to switch to Informatica""* (Solution Architect)

Seventhly, lead architects and domain architect maintain relevant inventories up-to-date in order to adequately represent the existing IT assets and technologies in the organization. Middle-level architecture processes at Telecom Institution are shown in Figure 4.16.

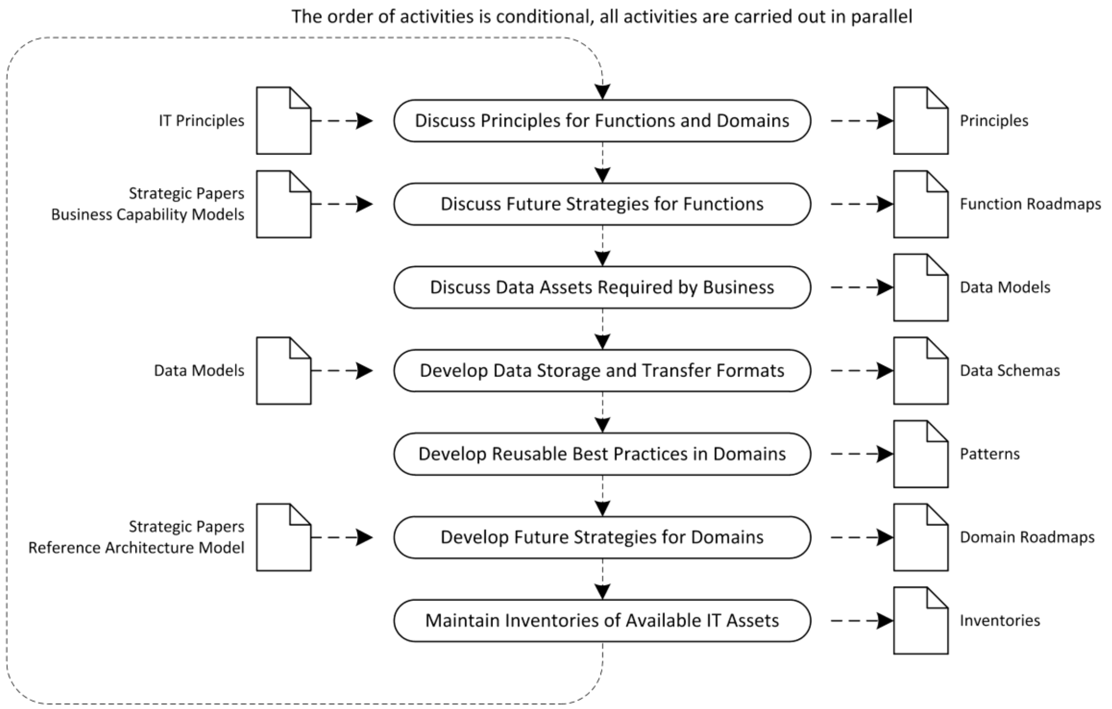

Figure 4.16. EA processes in Telecom Institution at the middle level

Solution -level architecture processes at Telecom Institution are sequential, step-wise and well-structured. They consist of ten separate steps carried out by solution architects (or platform architects) and then vendor architects to initiate, plan and deliver an individual IT solution. Firstly, a solution is initiated typically based on the plans described in existing function roadmaps and consistent with the required capabilities shown on business capability models. Solution architects develop a solution on a page to describe how the proposed solution can look like and discuss it with relevant business stakeholders.

> *"We have a concept documents, we call them solutions on a page. Sort of like a very brief outline of the solution, going through the concept to get funding [for the solution]"* (Solution Architect)

After the initial approval solution architects start to develop more detailed architecture for a proposed solution. They align the architecture to established business and IT principles, align the architecture to relevant domain roadmaps and reuse existing IT assets described in inventories, best practices described in patterns and data representation formats described in data schemas.

> *"When I design something and I need a tool that can do the data integration, you know, should I be using IBM or should I be using Informatica? [...] You can't reuse assets unless you have a list of assets"* (Solution Architect)

After the solution blueprint has been finalized, it is used for producing reasonably precise estimates of the size, scope and timelines of the solution and getting the final approval from relevant business stakeholders regarding the solution. Then the solution blueprint is transferred to external vendor architects provided by the outsourcing partners of Telecom Institution.

> *"Instead of use cases or user stories packaged up, [solution] blueprints are provided to a vendor to do the work. That is their requirements contract to build"* (Lead Domain Architect)

Vendor architects develop the detailed design for the solution described in the solution blueprint as well as an updated version of the platform architecture for the part of the IT landscape (platform) that will be changed after the solution is implemented. The updated platform architecture and detailed design for the solution is reviewed and approved by solution architects (or platform architects) and then vendor IT specialists deliver the solution based on the architecture described in the detailed design.

> *"Once we complete that solution blueprint we then provide it up to our partners with the user stories or requirements required in terms of delivery and they then produce the platform architecture document and these detailed design documents"* (Enterprise Architect)

Solution-level architecture processes at Telecom Institution are shown in Figure 4.17.

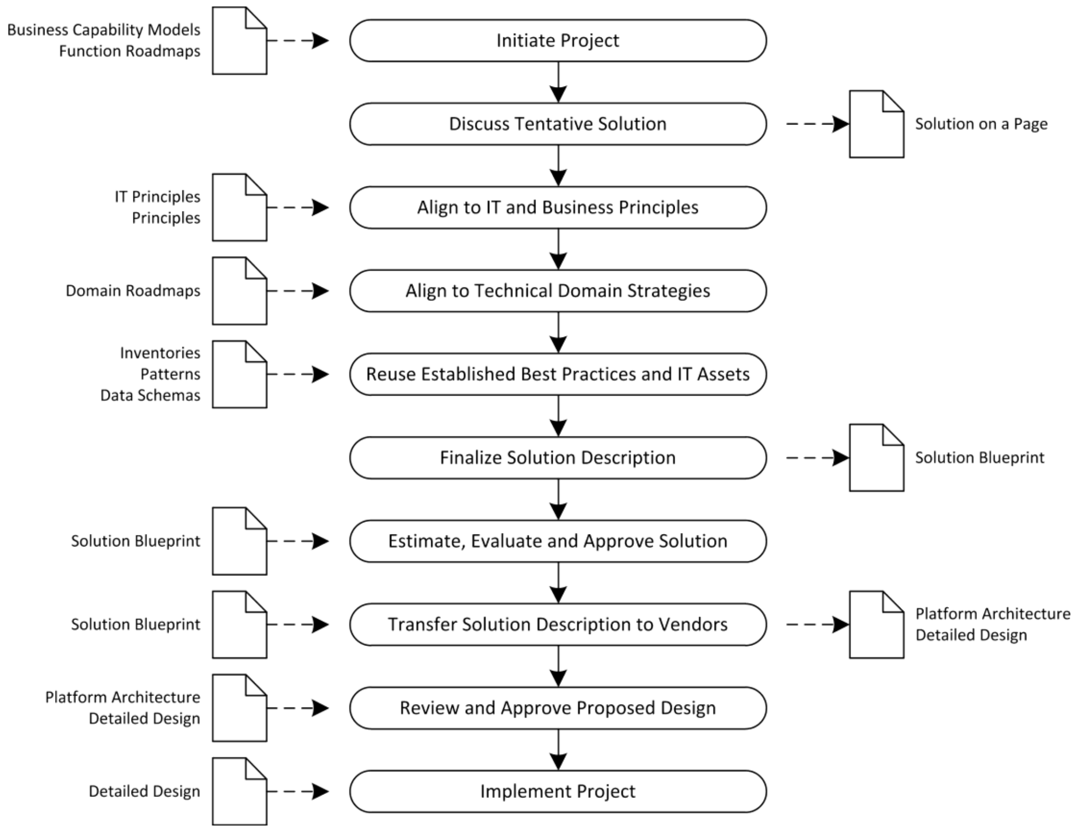

Figure 4.17. EA processes in Telecom Institution at the solution level

4.3.4. Grounded Theory Analysis

In order to analyse the collected interview data for Telecom Institution the three-step grounded theory procedure identical to the one used for Educational Institution and described in detail earlier in Section 3.5.4 has been applied. Samples of the grounded theory analysis process and the detailed list of all identified concepts and categories for Telecom Institution can be found in Appendix D.3.

As a result of the applied coding procedure 176 different codes have been assigned, which were subsequently consolidated into 56 consistent concepts. Of all 56 resulting concepts, 17 new previously unrecognized concepts have been identified relevant to each of the seven high-level categories, i.e. Artefacts, Benefits, External Factors, Information, Internal Factors, Usage and Users. Each of the four theoretical domains (see Figure 4.3) has been updated accordingly.

In the environment domain two new concepts has been identified related to Internal Factors category and one new concept has been identified related to External Factors category. Firstly, Functional Structure has been added as an important internal factor representing the corporate structure organized strictly according to functional divisions, e.g.

production, marketing and sales. From the IT perspective, Functional Structure implies diversification of business processes and corresponding IT systems across functional business units, but requires full integration of these processes through sharing relevant information between these business units. In other words, Functional Structure implements the Coordination operating model (Ross, 2005; Ross et al., 2006; Weill and Ross, 2009) which allows developing deep functional expertise while enabling end-to-end transactions. Secondly, Outsourcing has been added as a new significant internal factor representing the critical reliance of an organization on the outsourcing arrangements with its delivery partners for the implementation of new IT systems. The dependence on Outsourcing requires effective engagement mechanisms, coordination and collaboration between in-house and external IT specialists involved in the implementation of information systems on behalf of an organization (Fonstad, 2006; Ross and Beath, 2006). Thirdly, Vendor Dependence has been added as a considerable external factor representing the strategic dependence of an organization on the products, platforms and services provided by a limited number of technological vendors, e.g. SAP, HP or Oracle.

In the artefacts domain three new concepts have been identified related to Artefacts category and three new concepts have been identified related to Information category. Firstly, Data Models have been added as a new type of graphical EA artefacts providing certain organization-wide Data Imperatives governing the data structures for core data entities, e.g. what information about its customers an organization needs to know and manage. Secondly, Direction Statements have been added as new EA artefacts of a mixed format offering executive-level Business Considerations regarding the overall future course of action for business and IT approved by senior leaders. Thirdly, Data Schemas have been added as a new type of technical EA artefacts providing rather detailed Data Structures defining the platform-specific formats for storing key data entities, e.g. customers, products and orders.

Based on the constant comparative method (Glaser and Strauss, 1967; Strauss and Corbin, 1998), i.e. on the analysis of differences and similarities between the existing and newly identified concepts, two concepts in the artefacts domain have been generalized to form more generic and higher-order concepts. Specifically, the Artefacts concepts of Principles, Policies and Data Models have been merged to form a broader concept of Rules including all types of conceptual rules set by business executives. The corresponding Information concepts of Business Imperatives, Mandatory Rules and Data Imperatives have been merged accordingly into a broader concept of Conceptual Prescriptions encompassing all sorts of global prescriptions for decision-making.

In the use domain one new concept has been identified related to Users category and three new concepts have been identified related to Usage category. Firstly, Delivery Partners have been added as new actors of an EA practice engaged from external organizations, e.g. partners or vendors, and responsible for delivering new IT solutions together with internal architects and IT staff. Solutions Shaping has been added as a new use case of EA artefacts when corresponding artefacts are used shape the internal structure of new IT solutions from the conceptual perspective, e.g. how the solution should be organized at a high level to capture the required customer data. Data Structures Selection has been added as new usage of EA artefacts intended to facilitate the selection of appropriate data entities, structures and formats for new IT solutions, e.g. how exactly products and orders should be stored or transferred. Asset Management has been added as a new use case of EA artefacts representing the analysis of the status of available IT assets, determining their lifecycles, reuse and retirements opportunities.

Based on the analysis of differences and similarities between the existing and newly identified concepts, two concepts in the use domain have been generalized to form more generic and higher-order concepts. Firstly, the concepts of Project Team Members and Delivery Partners have been merged to form a broader concept of Initiative Implementers embracing both the internal IT specialists and third parties involved in the implementation of IT initiatives. Secondly, the concepts of Asset Management and Sequencing have been merged into a broader concept of Lifecycle Management since both these concepts deal with the planning and controlling the lifecycle of available IT assets.

In the benefits domain four new concepts have been identified related to Benefits category: Data Consistency, Improved Interoperability, Increased Reuse and Better Partner Management. Data Consistency represents the conceptual consistency of information assets in an organization, i.e. all core data entities are handled, managed and stored in a uniform way corresponding to the global business vision. Improved Interoperability stands for improved technical interoperability between various information systems achieved through the unification of key data entities, their fields and storage formats. Increased Reuse represents the improved ability to identify, leverage and reuse the appropriate IT assets available in an organization in new IT initiatives. Better Partner Management stands for the improved management, control and collaboration with delivery partners, e.g. vendors and outsourcers, involved in the implementation of new IT initiatives on behalf of an organization.

Based on the analysis of differences and similarities between the existing and newly identified concepts, two concepts in the benefits domain have been generalized to form more generic and higher-order concepts. Firstly, since IT risks are very closely associated with an uncontrolled IT complexity (Westerman and Hunter, 2007), the concepts of Reduced Complexity and Reduced Risk have been merged into a broader concept of Reduced Complexity and Risk. Secondly, the concepts of Increased Reuse and Reduced Duplication have been merged to form a broader concept of Reuse and Consolidation since these two concepts essentially represent "two sides of the same coin".

The updated set of concepts resulting from the analysis of the collected data from Telecom Institution allows updating the identified roles of EA artefacts accordingly.

4.3.5. Updated Roles of Enterprise Architecture Artefacts

The data collected and analysed for Telecom Institution confirms, generalizes and extends the set of roles of EA artefacts developed previously. The identified roles of EA artefacts in Telecom Institution appear to be generally similar to the previously identified roles, but some organization-specific differences are still present. Specifically, seven previously identified roles have been confirmed with appropriate generalizations. Five previously identified roles have been confirmed and subsequently merged to form two more generic roles. Additionally, two roles have been identified that can be considered as new. The status of all the identified roles of EA artefacts after the third case study is shown in Table 4.9.

Table 4.9. Status of the roles of EA artefacts after the third case study

Role	Status	Explanation
Approach Providers	Confirmed and generalized	Resulting Benefits generalized
Baseline Descriptors	Confirmed and generalized	Resulting Benefits generalized
Data Structure Providers	Newly identified	Completely new role helping reuse standardized field structures and formats of key data entities in new IT projects
Decision Assessors	Confirmed and generalized	New Artefacts added, current Artefacts generalized
Initiative Planners	Confirmed and generalized	Resulting Benefits generalized
Lifecycle Managers (former Change	Confirmed, generalized and renamed	Corresponding Usage generalized

Sequencers)		
Project Implementers	Confirmed and generalized	New Benefits added, Users generalized
Solution Shapers	Newly identified	Completely new role helping shape the conceptual structure of new IT solutions
Strategic Aligners (merged Investment Guides, Investment Prioritizers and Initiative Launchers)	Confirmed and merged	Former Investment Guides, Investment Prioritizers and Initiative Launchers have been merged into a single role since all these roles imply closely related Usage, same Users, same Benefits and fulfilled by similar Artefacts
Technology Providers	Confirmed and generalized	Resulting Benefits generalized
Value Estimators (merged Initiative Shapers and Initiative Tags)	Confirmed and merged	Former Initiative Shapers and Initiative Tags have been merged into a single role since both these roles imply closely related Usage, same Users, Benefits and Artefacts

As summarized in Table 4.9, after the third case study most identified roles have been confirmed with appropriate generalizations taking into account, for instance, routine organization-specific differences in EA practices in a way similar to the generalizations made after the previous case study. However, some roles have been confirmed and then merged into more generic roles reflecting considerable similarities between the underlying roles.

Moreover, the roles of Solution Shapers and Data Structure Providers have been added as potentially new roles. Solution Shapers help shape the conceptual structure of new IT solutions. This role is fulfilled by Rules EA artefacts providing high-level Conceptual Prescriptions explaining certain fundamental requirements relevant to all IT systems. Rules are used by Architects and Business Executives for Solutions Shaping to form a set of very abstract initial requirements, e.g. to be capable of handling all the necessary data properties, for new IT solutions improving their overall Organizational Fitness. Data Structure Providers help reuse standardized field structures and formats of key data entities in new IT projects. This role is fulfilled by Data Schemas describing technical Data Structures defining core data objects used in an organization. Data Schemas are used by Architects for Data Structures Selection to align the structure of database tables created for new IT systems to commonly used formats and, thereby, achieve Improved Interoperability between all IT systems.

4.3.6. Summary of the Identified Roles

A high-level summary of all the eleven roles of EA artefacts identified after the third case study in terms of the underlying concepts structured according to the established four-domain theoretical framework (see Figure 4.3) is provided in Figure 4.18 (part 1) and Figure 4.19 (part 2).

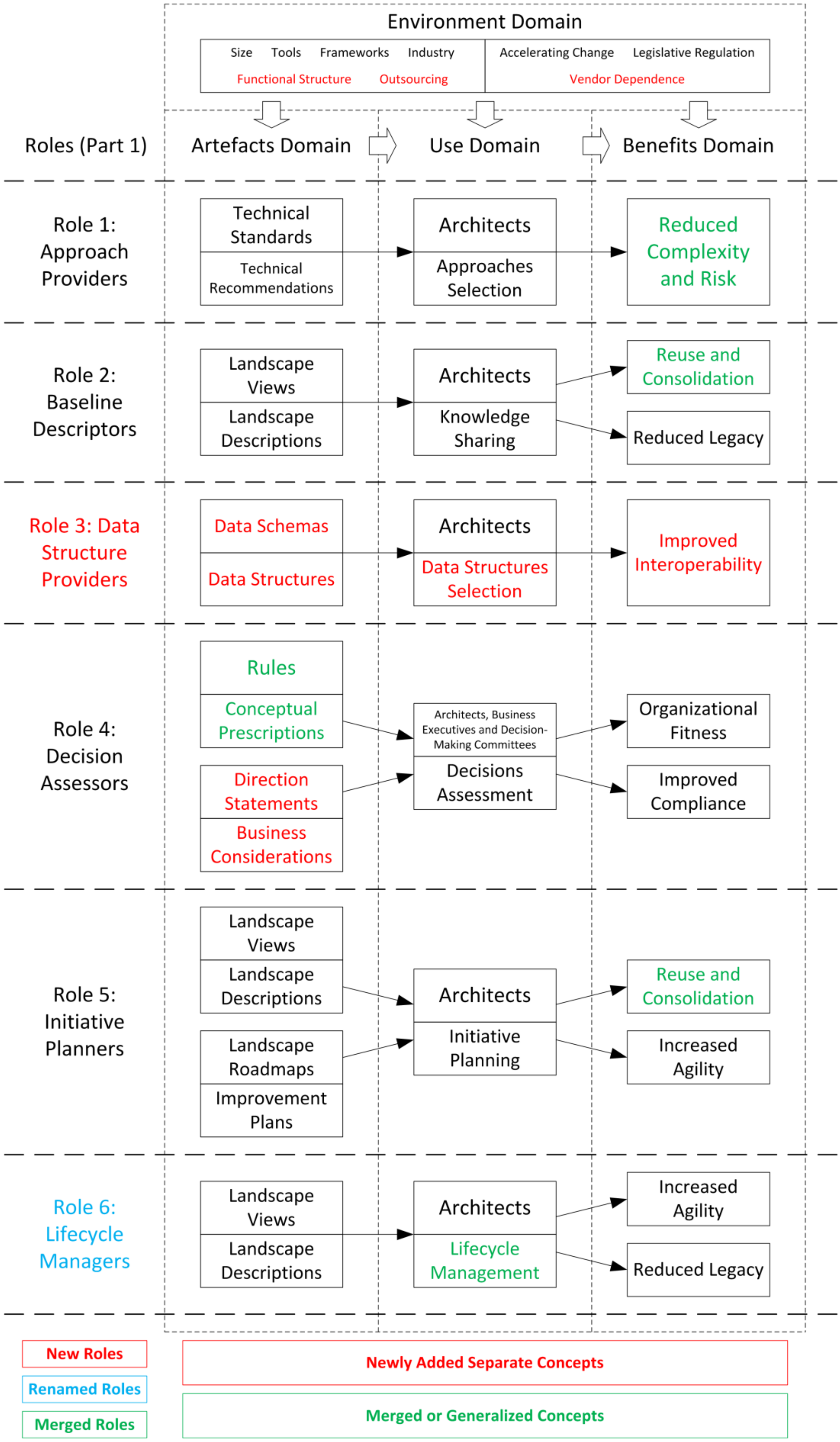

Figure 4.18. Summary of the roles of EA artefacts after the third case study (part 1)

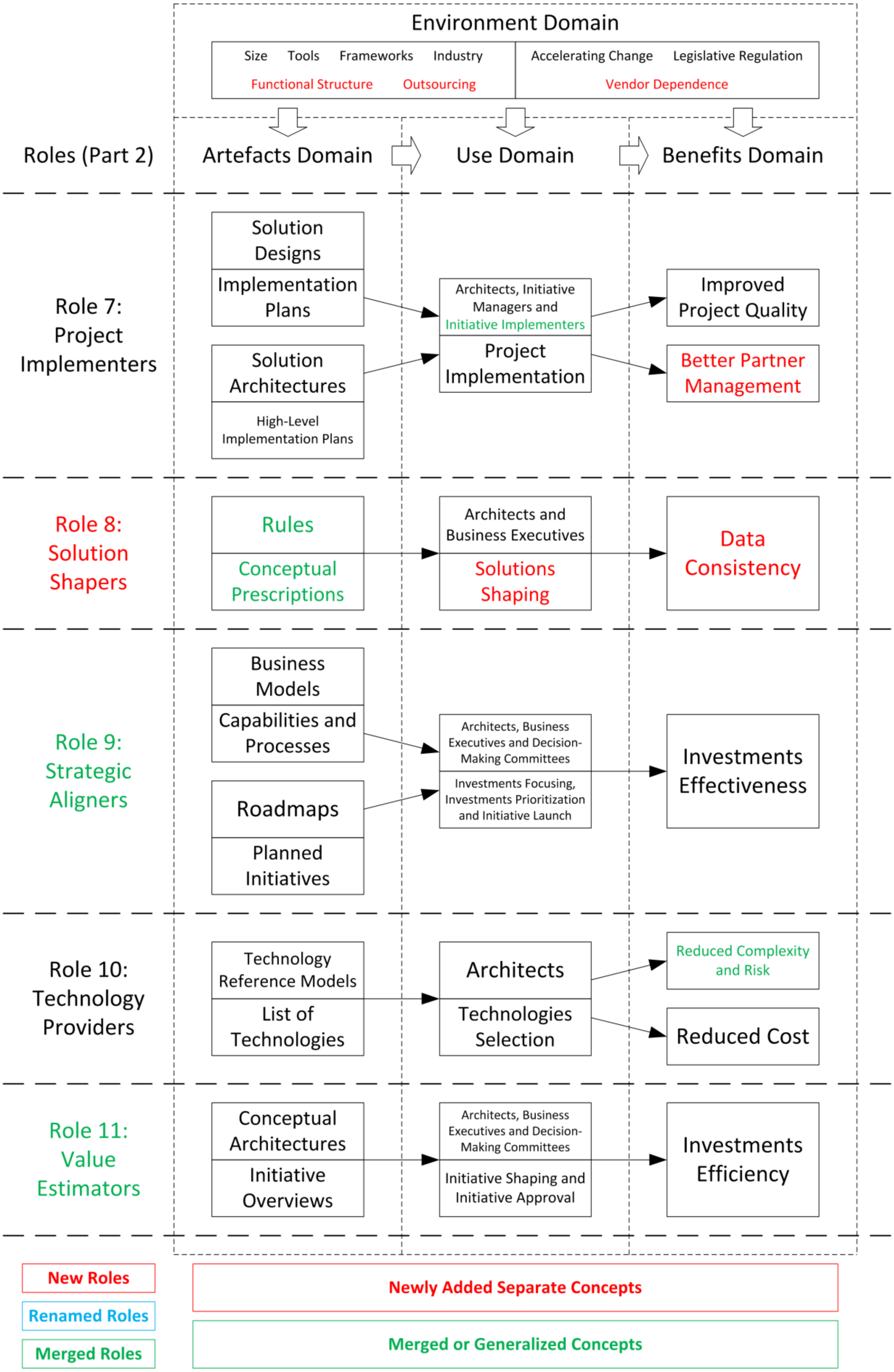

Figure 4.19. Summary of the roles of EA artefacts after the third case study (part 2)

4.3.7. Influence of Environmental Factors on the Roles of EA Artefacts

The comparison of the identified roles of EA artefacts and underlying concepts between Telecom Institution and the two previously studied organizations (Educational Institution and Financial Institution) allows continue theorizing on the influence of various environmental factors on the roles of EA artefacts.

Firstly, the identification of the new roles of Solution Shapers and Data Structure Providers can be clearly attributed to the strict Functional Structure of Telecom Institution. Since separate business functions represent not independent lines of business, but essential parts of a single business, these functions cannot operate in isolation from each other to generate business value. For this reason, all business functions should be seamlessly integrated to enable cross-functional transactions and constitute the organization as a whole. The critical need for integration between IT systems running in different business functions imposes strict system integration requirements. Moreover, effective system integration across the business functions requires both conceptual data consistency at the semantic level (e.g. common understanding of the notion of customer or order) and "physical" data consistency at the technical level of field titles, types and formats (e.g. specific database columns for customer and order entities). These requirements are naturally addressed by the roles of Solution Shapers and Data Structure Providers helping achieve conceptual and technical interoperability between IT systems from different business functions via the centralized architectural planning and governance of data.

Secondly, the critical reliance of Telecom Institution on Outsourcing for the implementation of new IT solutions significantly influences the role of Project Implementers. While in the two previously studied organizations Project Implementers provided the instruments of collaboration between Architects and other internal IT specialists, in Telecom Institution the role of Project Implementers shifts towards providing the means of communication and agreement between internal Architects and external IT specialists from partner organizations. Specifically, this difference is most clearly manifested in the use domain, where Delivery Partners act as users of corresponding EA artefacts instead of regular Project Team Members, and in the benefits domains, where Better Partner Management is identified as an additional benefit of Project Implementers along with the previously identified Improved Project Quality.

Thirdly, considerable Vendor Dependence undermines the role of Technology Providers. Since Telecom Institution relies on a small number of strategic technology vendors, its choice of technologies for new IT solutions is naturally limited to the offerings of these vendors. Essentially, in the case of high Vendor Dependence the technology portfolio of an organization is largely shaped, or even dictated, by strategic vendors providing their equipment, products and platforms. In other words, an organization largely delegates the technology selection processes to its vendors and loses the ability to fully control its technology stack. On the one hand, this delegation is manifested in the artefacts domain as the reduced volume and scope of the corresponding EA artefacts describing the technology portfolios, i.e. full-fledged Technology Reference Models are reduced and partially substituted with the list of available vendors to choose from. On the other hand, this delegation is also manifested in the benefits domain since in the case of vendor lock-in an organization is often forced to make suboptimal technical choices dictated by its vendors undermining the potential benefits from managing its technology portfolio, e.g. cost and complexity reductions. The influence of environmental factors on the roles of EA artefacts in Telecom Institution analysed above is summarized in Figure 4.20.

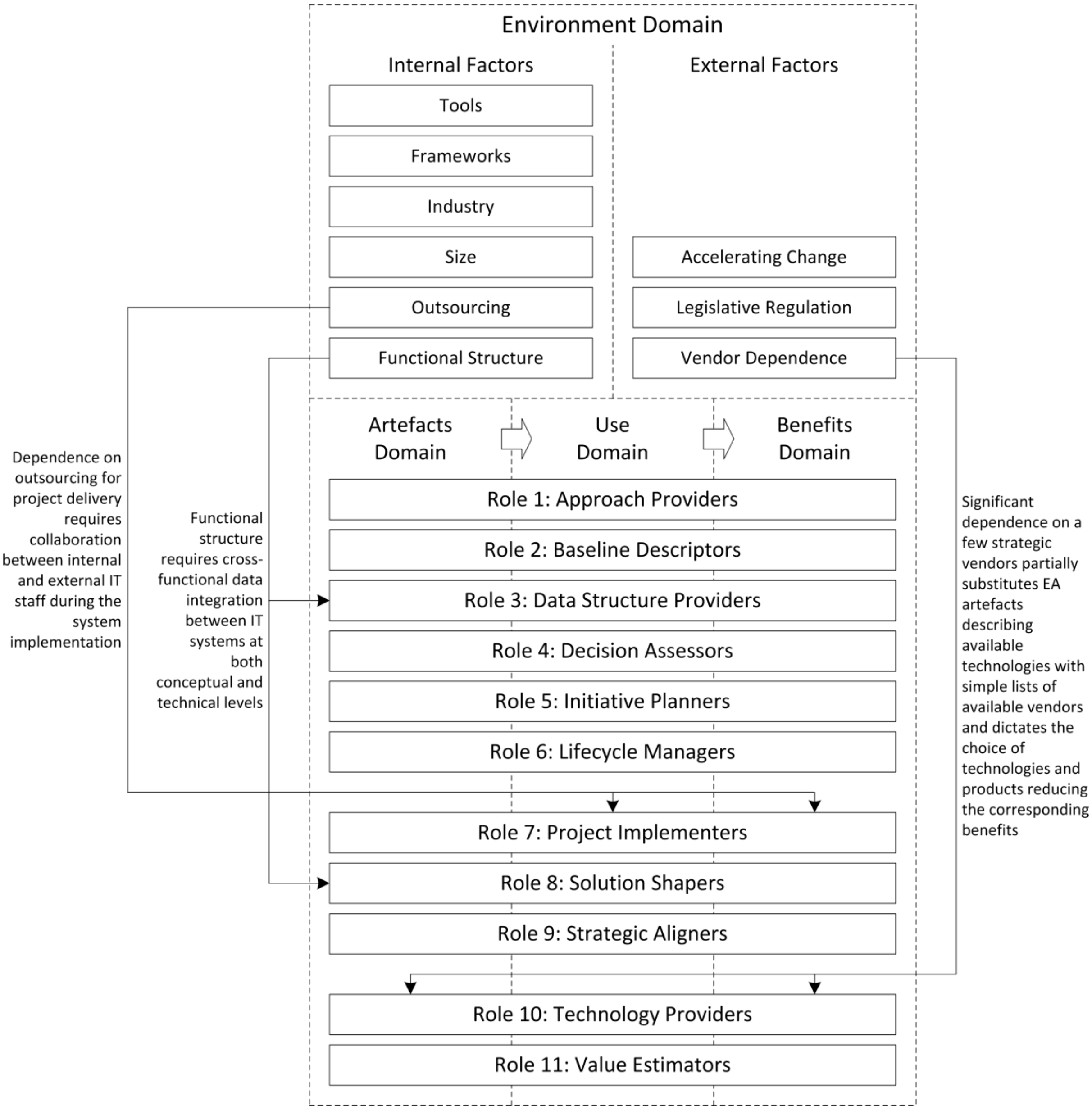

Figure 4.20. Influence of environmental factors on the roles in Telecom Institution

4.3.8. Saturation Assessment

17 of 56 substantive concepts identified in the third case study were new and previously unidentified. Moreover, twelve of these concepts were significantly different from the existing concepts. These concepts could not have been merged with the existing concepts and, therefore, have been added to the resulting conceptual framework.

As a result of the third case study, the resulting conceptual framework has been extended and generalized, while the roles of EA artefacts have been refined accordingly. Despite that a considerable number of new concepts have been identified and added, many existing concepts proved to be consistent across all the three studied organizations. The identified roles of EA artefacts also demonstrate the first signs of convergence to a smaller number of consistent organization-neutral patterns. Consequently, the emerging conceptual framework at this stage of the study shows only the early signs of saturation and the identified roles of EA artefacts can now be considered as somewhat consistent findings. However, additional analysis of other organizations is still required to achieve better saturation of the resulting theory.

4.3.9. Selecting the Next Case

The first, second and third studied organizations, i.e. Educational Institution, Financial Institution and Telecom Institution, are either very centralized or moderately decentralized organizations. Since very decentralized organizations typically have corresponding decentralized IT governance structures allowing local decision-making flexibility in their major business units (Weill and Ross, 2004), these organizations may also practice different approaches to EA. From this perspective, exploring some very decentralized organizations with significant local decision-making autonomy might be desirable for theoretical saturation to enrich the emerging conceptual framework. Consequently, the selection of the next case organization for this study was driven by the intention to study a very decentralized organization consisting of largely independent business units.

4.4. Case Study Four: Delivery Institution

The fourth case organization studied in this research is Delivery Institution. Delivery Institution satisfies the case selection criteria described above driven by the theoretical sampling considerations. Specifically, Delivery Institution is a decentralized organization consisting of three lines of business acting largely as independent profit centres. Delivery Institution also satisfies minimal case selection requirements since it employs more than 500 IT specialists and practices EA for more than five years.

Delivery Institution is one of the prominent goods delivery companies operating on the Australian market. It provides a wide range of delivery services to individuals and organizations. Delivery Institution employs more than 30 thousand people, including several hundred internal IT staff. It has multibillion dollar revenues and delivers several billion items annually. Organizationally Delivery Institution is structured into three largely independent lines of business serving as independent profit centres. Delivery Institution has a centralized IT function providing various IT services to these three lines of business.

Delivery Institution initially started to practice EA in the mid-2000s, but the EA practice in its current form was established only in 2010. Delivery Institution has a very mature, well-established and award-winning EA practice recognized by several international architecture excellence awards.

> *"[Our] enterprise architecture and architecture capabilities are quite strong I think. I mean that we won a couple of international awards in the last twelve months, so they [our EA leaders] are doing something right"* (Solution Architect)

4.4.1. Enterprise Architecture Function

Due to its large scope and its extensive use of information systems, the EA function at Delivery Institution has a sophisticated structure. The EA function is headed by the CTO, who reports to the CIO, and consists of around 50 architects of four different types: chief architects, principal architects, enterprise architects and solution architects.

At the enterprise level the EA function has a matrix structure with two orthogonal dimensions of responsibility: three independent lines of business and five enterprise-wide domains (product and pricing, customer, information management, integration and infrastructure).

> *"It's a bit of a hybrid structure. [...] There is the chief technology officer (CTO), who is the head of all architects, and within that there is a small team which is called the enterprise architects. They cover off topics like customer, information management, infrastructure and so on. And then there are series of principal architects that are looking at specific [business] domains and then there is a pool of solution architects"* (Principal Architect)

Each line of business has a dedicated chief architect and 2-4 subordinate principal architects. Principal architects are responsible for a strategic IT planning for their lines of business up to 3-5 years ahead, while chief architects are responsible for managing these principal architects as well as for the overall architectural output related to their lines of business. Enterprise architects are responsible for a strategic IT planning of their domains across all lines of business, typically up to 3-5 years ahead. At the solution level each line of business has a separate pool of solution architects responsible for an architectural planning of individual IT initiatives related to their lines of business.

"There are a number of chief architects that are aligned to the lines of business. [...] They all have one or two principal architects reporting to them and then there is a big pool of solution architects who work on projects" (Enterprise Architect)

The structure of the architecture function at Delivery Institution is shown in Figure 4.21.

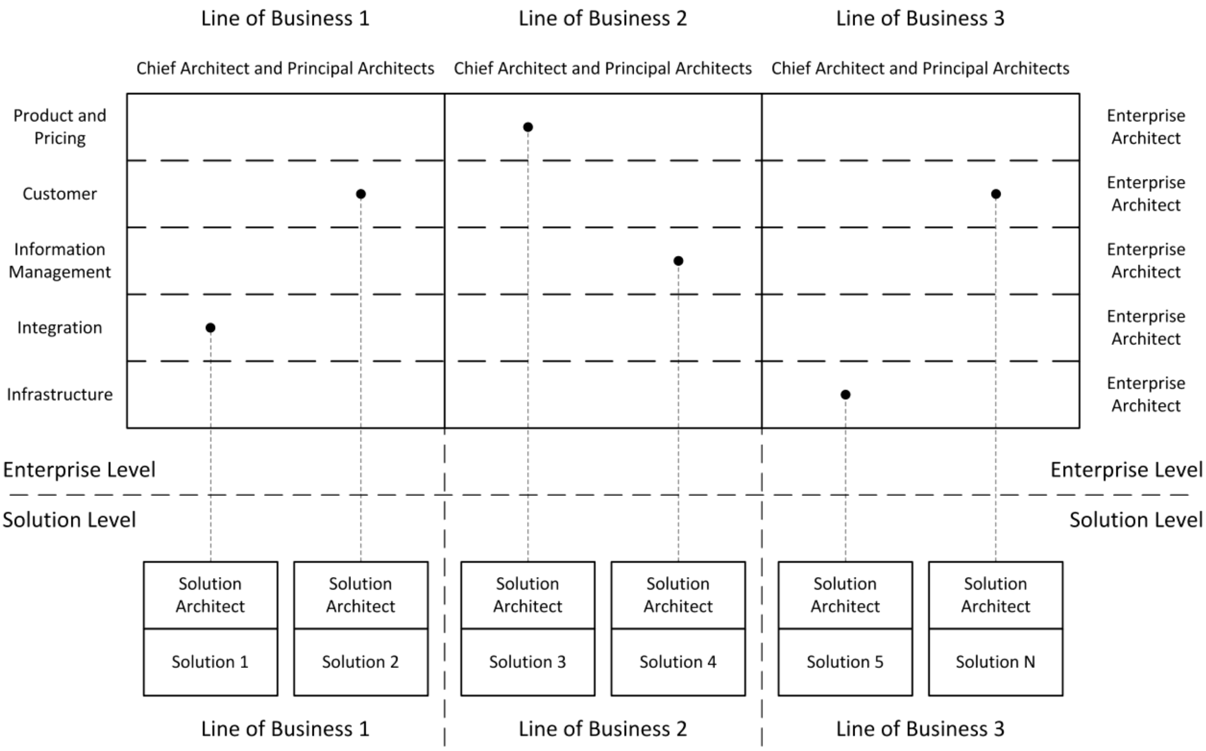

Figure 4.21. EA function in Delivery Institution

4.4.2. Enterprise Architecture Artefacts

The EA practice at Delivery Institution is based on eleven distinct types of EA artefacts produced by architects with the necessary involvement of other relevant stakeholders. EA artefacts used at Delivery Institution with their brief description and meaning are described in Table 4.10.

Table 4.10. EA artefacts in Delivery Institution

Owners	Artefacts	Description
Principal architects	Principles	Principles describe high-level architecture guidelines relevant for the whole organization or specific lines of business. Global principles are abstract guidelines for the whole organization, while principles for particular lines of

		business are more specific versions of these global principles refined to their specific areas
	Business capability model	Business capability model is a one-page diagram describing business capabilities of the whole organization up to three or four nested levels of abstraction
	Blueprints	Blueprints are business-oriented descriptions of the desired future states in particular lines of business typically up to 3-5 years ahead. They are large, A3-sized one-page diagrams showing business drivers, key decisions, architecture overview, customer outcomes, business outcomes and other relevant information. However, each blueprint also includes some more detailed supplementary information packs
	Roadmaps	Roadmaps are business-oriented one-page diagrams describing the progression of IT initiatives necessary for achieving the desired future states envisioned in blueprints for corresponding lines of business. The level of detail in roadmaps is gradually decreasing from short-term time horizons to longer-term horizons and the period of the next financial year is described in a most detailed manner
Enterprise architects	Reference architectures	Reference architectures describe reusable technical patterns providing solutions to typical problems in specific domains (product and pricing, customer, information management, integration and infrastructure) and sometimes in specific lines of business
	Standards	Standards are lists of main technologies, tools, products and vendors that should be used in all IT solutions in the organization
	Technology blueprints	Technology blueprints are descriptions of the desired future states in particular technology domains typically up to 3-5 years ahead. They are A3-sized one-page diagrams structured similarly to business-oriented blueprints. However, most of them, and especially in integration and infrastructure domains, are largely irrelevant to business stakeholders
	Technology roadmaps	Technology roadmaps are one-page diagrams describing the progression of IT initiatives necessary to achieve the desired future states envisioned in technology blueprints. Their format is similar to the format of business-oriented roadmaps, but they are largely irrelevant to business stakeholders
Solution architects	Idea briefs	Idea briefs are high-level descriptions of individual IT solutions in business language. They describe the general ideas, goals and benefits of IT projects and provide enough architectural information to estimate their costs with a 50% precision
	Preliminary solution	Preliminary solution architectures are high-level technical descriptions of individual IT solutions typically about 30 pages long. They are detailed enough

	architectures	to estimate the costs and timelines of IT projects with a 20% precision and inform their business cases
	Full solution architectures	Full solution architectures are detailed technical descriptions of individual IT solutions typically about 50 pages long

4.4.3. Enterprise Architecture Processes

Architecture processes constituting the EA practice at Delivery Institution can be roughly separated into enterprise-level processes and solution-level processes. Principal architects and enterprise architects are the main actors of enterprise-level processes, while solution-level processes are carried out largely by solution architects.

Enterprise-level architecture processes at Delivery Institution are largely unstructured and not formalized. They consist of six distinct activities of principal architects and enterprise architects influencing the whole enterprise. These activities are largely independent of each other and carried out in parallel without any particular predefined order, except that blueprints and technology blueprints are typically developed or updated before roadmaps and technology roadmaps are developed or updated. Firstly, principal architects communicate with relevant business stakeholders and formulate architecture principles related to their lines of business.

> *"Business stakeholders are certainly involved in the framing and the socialization of those principles and via the enterprise architecture council they get some say in the approval of those principles"* (Principal Architect)

Secondly, principal architects discuss business strategy with senior business stakeholders in order to understand which business capabilities should be improved with IT systems. Thirdly, principal architects and enterprise architects discuss the desired future states of their lines of business or technology domains with relevant stakeholders and develop blueprints to capture and depict these future states.

> *"[Blueprints is] the way we document our understanding of the strategic direction of the business and what the technology response to that needs to be, or what the recommended technology response is"* (Principal Architect)

Fourthly, principal architects and enterprise architects discuss the optimal ways to achieve the desired future states envisioned in blueprints with relevant stakeholders and develop roadmaps to depict the necessary steps and investments.

> *"Roadmap is a depiction of how we get from the current state and the steps we propose to take to get to the target states build out in the blueprints. So, the blueprints build out, as I said, some sort of target state, roadmap basically says "this is how we are going to get there". Are we gonna do it in one step? Are we gonna do it in multiple steps? Is it gonna take one year? Is it gonna take three years?"* (Principal Architect)

Fifthly, enterprise architects and principal architects turn typical solutions to specific problems relevant to their lines of business or domains into reusable reference architectures.

> *"We are doing cloud architectures, so we've actually got some patterns for that. Architects would be using that and actually producing [new] reference architectures or patterns that we can reuse in the future"* (Enterprise Architect)

Sixthly, enterprise architects carry out technology selection processes and establish the lists of desired technologies, platforms, vendors, products and applications appropriate for their specific domains.

> *"If I introduce a new technology, it will be an architectural selection, or product selection, that will get endorsed. We will bring it in and then our designers will pick that up and go "right, so this is the technology. I'm gonna build the design standard to help us build and support it""* (Solution Architect)

Enterprise-level architecture processes at Delivery Institution are shown in Figure 4.22.

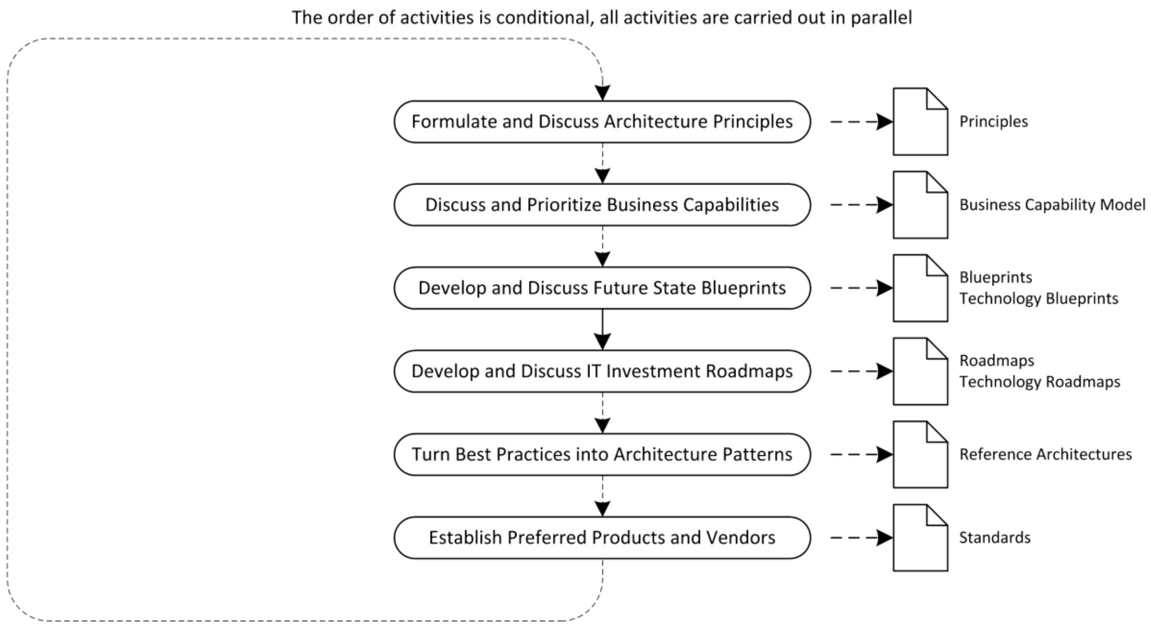

Figure 4.22. EA processes in Delivery Institution at the enterprise level

Solution-level architecture processes at Delivery Institution are sequential, step-wise and well-structured. They consist of twelve separate steps carried out by solution architects. Firstly, a project from the roadmap for the line of business is initiated by collaborative efforts of business stakeholders, principal architects and solution architects. As a result, the idea brief for the project is produced describing the project purpose, expected benefits and tentative costs as well as a very high-level architectural overview.

> *"The project methodology starts off with an idea brief. If a business stakeholder comes along and says "we got a new product or we got an idea for changing the channels", they do a piece of work that might be a business proposal that says "I want to launch a new product". What comes then is they engage with IT. What comes out of that is an idea brief that says "the business has this idea to do this thing, it's documented in this document and here is our initial technology thinking around what our response might be""* (Principal Architect)

Then, relevant business stakeholders assess the feasibility of the proposed project and approve it for further elaboration. The assigned solution architect starts to develop more detailed architectural design for the project. The solution architect aligns the solution architecture to established principles and selects the most appropriate products from the list of available technology standards.

"[For compliance with principles and standards] we rely heavily on the knowledge of the principal architects and enterprise architects, who sit in the right review forums. Based on their knowledge, they will go "this is complying or this is not complying"" (Solution Architect)

The solution architect also aligns the solution architecture to relevant technology roadmaps and reuses established best practices or patterns described in reference architectures.

"The onus is really on us, on solutions architects, we should be following those patterns. If we are putting up the solution that doesn't adhere to our patterns or our blueprints, we have to go and ask for an exception" (Solution Architect)

As a result, the solution architect produces the preliminary solution architecture for the project detailed enough to estimate the costs and timelines of the project with a reasonable accuracy. The estimates from the preliminary solution architecture inform the formal business case for the project.

"The preliminary solution architecture is developed there [at the evaluation stage] and used to decide whether we go forward. It also feeds into the business case to decide whether we go ahead with the build. So, these documents are all used as part of the chain of decisions through the project lifecycle" (Enterprise Architect)

After the business case for the project is approved by its business sponsors, the solution architect starts to develop the detailed full solution architecture. Finally, the full solution architecture is transferred to a project team to actually deliver the IT solution.

"[Full] solution architecture's role has to inform all the downstream design work. So, it needs to be complete enough that a designer can go "right, I know what the intent was here, I know the components I need, I know the standards I need"" (Solution Architect)

Solution-level architecture processes at Delivery Institution are shown in Figure 4.23.

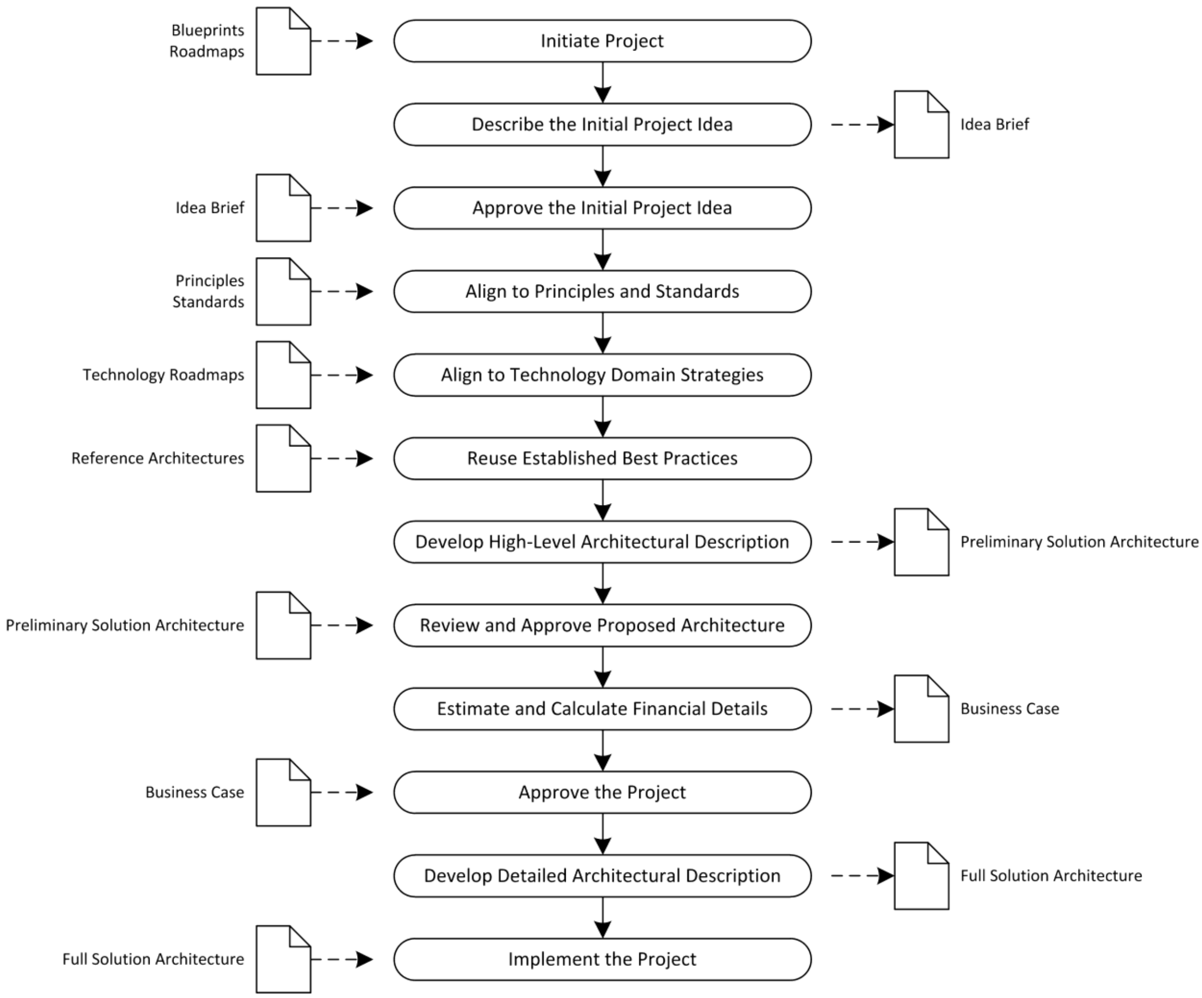

Figure 4.23. EA processes in Delivery Institution at the solution level

4.4.4. Grounded Theory Analysis

In order to analyse the collected interview data for Delivery Institution the three-step grounded theory procedure identical to the one used for Educational Institution and described in detail earlier in Section 3.5.4 has been applied. Samples of the grounded theory analysis process and the detailed list of all identified concepts and categories for Delivery Institution can be found in Appendix D.4.

As a result of the applied coding procedure 165 different codes have been assigned, which were subsequently consolidated into 55 consistent concepts. Of all 55 resulting concepts, seven new previously unrecognized concepts have been identified relevant only to Artefacts, Benefits, Information and Internal Factors categories. The corresponding theoretical domains (see Figure 4.3) have been updated accordingly.

In the environment domain two new concepts have been identified related to Internal Factors category. Firstly, LoB (line of business) Structure has been added as an important internal factor representing the corporate structure organized according to different lines of business, e.g. retail, wholesale and e-commerce. This organizational structure implies considerable autonomy of local decision-making in business units and allows these business units to act largely as independent businesses (profit centres) while leveraging the thin "layer" of common organization-wide supporting functions, e.g. human resources, finance and vendor management. Secondly, Maturity has been added as a considerable internal factor representing the overall maturity of an EA practice, EA-related processes and underlying EA artefacts. Mature EA practices imply consistent and repeatable EA-related processes, established sets of EA artefacts and continuous optimization of these processes and artefacts based on the needs of the business (DoC, 2007; NASCIO, 2003).

Based on the constant comparative method (Glaser and Strauss, 1967; Strauss and Corbin, 1998), i.e. on the analysis of differences and similarities between the existing and newly identified concepts, one concept in the environment domain has been generalized to form more generic and higher-order concept. Specifically, the concepts of Functional Structure and LoB Structure have been merged into a broader concept of Structure encompassing all considerable aspects of organizational structure including both functional and line-of-business approaches.

In the artefacts domain two new concepts have been identified related to Artefacts category and two new concepts have been identified related to Information category. Firstly, Target States have been added as a new type of one-page graphical EA artefacts providing explicit descriptions of the long-term Desired Future for specific business areas or functions, e.g. customer relationship management or retail outlets. Analogously, IT Target States have been added as new technical one-page EA artefacts offering explicit descriptions of the long-term Desired IT Future in specific "layers" of the organizational IT landscape, e.g. information integration or cloud services.

Based on the analysis of differences and similarities between the existing and newly identified concepts, seven concepts in the artefacts domain have been generalized to form more generic and higher-order concepts. Firstly, the concepts of Technical Recommendations, List of Technologies and Data Structures have been merged into a broader concept of Implementation Recommendations encompassing all aspects of system implementation including technologies, approaches and data formats. The corresponding concepts of Technical Standards and Data Schemas have been merged accordingly into a broader concept of Implementation Standards. Secondly, the concepts of Landscape Roadmaps providing technical Improvement Plans and IT Target States providing descriptions of Desired IT Future have been merged to form a broader concept of Evolution Views providing all sorts of technical Optimization Plans including both roadmap-type plans and target-state plans. Thirdly, the concepts of Solution Architectures and Solution Designs have been merged into a broader concept of Designs embracing all technical documentation for new IT initiatives. The concept of High-Level Implementation Plans has been merged accordingly into the extended concept of technical Implementation Plans of any granularity. Fourthly, the concepts of Conceptual Prescriptions and Business Considerations have been merged into a broader concept of Conceptual Requirements embracing both strict prescriptions and softer considerations.

In the use domain no new concepts have been identified related to Users or Usage categories. However, based on the analysis of differences and similarities between the existing concepts, six concepts in the use domain have been generalized to form more generic and higher-order concepts. Firstly, the concepts of Business Executives and Decision-Making Committees have been merged to form a broader concept of Business Leaders embracing all subjects of senior business decision-making, including both individual business executives and groups of executives constituting decision-making committees. Secondly, the concepts of Initiative Managers and Initiative Implementers have been merged into a broader concept of Project Teams including both technical specialists working on the implementation of IT initiatives and managers organizing their work and providing the necessary resources. Thirdly, the concepts of Decisions Assessment and Solutions Shaping have been merged to form a broader concept of Decisions Guidance embracing both the conceptual shaping of new IT solutions and the assessment of IT-related planning decisions. Fourthly, the closely related concepts of Approaches Selection, Technologies Selection and Data Structures Selection have been merged into a broader concept of Implementation Guidance encompassing all types of guidance relevant to the technical side of project implementation including all technical, technological and data-related aspects. Fifthly, the concepts of Investments Focusing and Investments Prioritization have been merged into a single concept of Focusing and Prioritization embracing both the initial focusing of IT investments and their subsequent prioritization. Similarly, the concepts of Initiative Shaping and Initiative Approval have been merged into a single concept of Initiative Shaping and Approval covering both the initial shaping of IT solutions and their subsequent formal approval.

In the benefits domain only one new concept of Increased Delivery Speed has been identified related to Benefits category. Increased Delivery Speed represents the accelerated implementation speed of all new IT solutions attributed to using proven implementation approaches and technologies. Based on the analysis of differences and similarities between the existing and newly identified concepts, two concepts in the benefits domain have been generalized to form more generic and higher-order concepts. Firstly, the concepts of Organizational Fitness and Data Consistency have been merged into a broader concept of Improved Consistency representing all types of conceptual consistency between fundamental business needs and corresponding IT reactions, including process, application, data and other relevant aspects. Secondly, the concepts of Improved Project Quality and Better Partner Management have been merged into a single extended concept of Improved Project Quality including, among other aspects, the quality aspects resulting from the improved partner management.

The updated set of concepts resulting from the analysis of the collected data from Delivery Institution allows updating the identified roles of EA artefacts accordingly.

4.4.5. Updated Roles of Enterprise Architecture Artefacts

The data collected and analysed for Delivery Institution confirms and generalizes, but does not extend, the set of roles of EA artefacts developed previously. The identified roles of EA artefacts in Delivery Institution appear to be highly similar to all the previously identified roles, but with small organization-specific differences in some of their aspects. Specifically, six previously identified roles have been either fully confirmed or confirmed with small generalizations. Five previously identified roles have been confirmed and subsequently merged to form two more generic roles. No new roles have been identified beyond the existing ones. The status of all the identified roles of EA artefacts after the fourth case study is shown in Table 4.11.

Table 4.11. Status of the roles of EA artefacts after the fourth case study

Role	Status	Explanation
Baseline Descriptors	Fully confirmed	The existing role completely fits new data in all aspects
Context Setters (merged Decision Assessors and Solution Shapers)	Confirmed and merged	Former Decision Assessors and Solution Shapers have been merged into a single role since both these roles imply closely related Usage, same Users, same Benefits and fulfilled by similar Artefacts
Initiative Planners	Confirmed and generalized	Artefacts fulfilling this role are generalized
Instrument Providers	Confirmed and merged	Former Approach Providers, Technology Providers

(merged Approach Providers, Technology Providers and Data Structure Providers)		and Data Structure Providers have been merged into a single role since all these roles imply closely related Usage, same Users, similar Benefits and fulfilled by similar Artefacts. New Benefits were also identified
Lifecycle Managers	Confirmed and generalized	Artefacts fulfilling this role are generalized
Project Implementers	Confirmed and generalized	Underlying Artefacts, involved Users and resulting Benefits generalized
Strategic Aligners	Confirmed and generalized	Usage and Users generalized, new Artefacts added
Value Estimators	Confirmed and generalized	Usage and Users generalized

As summarized in Table 4.11, after the fourth case study all identified roles have been confirmed, although with rather small generalizations. Some roles have been confirmed and then merged into more generic roles reflecting considerable similarities between the underlying roles identified earlier.

4.4.6. Summary of the Identified Roles

A high-level summary of all the eight roles of EA artefacts identified after the fourth case study in terms of the underlying concepts structured according to the established four-domain theoretical framework (see Figure 4.3) is provided in Figure 4.24 (part 1) and Figure 4.25 (part 2).

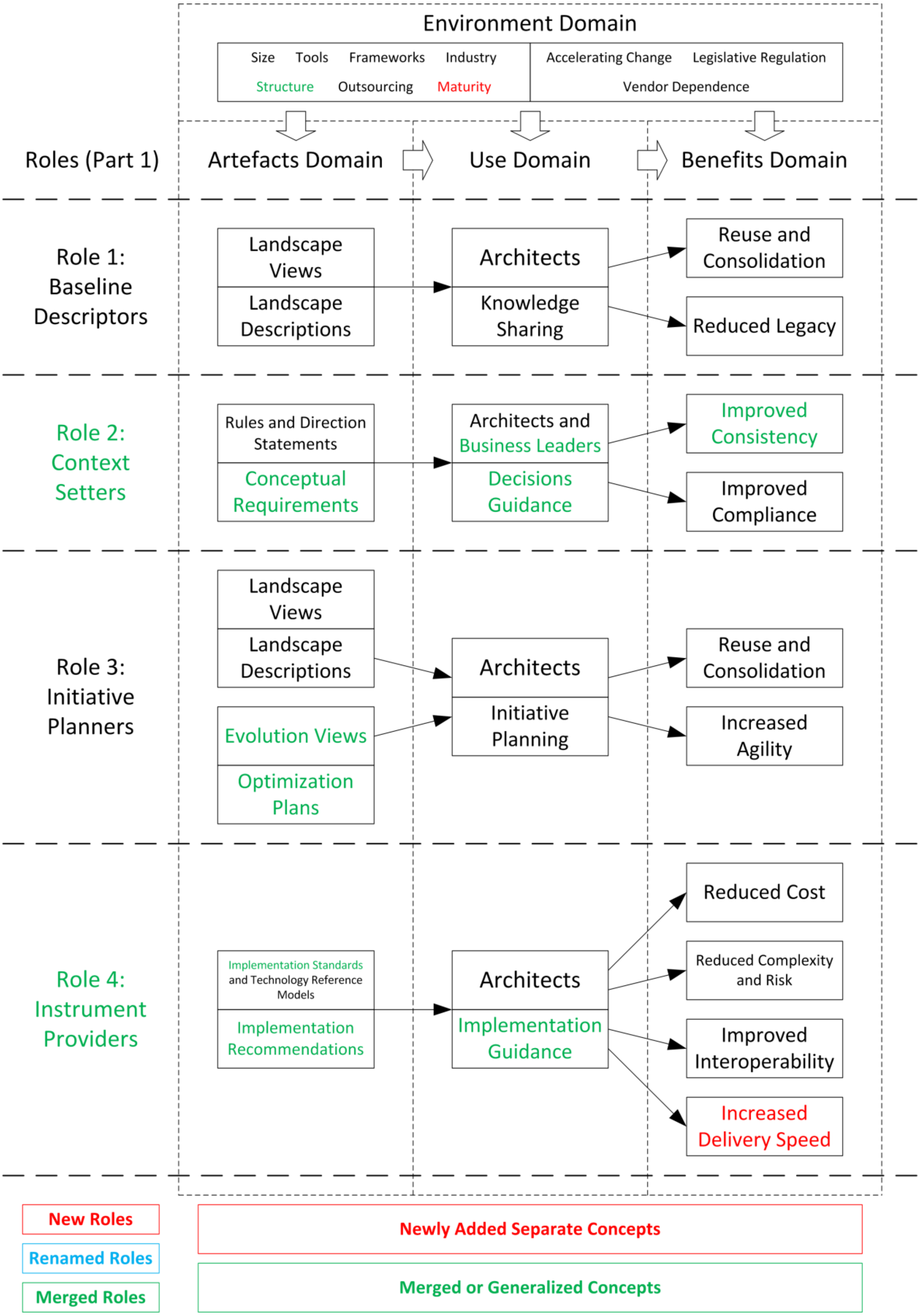

Figure 4.24. Summary of the roles of EA artefacts after the fourth case study (part 1)

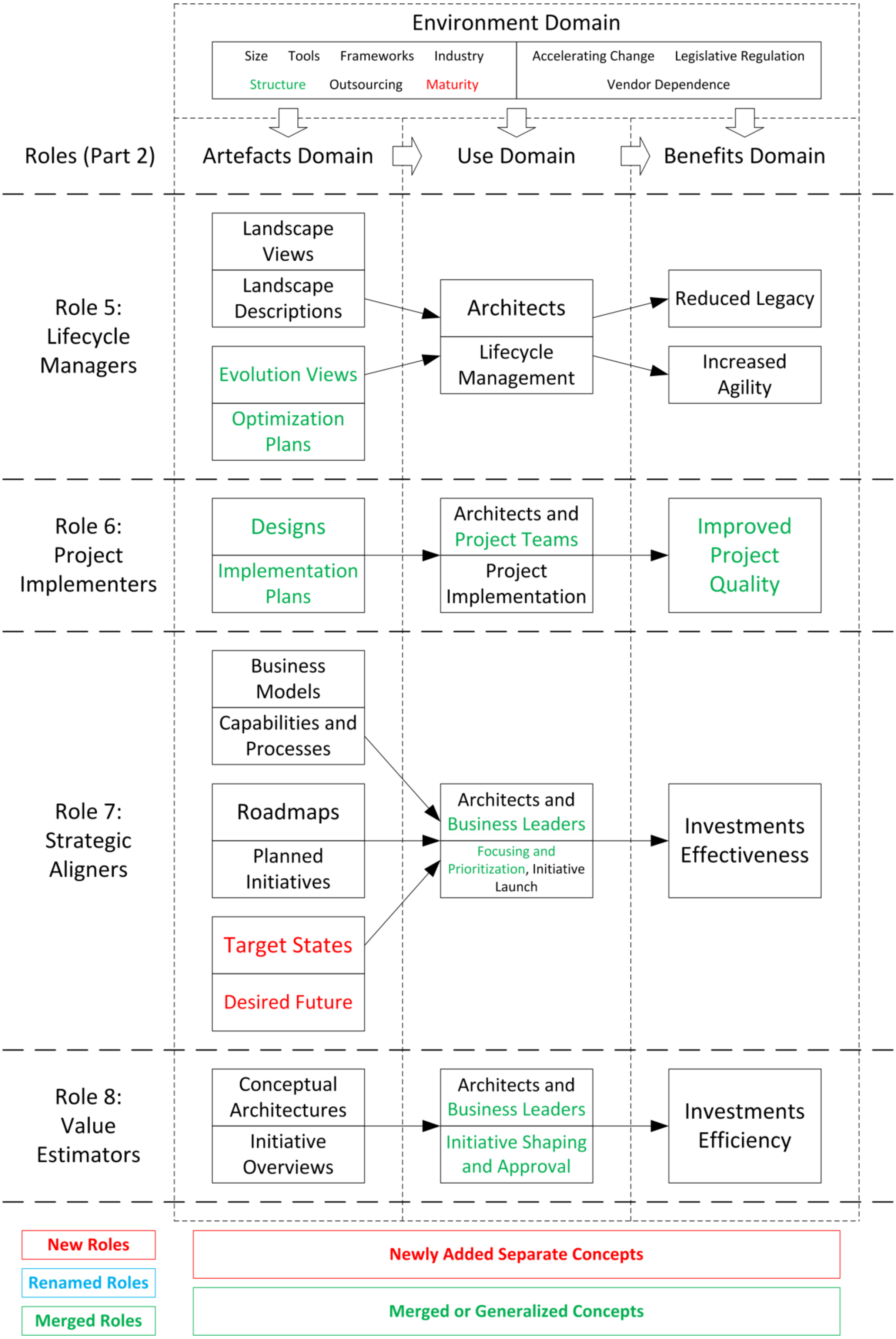

Figure 4.25. Summary of the roles of EA artefacts after the fourth case study (part 2)

4.4.7. Influence of Environmental Factors on the Roles of EA Artefacts

The comparison of the identified roles of EA artefacts and underlying concepts between Delivery Institution and the three previously studied organizations allows continue theorizing on the influence of various environmental factors on the roles of EA artefacts.

Firstly, the high maturity of an EA practice in Delivery Institution influences the roles of Strategic Aligners. While in all the previously studied organizations the desired long-term future has been planned only in terms of “heatmapped” business capabilities or processes on Business Models and then in terms of planned initiatives in Roadmaps, in Delivery Institution the desired long-term future is planned more explicitly using Target States providing formal descriptions of Desired Future on the horizon of 3-5 years, which helps further enhance strategic effectiveness of IT investments. Similarly, the maturity of an EA practice in Delivery Institution is manifested in the roles of Initiative Planners and Lifecycle Managers. While in the previous organizations the future planning aspects of these roles have been fulfilled by Landscape Roadmaps providing technical Improvement Plans, in Delivery Institution these roles are fulfilled also by explicit IT Target States providing formal descriptions of Desired IT Future in corresponding technical domains, e.g. integration and infrastructure, improving the realization of corresponding benefits.

Secondly, the highly decentralized Structure of Delivery Institution influences the roles of Context Setters and Strategic Aligners. The corresponding EA artefacts and users involved in these roles in Delivery Institution are strictly aligned to the respective lines of business. Specifically, Rules, Roadmaps and Target States in Delivery Institution are developed in a hierarchical manner for particular lines of business by Architects responsible for IT planning in these specific lines of business. The influence of environmental factors on the roles of EA artefacts in Delivery Institution analysed above is summarized in Figure 4.26.

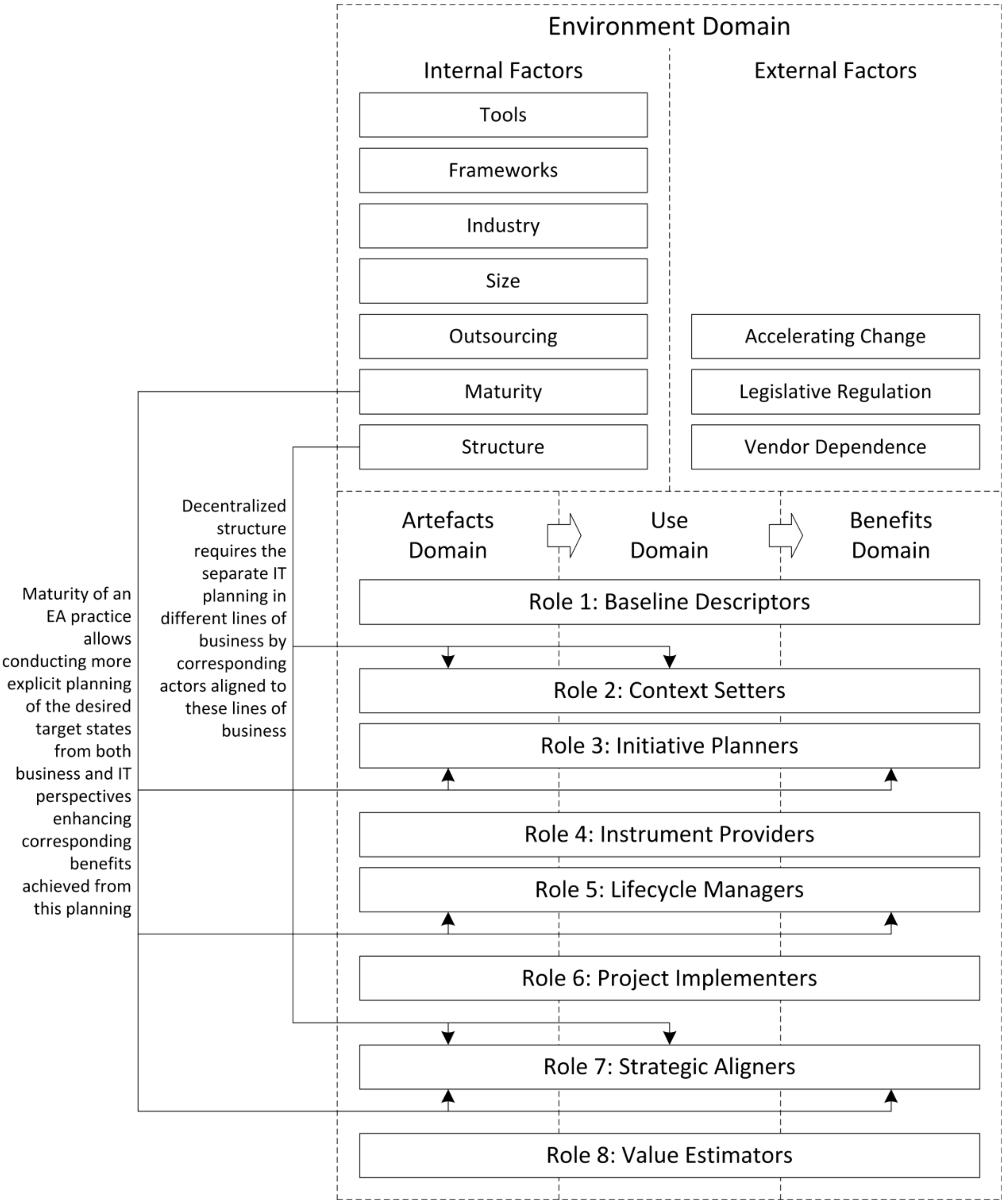

Figure 4.26. Influence of environmental factors on the roles in Delivery Institution

4.4.8. Saturation Assessment

7 of 55 substantive concepts identified in the fourth case study were new and previously unidentified. However, only four of these concepts were significantly different from the existing concepts. These concepts could not have been merged with the existing concepts and, therefore, have been added to the resulting conceptual framework.

As a result of the fourth case study, the resulting conceptual framework has been significantly generalized and slightly extended, while all the previously identified roles of EA artefacts have been confirmed with some generalizations. Despite that most existing concepts proved to be consistent across all the four studied organizations, some new concepts have been also identified and added. Consequently, the emerging conceptual framework at this stage of the study shows reasonably clear signs of saturation and the identified roles of EA artefacts can now be considered as reasonably mature findings. However, additional analysis of other organizations still might be required to fully saturate the grounded theory.

4.4.9. Selecting the Next Case

The four previously studied organizations, i.e. Educational Institution, Financial Institution, Telecom Institution and Delivery Institution, are organizations of various sizes and of different degrees of decentralization representing diverse industry sectors. However, the influence of industry-specific differences on organizational IT-related practices may be pretty significant and is often underestimated in IS research (Chiasson and Davidson, 2005). From this perspective, exploring some organizations working in "peculiar" industries might be desirable to fully saturate and complete the emerging conceptual framework. Consequently, the selection of the next case organization for this study was driven by the intention to study an organization working in different, somewhat special industry sector.

4.5. Case Study Five: Retail Institution

The fifth case organization studied in this research is Retail Institution. Retail Institution satisfies the case selection criteria described above driven by the theoretical sampling considerations. Specifically, Retail Institution operates in the fast-moving consumer goods business (FMCG) characterized by a highly specific, very dynamic and unpredictable competitive environment. Retail Institution also satisfies minimal case selection requirements since it employs more than 1000 IT specialists and had been practicing EA for more than four years at the time of the data collection.

Retail Institution is a major player in the fast-moving consumer goods retail market in Australia. It has multibillion dollar revenues and employs tens of thousands of people, including more than a thousand IT staff and a similar number of its partners' outsourced IT personnel. The company is split into several lines of business and operates several hundred retail outlets across Australia. Each line of business has its own IT delivery function.

The fast-moving consumer goods business (FMCG) implies high sales volumes, low margins, fast stock turnover and heavy reliance on complex logistic networks for goods delivery and storage. From the management perspective the competitive position of a retail chain largely stands upon three pillars: lowering the cost, increasing the revenue and improving the customer experience. The Australian retail market is very dynamic, highly competitive and influenced by aggressive new market entrants. Companies are constantly competing on price and struggling to increase their market shares, while continually accommodating changing legislation. Moreover, companies have to respond quickly to their competitors' moves in order to stay afloat. Therefore, the fast-moving consumer goods retail business in Australia is very fast-paced, cost-sensitive and reactive. Its business environment is highly competitive, rapidly changing and largely unpredictable, which poses considerable challenges for an EA practice.

> *"Because FMCG, and I'm sure all retail organizations, are very fast-paced, they move very quickly. There is not enough time to actually do proper enterprise architecture, there is no time. Business has moved even before you can say "go". They [business leaders] need something to be done very quickly. So, it's an interesting challenge"* (Manager of Architecture)

The business strategy of Retail Institution is very volatile and elusive. Declared strategic goals and objectives may change several times a year inhibiting the long-term architectural planning.

> *"In the traditional enterprise architecture cycle with a plan for say three to five years they [enterprise architects] can posit a target state and perhaps an interim state. They will create a roadmap for three to five years [...]. The problem with an organization like this is that in twelve months the organization has changed its direction three or four times. So, you are not going to get that kind of stability that fits those timeframes. [...] An insurance company or a bank may have the stability to be able to look into five years ahead. In this industry things change, it's constantly changing, it's very different"* (Solution Architect)

Despite that Retail Institution established its EA function and permanent EA team around 2011, it is still in the process of refining its own company-specific way to practice EA.

4.5.1. Enterprise Architecture Function

Retail Institution has a centralized architecture function for the whole organization that includes enterprise and solution architects and is managed by the head of architecture, who reports directly to the CIO. The EA team is responsible for company-wide strategic architecture planning and consists of two enterprise architects reporting to the head of architecture. The solution architecture team is responsible for project-level architecture planning and consists of twelve solution architects reporting to the manager of architecture, who also reports to the head of architecture. Additionally, apart from the central architecture function, IT delivery functions of different lines of business have independent teams of application architects, domain and subject matter experts responsible for detailed technical designs of ongoing IT projects.

> *"[The organization] has an enterprise architecture team, a solution architecture team and they also have a number of application architects that are narrow domain-specific architects, but they are not considered a part of the architecture, the inner architecture team [...]. [We have] approximately 15 architects where there are two enterprise, dozen solution and boss [manager of architecture]. [...] And then there is, like I said, a number of application architects"* (Solution Architect)

The structure of the architecture function at Retail Institution is shown in Figure 4.27.

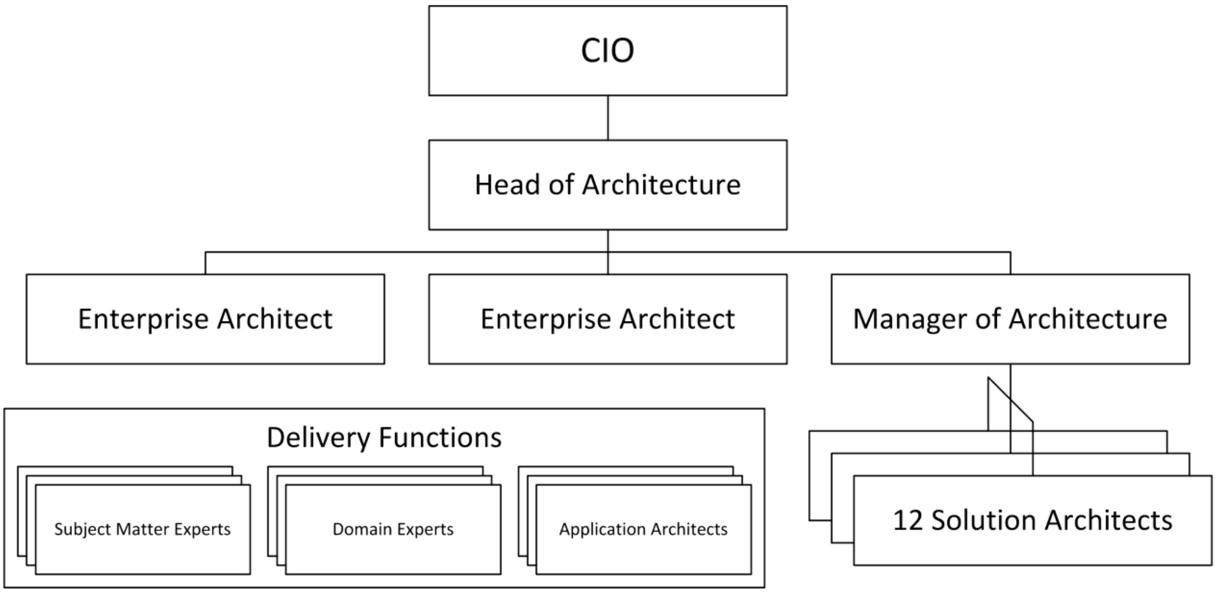

Figure 4.27. EA function in Retail Institution

4.5.2. Enterprise Architecture Artefacts

The EA practice at Retail Institution is based on twelve distinct types of EA artefacts produced by architects with the necessary involvement of other relevant stakeholders. EA artefacts used at Retail Institution with their brief description and meaning are described in Table 4.12.

Table 4.12. EA artefacts in Retail Institution

Owners	Artefacts	Description
Enterprise architects	Strategy papers	Strategy papers are very high-level analytical documents discussing the potential influence and impact of disruptive technical trends on the company's business. Essentially, they represent the results of a SWOT (strengths, weaknesses, opportunities and threats) analysis from the technology perspective
	Principles	Principles are abstract global architecture maxims relevant for all IT solutions in the organization. Principles range from common IT policies found in many organizations, such as "reuse before buy, buy before build", to highly company-specific policies, such as "all store solutions should be robust to intermittent connectivity and network failure"
	Business capability model	Business capability model is a one-page diagram describing business capabilities of the whole organization up to two or three nested levels of abstraction
	Business reference architectures	Business reference architectures describe the desired ideal organization of business processes according to recognized industry best practices in certain important business capabilities
	Roadmaps	Roadmaps are business-focused documents describing desired future IT investments and their impact in certain important areas for three years ahead. Roadmaps are written in business language and aimed at answering core questions of relevant stakeholders. Roadmaps describe planned IT investments through different "lenses", including financial, value, capability, structure and other lenses
	Technical reference architectures	Technical reference architectures are high-level descriptions of the current and ideal target states of the IT landscapes supporting certain business capabilities. They are purely technical and IT-specific in nature. Technical reference architectures exist for 60-70% of business capabilities, but only 20-30% of business capabilities have their ideal future states described

	Inventories	Application, infrastructure and information inventories are catalogues of the corresponding entities available in the organization
	Standards	Standards are specific technical recommendations relevant for all IT solutions in the organization, for instance, that all solutions should be based on the Microsoft .NET platform or that all customer-facing mobile apps should support both iOS and Android platforms with native applications
Solution architects	Solution overviews	Solution overviews are high-level documents describing specific IT solutions. The level of detail in solution overviews is abstract enough to be understandable for business stakeholders, but is specific enough for obtaining approximate estimates of time, cost and risk
	Solution architectures	Solution architecture documents are rather detailed technical descriptions of specific IT solutions
	Key design decisions (KDDs)	Key design decisions (KDDs) are summary documents describing significant architectural decisions taken for specific IT solutions, reasoning behind them, their justifications, pros and cons. For instance, KDDs should explain any deviations of a solution from established principles, standards, roadmaps or technical reference architectures

Retail Institution does not use any specific software tools for developing, storing and managing EA artefacts. All EA artefacts are developed with the standard MS Office suite (PowerPoint, Word and Visio) and stored in the central SharePoint repository with the exception of inventories, which were initially stored as MS Excel spread sheets, but eventually migrated into the ServiceNow configuration management database (CMDB).

4.5.3. Enterprise Architecture Processes

Architecture processes constituting the EA practice at Retail Institution can be roughly separated into enterprise-level processes and project-level processes. Enterprise architects are the main actors of enterprise-level processes, while project-level processes are carried out largely by solution architects.

Enterprise-level architecture processes at Retail Institution are mostly unstructured and not formalized. They consist of eight distinct activities of enterprise architects. These activities are largely independent of each other and can be carried out in parallel without any particular predefined order. Therefore, they are discussed starting from more “generic” activities and ending with more “specific” ones.

Firstly, enterprise architects monitor relevant technology trends in the external environment, communicate with senior business stakeholders and periodically produce strategic papers with the analysis of the possible impact and influence of these trends on the organization.

> *"What are some of the things that are impacting us? Things like labour cost or capital markets or global warming, for example. So, there are a lot of environmental factors that are affecting the business and increasing cost. Then what we are also doing is looking at the technology landscape from other industries and then saying "well, these landscapes will come, these technologies are potentially coming, disrupting our operating environment and we have to be prepared for it""* (Enterprise Architect)

Secondly, enterprise architects formulate architecture principles for the whole organization and discuss them with senior business stakeholders. Thirdly, enterprise architects maintain the business capability model and use it for discussions with senior business stakeholders in order to understand in which capabilities the IT investments should go.

> *"The business capability model is used really just to represent the business. But its key purpose is to facilitate conversation around where the business wants to prioritize its investment"* (Enterprise Architect)

Fourthly, enterprise architects together with senior business stakeholders develop business reference architectures for important business capabilities by means of adapting established industry best practices to the Retail Institution's environment.

> *"We would refer to an industry best practice and then we would translate that to our context. What is being required for our future state? Then we would identify those capabilities within that future state which reflect different general capabilities that will help us compete. This understanding would then be turned into the sequence of what we are going to invest in the roadmap"* (Enterprise Architect)

Fifthly, for the most important business capabilities enterprise architects develop IT investment roadmaps agreed with the relevant business stakeholders.

> *"I spend most of my time speaking to business unit leaders. [...] They have a portfolio of projects and I'll give them a general roadmap and indication of where the investments should be focused [...]. We are using each individual project as a vehicle, and then they will ensure that investment occurs in various capabilities that I have identified [as strategic]"* (Enterprise Architect)

Sixthly, enterprise architects develop and maintain technical reference architectures for important business capabilities according to their best understanding of the business needs and direction. Seventhly, enterprise architects maintain the technical inventories to adequately reflect the currently available IT assets. Eighthly, enterprise architects together with solution architects maintain and update enterprise-wide technical standards for IT project implementation. Enterprise-level architecture processes at Retail Institution are shown in Figure 4.28.

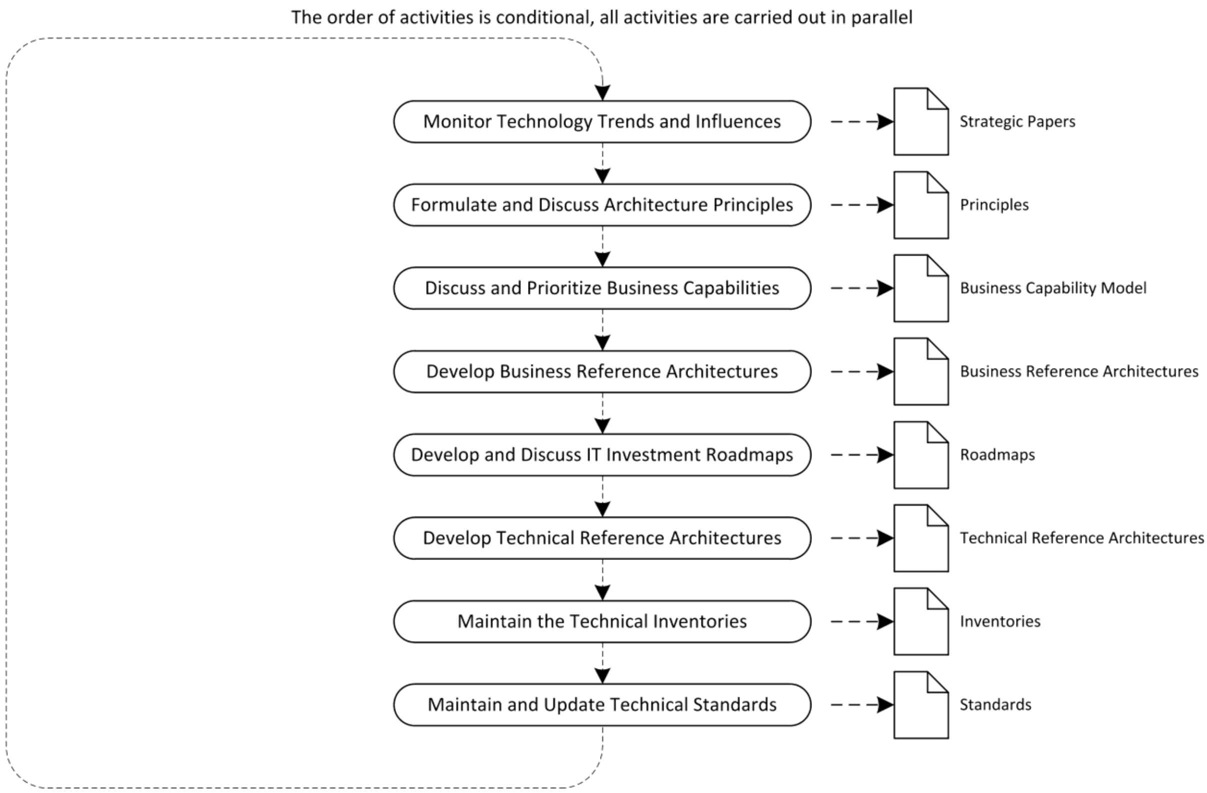

Figure 4.28. EA processes in Retail Institution at the enterprise level

Project-level architecture processes at Retail Institution are well-structured and largely revolve around two distinct governance bodies: innovation forum and architecture review forum (ARF). The innovation forum is a governance body for testing and approving ideas for projects. It runs every two weeks and engages senior business leaders, including finance officers responsible for the budgeting process. All IT projects are presented at the innovation forum where business leaders evaluate the viability of each project from the business perspective based on its estimated cost, value, benefits, maintainability, risk and other factors. Only worthwhile projects are given approval and necessary funding. However, the most significant projects requiring substantial resources need additional approvals directly from the executive committee.

> *"The innovation forum is a testing and governance forum for ideas. People who do business will have ideas to do particular things and they may obtain some seed funding to do exploration and to establish some information in order to take to the innovation forum. And really the information that they take is effectively a business case"* (Solution Architect)

The architecture review forum is an IT-focused governance body engaging senior IT managers, enterprise and solution architects. Participants of the architecture review forum scrutinize the architectures of all proposed IT projects and assess their viability from the technology perspective. For instance, they review main technical decisions taken by projects, validate them against the established standards and ideal future states described in technical reference architectures (when they exist), discuss potential deviations and ensure that their architectures are as strategic as possible. Additionally, the community architecture forum presents an opportunity for information sharing, ideas dissemination and communication to all architects. It has optional attendance and no formal governance authority.

> *"There is an architectural review forum which is purely down the architecture. This is where the solution architects bring in a solution architecture or design document and the KDDs [key design decisions] and validate that against the future state and identify where it is baselined"* (Enterprise Architect)

Retail Institution has a flexible budgeting cycle that allows initiating and funding projects continuously over the year. Each project starts its life as an idea proposed by business stakeholders. After an initial informal discussion and approval of the "seed" funding this idea is elaborated into a solution overview of the potential future IT project by the assigned solution architect. The solution architect engages relevant domain and subject matter experts and develops the solution overview based on the established standards and principles.

> *"They effectively create the first concrete picture of what the solution might look like, they will identify key risks, assumptions and issues. That's then provided to the various stakeholders, they will be responsible for having some input into that project"* (Solution Architect)

Inventories providing the descriptions of currently available entities help solution architects reuse and leverage existing IT assets. For most areas technical reference architectures provide high-level descriptions of the current IT landscapes in these areas to facilitate the solution planning. Additionally, if the relevant technical reference architecture provides a description of the desired future state for the business capability that the project aims to enhance, then the solution architect aligns the solution overview to this ideal target state.

> *"[Technical] reference architecture is primarily used by the solution architects to basically guide their decisions. [...] When the target state is known, as we execute projects and develop solutions we are opportunistically trying to get towards this target state. So, in the absence of the formal roadmap each project will look at business capabilities, will look at reference architecture, will look at a target state to determine whether we know in this particular domain where we are trying to go"* (Solution Architect)

When the solution overview is ready, the solution architect prepares key design decisions (KDDs) for the project and presents the solution overview together with its KDDs at the architecture review forum (ARF) for discussion and consideration. The ARF reviews the solution overview and KDDs to ensure that the project is aligned to established principles, standards and the target state defined in the technical reference architecture (if it is defined for the corresponding business capability) as well as to ensure that all potential deviations are justified. As a result of this review, the ARF concludes whether the project is desirable or feasible from the technical perspective.

> *"In fact the innovation forum wants to see that the ARF have approved something. If the ARF does not endorse a solution the chances of it proceeding through the innovation forum successfully are very low"* (Solution Architect)

After the solution overview is reviewed by the ARF, the business case for the project is prepared. A high-level description of the project provided by the solution overview is used as a basis for estimating its value, benefits, time, cost and ROI that shape the business case.

> *"Solution overview is a high level document usually used to inform a business case [...]. It's often used as a basis for obtaining high level estimates that feed into a business case"* (Solution Architect)

Then the business case, KDDs and other documentation for the proposed project are presented at the innovation forum, where senior business leaders make the ultimate investment decision regarding the project. Participants of the innovation forum consider three main factors when approving projects: (1) financial considerations described in the business case, (2) alignment to the agreed-upon IT investment roadmaps and (3) conclusions of the ARF on the technical desirability of the project. In certain cases the innovation forum can approve a project even if it deviates from the roadmaps or if it is not endorsed by the ARF, for example, when the project has compelling financial benefits, strict time limitations or satisfies urgent legislative requirements. If the project is approved, then the business sponsor who initiated the project takes accountability for the benefits and outcomes estimated in the business case.

> *"If the project is approved on a basis of the benefits and costs that you've identified, then that business owner who owns that outcome will actually be held accountable for that outcome. If that benefit is not realized, they will be held accountable. So, it actually sharpens everyone's minds a little bit and focuses everyone"* (Solution Architect)

When the project is approved and funded, the solution architect with relevant domain and subject matter experts develop a more detailed solution architecture document (SAD) for the project and refine its KDDs.

> *"Once a project has been approved and has received funding, there will be a more detailed solution architecture document or SAD"* (Solution Architect)

The SAD and KDDs are again reviewed by the ARF and then the SAD is passed either to an internal project implementation team or to a vendor in order to actually deliver the project. However, Retail Institution practices an agile approach to project delivery, which implies minimized amount of upfront architectural planning and reduced volume of resulting solution architecture documents. Solution architectures in Retail Institution are intended to stipulate only the most significant project planning decisions, e.g. recommended technologies, key data sources and systems, while other more specific details of the project implementation are clarified along the way towards the actual implementation by collaborative efforts of involved solution architects and project teams. Cut-down solution architectures used at Retail Institution do not provide full traceability of business requirements and do not describe in detail how exactly these requirements should be addressed, which diminishes typical benefits associated with careful architectural project planning, but helps accommodate changing requirements and business priorities. Project-level architecture processes at Retail Institution are shown in Figure 4.29.

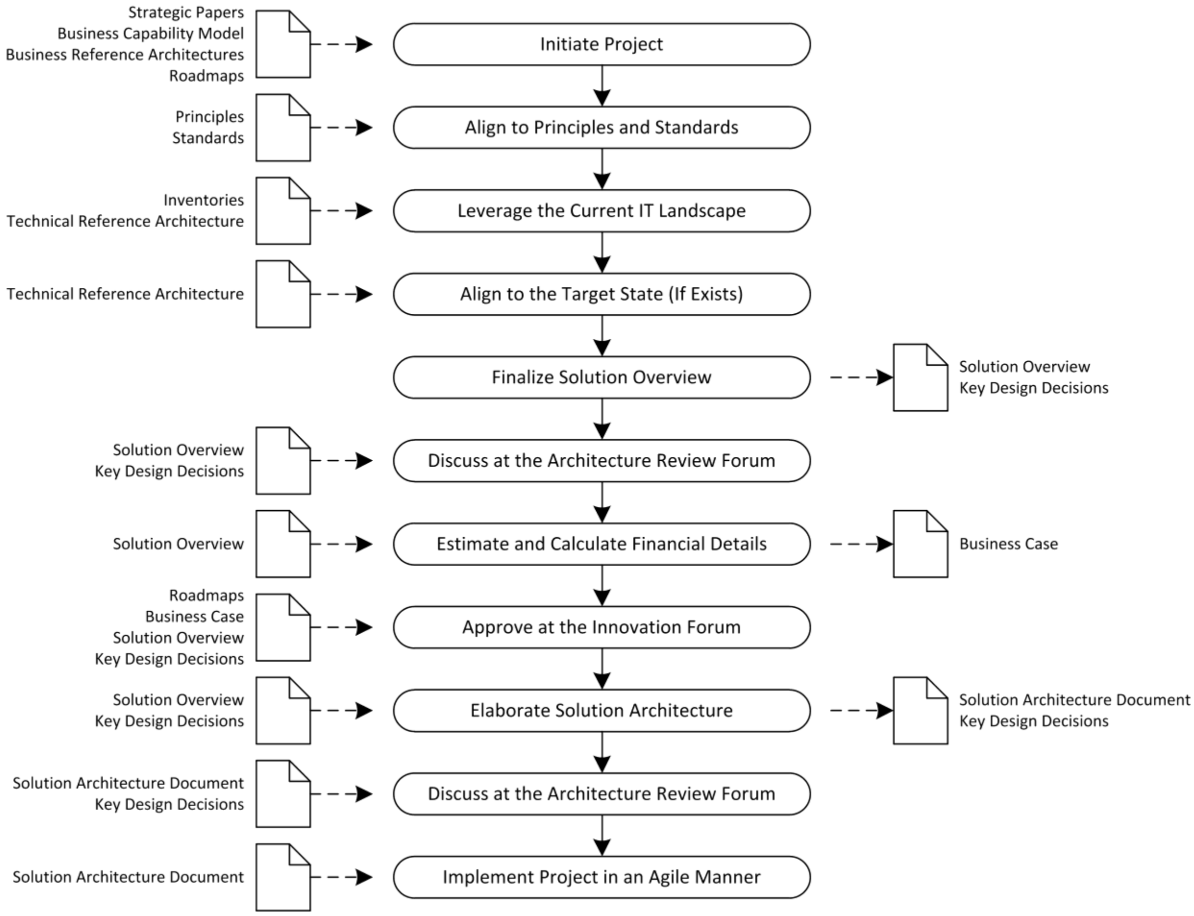

Figure 4.29. EA processes in Retail Institution at the project level

4.5.4. Grounded Theory Analysis

In order to analyse the collected interview data for Retail Institution the three-step grounded theory procedure identical to the one used for Educational Institution and described in detail earlier in Section 3.5.4 has been applied. Samples of the grounded theory analysis process and the detailed list of all identified concepts and categories for Retail Institution can be found in Appendix D.5.

As a result of the applied coding procedure 111 different codes have been assigned, which were subsequently consolidated into 49 consistent concepts. Of all 49 resulting concepts, only four new previously unrecognized concepts have been identified relevant only to Artefacts, External Factors and Internal Factors categories. The corresponding theoretical domains (see Figure 4.3) have been updated accordingly.

In the environment domain one new concept has been identified related to Internal Factors category and one new concept has been identified related to External Factors category. Firstly, Agile Delivery has been added as an important internal factor representing more agile approach to project delivery. Agile Delivery implies shortened planning cycles for IT initiatives, where only the most significant project-related planning decisions, e.g. preferred technologies, are stipulated upfront, while most less significant planning decisions are made later along the way as part of the project implementation (Cohn, 2005). Secondly, Strategic Uncertainty has been added as a critical factor of the external business environment having a considerable impact on an EA practice. Strategic Uncertainty of the fast-moving consumer goods business hinders the long-term planning, blurs strategic vision and is manifested in the constant change of strategic goals and objectives.

In the artefacts domain two new concepts have been identified related to Artefacts category: Decision Summaries of CAs (Conceptual Architectures) and Decision Summaries of Ds (Designs). Decision Summaries of CAs and Decision Summaries of Ds provide concise textual extracts of the most significant and discussable planning decisions reflected in corresponding Conceptual Architectures and Designs.

Moreover, based on the analysis of differences and similarities between the existing concepts, eight concepts in the artefacts domain have been generalized to form more generic and higher-order concepts. Firstly, the concepts of Rules and Direction Statements have been merged into a broader concept of Considerations encompassing all EA artefacts providing high-level suggestions of conceptual nature including both rules and directions. Secondly, the concepts of Implementation Standards and Technology Reference Models have been merged to form a broader concept of Standards covering all EA artefacts providing standardized ways of implementing new information systems including their technical, logical and technological aspects. Thirdly, the concepts of Business Models, Roadmaps and Target States have been merged into a broader concept of Visions embracing all EA artefacts providing graphical views of the desired future in various forms. The corresponding Information concepts of

Capabilities and Processes, Planned Initiatives and Desired Future have been merged accordingly into a broader concept of Future Descriptions covering all types of information on the desired future understandable to business stakeholders. Fourthly, the concepts of Landscape Views and Evolution Views have been merged to form a broader concept of Landscapes encompassing all graphical EA artefacts of technical nature describing the IT landscape. The Information concept of Optimization Plans has been merged accordingly into the extended concept of Landscape Descriptions covering both the current state of the IT landscape and planned future improvements in the landscape. Fifthly, the newly identified concepts of Decision Summaries of CAs and Decision Summaries of Ds have been merged accordingly into the corresponding extended concepts of Outlines and Designs covering both initiative descriptions and their brief summaries.

The updated set of concepts resulting from the analysis of the collected data from Retail Institution allows updating the identified roles of EA artefacts accordingly.

4.5.5. Updated Roles of Enterprise Architecture Artefacts

The data collected and analysed for Retail Institution fully confirms all the previously identified roles of EA artefacts, though with some minor generalizations covering organization-specific peculiarities. Specifically, three previously identified roles have been fully confirmed. Two other roles have been confirmed with only minor generalizations. Finally, the three remaining roles have been fully confirmed and merged into a more generic role. The status of all the identified roles of EA artefacts after the fifth case study is shown in Table 4.13.

Table 4.13. Status of the roles of EA artefacts after the fifth case study

Role	Status	Explanation
Context Setters	Fully confirmed	The existing role completely fits new data in all aspects
Instrument Providers	Fully confirmed	The existing role completely fits new data in all aspects
Knowledge Repositories (merged Baseline Descriptors, Initiative Planners and Lifecycle Managers)	Fully confirmed and merged	Former Baseline Descriptors, Initiative Planners and Lifecycle Managers have been merged into a single role since all these roles imply closely related Usage, same Users, same Benefits and fulfilled by same Artefacts

Project Implementers	Confirmed with negligible generalizations	Organization-specific Artefacts added
Strategic Aligners	Fully confirmed	The existing role completely fits new data in all aspects
Value Estimators	Confirmed with negligible generalizations	Organization-specific Artefacts added

As summarized in Table 4.13, after the fifth case study all previously identified roles have been fully confirmed with insignificant, purely organization-specific generalizations. Therefore, these six roles represent the final set of the roles of EA artefacts developed as part of the grounded theory-building process. These roles proved consistent across all the five studied organizations and conceptually explain the meaning of all 61 EA artefacts identified during the data collection process.

Context Setters is the general role of EA artefacts which implies setting the overarching intellectual context for business and IT planning to avoid making inappropriate planning decisions. Instrument Providers is the general role which implies providing proven instruments for implementing new IT systems to minimize technical inconsistency. Knowledge Repositories is the generic role which implies capturing, storing and sharing the technical knowledge on the structure of the IT landscape to use this knowledge for IT planning purposes. Project Implementers is the role which implies supporting the implementation of new IT projects to ensure the connection between high-level architectural plans and low-level system implementation. Strategic Aligners is the general role which implies determining the overall long-term direction for future IT investments to ensure their close alignment with the business strategy and goals. Value Estimators is the generic role which implies estimating the overall business value of proposed IT initiatives to justify corresponding IT investments. These roles are discussed and analysed in great detail in the next chapter.

4.5.6. Summary of the Identified Roles

A high-level summary of all the six resulting roles of EA artefacts identified after the fifth case study structured according to the established four-domain theoretical framework (see Figure 4.3) is provided in Figure 4.30.

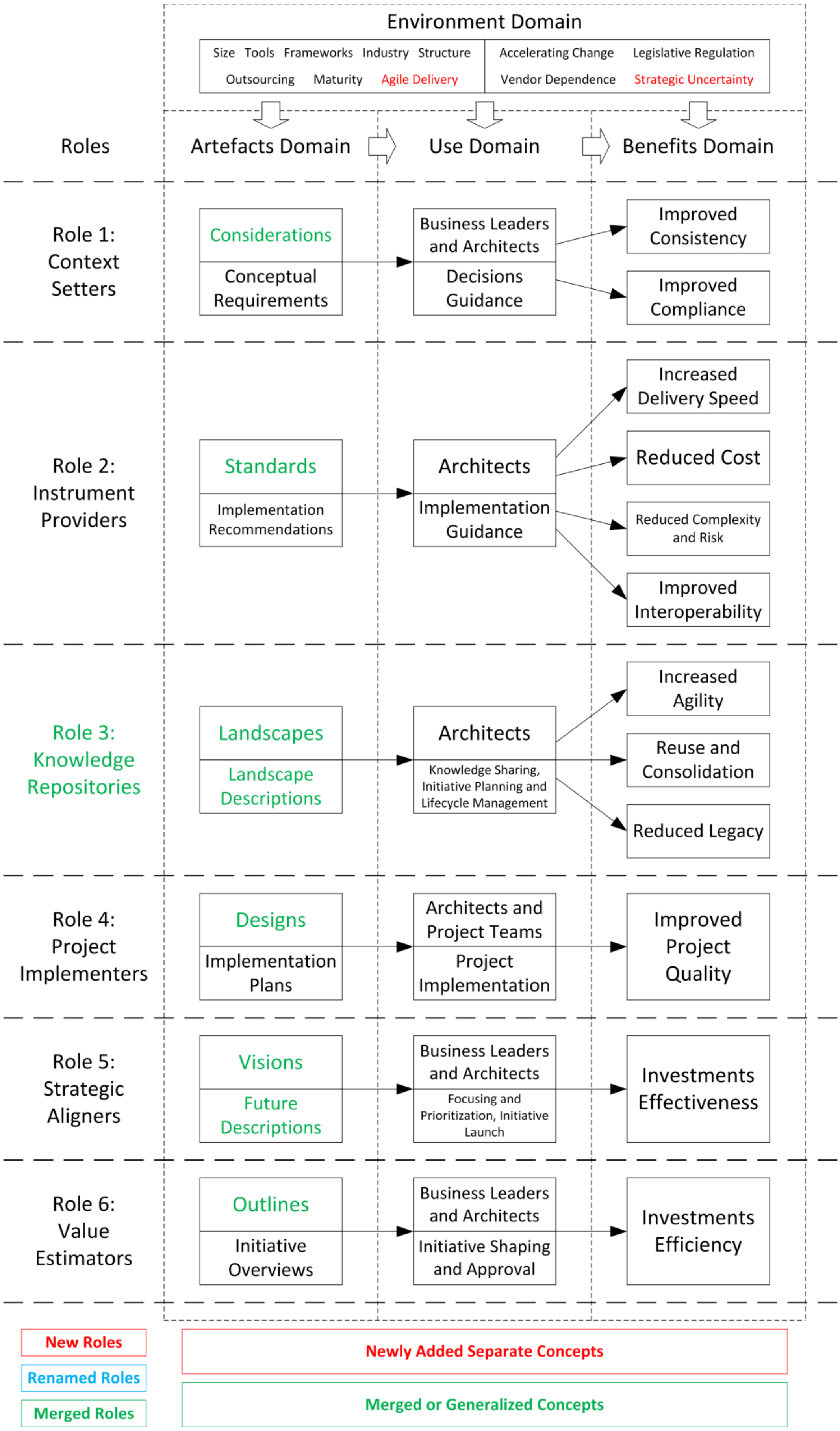

Figure 4.30. Summary of the roles of EA artefacts after the fifth case study

4.5.7. Influence of Environmental Factors on the Roles of EA Artefacts

The comparison of the identified roles of EA artefacts and underlying concepts between Retail Institution and the four previously studied organizations allows continue theorizing on the influence of various environmental factors on the roles of EA artefacts.

Firstly, the role of Project Implementers is influenced by Agile Delivery practiced at Retail Institution. While all the previously studied organizations conducted more or less detailed planning of IT projects before their delivery and documented these plans in corresponding Designs EA artefacts, Retail Institution is less reliant on the upfront project planning and documents only the most essential planning decisions in its Designs. This preference towards greater agility eventually leads to the reduced volume and shortened development timeframes of these Designs, however, potentially undermining the value of Project Implementers as the instruments for improving the project quality. The usage of key design decisions in Retail Institution as separate EA artefacts providing bullet-point summary lists of essential project-level decisions can be also attributed to the preference for Agile Delivery and shorter discussion and approval cycles.

Secondly, the Strategic Uncertainty of the competitive environment significantly influences the role of Strategic Aligners. The considerable uncertainty in the external business environment causes constant shifts in strategic plans, goals and objectives of Retail Institution. In their turn, these quick changes in business priorities complicate the usage of Strategic Aligners for their primary purpose, i.e. for focusing and prioritizing future IT investments to improve their potential contribution to the business strategy. Essentially, the high Strategic Uncertainty experienced by Retail Institution hinders and even undermines the achievement of long-term business and IT alignment normally resulting from the usage of Strategic Aligners. The influence of environmental factors on the roles of EA artefacts in Retail Institution analysed above is summarized in Figure 4.31.

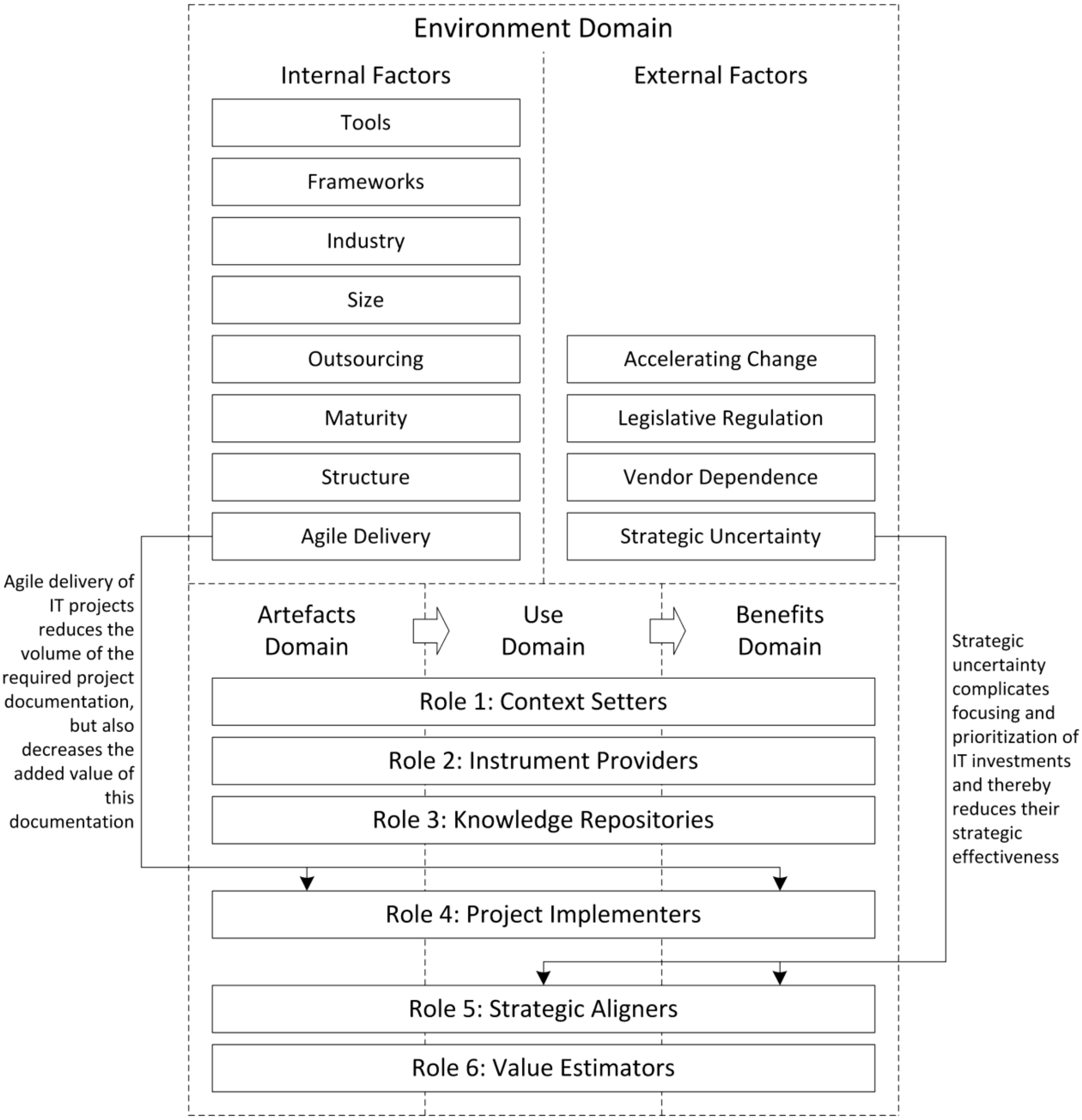

Figure 4.31. Influence of environmental factors on the roles in Retail Institution

4.5.8. Saturation Assessment

Only four of 49 substantive concepts identified in the fifth case study were new and previously unidentified. Moreover, two of these concepts were not significantly different from the existing concepts and, therefore, have been merged into the existing concepts enriching but not modifying the resulting conceptual framework.

As a result of the fifth case study, the resulting conceptual framework has been significantly generalized with only minor extensions, while all the previously identified roles of EA artefacts have been fully confirmed. The existing concepts proved to be consistent across all the five studied organizations. Consequently, the emerging conceptual framework at this stage of the study can be considered as completely saturated and the identified roles of EA artefacts can now be considered as the final findings of this study. No additional analysis of other organizations is required. The final rich conceptual framework underpinning the six resulting roles of EA artefacts is described in great detail in Appendix E.

4.6. Chapter Summary

This chapter described the overall iterative process of constructing a grounded theory of the roles of EA artefacts based on the analysis of five case studies. For each of the five studied organizations this chapter provided a brief overview of this organization, described the structure of an EA function in this organization, EA artefacts used in this organization, EA processes followed in this organization and finally the applied grounded theory analysis procedure addressing the roles of different EA artefacts identified in this organization.

CHAPTER 5: RESULTING GROUNDED THEORY

This chapter provides an end-to-end description of the resulting grounded theory of the roles of EA artefacts and its various aspects. Firstly, this chapter provides a detailed comprehensive description of the resulting conceptual framework, six roles of EA artefacts and their interrelationships. Then, this chapter explains the influence of internal and external environmental factors on these roles of EA artefacts. Finally, this chapter discusses the EA benefits realization through the analytical lenses of the identified roles of EA artefacts.

5.1. Resulting Conceptual Framework

As it was demonstrated earlier in Chapter 2, the available EA literature essentially considers EA largely as a "black box" with useful information which brings numerous benefits to organizations, but does not provide any comprehensive theories and even basic descriptive views explaining how exactly different artefacts constituting EA are used in practice to realize the expected benefits. As fairly noticed by Niemi and Pekkola (2017, p. 327), "currently a theoretical model of EA artefact use does not exist" and "the coverage of the [EA artefact use] situations identified in the literature is limited in both extent and level of detail".

In the previous chapter, based on the five consecutive case studies of established EA practices, a comprehensive descriptive theory has been developed explaining the usage and roles of EA artefacts in an EA practice as well as the potential influence of environmental factors on these roles. The resulting theory is based on the underlying rich conceptual framework consisting of 48 different concepts relevant to the roles of EA artefacts grouped into seven broad categories (Artefacts, Benefits, External Factors, Information, Internal Factors, Usage and Users) and four higher-level theoretical domains (see Figure 4.3). The full resulting conceptual framework is shown in Figure 5.1.

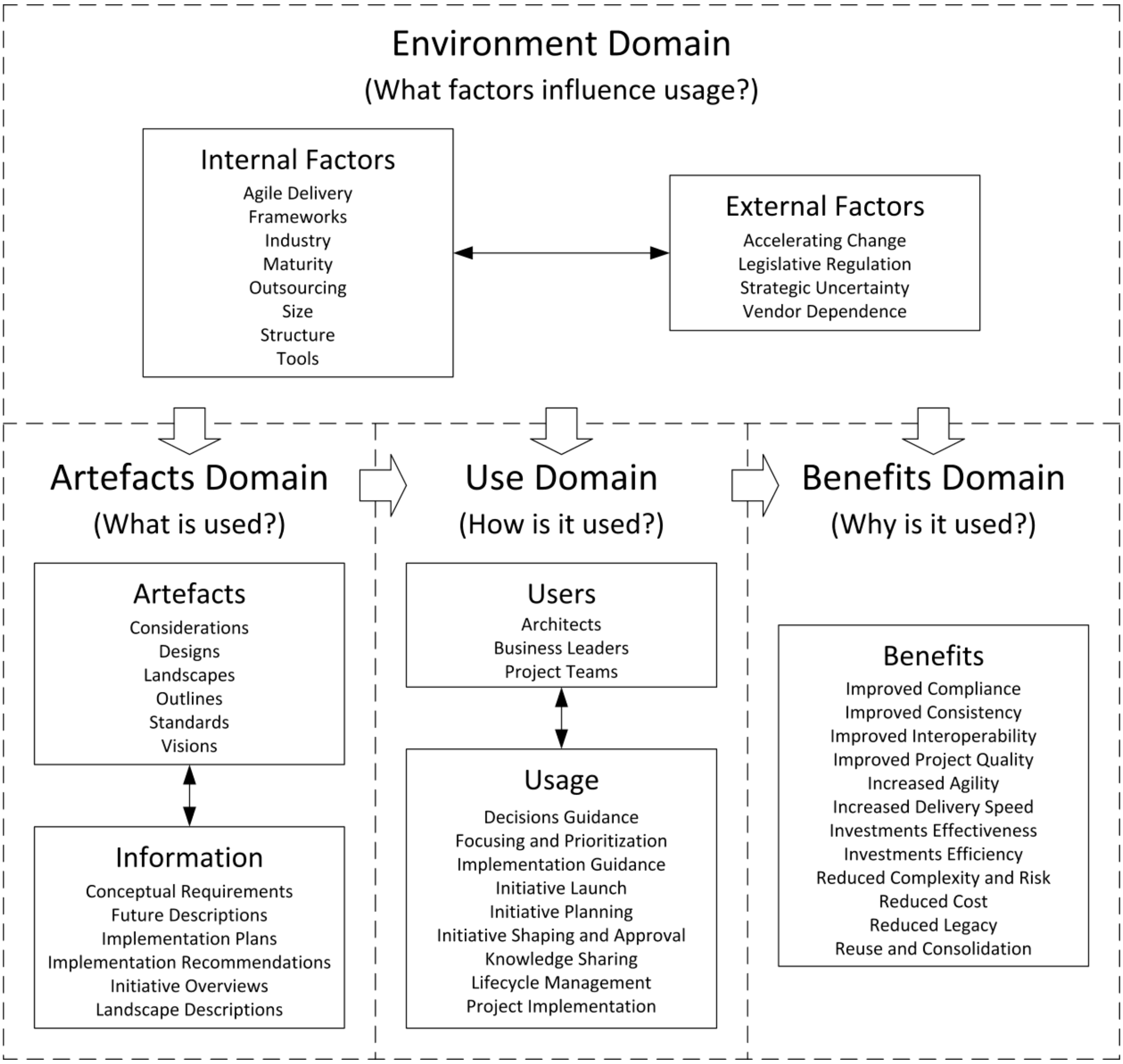

Figure 5.1. Resulting conceptual framework

All the 48 concepts constituting the resulting conceptual framework are described in detail in Appendix E.

5.2. Six Resulting Roles of Enterprise Architecture Artefacts

Based on the underpinning conceptual framework developed as part of the grounded theory analysis (see Figure 5.1), the resulting theory articulates six consistent and organization-neutral, but significantly different roles fulfilled by EA artefacts in the context of an EA practice. These roles initially emerged and then were progressively refined through applying the grounded theory method and constant comparative technique (Corbin and Strauss, 1990; Strauss and Corbin, 1998) to the empirical data collected from the five studied organizations operating in diverse industries. From the grounded theory perspective, these roles represent six consistent top-level themes structured around the core Usage category and based on the set of underlying fine-grained concepts.

The six resulting roles of EA artefacts cover all EA artefacts and corresponding usage scenarios identified in the studied organizations. In line with the conceptually similar research of Smolander et al. (2008), these roles have been titled with the following two-word metaphors concisely communicating the overall meaning of these roles in an EA practice: Context Setters, Instrument Providers, Knowledge Repositories, Project Implementers, Strategic Aligners and Value Estimators (see Figure 4.30).

Context Setters is the role of EA artefacts which implies setting the overarching mental context for business and IT planning to avoid inappropriate planning decisions. This role is fulfilled by Considerations (Artefacts), operationalized in Decisions Guidance (Usage) involving both Business Leaders and Architects (Users), and entails Improved Consistency and Improved Compliance (Benefits).

Instrument Providers is the role of EA artefacts which implies providing proven instruments for implementing new IT systems to avoid "reinventing the wheels". This role is fulfilled by Standards (Artefacts), operationalized in Implementation Guidance (Usage) involving only Architects (Users) and entails Increased Delivery Speed, Reduced Complexity and Risk, Reduced Cost and Improved Interoperability (Benefits).

Knowledge Repositories is the role of EA artefacts which implies capturing, storing and managing knowledge on the technical structure of the organizational IT landscape to leverage this knowledge for IT planning purposes. This role is fulfilled by Landscapes (Artefacts), operationalized in Lifecycle Management, Knowledge Sharing and Initiative Planning (Usage) involving only Architects (Users) and entails Increased Agility, Reuse and Consolidation and Reduced Legacy (Benefits).

Project Implementers is the role of EA artefacts which implies bridging the planning and delivery of new IT initiatives to ensure the connection between high-level architectural plans and low-level system implementation. This role is fulfilled by Designs (Artefacts), operationalized in Project Implementation (Usage) involving both Architects and Project Teams (Users), and entails Improved Project Quality (Benefits).

Strategic Aligners is the role of EA artefacts which implies showing the overall long-term direction for future IT investments to ensure their close alignment with the business strategy. This role is fulfilled by Visions (Artefacts), operationalized in Focusing and Prioritization and Initiative Launch (Usage) involving both Business Leaders and Architects (Users), and entails Investments Effectiveness (Benefits).

Value Estimators is the role of EA artefacts which implies estimating the overall business value of proposed IT initiatives to justify corresponding IT investments. This role is fulfilled by Outlines (Artefacts), operationalized in Initiative Shaping and Approval (Usage) involving both Business Leaders and Architects (Users) and entails Investments Efficiency (Benefits). These six distinct roles of EA artefacts are described in detail in the next sections.

5.2.1. Context Setters

Context Setters is the role of EA artefacts which implies setting the overarching mental context for business and IT planning to avoid inappropriate planning decisions. This role in the context of an EA practice is fulfilled specifically by Considerations EA artefacts, i.e. principles, maxims, policies, etc.

The overall meaning of the role of Context Setters is providing the overarching organizational context for information systems planning. Context Setters setup a common intellectual environment for all relevant actors involved in strategic decision-making and implementation of IT systems. Often Context Setters are relevant to an entire organization. However, in highly decentralized organizations major business units (e.g. lines of business or divisions) can also develop their own Context Setters reflecting local unit-specific strategies consistent with the global organization-wide context.

The general purpose of the role of Context Setters is to help achieve the agreement on basic principles, values, directions and aims between all relevant stakeholders. By means of using Context Setters for discussions, Business Leaders and Architects can achieve a shared understanding of what is really important for an organization and how an organization needs to work. This shared understanding underpins all IT-related plans and stops Architects from making wrong planning decisions detrimental to the best interests of the business.

Context Setters are developed collaboratively by Business Leaders and Architects based on their common understanding of how an organization should work in the future to achieve its long-term goals and objectives. Some Context Setters, e.g. policies, might be derived directly from the requirements of external compliance laws or industry regulations. After being established, Context Setters influence all IT-related decision-making processes in an entire organization or in its major business units. For example, the requirement to provide a single customer view documented in Context Setters might have numerous and diverse implications for IT planning at different organizational levels including the selection of reliable and secure storage technologies for a unified customer database, the deployment of an appropriate integration infrastructure for accessing the central customer database from all running IT systems, the cancellation of current or planned IT initiatives contradicting the idea of a single customer view and even the modification of the designs of all new IT projects to make them access the same customer database. Similarly, the policy restricting the storage of a commercially sensitive data in offshore datacentres documented in Context Setters may also have extensive implications for IT planning at both organization-wide and project levels. The alignment of all IT-related planning decisions to Context Setters is usually achieved via governance mechanisms and procedures, when corresponding EA artefacts are formally reviewed by Architects and Business Leaders to ensure their conformance with the suggestions of Context Setters.

Context Setters improve overall conceptual consistency between business and IT. They help make sure that all organizational information systems are implemented according to the key overarching requirements of Business Leaders. Additionally, Context Setters put the process of information systems planning in a legislative context by incorporating relevant legislative norms and thereby improving regulatory compliance.

The general meaning of the Context Setters role is typically described by the interviewees with the following or similar statements:

> *"Maxims are very high-level principles and they are intended to apply to any project. The maxims help see whether on a highest level the project aligns to the business and technical needs. The intent of maxims is to be able to score the project to see what the organizational fit of the project is"* (Director of Architecture, Educational Institution)

> *"Principles reflect the business's desire for how to operate. They are like a business preference of how we should operate. So, if we declare "reuse before buy before build" as a principle, for example, then it has to reflect the business's willing to operate like that"* (Solution Architect, Retail Institution)

> *"Every architecture decision has to be evaluated against these architecture principles"* (Lead Architect, Telecom Institution)

> *"Our architecture principles are used to guide decision-making and they reflect some policy-level decisions that we have made. For example, an architecture principle might say "we want to have a centralized customer information repository". It does not tell you how exactly we are going to do it,*

but we have taken the decision that we do not want multiple [customer information repositories]" (Principal Architect, Delivery Institution)

The role of Context Setters structured according to the established four-domain theoretical framework (see Figure 4.3) is shown in Figure 5.2.

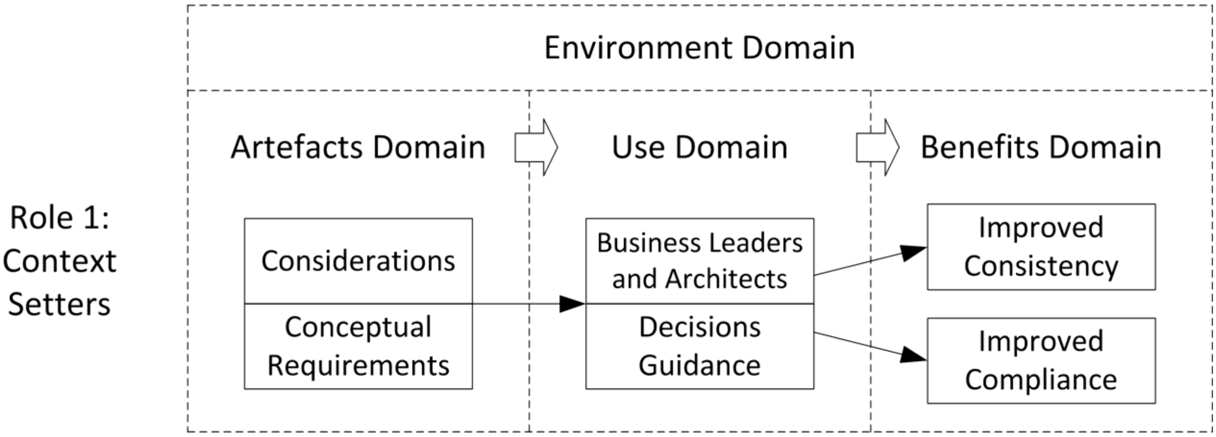

Figure 5.2. The role of Context Setters

5.2.2. Instrument Providers

Instrument Providers is the role of EA artefacts which implies providing proven instruments for implementing new IT systems to avoid "reinventing the wheels". This role in the context of an EA practice is fulfilled specifically by Standards EA artefacts, i.e. technology reference models, patterns, IT principles, etc.

The overall meaning of the role of Instrument Providers is providing proven reusable means for IT systems implementation. They capture effective and reliable implementation approaches that proved useful in previous IT projects for their further reuse covering various technical, technological and data-related aspects. Thereby, Instrument Providers facilitate organizational learning, accumulate and allow reusing the experience and "wisdom" of multiple senior IT specialists. The recommendations documented in Standards offer experience-based advice regarding the design of new IT solutions in the context of an organization. Instrument Providers essentially offer numerous time-tested IT tools and recipes for solving organizational business problems.

The general purpose of the role of Instrument Providers is to help achieve technical consistency and technological homogeneity. The use of Instrument Providers for planning new IT solutions can ensure that all IT systems in an organization use similar approaches in similar situations, similar solutions to similar problems, same property fields for same data entities and same technologies at all layers of the technology stack.

Instrument Providers are developed by Architects with the involvement of relevant subject-matter experts when necessary. As part of their development, Architects discuss, select and document the most appropriate technologies and system implementation approaches on behalf of the whole organization based on their best understanding of its business interests. After being established, Instrument Providers influence architectures of all IT initiatives. They are used predominantly as technical reference materials by Architects during the planning of new IT solutions. The alignment of all project architectures to the recommendations of Instrument Providers is typically achieved via formal governance and oversight procedures, when the EA artefacts fulfilling the roles of Value Estimators (Outlines) and Project Implementers (Designs) are explicitly peer-reviewed and approved by Architects to ensure that corresponding project-level plans are based on the established technical best practices offered by Instrument Providers, e.g. use recommended technologies and approaches.

Essentially, Instrument Providers play the supporting “backend” role inside the IT department. Instrument Providers are created largely by Architects for Architects to facilitate IT project planning, but may have little or no external stakeholders outside of the architecture function. By providing recommended technical means for developing new systems, Instrument Providers shape architectures of all new IT solutions including their internal structure as well as their integration with the existing IT systems. At the same time, by shaping the structure of specific IT solutions, Instrument Providers eventually shape the overall structure of the entire organizational IT landscape. Put it simply, Instrument Providers shape the entire IT landscape via shaping separate IT solutions.

Instrument Providers allow simplifying and standardizing the organizational IT landscape as well as “pipelining” the delivery of new IT initiatives. Main ensuing organizational benefits of Instrument Providers can be summarized to faster initiative delivery, improved interoperability, reduced costs, risks and complexity. Firstly, Instrument Providers facilitate faster delivery of new IT initiatives due to a number of reasons, which include leveraging existing technical expertise, establishing reusable components for new IT systems and avoiding unnecessary learning curves for new technologies. Secondly, Instrument Providers reduce IT-related risks and complexity because of a systematic reuse of standardized and proven implementation approaches and technologies. Thirdly, Instrument Providers reduce IT-related costs due to a number of reasons, which include limiting the number of supported technologies, minimizing the license fees and streamlining the skill sets of IT staff. Fourthly, Instrument Providers improve technical and logical interoperability between different IT systems via minimizing the technological disparity, standardizing the data structures of shared information entities and leveraging common integration approaches and protocols.

The general meaning of the Instrument Providers role is typically described by the interviewees with the following or similar statements:

> *"We have the technology reference model [TRM] which shows us all the technologies that we have right now. So, everything [all IT projects] we do should line out with the TRM"* (Solution Architect, Educational Institution)

> *"For example, my domain is network and I have standards for networks. If somebody [of solution architects] is doing a project and they need to use the network, then they will use the standards I defined for networks. If they want to divert from the standards, then they have to fill an exemption form"* (Enterprise Architect, Financial Institution)

> *"Currently all our IT systems talk to each other through the integration bus. Now, the integration architects are coming up with a new strategy to change the integration pattern to content-based routing approach. [...] Now, all our [project] architecture has to align to that pattern"* (Lead Architect, Telecom Institution)

> *"Standards define that in the integration space we use Tibco as a key integration product. I cannot just put another middleware product in my project without having a good case. The assumption would be that I will use Tibco as my middleware unless there is a really good reason for not doing that"* (Solution Architect, Delivery Institution)

The role of Instrument Providers structured according to the established four-domain theoretical framework (see Figure 4.3) is shown in Figure 5.3.

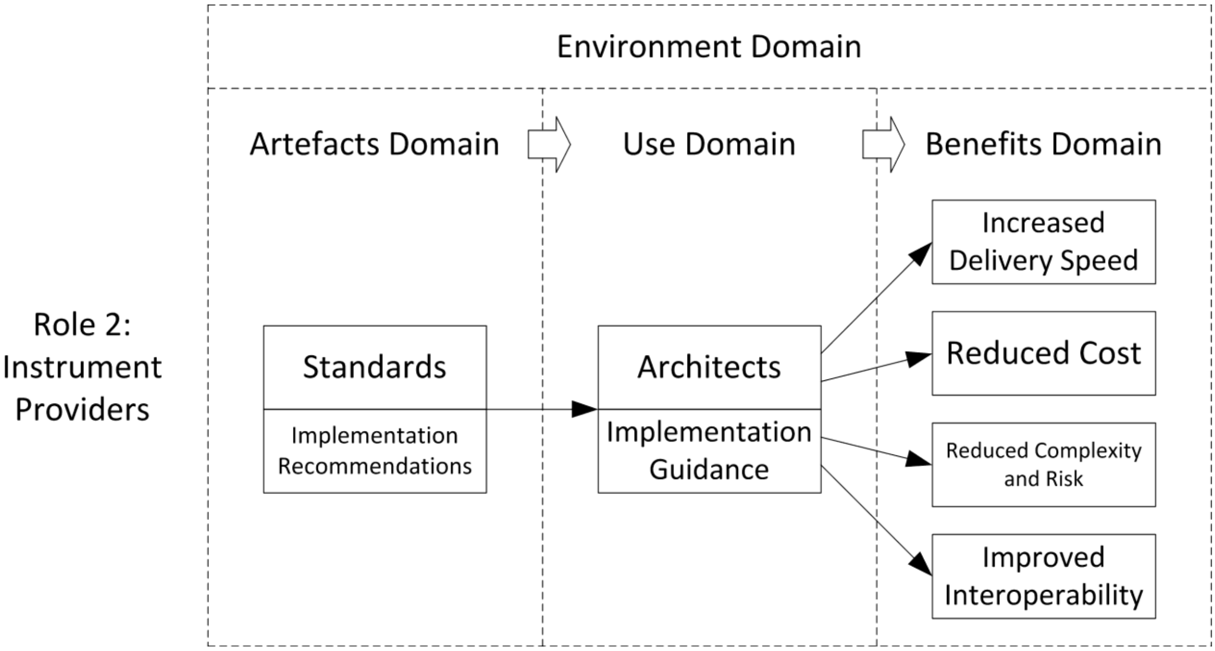

Figure 5.3. The role of Instrument Providers

5.2.3. Knowledge Repositories

Knowledge Repositories is the role of EA artefacts which implies capturing, storing and managing knowledge on the technical structure of the organizational IT landscape to leverage this knowledge for IT planning purposes. This role in the context of an EA practice is fulfilled specifically by Landscapes EA artefacts, i.e. inventories, one-page diagrams, platform architectures, etc.

The overall meaning of the role of Knowledge Repositories is providing a knowledge base of reference materials on the IT landscape. Essentially, a set of Landscapes can be considered as a shared organizational repository of documents describing the overall structure and high-level technical details of the IT landscape. Knowledge Repositories enable the accumulation and storage of the technical knowledge on the IT landscape as well as the exchange of this knowledge between Architects. As a common knowledge base for IT stakeholders, Knowledge Repositories provide the information on what IT systems, applications, databases and infrastructure exist in an organization, how they are interconnected and used. Instant access to this information helps Architects make better technical planning decisions and find more optimal IT responses to constantly emerging business needs.

The general purpose of the role of Knowledge Repositories is to help understand, analyse and modify the structure of the IT landscape. Knowledge Repositories serve as a starting point and reference materials for technical decision-making to Architects. Instead of "reverse engineering" and exploring the current structure of the IT landscape on an as-necessary basis, Architects can use Knowledge Repositories to get the initial high-level view of the existing IT environment in particular areas of interest. They provide a certain baseline to start planning with instead of starting from scratch every time. Informed by Knowledge Repositories, Architects are able to make better planning decisions regarding the designs of specific IT projects as well as regarding the organization of the entire IT landscape in general.

Knowledge Repositories are developed and maintained largely by Architects alone. Knowledge Repositories are irrelevant to most business stakeholders and used predominantly inside the architecture function to accumulate knowledge on the structure of the organizational IT landscape and share this knowledge between Architects, including permanent ones and temporary contractors. Knowledge Repositories also help plan the architecture of new IT initiatives. They show Architects the overall structure of the surrounding IT landscape and help decide how to integrate new IT solutions with the existing IT systems. For example, during the planning of new IT solutions Knowledge Repositories offer the information on what current systems these solutions can communicate with, where the necessary input data can be extracted from, where the resulting output data can be transmitted to and where the new IT systems can be hosted. Additionally, Knowledge Repositories help manage the lifecycle of the available IT assets. They show Architects the lifecycle phases of different IT assets and help understand which IT systems, applications or platforms can be safely reused or which retiring IT assets should be removed from the landscape in the future. Knowledge Repositories are continuously updated to stay current after some changes in the IT landscape occur, e.g. after new IT projects get implemented and deployed.

Knowledge Repositories enable better understanding, management and optimization of the organizational IT landscape. Firstly, Knowledge Repositories help Architects identify suitable IT assets to be reused in new IT projects as well as duplicated IT assets to eliminate them in the future. Secondly, Knowledge Repositories help Architects identify fragile legacy IT systems and decommission them in a timely manner. Thirdly, Knowledge Repositories provide a baseline of the current IT landscape accelerating the planning of new IT solutions and increasing overall IT agility.

The general meaning of the Knowledge Repositories role is typically described by the interviewees with the following or similar statements:

"They [enterprise architects] also provide a reference architecture model. It describes the overall landscape of all the IT systems in place, and what systems are responsible for what function" (Data Architect, Telecom Institution)

"Solution architects will use the asset register to understand what systems we have in the company. It also defines which assets we are trying to reuse, which ones we are trying to decommission. If you have to build a blueprint, it is a good idea not to build it on the assets we are trying to get rid of. It is all in that repository" (General Manager for Architecture and Strategy, Financial Institution)

"The platform architecture document tends to live with the platform describing its current state. Then, when a new project comes along there will be a new blueprint, and then the changes from that blueprint will be applied to the existing platform architecture. So, the platform architecture will be continually updated with each project" (Solution Architect, Telecom Institution)

"Inventories are used during design. When I design some project and I need a tool for data integration, should I use the tool from IBM or should I use the tool from Informatica? You cannot reuse assets unless you have a list of assets" (Solution Architect, Telecom Institution)

"We refer to our application inventory, which is still in the infancy, but it is fully populated. It was on a spread sheet, now it is in the CMDB. It lists all the applications [in our company]. So, from an application perspective we understand what applications we have. It means we can better leverage these existing systems in our new projects. [...] But from an information perspective we are only starting to understand our current state because that has not been documented up-to-date" (Enterprise Architect, Retail Institution)

The role of Knowledge Repositories structured according to the established four-domain theoretical framework (see Figure 4.3) is shown in Figure 5.4.

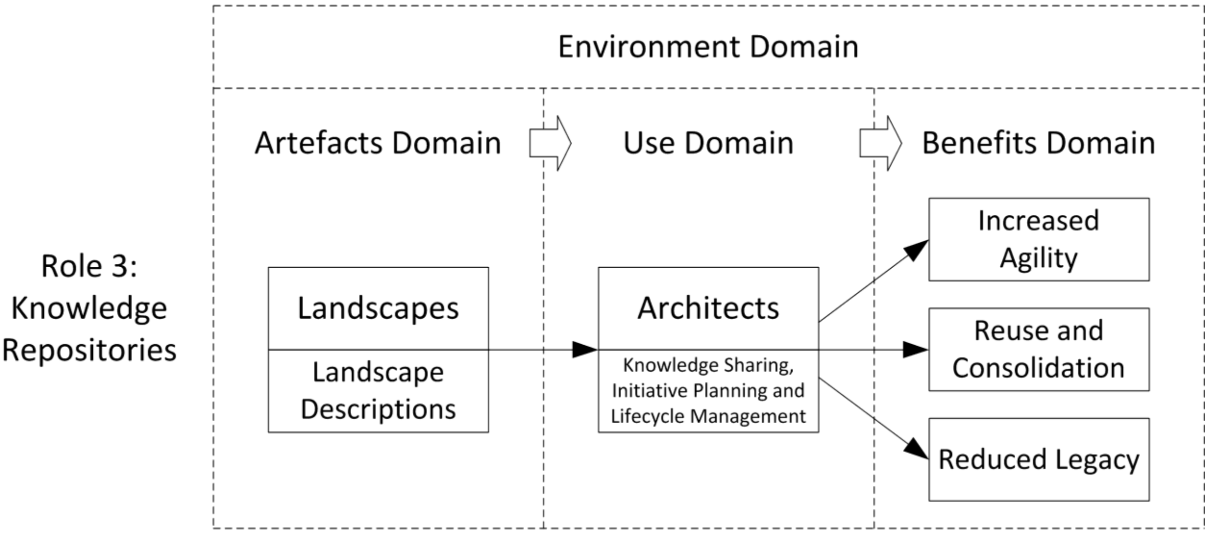

Figure 5.4. The role of Knowledge Repositories

5.2.4. Project Implementers

Project Implementers is the role of EA artefacts which implies bridging the planning and delivery of new IT initiatives to ensure the connection between high-level architectural plans and low-level system implementation. This role in the context of an EA practice is fulfilled specifically by Designs EA artefacts, i.e. solution designs, technical designs, solution architectures, etc.

The overall meaning of the role of Project Implementers is providing communication interfaces between Architects and Project Teams. Essentially, Project Implementers offer a link between architectural efforts and subsequent implementation efforts. They help ensure the connection between high-level planning decisions and low-level technical implementation. Project Implementers allow architects to balance global organization-wide architectural concerns (e.g. selection of specific technologies, reuse of specific IT assets, centralization of specific types of data, etc.) and local project-specific needs and requirements. Generally, the use of Project Implementers for delivering IT projects is the only existing mechanism in an EA practice to convert all intangible architectural decisions reflected on other “upstream” types of EA artefacts into tangible IT systems.

The general purpose of the role of Project Implementers is to help implement approved IT projects according to business and architectural requirements. Business requirements to IT projects usually include both functional and non-functional specifications for new IT systems, while architectural requirements to IT projects typically include key architectural suggestions regarding the implementation of these IT systems significant from the organization-wide perspective, e.g. appropriate technologies and vendor products. Project

Implementers help stipulate all the essential requirements from both the business and IT perspectives in advance and then ensure the compliance with these requirements during the project implementation. Thereby, Project Implementers enable clear traceability between the specified business requirements and actual functional capabilities of delivered IT systems as well as between the recommended and actual implementation approaches followed in these IT systems.

Project Implementers are developed collaboratively by Architects and Project Teams based on corresponding Value Estimators previously approved by Business Leaders. Specifically, high-level IT solutions described in Outlines are taken as the starting point for developing Designs and further elaborated with more implementation-specific technical details. All developed Designs are typically peer-reviewed by other architects and then undergo the procedure of a formal approval and sign-off. After being developed and approved, Project Implementers are used by Project Teams to implement IT projects. Project Implementers are "blueprints" of IT projects defining what exactly needs to be done to deliver these projects. They are actively used by project managers, software developers, database administrators, infrastructure engineers, testers and other project team members to coordinate their implementation activities. In some cases project teams may produce more detailed technical documentation for IT projects based on their architectural Designs in order to provide even more fine-grained implementation plans. During the whole period of the project implementations Architects supervise Project Teams to ensure that the prescriptions of Project Implementers are actually followed.

Project Implementers improve the overall quality of project delivery in organizations. When planning specific IT projects, Project Implementers allow identifying key risks associated with the project delivery, mitigating potential problems and selecting appropriate implementation approaches in advance. Project Implementers help avoid misunderstanding and confusion between all the parties involved in project implementation. They offer cornerstones for project delivery and provide common reference points for all project stakeholders and team members. As a result, the project delivery risks are lowered, deviations from the agreed requirements, budgets and timelines are minimized, and the overall system development process is streamlined.

The general meaning of the Project Implementers role is typically described by the interviewees with the following or similar statements:

> *"We get it [solution design] developed for the project with all the necessary details, and then for the whole duration of the implementation of the project that document is a key cornerstone document providing guidance for what we [project team] are implementing"* (Project Manager, Educational Institution)

> *"Full solution architecture's role is to inform all the downstream design and implementation work. It needs to be complete enough, so a [technical] designer can say "I know what is intended here, I know what components I need, I know what standards I need""* (Solution Architect, Delivery Institution)

> *"Then we go down to the design, we call it a high-level design. A high-level design is something like a mixture of architecture and design. It is how that [higher-level] architecture is going to be implemented. [In a high-level design] we are getting towards how many boxes we need, how many wires we need, more detail"* (Enterprise Architect, Financial Institution)

> *"Our role is to translate the business requirements into full solution architecture. But then there are designers who are the key consumers of that architecture. They will translate it into the specific implementation"* (Solution Architect, Delivery Institution)

The role of Project Implementers structured according to the established four-domain theoretical framework (see Figure 4.3) is shown in Figure 5.5.

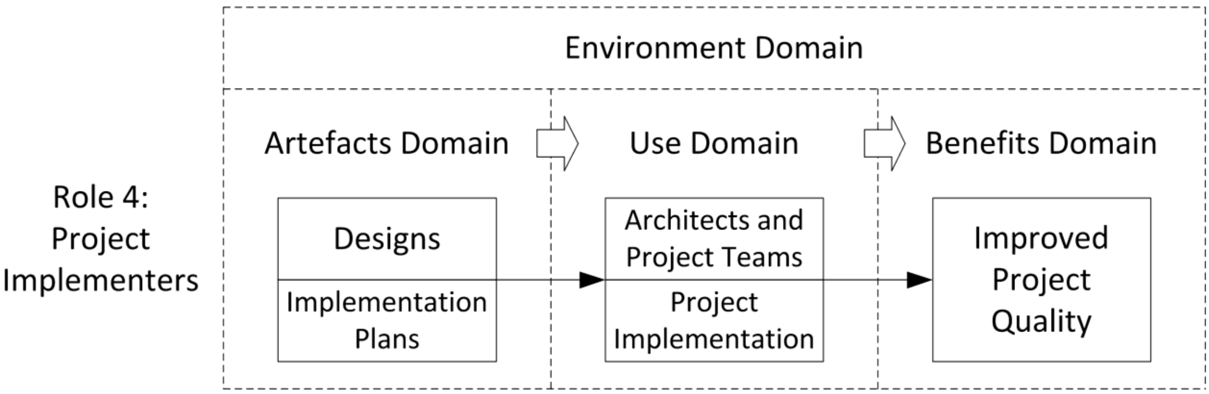

Figure 5.5. The role of Project Implementers

5.2.5. Strategic Aligners

Strategic Aligners is the role of EA artefacts which implies showing the overall long-term direction for future IT investments to ensure their close alignment with the business strategy. This role in the context of an EA practice is fulfilled specifically by Visions EA artefacts, i.e. business capability models, roadmaps, blueprints, etc.

The overall meaning of the role of Strategic Aligners is providing shared views of an organization and its future agreed by business and IT. They establish a common general future direction for all relevant actors involved in strategic decision-making and implementation of IT systems. Often Strategic Aligners are relevant to an entire organization. However, in highly decentralized organizations major business units (e.g. lines of business or divisions) can also develop their own Strategic Aligners reflecting local unit-specific strategies consistent with the global organization-wide strategy.

The general purpose of the role of Strategic Aligners is to help achieve the alignment between IT investments and long-term business outcomes. Using Strategic Aligners, Business Leaders and Architects can agree on the future course of action for IT and make sure that all planned IT investments contribute to the strategic business goals.

Strategic Aligners are developed collaboratively by Business Leaders and Architects. Thereby, they help synchronize business and IT plans, align future IT investments to the business strategy and facilitate day-to-day strategic communication between Business Leaders and Architects. After being approved, Strategic Aligners are used to guide IT investments, identify, prioritize and launch new IT initiatives. Firstly, Strategic Aligners help focus future IT investments on the business areas of strategic importance. High-level descriptions of an organization and its future provided by Visions help Business Leaders determine where exactly future IT investments should go to support the business strategy. Secondly, Strategic Aligners help arrange IT initiatives according to their business importance. They help Business Leaders understand when and in what sequence new IT initiatives should be launched. Thirdly, Strategic Aligners are used to understand which IT initiatives should be kicked off in the immediate future in order to execute the business strategy. The alignment of new IT initiatives to Strategic Aligners is usually achieved via formal governance procedures and mechanisms, when the EA artefacts fulfilling the role of Value Estimators (Outlines) are reviewed by Business Leaders and Architects to ensure their conformance with the high-level strategic plans outlined in Strategic Aligners.

Strategic Aligners improve the long-term effectiveness of IT investments and strategic business and IT alignment. Since Business Leaders align Strategic Aligners to their business strategy, all IT investments aligned to Strategic Aligners become "automatically" aligned to the business strategy. All IT initiatives guided by Strategic Aligners are explicitly linked to desirable strategic business outcomes. In other words, Strategic Aligners enable clear traceability between the organizational business strategy and its IT initiatives.

The general meaning of the Strategic Aligners role is typically described by the interviewees with the following or similar statements:

> *"The business capability model is used to represent the business of the organization. Its key purpose is to facilitate conversation around where the business wants to prioritize its investments. In our capability model for supply chain there might be around 30 capabilities, but we have only a limited set of resources. So, we recommend that you invest 20% of your IT budget into this capability because this capability is absolutely critical, but currently it is being neglected. It should be a number one priority on the [investment] roadmap. This is how we use our business capability model to facilitate a conversation with our business colleagues"* (Enterprise Architect, Retail Institution)

> *"If you say "I want to uplift my cross sale", then we look at the capability model to understand what we have in the company for our capabilities and what our gaps are. And then we translate that into initiatives"* (General Manager for Architecture and Strategy, Financial Institution)

> *"Roadmaps are largely for a senior executive audience in the university to make investment planning decisions"* (Director of Architecture, Educational Institution)

> *"The roadmap is a document that helps the business make decisions about its IT investments. So, it has to be framed that way. Showing a number of connections [between systems] does not help them [make investment decisions]"* (Enterprise Architect, Retail Institution)

The role of Strategic Aligners structured according to the established four-domain theoretical framework (see Figure 4.3) is shown in Figure 5.6.

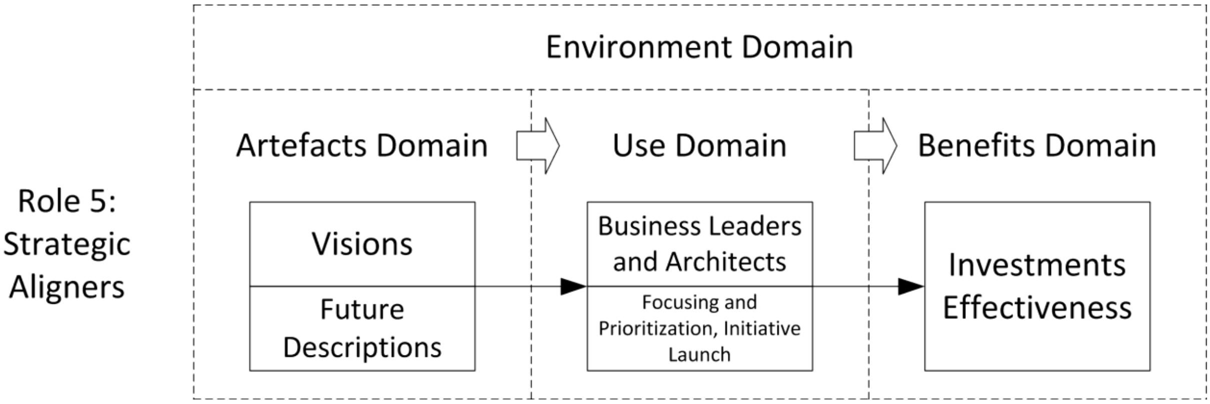

Figure 5.6. The role of Strategic Aligners

5.2.6. Value Estimators

Value Estimators is the role of EA artefacts which implies estimating the overall business value of proposed IT initiatives to justify corresponding IT investments. This role in the context of an EA practice is fulfilled specifically by Outlines EA artefacts, i.e. solution overviews, conceptual architectures, idea briefs, etc.

The overall meaning of the role of Value Estimators is essentially providing benefit, time and price tags for proposed IT initiatives. To Business Leaders they provide the most essential business information regarding each proposed IT initiative: expected business value, completion times and estimated costs. In other words, Value Estimators explain to business executives what business value will be delivered if a particular IT initiative is approved, when and for what price. Value Estimators typically explain both the strategic and tactical business value expected from the implementation of an IT initiative. Cost estimates provided in Outlines often include the initial financial investments required to deliver the IT initiative, or capital expenses (CAPEX), the recurring financial expenditures required to support the IT solution in the future, or operating expenses (OPEX), as well as the overall direct and indirect costs of the IT solution during its complete lifecycle, or total cost of ownership (TCO).

The general purpose of the role of Value Estimators is to help estimate the overall business impact and value of proposed IT initiatives. The use of Value Estimators for describing proposed IT initiatives allows Business Leaders to evaluate the advantages and disadvantages of specific IT initiatives, prioritize them based on their perceived importance and make informed investments decisions regarding these initiatives at their early stages. Value Estimators help Business Leaders select and fund only the most valuable IT initiatives with maximum payoff from the overall pool of all proposed initiatives. Essentially, Value Estimators are intended to “sell” corresponding IT initiatives to Business Leaders.

Value Estimators are developed for all proposed IT initiatives at their early stages by Architects with a significant involvement of relevant Business Leaders. Value Estimators often start their existence from early informal discussions of the general idea of the IT initiative between Architects and Business Leaders. Then, they are elaborated with more detail during the ongoing discussions with relevant business stakeholders and get formally approved by their executive sponsors. Value Estimators are often developed in parallel with business cases for IT initiatives and these business cases are typically based on the estimates of time and cost provided by Value Estimators. After being developed, Value Estimators are used by Business Leaders and Architects to assess, approve and fund specific IT initiatives. In particular, Value Estimators and corresponding business cases for proposed IT initiatives often undergo a formal approval and sign-off procedure involving senior business and IT stakeholders responsible for making IT investment decisions. As part of this procedure Value Estimators and business cases for IT initiatives are assessed from different perspectives and then the final investment decision regarding each IT initiative is made.

Value Estimators increase the returns on IT investments (ROI) and improve their efficiency. Using Value Estimators for prioritizing IT initiatives allows picking the most valuable IT initiatives, which deliver considerable business value for their costs, and thereby maximize the benefits/costs ratio for all IT investments. Value Estimators help Business Leaders consciously approve each IT investment based on an objective analysis of its benefits and costs, understand where IT dollars are spent, ensure transparency of investments and boost their efficiency.

The general meaning of the Value Estimators role is typically described by the interviewees with the following or similar statements:

> *"An idea brief provides the business information about the initiative: the benefits, the costs, what roughly it is going to deliver and what it is all about"* (Enterprise Architect, Delivery Institution)

> *"A solution overview is a high-level architectural document for a project. It is usually used to inform the business case. For example, it is often used as the basis for obtaining high-level estimates that feed into a business case"* (Solution Architect, Retail Institution)

> *"A blueprint explains that if you spend ten million dollars on the project, then these are the benefits you will get. [...] So, the blueprint is used to tell them*

[funding committee] "we know the solution, we know the steps and these are the benefits". We present blueprints to the funding committee to justify the spendings" (Enterprise Architect, Financial Institution)

"We need the idea brief to get to the point where we can say "yes, there is enough interest in this initiative, so we want to have a project", and then we will assign some money. [...] We use an idea brief during the project gating process to make sure that the money is being spent in the right way, that it is being spent wisely" (Principal Architect, Delivery Institution)

The role of Value Estimators structured according to the established four-domain theoretical framework (see Figure 4.3) is shown in Figure 5.7.

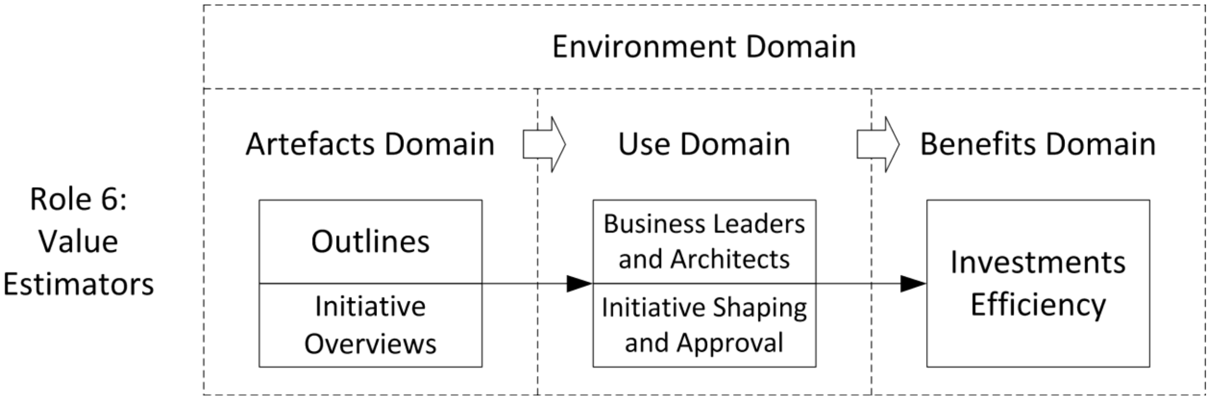

Figure 5.7. The role of Value Estimators

5.2.7. Dimensions of the Six Identified Roles

The six identified roles of EA artefacts represent six consistent organization-independent storylines structured around the usage of particular EA artefacts by relevant actors for specific purposes. Each of the six roles is characterized by underlying Artefacts, corresponding Information, specific Usage, involved Users and resulting organizational Benefits. These five core aspects of each role are represented by separate concepts from the underlying conceptual framework (see Figure 5.1). As discussed earlier, the concepts related to Artefacts, Information, Usage and Users categories can be analysed from the perspective of ten dimensions (see Table 4.2, Table 4.3, Table 4.4 and Table 4.5). Similar dimensions can be also applied to analyse various properties of respective roles of EA artefacts as well. A comprehensive comparison of the six identified roles of EA artefacts based on their key properties derived from the dimensions of underpinning concepts is summarized in Table 5.1.

Table 5.1. The comparison of the six roles of EA artefacts

Role	Context Setters	Instrument Providers	Knowledge Repositories	Project Implementers	Strategic Aligners	Value Estimators
General meaning	Overarching organizational context for information systems planning	Proven reusable means for IT systems implementation	Knowledge base of reference materials on the IT landscape	Communication interfaces between architects and project teams	Shared views of an organization and its future agreed by business and IT	Benefit, time and price tags for proposed IT initiatives
Key purpose	Help achieve the agreement on basic principles, values, directions and aims	Help achieve technical consistency and technological homogeneity	Help understand, analyse and modify the structure of the IT landscape	Help implement approved IT projects according to business and architectural requirements	Help achieve the alignment between IT investments and long-term business outcomes	Help estimate the overall business impact and value of proposed IT initiatives
Supporting Artefacts	Considerations (e.g. principles, maxims, policies, etc.)	Standards (e.g. TRMs, patterns, IT principles, etc.)	Landscapes (e.g. inventories, one-page diagrams, etc.)	Designs (e.g. solution designs, technical designs, etc.)	Visions (e.g. BCMs, roadmaps, blueprints, etc.)	Outlines (e.g. solution overviews, idea briefs, etc.)
Representation format and volume	Expressed in simple intuitive formats, often as brief written statements	Can be expressed in various formats, often using strict notations	Expressed in strict formats, often as complex one-page diagrams	Expressed as a mix of text, tables and diagrams, can be very voluminous	Expressed in brief informal formats, often as simple one-page diagrams	Expressed as a mix of textual descriptions and simple diagrams
Lifecycle	Developed once and then updated according to the ongoing changes in the business environment	Developed once and then updated according to the ongoing technology progress	Developed once and then and updated according to the evolution of the IT landscape	Developed at the later stages of IT initiatives for implementation and then archived	Developed once and then updated according to the ongoing changes in the business strategy	Developed at the early stages of IT initiatives to support decision-making and then archived
Relevant Information	Conceptual Requirements	Implementation Recommen-dations	Landscape Descriptions	Implementation Plans	Future Descriptions	Initiative Overviews
Embraced scope	Entire organizations or business units	Entire organizations or business units	Organizations, business units or areas	Separate IT projects	Organizations, business units or areas	Separate IT initiatives
Covered domains	Usually business and sometimes data domains	Various non-business domains	All technical domains and sometimes business domain	Usually all four domains	Usually business and sometimes systems domains	Usually business, systems and data domains
Time focus	Do not focus on specific points in time or focus on the long-term	Do not focus on specific points in time or focus on the current state	More focus on the current state	Usually focus on the short-term future up to one year ahead	Often focus on the long-term future up to 3-5 years ahead	Usually focus on the mid-term future up to 1-2 years ahead

	future					
Involved Users	Business Leaders and Architects	Architects	Architects	Architects and Project Teams	Business Leaders and Architects	Business Leaders and Architects
Associated Usage	Decisions Guidance	Implementation Guidance	Lifecycle Management, Knowledge Sharing and Initiative Planning	Project Implementation	Focusing and Prioritization and Initiative Launch	Initiative Shaping and Approval
Organizational integration	Created and used mostly as part of strategic management	Used as part of the project lifecycle	Used mostly as part of the project lifecycle	Created and used as part of the project lifecycle	Created and used as part of strategic management	Created and used as part of the project lifecycle
Actor involvement	Bilateral, both business and IT	Unilateral, only IT	Unilateral, only IT	Unilateral, only IT	Bilateral, both business and IT	Bilateral, both business and IT
Resulting Benefits	Improved Consistency and Improved Compliance	Increased Delivery Speed, Reduced Complexity and Risk, Reduced Cost and Improved Interoperability	Increased Agility, Reuse and Consolidation and Reduced Legacy	Improved Project Quality	Investments Effectiveness	Investments Efficiency

5.3. Relationships Between the Six Roles of EA Artefacts

The analysis of the six roles of EA artefacts described above suggests that these roles are closely linked with each other (the initial effort to explain the interrelationships between the roles of EA artefacts has been done earlier in Chapter 4, see Figure 4.4). In particular, specific roles of EA artefacts often influence other roles thereby creating a complex interrelated system representing an EA practice. These relationships between the six roles of EA artefacts are described in the sections below.

5.3.1. Relationships of Context Setters

The meaning of the Context Setters role is providing the overarching organizational context for information systems planning. Therefore, all other roles of EA artefacts essentially exist in the global context provided by Context Setters. Fundamental planning decisions embodied in Context Setters influence all the “downstream” planning decisions embodied primarily in Instrument Providers, Strategic Aligners and Value Estimators. All these roles align to the global planning requirements stipulated by Context Setters. However, Knowledge Repositories still might be considered as a largely context-free role which is intended mostly to capture the current structure of the IT landscape and implies little or no actual planning, while Project Implementers deal with purely technical implementation-level issues that are often not influenced by Context Setters directly.

5.3.2. Relationships of Instrument Providers

The meaning of the Instrument Providers role is providing proven reusable means for IT systems implementation. These means are influenced by Context Setters defining, among other things, the overarching requirements for all technical and technological choices. Accordingly, Instrument Providers are aligned to Context Setters. In their turn, Instrument Providers offer the technical implementation-level guidelines for Value Estimators at the early evaluation stages of IT initiatives as well as for Project Implementers at the later implementation stages of these initiatives. At the same time, by influencing the technical structures of implemented IT systems Instrument Providers also eventually shape the entire IT landscapes resulting from the implementation of these systems thereby indirectly shaping Knowledge Repositories reflecting the structure of this landscape.

5.3.3. Relationships of Knowledge Repositories

The meaning of the Knowledge Repositories role is providing a knowledge base of reference materials on the IT landscape. This knowledge base offers a comprehensive description of the existing IT environment supporting the high-level planning and early evaluation of proposed IT initiatives via Value Estimators and then more detailed planning and implementation of these initiatives via Project Implementers. Knowledge Repositories also often provide technical constraints to Strategic Aligners since some strategic options might be essentially infeasible with the current structure of the IT landscape and available IT assets. At the same time, Knowledge Repositories are typically updated after completion of every IT project accomplished via Project Implementers. Moreover, they are also shaped indirectly by Instrument Providers which influence the overall structure of the IT landscape thorough separate IT projects.

5.3.4. Relationships of Project Implementers

The meaning of the Project Implementers role is providing implementable architectural designs to IT project teams. Project Implementers is essentially the “last” role in the overall EA delivery chain. They benefit from the technical implementation guidelines offered by Instrument Providers as well as from the information on the surrounding IT environment provided by Knowledge Repositories. Most importantly, Project Implementers are based on the high-level overviews of proposed IT solutions previously approved by business leaders via Value Estimators. Additionally, Project Implementers essentially update Knowledge Repositories reflecting the structure of the IT landscape via facilitating the delivery of corresponding IT solutions modifying this landscape.

5.3.5. Relationships of Strategic Aligners

The meaning of the Strategic Aligners role is providing shared views of an organization and its future agreed by both business and IT. On the one hand, these views are influenced by Context Setters which provide certain boundaries for possible planning decisions, options and solutions. For this reason Strategic Aligners are naturally closely aligned to Context Setters. Strategic Aligners may be also constrained by Knowledge Repositories providing the boundaries of technically feasible strategic planning options. On the other hand, Strategic Aligners provide the basis for launching new IT initiatives and the business value of these initiatives is evaluated at their earlier stages via Value Estimators. From this perspective, Strategic Aligners essentially initiate the work of Value Estimators.

5.3.6. Relationships of Value Estimators

The meaning of the Value Estimators role is providing benefit, time and price “tags” for proposed new IT initiatives. These IT initiatives are launched based on global Strategic Aligners and influenced by Context Setters. They also benefit from the general solution implementation guidelines offered by Instrument Providers as well as from the information on the current IT environment provided by Knowledge Repositories. After being approved by business leaders, Value Estimators provide the basis for developing more detailed technical Project Implementers to deliver the IT initiatives as agreed with their executive sponsors.

5.3.7. Interrelationships Between the Six Roles

The understanding of the existing interrelationships between the roles of EA artefacts described above allows providing a comprehensive view of these roles as a unified dynamic system of diverse but complementary components. The most essential conceptual relationships between the six roles of EA artefacts expressed through the corresponding usage scenarios (Usage concepts) are summarized graphically in Figure 5.8.

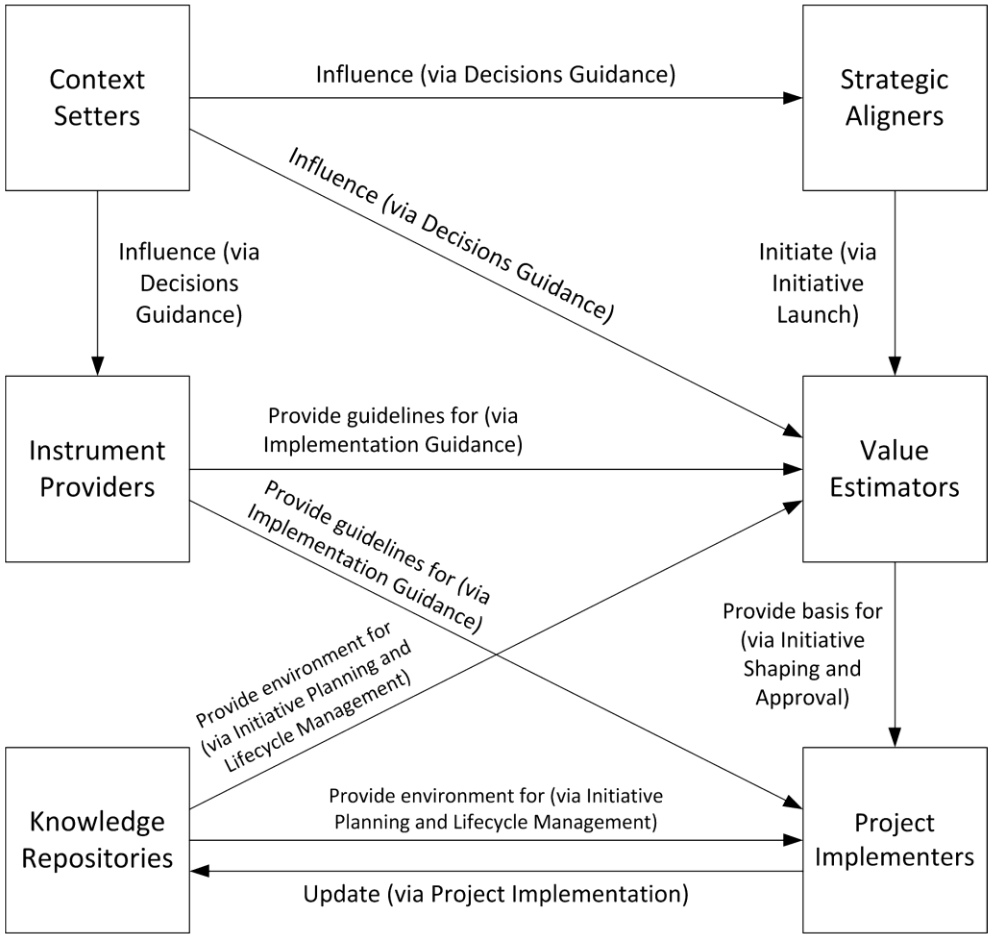

Figure 5.8. Relationships between the six roles of EA artefacts

Figure 5.8 provides a high-level explanatory view describing how exactly different roles of EA artefacts dynamically synergize with each other to compose a working EA practice helping deliver technically optimal IT solutions aligned to the global business strategy.

5.4. The Influence of Environment on the Six Roles of EA Artefacts

The aggregation of the relevant environmental factors and their impacts on the roles of EA artefacts identified earlier as part of the data analysis for corresponding organizations (see Figure 4.13, Figure 4.20, Figure 4.26 and Figure 4.31) provides a comprehensive theoretical view explaining the influence of both internal and external factors on the six resulting roles of EA artefacts. The influence of these factors on the roles of EA artefacts can be conditionally separated into three main categories:

- Positive influence – the influence that enhances effectiveness of corresponding EA artefacts in realizing the anticipated benefits from their usage
- Negative influence – the influence that undermines effectiveness of respective EA artefacts in achieving the expected benefits
- Qualitative influence – the influence that neither increases nor reduces effectiveness directly, but rather shifts the meaning or modifies some aspects of the corresponding roles of EA artefacts

The overall influence of the internal organizational context and external business environment on the six roles of EA artefacts is described in detail in the following sections.

5.4.1. The Influence of Internal Factors

The grounded theory data analysis conducted as part of this study identified seven different factors of the internal organizational context having considerable influence on the six roles of EA artefacts: Agile Delivery, Industry, Maturity, Outsourcing, Size, Structure and Tools.

Agile Delivery represents the inclination to implement new IT projects with little upfront architectural planning (Cohn, 2005). Agile Delivery impacts the role of Project Implementers via minimizing the volume of corresponding EA artefacts (Designs) and reducing "traditional" benefits related to Improved Project Quality, e.g. full traceability of business and architectural requirements.

Industry factor stands for the industry-specific IT "savvyness" and culture of the relationship between business and IT (Weill and Aral, 2004; Weill and Aral, 2005). Organizations in less IT savvy industry sectors require involvement of specialized liaison roles (e.g. engagement managers and solution consultants found in Educational Institution) in the roles of Strategic Aligners and Value Estimators to facilitate the communication between architects and senior business stakeholders. However, liaisons do not have their own planning objectives and, from the perspective of the actor-network theory (Sidorova and Kappelman, 2010; Sidorova and Kappelman, 2011), do not inscribe their interests in corresponding EA artefacts.

Maturity represents the overall maturity of an EA practice (DoC, 2007; NASCIO, 2003; Venkatesh et al., 2007). Organizations with more mature EA practices are able to plan their future states from both business and IT perspectives more explicitly thereby facilitating the realization of corresponding benefits from the Strategic Aligners and Knowledge Repositories roles.

Outsourcing stands for the significant dependence of an organization on the outsourcing arraignments for delivery of its IT projects. Outsourcing essentially shifts the focus of Project Implementers from enabling communication between architects and project teams to facilitating collaboration between internal architects and external IT specialists involved in the project implementation activities.

Size represents the size of an organization from the IT perspective, e.g. number of its IT systems and staff. Size influences the roles of Value Estimators, Project Implementers and Knowledge Repositories. Firstly, larger organizations more often execute full-fledged IT programs consisting of multiple IT projects shifting the focus of Value Estimators from separate projects to larger programs. Secondly, larger organizations tend to implement IT initiatives in two phases with high-level technical planning and then more detail technical planning modifying the role of Project Implementers. Thirdly, larger organizations tend to have more formal Knowledge Repositories necessary for capturing and analysing the structure of their extensive IT landscapes.

Structure of an organization can have a different impact on the roles of EA artefacts for functional structures and line-of-business structures. On the one hand, functional structures require organization-wide semantic and technical data consistency for enabling effective data exchange across different business functions and therefore shift the roles of Context Setters and Instrument Providers towards facilitating this consistency at conceptual and physical levels respectively. On the other hand, line-of-business structures imply high autonomy of decision-making and planning in different business units and therefore modify the roles of Context Setters and Strategic Aligners from supporting organization-wide planning to supporting unit-specific planning.

Finally, Tools represent software tools used in an organization to create, store and manage EA artefacts (McGregor, 2016; Searle and Kerremans, 2017). The use of specialized software tools for EA helps organizations better organize their Knowledge Repositories and realize greater benefits from the usage of corresponding EA artefacts (Landscapes). The impact of internal factors on the six roles of EA artefacts classified into positive, negative and qualitative influence is summarized in Figure 5.9.

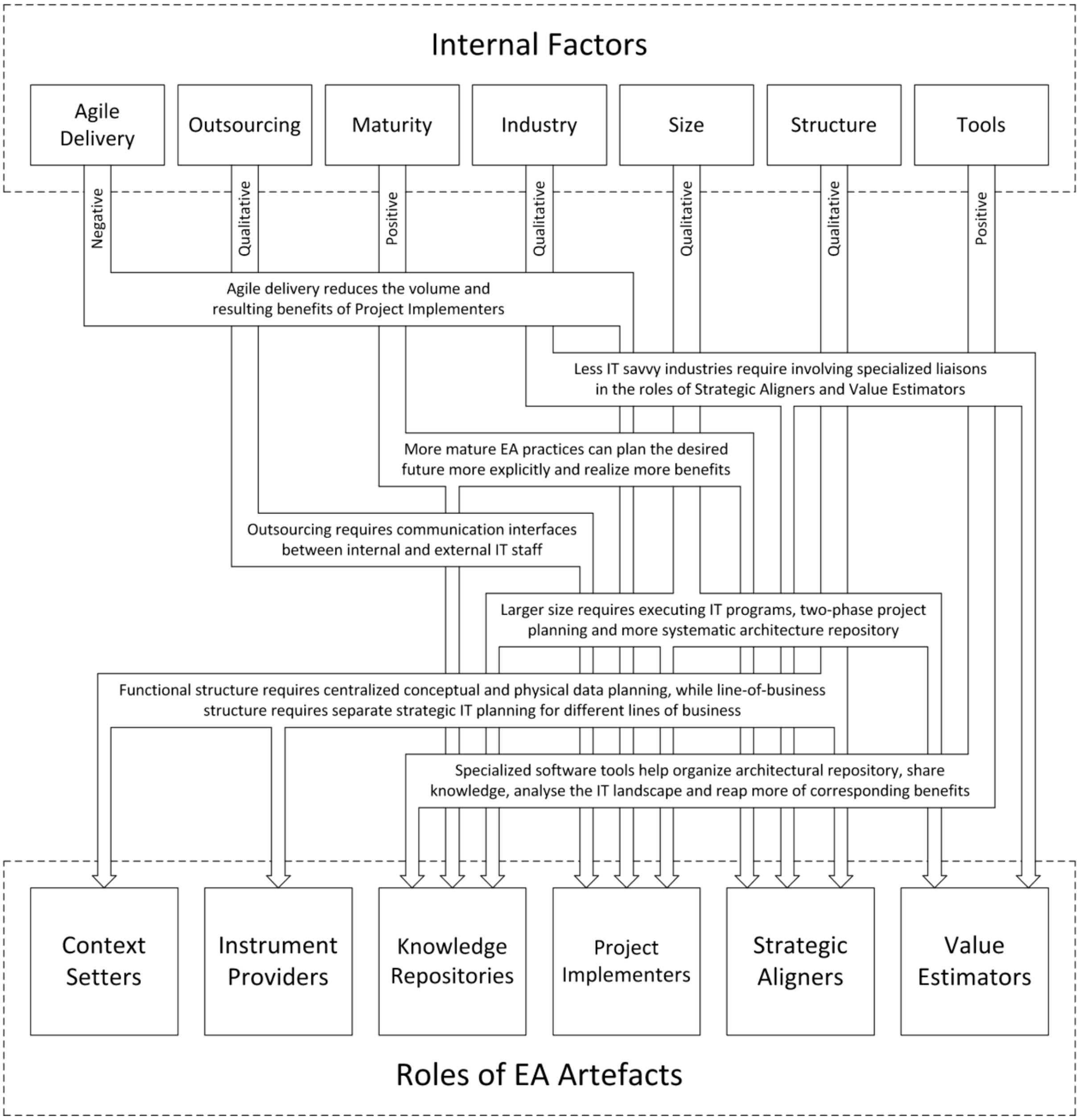

Figure 5.9. The influence of internal factors on the six roles of EA artefacts

5.4.2. The Influence of External Factors

The grounded theory data analysis identified three different factors of the external business environment having considerable influence on the six roles of EA artefacts: Legislative Regulation, Strategic Uncertainty and Vendor Dependence.

Legislative Regulation represents the dependence of an organization on the regulatory norms imposed by external industry regulators or national governments. Legislative Regulation shifts the role of Context Setters towards incorporating relevant legislative context, thereby, facilitating the achievement of the necessary degree of regulatory compliance.

Strategic Uncertainty stands for quickly changing business environment causing constant updates of the business strategy, priorities and objectives. Strategic Uncertainty naturally undermines the very meaning of the role of Strategic Aligners intended to align long-term IT investments to strategic business goals.

Vendor Dependence represents the technical dependence of an organization on the products and technologies provided by a few key strategic vendors. Significant Vendor Dependence essentially prevents an organization from controlling its own technology portfolio, delegates important technological choices to its vendors and undermines the realization of benefits from the role of Instrument Providers. The impact of external factors on the six roles of EA artefacts classified into positive, negative and qualitative influence is summarized in Figure 5.10.

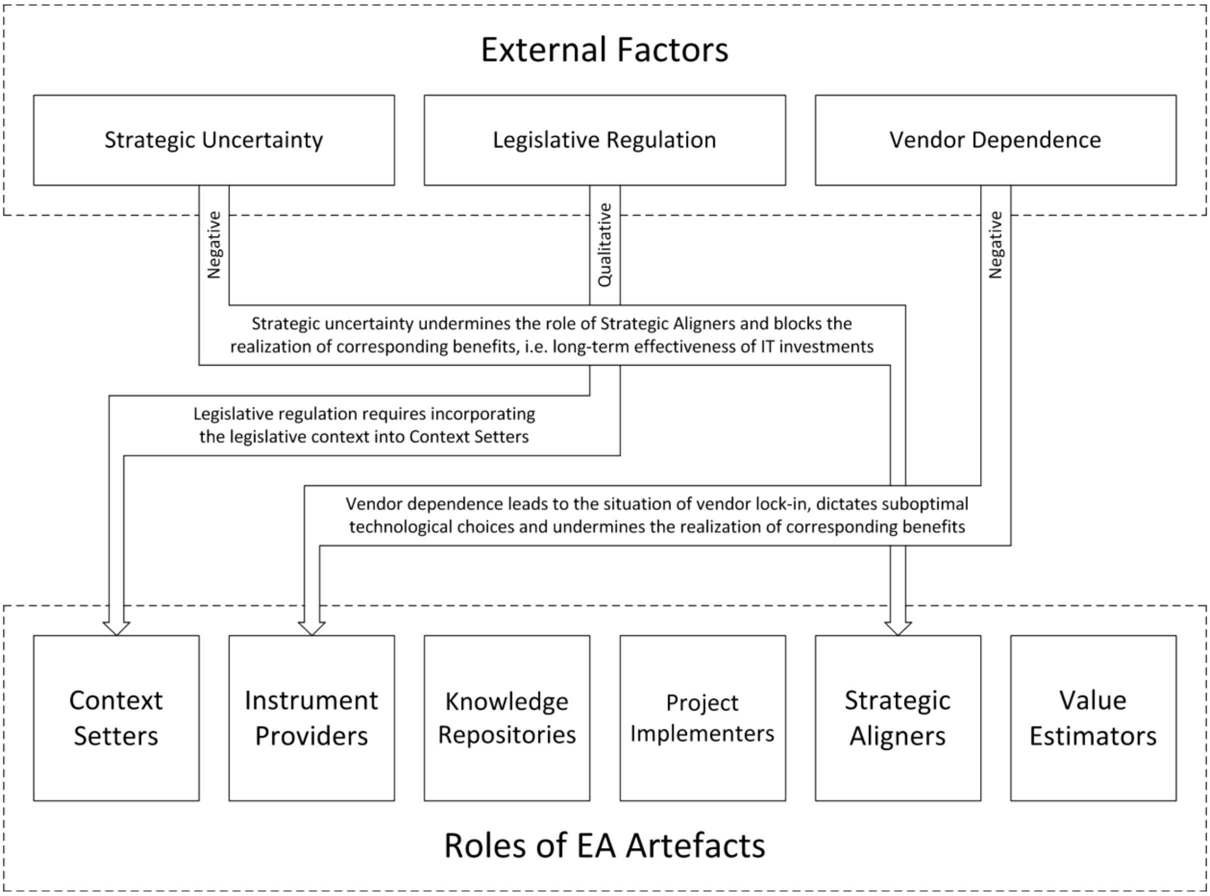

Figure 5.10. The influence of external factors on the six roles of EA artefacts

5.5. EA Benefits Realization and the Six Roles of EA Artefacts

A clear understanding of the six roles of EA artefacts, their mutual interrelationships and the influence of environmental factors on these roles allows further theorizing on the mechanisms of the EA benefits realization.

5.5.1. Realization of EA Benefits Through Using EA Artefacts

The six roles of EA artefacts imply that the proper usage of different types of EA artefacts leads to the realization of corresponding type-specific benefits for an organization (see Figure 5.2, Figure 5.3, Figure 5.4, Figure 5.5, Figure 5.6 and Figure 5.7). For instance, the role of Strategic Aligners is closely associated with the improved strategic effectiveness of IT investments, while the role of Instrument Providers is associated with reduced costs, risks and complexity.

However, it is important to understand that the benefits associated with most roles of EA artefacts are never materialized directly, i.e. merely by reflecting specific planning decisions in respective EA artefacts. Of all the six roles of EA artefacts, only the role of Project Implementers implies creating tangible IT systems and actually modifying the organizational IT landscape (via Project Implementation Usage), while all other roles of EA artefacts only convey some higher-level planning decisions that cannot be implemented directly, but should be taken into account sometime later during the subsequent "downstream" planning activities to benefit organizations. Since Project Implementers represent the "last" link in the EA delivery chain and the only available means of materializing all organization-wide and project-level planning decisions in concrete IT solutions, all planning decisions represented in other roles of EA artefacts should be eventually "embedded" in Project Implementers, directly or indirectly, to take any real effect for an organization. For example, Strategic Aligners defining the appropriate long-term focus for future IT investments do not bring any business value if the actual IT solutions delivered via Project Implementers are not initiated according to the suggestion of Strategic Aligners, e.g. do not intend to improve the "heatmapped" business capabilities or processes. Similarly, Instrument Providers defining perfect implementation approaches are completely useless unless the recommended approaches are actually incorporated into Project Implementers to be followed during the implementation of new IT systems.

Essentially, Project Implementers represent a "funnel" through which all new IT systems emerge directly, though indirectly shaped by all the "earlier", more abstract planning decisions represented in other roles of EA artefacts. Aligning Project Implementers to the suggestions of other roles allows delivering new IT projects that:

- Contribute to the long-term strategic goals (aligned to the suggestions of Strategic Aligners)
- Bring reasonable tactical business value (based on approved Value Estimators)

- Use proven technologies and approaches (follow recommendations of Instrument Providers)
- Properly leverage and integrate with existing IT systems (fit into the IT environment described in Knowledge Repositories)
- Do not undermine overall consistency (aligned to the conceptual requirements of Context Setters)

A clear understudying of which planning decisions are represented by which roles as well as how these decisions are taken into account during subsequent decision-making (see Figure 5.8) allows building a detailed “cause and effect” benefits realization network explaining how exactly abstract planning decisions reflected in most EA artefacts are eventually translated into concrete IT systems materializing the corresponding benefits from these decisions. The resulting EA benefits realization network based on the six roles of EA artefacts describing direct “physical” causes and indirect beneficial effects of these causes is shown in Figure 5.11.

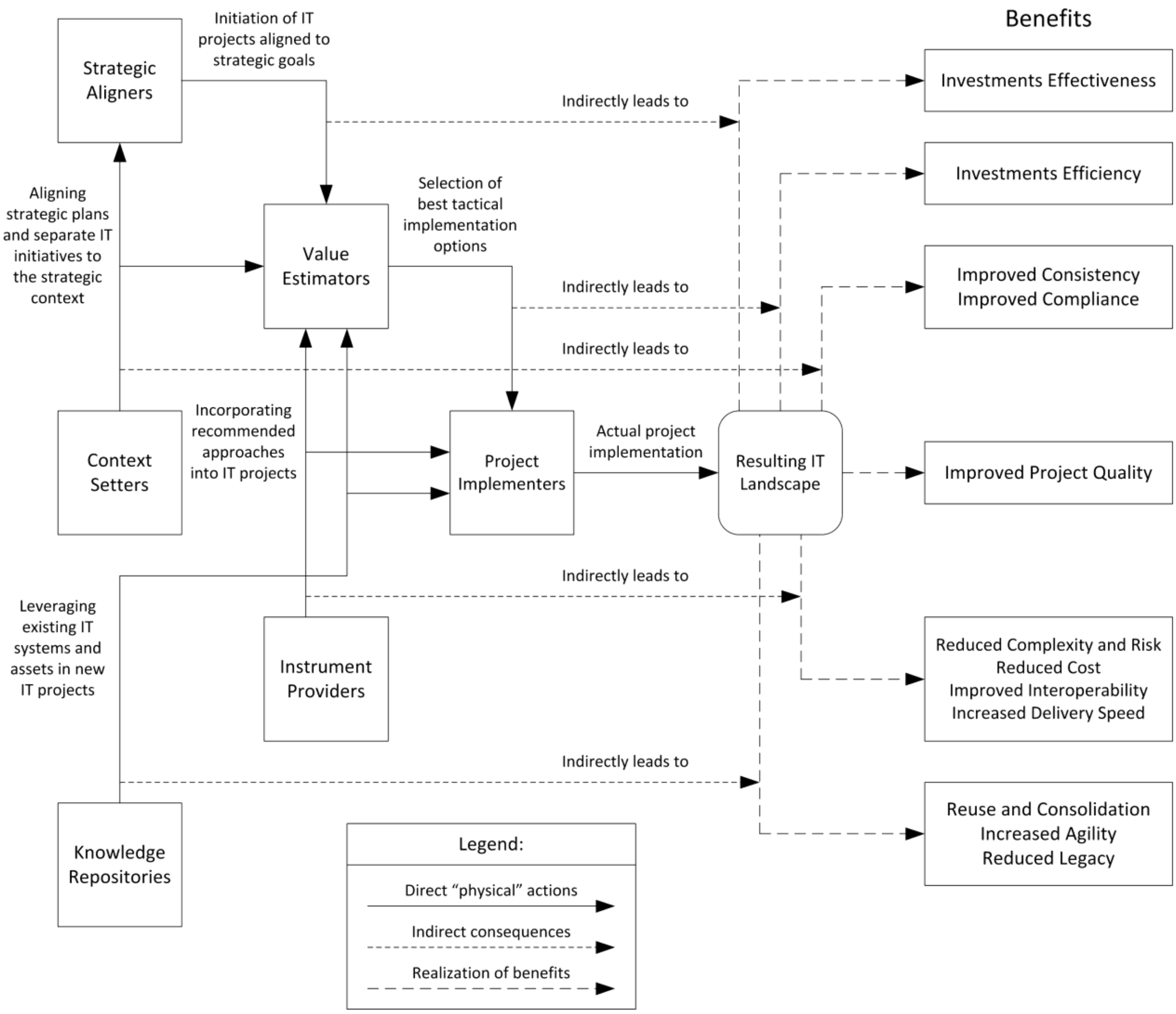

Figure 5.11. EA benefits realization network

5.5.2. Theoretical Propositions Explaining the Benefits Realization

An understanding of the six roles of EA artefacts and the impact of internal and external factors on these roles (see Figure 5.9 and Figure 5.10) allows constructing a number of testable theoretical propositions explaining the realization of corresponding benefits from the usage of particular types of EA artefacts. For example, the role of Context Setters suggests that the practical usage of Considerations, e.g. principles and policies, leads specifically to improved consistency and compliance via explicitly assessing key IT-related planning decisions against the established global rules documented in Considerations (according to the mechanisms explained earlier in Figure 5.11). Similarly, the role of Value Estimators suggests that the practical usage of Outlines, e.g. solution overviews and conceptual architectures, leads specifically to improved efficiency and ROI of IT investments via explicitly discussing the estimated benefits and costs of all proposed IT initiatives based on their Outlines and then picking and sponsoring only the most valuable initiatives. Following the analogous logic for other roles of EA artefacts and taking into account the influence of relevant environmental factors on these roles, ten verifiable propositions can be formulated explaining the connection between the usage of specific EA artefacts and resulting benefits as well as the key mechanisms and moderating factors of their realization:

> **Proposition 1**: The use of Consideration leads to improved consistency and compliance via explicitly evaluating all planning decisions for their organizational fitness

> **Proposition 2a**: The use of Designs leads to improved project quality via explicitly stipulating all business and architectural requirements, as well as the ways of addressing these requirements, for all IT projects

> **Proposition 2b**: The realization of benefits from using Designs related to project quality is negatively influenced by agile approaches to project delivery implying limited upfront project planning

> **Proposition 3a**: The use of Landscapes leads to reduced legacy, increased agility, reuse and consolidation via explicitly analysing the structure of the current IT landscape and then reusing and decommissioning appropriate IT assets

> **Proposition 3b**: The realization of benefits from using Landscapes is positively influenced by the use of software tools helping analyse the structure of the IT landscape and by the maturity of an EA practice allowing more proactive planning in terms of reusing, consolidating and decommissioning IT assets (however, greater maturity is not associated with increased agility)

> **Proposition 4**: The use of Outlines leads to improved efficiency of IT investments via explicitly discussing the benefits and costs of all proposed IT investments

> **Proposition 5a**: The use of Standards leads to faster initiative delivery, reduced costs, risks and complexity via explicitly selecting and reusing proven technologies and implementation approaches for all new IT projects

Proposition 5b: The realization of benefits from using Standards is negatively influenced by vendor dependence dictating non-optimal technological choices and implementation approaches

Proposition 6a: The use of Visions leads to improved effectiveness of IT investments via explicitly discussing and documenting the desired future course of action for IT

Proposition 6b: The realization of benefits from using Visions is negatively influenced by environmental uncertainty constantly shifting strategic priorities and goals of an organization

These ten propositions can be consolidated into a comprehensive theoretical model explaining the realization of benefits from different types of EA artefacts moderated by relevant environmental factors. The unified theoretical model of the EA benefits realization is shown in Figure 5.12.

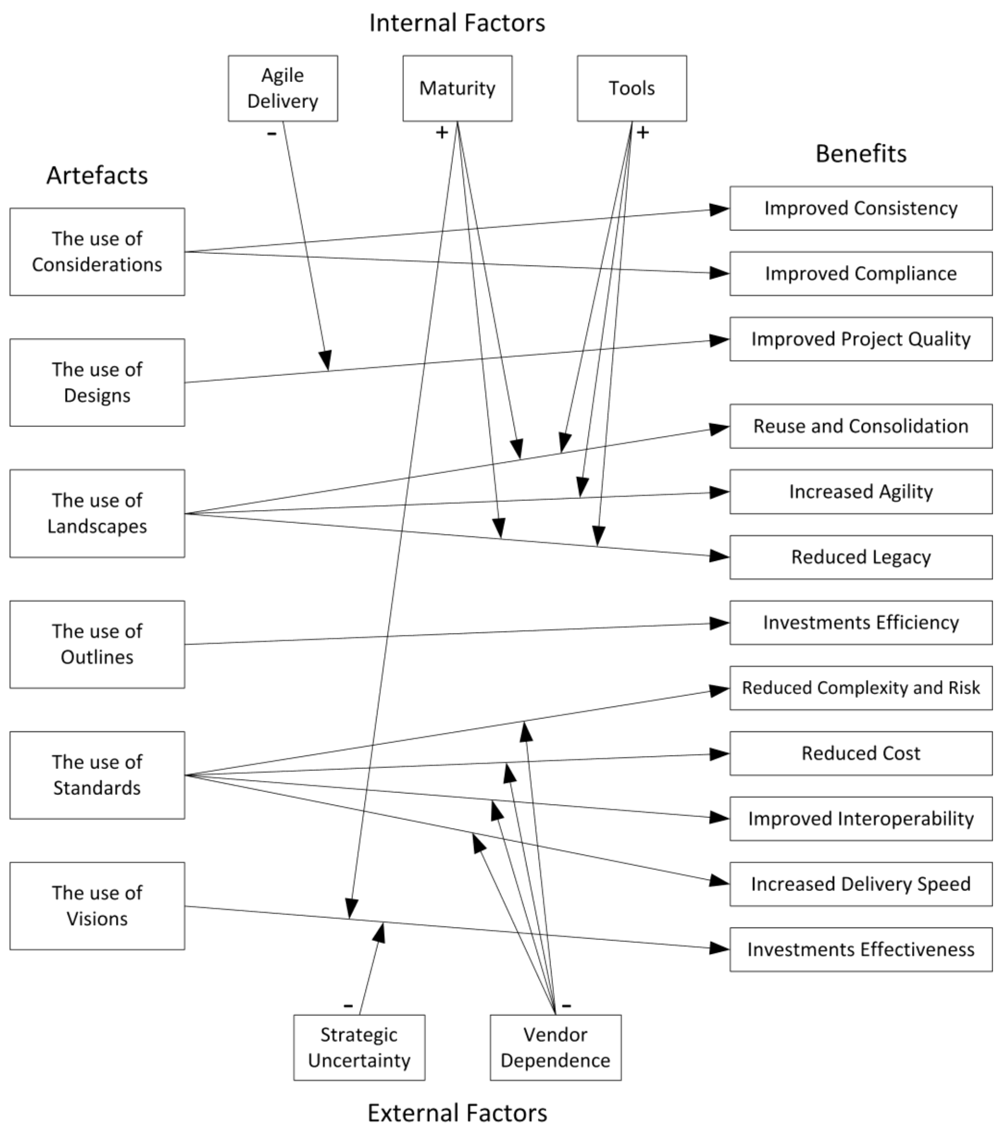

Figure 5.12. Theoretical model of the EA benefits realization

Additional insights regarding the theoretical interpretation of process-related aspects of an EA practice from the perspective of the six identified roles of EA artefacts resulting from this study can be found in Appendix F.

5.6. Chapter Summary

This chapter provided an end-to-end description of the resulting grounded theory of the roles of EA artefacts and its various aspects. Firstly, this chapter provided a detailed comprehensive description of the resulting conceptual framework, six roles of EA artefacts and their interrelationships. Then, this chapter explained the influence of internal and external environmental factors on these roles of EA artefacts. Finally, this chapter discussed the EA benefits realization through the analytical lenses of the identified roles of EA artefacts.

CHAPTER 6: PRACTICAL IMPLICATIONS OF THE RESULTING THEORY

This chapter describes the practical side and implications of the developed grounded theory of the roles of EA artefacts. Firstly, this chapter explains how the resulting theory helps address the typical practical problems with EA in organizations. Then, this chapter proposes a convenient practical taxonomy for organizing EA artefacts based on the core ideas of the resulting theory. Finally, this chapter presents the results of the evaluation of the proposed taxonomy for EA artefacts based on in-depth discussions with EA experts confirming its potential practical usefulness, descriptive power and validity.

6.1. Relationship to the Typical Practical Problems with EA

Besides the theoretical motivation for this study, i.e. the lack of a comprehensive theory addressing the roles of EA artefacts, this study was also motivated by the commonly reported practical problems with EA (see Section 1.2). As noted earlier, EA efforts historically have been considered as risky initiatives with low success rates (Bloomberg, 2014; Holst and Steensen, 2011; Jacobson, 2007; Kemp and McManus, 2009; Roeleven, 2010; Zink, 2009). For instance, the U.S. Federal Government has invested more than $600 million in the development of EA artefacts for all governmental bureaus and agencies, but the resulting EA artefacts proved largely useless (GAO, 2006; GAO, 2015; Gaver, 2010). Jeanne Ross argues that "there isn't a high level of success [with EA] because there's too much architecture for the sake of architecture" (Kappelman, 2010, p. 12).

As discussed in Chapter 1, typical reported practical problems with EA can be summarized into three main issues related to EA artefacts (Lohe and Legner, 2012; Lohe and Legner, 2014): (1) extraordinary efforts are needed to develop and maintain EA artefacts, (2) low quality of EA artefacts undermines their usability and (3) an EA program is not sufficiently integrated into an organization. The theory of the roles of EA artefacts resulting from this study can help alleviate these three practical problems with EA in organizations and, therefore, may have significant practical importance. The following sections explain how the resulting theory helps address the three main practical problems with EA.

6.1.1. Enterprise Architecture Artefacts Are Hard to Develop and Maintain

The popular EA literature for practitioners (Bernard, 2012; Spewak and Hill, 1992; TOGAF, 2011; TOGAF, 2018; van't Wout et al., 2010) recommends describing comprehensively both the current and future states of an organization with a significant number (~30-80) of different EA artefacts. Unsurprisingly, the development and maintenance of EA is associated with significant efforts (Kim and Everest, 1994; Lohe and Legner, 2014; Roth et al., 2013; Seppanen et al., 2009).

In line with the previous research (Basten and Brons, 2012; Beeson et al., 2002; Erder and Pureur, 2006; Kim and Everest, 1994; Lohe and Legner, 2014; Schmidt and Buxmann, 2011), this study also shows that creating comprehensive sets of EA artefacts recommended by the popular practitioner EA literature is impractical. This study also demonstrates that established EA practices are based on rather limited sets of pragmatic EA artefacts with clearly defined roles, purposes, users and use cases. For instance, the studied organizations used from ten to 15 different types of EA artefacts (12.2 on average per organization). Moreover, this study shows that established EA practices typically use only 1-3 value-adding EA artefacts fulfilling each of the six general roles, i.e. Context Setters, Instrument Providers, Knowledge Repositories, Project Implementers, Strategic Aligners and Value Estimators.

Therefore, this study clearly shows that EA practitioners in established EA practices focus on mastering a reasonable number (10-15) of different EA artefacts fulfilling all the six typical roles instead of producing and maintaining heaps of recommended EA artefacts to holistically describe their organizations. The strategy of developing only 1-3 pragmatic EA artefacts for fulfilling the capabilities of each of the six general roles suggested by this study can significantly reduce the overhead associated with maintaining a large number of EA artefacts and, thereby, helps address the first typical practical problem with EA.

6.1.2. Poor Usability of Enterprise Architecture Artefacts

The popular EA literature for practitioners (Bernard, 2012; Spewak and Hill, 1992; TOGAF, 2011; TOGAF, 2018; van't Wout et al., 2010) recommends using different representation techniques for creating EA artefacts including matrices, catalogues, diagrams and models (see Appendix A), as well as using special modelling languages for describing EA artefacts including ArchiMate, UML, ARIS and BPMN (Desfray and Raymond, 2014; Holt and Perry, 2010; Lankhorst, 2013; Lankhorst and van Drunen, 2007; Scheer, 1992). However, using these representation techniques and modelling notations often results in excessively complex and detailed “charts that look more like circuit diagrams than business descriptions and that are useful as little more than doorstops” (Ross et al., 2006, p. vii). “The problem is EA information often is unintelligible. The necessary data might be there, but the presentation is so poor that the decision-maker’s ability to use it is impaired” (Blumenthal, 2007, p. 63).

The resulting theory of the roles of EA artefacts clearly shows that all EA artefacts used in established EA practices have specific informational contents and representation formats appropriate for their roles and convenient their intended users. Of the six identified general roles of EA artefacts, the roles of Context Setters, Strategic Aligners and Value Estimators involve both Architects and Business Leaders, while the roles of Instrument Providers, Knowledge Repositories and Project Implementers involve only technical specialists, i.e. Architects and Project Teams. This separation of roles on business-related roles and technical roles has a profound influence on the meaning and representation of the information contained in EA artefacts fulfilling these roles. On the one hand, EA artefacts fulfilling business-related roles (Context Setters, Strategic Aligners and Value Estimators) tend to present the information from the perspective of money, customers, capabilities, business goals, competitive advantages or other business notions. Even if some IT-specific information about applications, databases or technologies is included in business-related EA artefacts, this information is presented in a very high-level and abstract manner understandable to business stakeholders. Business-related EA artefacts are typically represented as simple, intuitive, often one-page diagrams convenient for decision-makers. They usually present only the most essential information in a brief summarized form consumable even to executive-level audience without any IT background. On the other hand, EA artefacts fulfilling “technical” roles (Instrument Providers, Knowledge Repositories and Project Implementers) tend to present the information from the perspective of systems, applications, databases, platforms, networks or other highly IT-specific notions. Unlike business-related EA artefacts, these EA artefacts can be represented in any form ranging from one-page diagrams to voluminous multi-page MS Word documents or comprehensive tables. Technical EA artefacts typically provide detailed and specific information with all the relevant details in any reasonable format or even using special sophisticated modelling notations.

Moreover, EA artefacts fulfilling each of the six identified roles usually have their own, highly role-specific representation formats commonly used in corresponding artefacts (see Table 5.1). For instance, EA artefacts fulfilling the role of Context Setters (e.g.

principles, policies and maxims) are typically expressed in simple intuitive formats, often as brief written statements. Instrument Providers (e.g. technology reference models, standards and patterns) can be expressed in various formats, often using strict notations. EA artefacts fulfilling the role of Knowledge Repositories (e.g. one-page diagrams, inventories and platform architectures) are usually expressed in strict formats, often as complex one-page diagrams using formal modelling notations. Project Implementers (e.g. solution designs and technical designs) are normally expressed as a mix of text, tables and complex diagrams, can be voluminous and often use formal modelling notations. EA artefacts fulfilling the role of Strategic Aligners (e.g. business capability models, process model and roadmaps) are typically expressed in brief informal formats, often as simple one-page diagrams. Finally, Value Estimators (e.g. conceptual architectures and idea briefs) are usually expressed as a mix of textual descriptions and simple diagrams.

The findings of this study also suggest that popular EA-related modelling notations including ArchiMate, UML, ARIS and BPMN in most cases can hardly be useful for modelling of EA artefacts fulfilling business-related roles since business stakeholders usually find these notations too complex and "scary". Essentially, the applicability of specific formal EA-related modelling notations is largely limited only to Knowledge Repositories and Project Implementers, while the four other roles typically use either simplistic informal diagrams or textual representations without any diagrams. Moreover, the findings of this study show that matrices as a representation form for EA artefacts, though advocated by the existing EA literature (Spewak and Hill, 1992; TOGAF, 2018), are typically found to be inconvenient in practice.

Therefore, this study clearly shows that EA practitioners in established EA practices choose appropriate, highly role-specific representation formats for EA artefacts enabling their successful usage and "consumption" by the intended audience. The developed theory provides the general guidelines regarding the selection of convenient representation formats for EA artefacts fulfilling different roles in an EA practice. Sticking with the guidelines provided by the resulting theory and described above can significantly reduce the risk of producing unintelligible and unusable EA artefacts incomprehensible for their intended stakeholders and, thereby, address the second typical practical problem with EA.

6.1.3. Poor Integration of Enterprise Architecture Practices in Organizations

The popular EA literature for practitioners (Bernard, 2012; Spewak and Hill, 1992; TOGAF, 2011; TOGAF, 2018; van't Wout et al., 2010) recommends following sequential step-wise processes to develop and use EA artefacts. However, following these processes often leads to the creation of parallel EA-related lifecycles essentially “disconnected” from normal organizational processes (Lohe and Legner, 2012; Lohe and Legner, 2014). “The paradox is that EA efforts are aimed at integrating the various organizational elements, whereas the architecture efforts are not integrated in the organization” (Janssen, 2012, p. 32). As a result, EA initiatives are often isolated from all other organizational activities and eventually end up in “ivory towers” (Ambler, 2010; Burton, 2009; Hauder et al., 2013; Hobbs, 2012; Jacobson, 2007; Levy, 2014; van der Raadt et al., 2010; van der Raadt and van Vliet, 2008).

To avoid this problem, as demonstrated by Lohe and Legner (2014), EA artefacts should be developed and used as part of regular organizational processes, rather than separately from them. In line with this suggestion of Lohe and Legner (2014), the theory developed in this study explains the typical mechanisms of integration between EA-related and regular organizational processes (see Table 5.1). Specifically, in established EA practices the processes around EA artefacts fulfilling the roles of Context Setters and Strategic Aligners are closely integrated with strategic management processes. Context Setters are often developed, updated and reapproved on a yearly basis after the long-term strategic business plan is approved by the top management at the annual meeting. Strategic Aligners are also developed, updated and formally approved after the business plan is approved, but they can be also updated dynamically during the year as soon as major shifts in business priorities occur or significant events happen in the competitive environment.

The processes around EA artefacts fulfilling the roles of Value Estimators and Project Implementers in established EA practices are tightly integrated into the regular project lifecycle and project management processes. Value Estimators together with business cases are developed at the early stages of all IT initiatives and used to support informed decision-making. At the beginning of the project lifecycle, Value Estimators help initiate projects based on their expected value, cost and alignment to the long-term and short-term business objectives. Project Implementers are developed at the later stages of all IT initiatives, i.e. after the decision to implement corresponding initiatives has been made based on Value Estimators, to support the actual technical implementation of these IT initiatives. Project

Implementers help deliver IT projects according to the declared business requirements and relevant technical guidelines at the middle of the project lifecycle.

However, the processes around EA artefacts fulfilling the roles of Instrument Providers and Knowledge Repositories in established EA practices might be relatively independent from other organizational processes. Essentially the processes around these EA artefacts are "backend" processes carried out largely inside EA departments and supporting other EA-related processes. Instrument Providers are typically updated by architects on a periodical basis, often yearly, or sometimes as a result of specific projects introducing new technologies, guidelines or patterns. Instrument Providers are then used largely during the project planning stage providing the guidelines for Value Estimators and Project Implementers, as shown earlier in Figure 5.8. Landscapes are typically updated after some changes in IT landscapes occur, often at the completion stages of IT projects, and then support general IT decision-making and project planning by providing environment for Value Estimators and Project Implementers, as also shown earlier in Figure 5.8.

Therefore, the resulting theory shows that EA practitioners in established EA practices integrate the processes around Context Setters and Strategic Aligners with organizational strategic management and investment decision-making processes, the processes around Value Estimators and Project Implementers into project management lifecycles, while the processes around Instrument Providers and Knowledge Repositories can be carried out largely independently from other organizational processes, though these EA artefacts are also actively used during the project lifecycle and often updated after its completion. Following these suggestions of the resulting theory can reduce the risk of establishing "ivory tower" EA practices and, thereby, address the third typical practical problem with EA.

6.2. Practical Taxonomy for Organizing EA Artefacts

In order to accomplish the intended objectives of this study from the practical side, i.e. provide a practical devise for resolving common real-world problems with EA discussed above, the resulting theory of the roles of EA artefacts should be presented in some simplified form which is easy-to-understand for ordinary EA practitioners. As part of the search for the most convenient practical representation of the resulting theory, various options have been considered which included organizing and relating the six identified roles of EA artefacts in various ways based on different aspects of their properties. Although many different ways of presenting the resulting theory potentially exist and the choice of any particular one of these ways is largely subjective, specifically a taxonomical representation have been chosen arguably as the most intuitive and preferable way to present the developed theory to the audience of EA practitioners. Historically, EA was closely associated with numerous two-dimensional taxonomies, or frameworks, for organizing EA artefacts (PRISM, 1986; Pulkkinen, 2006; Schekkerman, 2006; Sowa and Zachman, 1992; TEAF, 2000; van't Wout et al., 2010; Zachman, 1987). Similarly, the resulting theory of the roles of EA artefacts may be also represented in a simplified form as a convenient taxonomy for classifying EA artefacts from the perspective of their roles and purposes in an EA practice.

As discussed earlier, each of the six general roles is fulfilled by corresponding types of EA artefacts providing the necessary information to involved actors enabling a particular usage. Specifically, the role of Context Setters is fulfilled by Considerations artefacts (principles, maxims, policies, etc.), Instrument Providers – by Standards (technology reference model, patterns, etc.), Knowledge Repositories – by Landscapes (platform architectures, one-page diagrams, inventories, etc.), Project Implementers – by Designs (solution designs, detailed designs, etc.), Strategic Aligners – by Visions (business capability models, roadmaps, etc.) and Value Estimators – by Outlines (solution overviews, conceptual architectures, etc.). The analysis of the differences and similarities between these six types of EA artefacts and their informational contents suggests that these EA artefacts can be conveniently organized as a two-dimensional taxonomy based on (1) what useful information they contain and (2) how this information is presented (these dimensions seem to be the most convenient dimensions for organizing EA artefacts, but far from the only possible ones).

Firstly, the analysis of the differences and similarities between EA artefacts shows that both Considerations and Standards contain some broad global *rules* defining the organization, both Landscapes and Visions describe some high-level *structures* of the organization, while both Designs and Outlines focus on specific proposed *changes* to the organization. Secondly, the analysis of the differences and similarities between EA artefacts shows that Considerations, Outlines and Visions present information in the *business-focused* manner easily understandable to business audience, while Designs, Landscapes and Standards present information in the *IT-focused* manner intended only for technical specialists, i.e. for architects and project teams. These two classifications are described in more detail in Table 6.1 and Table 6.2 respectively.

Table 6.1. Classification of EA artefacts based on what information they contain

Category	Rules	Structures	Changes
Artefacts	Considerations and Standards	Landscapes and Visions	Designs and Outlines
Information	Offer broad global *rules* defining the organization	Provide high-level *structures* of the organization	Focus on specific proposed *changes* to the organization
Common usage	Help guide decision-making and implementation	Help understand what changes are desirable and how to implement them	Help plan separate changes in detail
Common role	Basis for all other planning decisions	High-level "maps" facilitating decision-making	Tactical plans of an organization

Table 6.2. Classification of EA artefacts based on how the information is presented

Category	Business-focused	IT-focused
Artefacts	Considerations, Outlines and Visions	Designs, Landscapes and Standards
Information	Provide information in a *business-focused* manner	Provide information in an *IT-focused* manner
Common formats	Technology-neutral, brief and intuitive business descriptions	Purely technical, formal and IT-specific descriptions
Common users	Business leader and architects	Architects and project teams
Common usage	Help business leader manage IT	Help architects organize IT
Common role	Communication interfaces between business and IT	Internal IT tools invisible to business

Since these two classifications are orthogonal to each other, together they can be used as the basis for a two-dimensional taxonomy for organizing EA artefacts fulfilling different roles defined by the resulting grounded theory. The proposed taxonomy for organizing EA artefacts is shown in Figure 6.1.

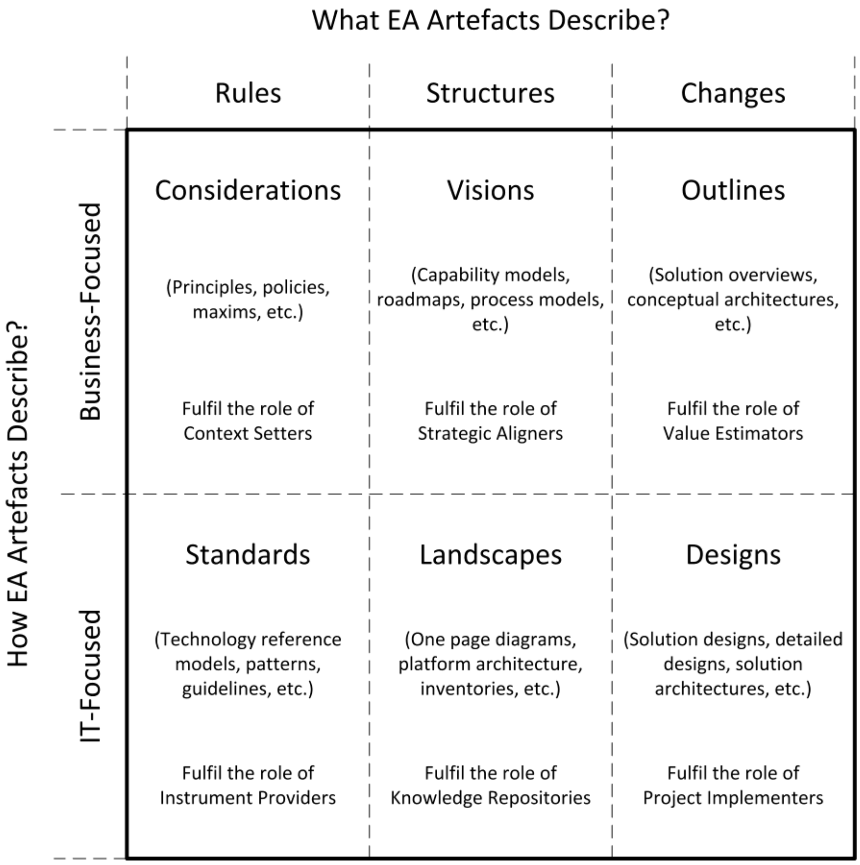

Figure 6.1. Taxonomy for organizing EA artefacts

The taxonomy shown in Figure 6.1 represents arguably the most convenient way (however, certainly still only one of many possible ways) to organize the six types of EA artefacts fulfilling different practical roles. The taxonomy highlights the essential conceptual commonalities and differences between different types of EA artefacts. The proposed taxonomy with the most typical illustrative examples of corresponding EA artefacts is shown in Figure 6.2.

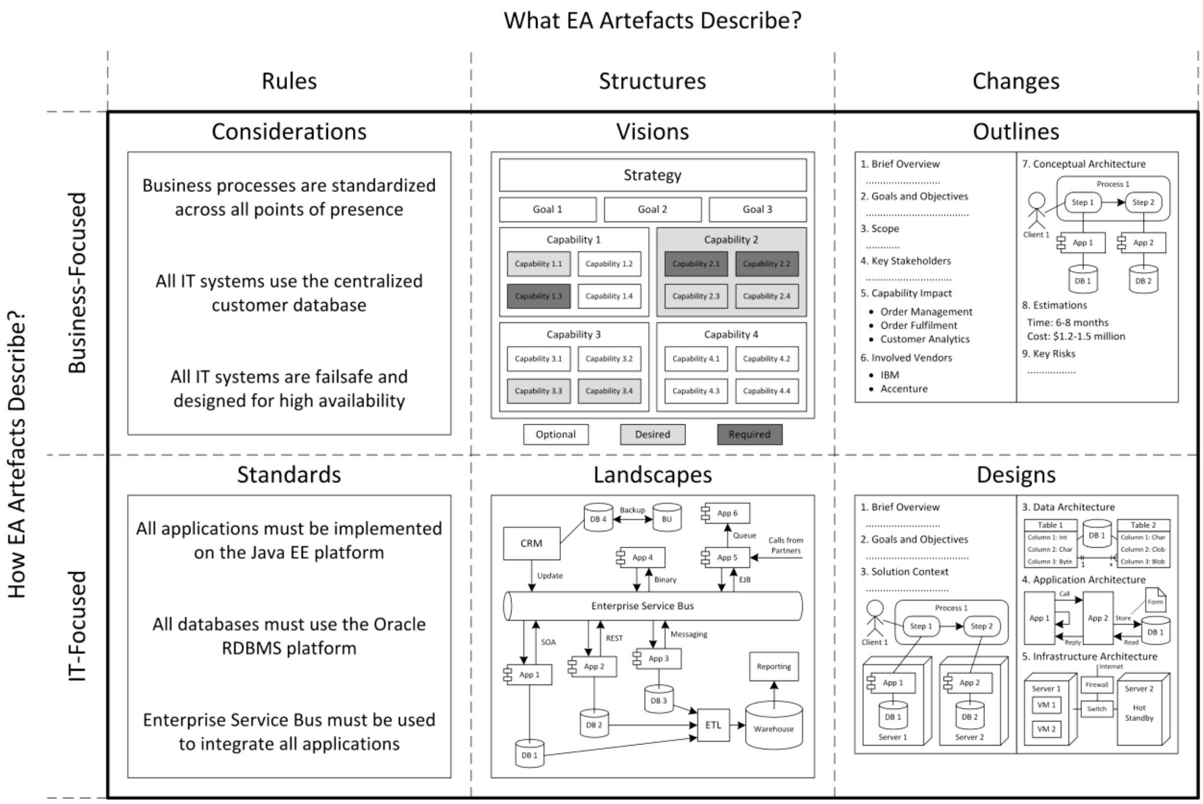

Figure 6.2. Taxonomy with the typical examples of the corresponding EA artefacts

This taxonomy can be used for presenting a convenient practical view of the resulting grounded theory of the roles of EA artefacts. Specifically, each of the six types of EA artefacts is closely associated with certain informational contents, users, usage and benefits corresponding to their roles. These core properties of EA artefacts can be linked to the corresponding cells of the taxonomy for classifying these artefacts. The resulting practical taxonomy for EA artefacts explaining their key properties is shown in Figure 6.3.

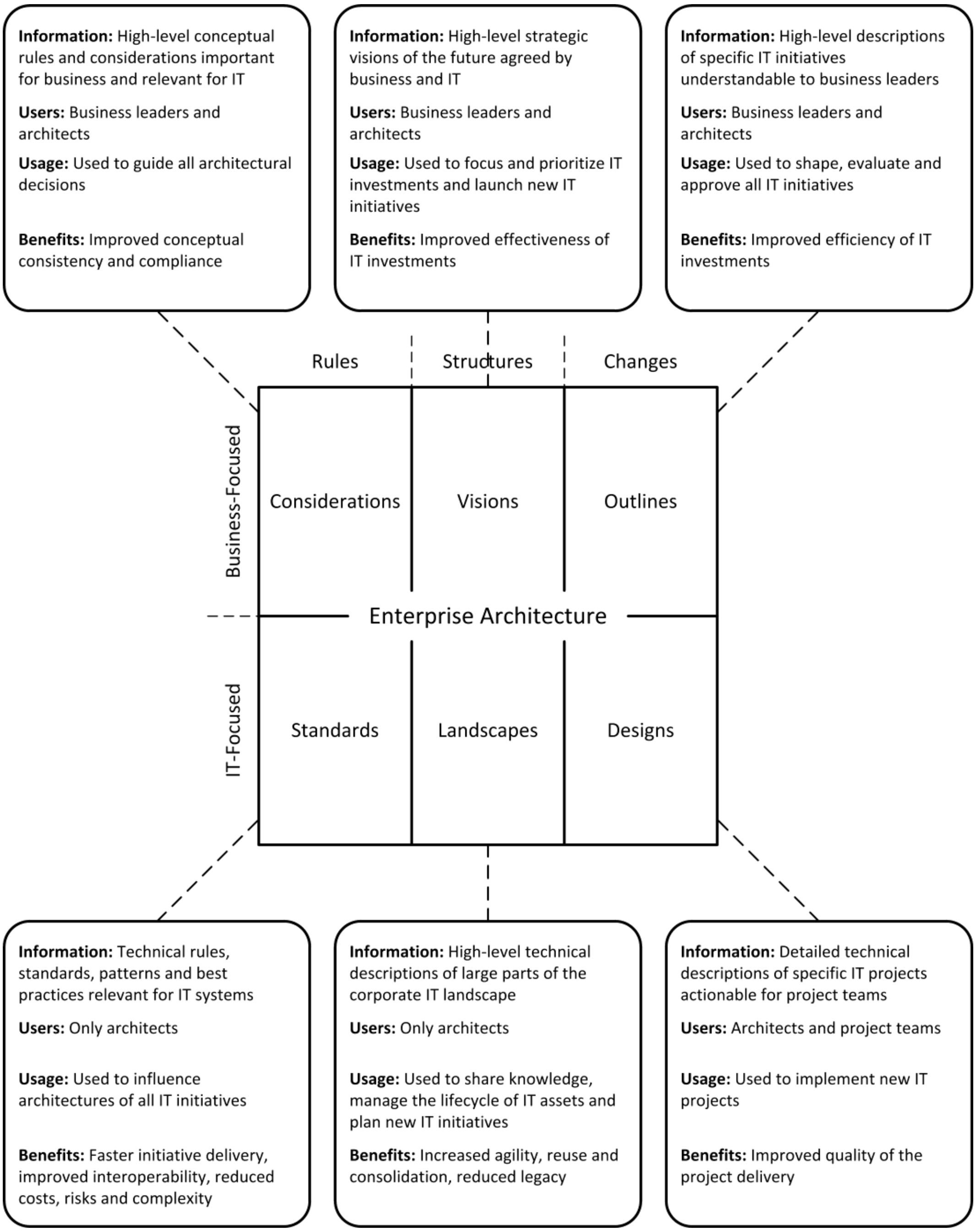

Figure 6.3. Taxonomy explaining the key properties of EA artefacts

6.3. Evaluation of the Taxonomy via Discussions with EA Experts

In order to discuss its potential practical utility, the resulting taxonomy for EA artefacts has been discussed with ten experienced EA experts from different countries (including seven EA practitioners and three EA academics, see Table 3.11). The purpose of these discussions was twofold. Firstly, the intention was to discuss the potential usefulness of the taxonomy as a general sense-making instrument for EA artefacts as well as for an EA practice in general. Secondly, the intention was also to check the accuracy of the descriptions provided by the taxonomy and essentially conduct an external validity test via applying the taxonomy to classify EA artefacts used in other organizations. From this perspective, these discussions might be considered as double-checking, or triangulating, the resulting grounded theory based on other empirical data to ensure its sound validity.

Specifically, the resulting taxonomy for organizing EA artefacts (see Figure 6.3) has been presented and explained to the interviewees and then the interviewed EA experts have been asked to provide their feedback, opinions and comments regarding the taxonomy and its practical aspects. The full list of EA experts interviewed in this study for concluding taxonomy discussion has been presented earlier in Table 3.11. The brief summary of the essential feedback provided by the interviewed EA experts is shown in Table 6.3.

Table 6.3. Summary of the feedback provided by EA experts

Expert	Feedback
#1 – EA practitioner from Australia	Agreed with the taxonomy and confirmed its validity, but suggested some rewordings in descriptions of EA artefacts and their properties
#2 – EA practitioner from Australia	Agreed with the taxonomy and its practical value, but argued that some EA artefacts used in his organization may border between different types depending on their instance-specific informational contents
#3 – EA practitioner from Australia	Agreed with the taxonomy and confirmed its usefulness, but argued that the informational contents of some EA artefacts may vary and the difference between business and IT in some cases can be blurred
#4 – EA practitioner from Australia	Agreed with the taxonomy, confirmed its descriptive power and especially noted the value of a clear understanding of the expected benefits of different types of EA artefacts provided by the taxonomy
#5 – EA practitioner from Australia	Agreed with the taxonomy, confirmed its usefulness and noted the clarity with which the taxonomy describes all EA artefacts produced by the architecture function in his organization
#6 – EA practitioner from Australia	Agreed with the taxonomy, confirmed its validity and especially noted its comprehensiveness, but suggested some rewordings in descriptions of EA artefacts
#7 – EA practitioner from Australia	Agreed with the taxonomy and its practical value, but argued that in his organization Standards also contribute to regulatory compliance along with Considerations
#8 – EA academic with practical experience from the Netherlands	Agreed with the taxonomy, confirmed its explanatory value and emphasized the potential usefulness of the taxonomy for teaching EA

	courses in universities to students
#9 – EA academic with practical experience from the Netherlands	Agreed with the taxonomy, confirmed its validity and also noted that the taxonomy might be useful for explaining the general ideas of EA to university students
#10 – EA academic with practical experience from Finland	Agreed with the taxonomy and confirmed its validity, but noted that the benefits explained by the taxonomy represent only direct benefits, while numerous indirect benefits can also be added to different types of EA artefacts

The following sections briefly summarize the essential comments provided by the interviewees.

6.3.1. The General Idea of the Taxonomy

As a first step of the discussion, the proposed taxonomy for EA artefacts (see Figure 6.3) has been presented and explained to the interviewees. Then, the interviewees have been asked to apply the taxonomy to the EA artefacts used in their organizations, classify them into one of the six general types defined by the taxonomy and compare their properties with the properties described by the taxonomy.

The interviewed EA experts generally understood the core idea of the proposed two-dimensional classification, agreed with the meanings of the six general types of EA artefacts and appreciated their simple taxonomical representation. All the experts found the proposed taxonomy intuitively simple, easy-to-understand and quickly grasped its meaning. For instance, the expert #7 even gave the following comment:

> *"I think it's a really good model actually, it's a very good model. [...] So, in fact it's such a good model, I'm surprised that I haven't seen it before. In other words, there is a characteristic of good models is that they seem obvious when you see them. And this [model] seems very obvious and I'm surprised that no one's actually come up with it, so well done"* (Expert #7)

Similarly, the expert #2 was able to easily and accurately summarize his understanding of the taxonomy in the following way:

> *"I definitely understand Rules [Considerations and Standards] and Structures [Visions and Landscapes], which describe the overall landscape as it is, and then Changes, which are the changes we are going to make to that landscape*

guided by those Standards and Considerations. [...] I get the concept" (Expert #2)

All the interviewed EA experts were generally able to unambiguously classify the EA artefacts used in their organizations and agreed with their roles described by the taxonomy including their informational contents, users, usage and resulting benefits. However, EA experts #2 and #6 reported that some rare types of EA artefacts can hardly be unambiguously classified into only one of the six general types of EA artefacts because the contents and meaning of these EA artefacts can vary from time to time:

"I think whitepapers [as EA artefacts that we use in our organization] will often encompass an area rather than a dot because we do [different] whitepapers for all sorts of reasons. Often they will have elements of Structures. Also they can be setting out a language, putting out a proposition, investigating a proposition or do something else. But if it has to sit somewhere, if you only get a single dot to play with, then it would be in that space [Considerations]" (Expert #2)

"[Depending on a particular instance], position papers can be more sitting over here [Visions] or in between [Considerations and Visions]" (Expert #6)

Similarly, EA expert #3 also reported that the contents of strategic papers, as a type of EA artefacts used in his organization, can vary for different instances of these EA artefacts. Therefore, the inability of the taxonomy to classify and unambiguously explain the roles of specific EA artefacts with varying contents can be considered as its natural limitation.

6.3.2. Usefulness of the Taxonomy

As a second step of the discussion, the interviewees have been asked to provide their opinions on whether the proposed taxonomy provides a practical way to explain the roles of EA artefacts as well as the concept of EA in general. The interviewed EA experts generally agreed that the taxonomy adequately describes the roles of EA artefacts in an EA practice and provides a useful way to conceptualize EA:

"That's really good, I think that represents it [EA]. I think it's a really good diagram, I'm tempted to take a photo, I like that. [...] I agree with everything on there, I think that's captured really well, it's a really good page [Figure

> *6.3]. [...] And everything else that you've got in terms of who uses it [EA artefacts] and how it's pretty good. [...] I think this [taxonomy] maps the audience of those [EA artefacts] really well as well. Yeah, it's good"* (Expert #2)

The EA expert #6 specifically noted that the resulting taxonomy provides a comprehensive coverage and description of all types of EA artefacts used in EA practices:

> *"I think you are covering all the main areas [of EA in your taxonomy]. [...] I think you captured all what would go into enterprise architecture or be encompassed by enterprise architecture"* (Expert #6)

The EA expert #4 especially appreciated the value of describing the benefits of using different types of EA artefacts in the taxonomy:

> *"The separation of business and IT [in the taxonomy] makes a lot of sense. [...] I like the two-dimensional taxonomy that you've actually got here [Figure 6.3]. [...] I like that it gives a reason in this description [for producing EA artefacts]. The one [feature of the taxonomy] that stands out is the purpose and the benefits [of EA artefacts]. Often you get the question "Why are you doing all this?" If you know the purpose and benefits [of EA artefacts] you get some idea of answering that question"* (Expert #4)

The EA expert #5 opined that the proposed taxonomy provides a clearer conceptual explanation of EA artefacts, as well as of an EA practice in general, than popular frameworks, including TOGAF:

> *"It's pretty good to be honest. TOGAF is different, it's got more of a process flow where things get through that [ADM] cycle and all the documents spin off. But it doesn't actually [describes EA] as simple as this [taxonomy], certainly not the documents and where they sit as artefacts. This is a real architecture, this is what I really do. [...] This is the stuff [EA artefacts] that we actually produce and typically this is where they sit, some are more business-specific, some are more IT-specific. I think it's pretty good. [...] That [taxonomy] describes what I do as an enterprise architect, all of the artefacts I produce. [...] That's a good description of the artefacts I produce and where*

they sit. So, if I'm an enterprise architect and I want to know what sorts of documents [I need] and where they fit that's really good" (Expert #5)

EA experts #8 and #9, who teach EA courses in universities, opined that the proposed taxonomy can be used to explain the meaning of EA artefacts and of an EA practice in general to university students.

6.3.3. Limitations of the Taxonomy

The EA experts #2 and #3 noted the inherent limitations of the proposed taxonomy including a static view of EA artefacts, architecture-centricity and technical focus:

"I think it's a really useful model for describing different artefacts. I think it's a really-really useful model from this point of view, but it's a static view of them and it's an architecture-centric view of the world. If I were using this [taxonomy] to talk to other architects or other technical people it would be useful, but I wouldn't use it as a model in that form for discussing with the business, for example. [...] Business persons they know their business really-really well, but they care less about architecture and models like that" (Expert #3)

"It's a useful taxonomy, it's a great taxonomy. I think it's a nice and good structure, but that's not how [business people] think. I need to move into their world" (Expert #2)

6.4. Potential Applications of the Taxonomy

As confirmed by the interviewed EA experts, the two-dimensional taxonomy for organizing EA artefacts discussed above can be considered as a helpful practical design artefact based on the underlying grounded theory of the roles of EA artefacts described in detail earlier in Chapter 5. Although many taxonomies for organizing EA artefacts have been proposed earlier by different authors (Pulkkinen, 2006; Schekkerman, 2006; Sowa and Zachman, 1992; TEAF, 2000; van't Wout et al., 2010; Zachman, 1987), these taxonomies organize EA artefacts based only on what aspects of organizations they describe, e.g. domains (business, data, applications, etc.), interrogatives (what, how, where, etc.) and abstraction levels (enterprise, business unit, segment, etc.), but none of them explains how exactly these EA artefacts should be used, by whom and for what purpose (as discussed earlier in Section 4.1.9, practical roles of EA artefacts are determined essentially only by their semantic meaning, while some general characteristics of EA artefacts, e.g. their domains or abstraction levels, alone can hardly predict these practical roles). Therefore, the taxonomy proposed above is complimentary to the existing EA frameworks. Unlike the existing EA frameworks, the analytical taxonomy constructed based on the resulting theory of the roles of EA artefacts clarifies the typical usage and intended purpose of different types of EA artefacts.

This taxonomy can help EA practitioners cope with the three typical practical problems with EA discussed above (see Section 6.1). Firstly, by placing EA artefacts used in their organizations in corresponding cells of the taxonomy, EA practitioners may identify redundant EA artefacts, i.e. excessive numbers of EA artefacts fulfilling the same role, and then limit the number of these artefacts to 2-3 for each specific role, thereby reducing the efforts required to maintain them. Secondly, the taxonomy explains the intended audience of different types of EA artefacts thereby helping select appropriate presentation formats for these artefacts making them more “consumable and digestible” for their stakeholders. Thirdly, the taxonomy explains the usage and corresponding benefits of EA artefacts thereby helping integrate the usage of these artefacts into relevant organizational processes. Consequently, the proposed taxonomy provides a reasonable practical tool for solving the most common problems associated with EA.

The developed taxonomy for EA artefacts can be potentially used in the following ways:

- As a convenient tool for thinking about EA artefacts by practicing architects
- As a general “map” of EA for explaining and communicating its business value, as well as in the opposite way, i.e. for understanding which specific types of EA artefacts are required for realizing particular EA benefits
- As a simple reference model for teaching EA to students, as suggested by some of the interviewed EA experts

6.5. Chapter Summary

This chapter described the practical side and implications of the developed grounded theory of the roles of EA artefacts. Firstly, this chapter explained how the resulting theory helps address the typical practical problems with EA in organizations. Then, this chapter proposed a convenient practical taxonomy for organizing EA artefacts based on the core ideas of the resulting theory. Finally, this chapter presented the results of the evaluation of the proposed taxonomy for EA artefacts based on in-depth discussions with EA experts confirming its potential practical usefulness, descriptive power and validity.

CHAPTER 7: DISCUSSION AND LITERATURE COMPARISON

This chapter discusses the main findings of this research and their implications. Firstly, this chapter discusses the resulting theory in the broader context of the IS discipline and relates the theory back to the existing studies on the roles of EA artefacts, environmental factors and EA benefits. Then, this chapter discusses the implications of the resulting grounded theory for the EA discipline. Finally, this chapter describes important empirical observations of this study and explains their potential consequences for the EA discipline.

7.1. Resulting Theory in the Context of the IS Discipline

As the final step of this study, the newly developed grounded theory of the roles of EA artefacts has been related back to the existing literature (Corbin and Strauss, 1990; Creswell, 2007; Glaser and Strauss, 1967; Strauss and Corbin, 1998). The resulting grounded theory follows the earlier call of Niemi and Pekkola (2017) to explore the practical usage of EA artefacts and provides the first available comprehensive theorization of the roles of EA artefacts in an EA practice. Essentially, the developed theory has no direct "competitors" in the available EA literature.

Specifically, the resulting theory articulates six distinct roles fulfilled by EA artefacts in the context of an EA practice (see Table 5.1), describes the conceptual relationships and synergy between them (see Figure 5.8), explains the influence of internal and external environmental factors on these roles (see Figure 5.9 and Figure 5.10) and elucidates the EA benefits realization through the lenses of these roles (see Figure 5.11 and Figure 5.12). From this perspective, the design of this study and the resulting theory of the roles of EA artefacts are conceptually similar to the previous grounded theory-based study of Smolander et al. (2008) that identified and analysed four practical roles of software architecture.

Gregor (2006) argues that theories in the IS discipline may generally include one or more of the following four aspects: descriptive, explanatory, predictive and design. The created grounded theory of the roles of EA artefacts is highly descriptive in nature, but also includes rather clear explanatory, predictive and design features. As a descriptive theory, it provides a comprehensive descriptive view of the practical usage of EA artefacts which is currently missing in the EA literature (Niemi and Pekkola, 2017), i.e. describes how exactly different types of EA artefacts are used, by whom, for what purpose and what benefits are expected from their usage. As noted by Gregor (2006, p. 623), descriptive theories are often grounded theories where "the grounded theory method gives rise to a description of categories of interest", which is perfectly true for the theory developed in this study. Gregor (2006, p. 624) also argues that descriptive theories are especially valuable "when little is known about some phenomena". Consequently, the resulting theory fills an important gap in the EA discipline by providing a sound descriptive view of a previously unexplored area of knowledge, i.e. practical usage and roles of EA artefacts. Generally, descriptive theories constitute more than one third of all grounded theory studies in leading IT outlets (Wiesche et al., 2017).

As an explanatory and predictive theory, the resulting grounded theory provides an in-depth explanation of how exactly EA, as a collection of specific documents used for planning, leads to the realization of tangible benefits for organizations (see Figure 5.11). Moreover, the theory offers a number of testable theoretical propositions predicting the achievement of certain types of organizational benefits from the usage of particular types of EA artefacts moderated by relevant environmental factors (see Figure 5.12).

Finally, as demonstrated in Chapter 6, the resulting grounded theory helps address the most typical practical problems associated with EA and was even used to create a useful design artefact – the taxonomy for organizing EA artefacts and explaining the core practical aspects of their usage (see Figure 6.3). Therefore, the resulting theory of the roles of EA artefacts is a multifaceted theory addressing important theoretical gaps existing in the current EA discipline as well as the commonly reported problems in the EA practice.

7.2. Relationship to Other Theories of the Roles of EA Artefacts

As demonstrated earlier in Chapter 2, the current EA literature provides a number of studies explaining the role of EA artefacts in general (see Table 2.2) as well as the roles of specific types of EA artefacts in particular (see Table 2.3). On the one hand, the role of EA artefacts in general had been analysed through the lenses of the boundary objects theory (Abraham, 2013; Abraham et al., 2015; Abraham et al., 2013), actor-network theory (Sidorova and Kappelman, 2010; Sidorova and Kappelman, 2011) and even from the perspective of the roles of software architecture (Bischoff et al., 2014; Niemi and Pekkola, 2017) identified by Smolander et al. (2008). On the other hand, the roles of specific types of EA artefacts had been extensively studied for principles (Greefhorst and Proper, 2011b; Haki and Legner, 2012; Hugoson et al., 2010) and less extensively for other types of EA artefacts including standards (Boh and Yellin, 2007), business capability maps (Khosroshahi et al., 2018) and core diagrams (Ross et al., 2006). The following sections describe the relationship between the findings of this study and the findings of the previous studies on the roles of EA artefacts.

7.2.1. The View of EA Artefacts as Boundary Objects

The boundary objects theory suggests that specialized boundary objects help diverse social communities successfully pursue shared goals despite their different backgrounds by means of providing different information to representatives of these social communities (Star and Griesemer, 1989). Leveraging the boundary objects theory, Abraham (2013), Abraham et al. (2013) and Abraham et al. (2015) consider EA artefacts as potential boundary objects between different stakeholders in enterprise transformations, identify the desired properties of EA artefacts as boundary objects and explain which of these properties are required to overcome different knowledge boundaries existing between business and IT communities.

The findings of this study generally support the view that EA artefacts fulfil the role of boundary objects between diverse social communities of business and IT specialists, however, with two critical clarifications. On the one hand, the findings of this study clearly demonstrate that most, but not all types of EA artefacts can be considered as boundary objects. Specifically, EA artefacts fulfilling the roles of Instrument Providers and Knowledge Repositories (e.g. technology reference models, patterns, platform architectures and inventories) can hardly be considered as boundary objects simply because they are not used for communication between diverse communities, but are employed within IT departments as reference materials by architects alone with little or no relevance to business stakeholders and, in many cases, even to project teams. Essentially, these types of EA artefacts are used only by the community of architects and, therefore, cannot be boundary objects merely "by definition".

On the other hand, the findings of this study clearly demonstrate that all other roles of EA artefacts, i.e. Context Setters, Project Implementers, Strategic Aligners and Value Estimators, are inherently boundary-spanning in nature and the corresponding EA artefacts actually represent "classic" examples of boundary objects. Moreover, the developed grounded theory also (1) shows that different roles of EA artefacts span the boundaries between different communities and (2) explains which exactly boundary-spanning information is contained in different types of EA artefacts representing boundary objects. In particular, Context Setters serve primarily as boundary objects between business leaders and architects. For business leaders the corresponding EA artefacts provide the information regarding how the business operates or wants to operate in the future, while for architects the same artefacts provide the information regarding how the IT function operates or needs to operate in the future to meet the strategic business demands. Similarly, Strategic Aligners serve primarily as boundary objects between business leaders and architects. For business leaders the respective EA artefacts provide the information regarding what the business wants to do in the future, while for architects the same artefacts provide the information regarding what the IT function needs to do in the future to meet the strategic business objectives. Value Estimators also serve primarily as boundary objects between business leaders and architects. For business leaders the corresponding EA artefacts provide the information regarding what options for proposed IT initiatives are desirable for the business, while for architects the same artefacts provide the information regarding what approximately needs to be implemented as part of these initiatives. On the contrary, Project Implementers serve primarily as boundary objects between project teams and architects. For project teams the respective EA artefacts provide the information regarding what exactly needs to be implemented as part of IT projects, while for architects the same artefacts provide the information regarding what project implementation approaches are acceptable or preferable from the organization-wide perspective. The theoretical interpretation of the findings of this study from the perspective of the boundary objects theory is shown in Figure 7.1.

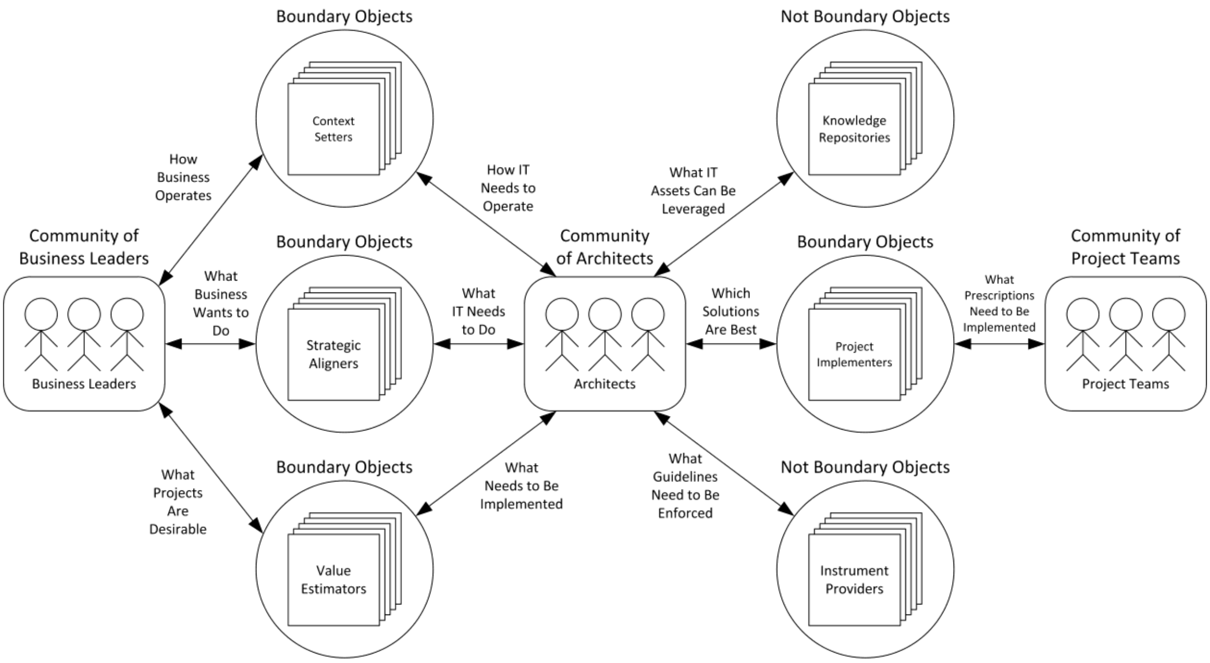

Figure 7.1. Different types of EA artefacts as boundary objects

Therefore, the findings of this study demonstrate that the boundary objects theory generally can be very appropriate for studying and understanding the complex phenomenon of EA artefacts, but still not all types of EA artefacts. Moreover, the developed theory of the roles of EA artefacts helps provide an advanced view of EA artefacts through the lenses of the boundary objects theory, i.e. explain which EA artefacts serve as boundary objects between different communities and which boundary-spanning information is provided by these artefacts to the members of these communities.

7.2.2. The View of EA Artefacts as Elements of the Actor-Network

Actor-network theory interprets the creation, existence and evolution of socio-technical networks through the interaction of independent actors including both people and objects (Callon and Latour, 1981; Sarker et al., 2006; Walsham, 1997). The core concept of the actor-network theory is the notion of inscription (Hanseth and Monteiro, 1997; Sarker et al., 2006; Walsham, 1997). Inscription can be considered as "a process of creation of artefacts that would ensure the protection of certain interests" (Sarker et al., 2006, p. 56).

Leveraging the ideas of the actor-network theory, Sidorova and Kappelman (2010) and Sidorova and Kappelman (2011) consider an EA practice involving multiple independent EA stakeholders interacting through using EA artefacts as a complex socio-technical actor-network. Similarly to information infrastructure standards (Hanseth and Monteiro, 1997), EA artefacts can capture and represent the interests inscribed in them by their main stakeholders.

Accordingly, Sidorova and Kappelman (2011, p. 39) conclude that "enterprise architecture work helps to achieve agreement and thus alignment of the interests of internal actors within the context of enterprise interests and inscribes such agreement into architectural artefacts".

The findings of this study support the view of an EA practice as a complex socio-technical actor-network proposed by Sidorova and Kappelman (2011), where different actors inscribe their interests in corresponding EA artefacts subsequently representing these interests for their creators. The theory of the roles of EA artefacts developed in this study suggests that the mechanism of inscription indeed has multiple manifestations in an EA practice and can be even considered as one of the key underlying mechanisms of an EA practice. Moreover, the resulting grounded theory clarifies the topology of this actor-network from the perspective of the roles of EA artefacts.

In particular, the theory of the roles of EA artefacts suggests that the most fundamental organization-wide planning decisions are inscribed by senior business leaders in Context Setters, which subsequently represent these interests by influencing all other "downstream" planning decisions. Similarly, senior business leaders inscribe their interests regarding the desired long-term direction for IT investments in Strategic Aligners, which subsequently represent the inscribed interests mostly through launching new IT initiatives aligned to these interests. Business leaders also inscribe their interests regarding specific IT initiatives in corresponding Value Estimators, which subsequently represent these interests by providing the basis for further, more detailed technical planning of these initiatives. Architects inscribe their interests regarding the desired organization-wide technology portfolio in Instrument Providers, which subsequently represent these interests by providing recommended implementation approaches for all IT initiatives. Architects also inscribe their interests regarding the technical implementation of specific IT projects in corresponding Project Implementers, which subsequently represent these interests by providing detailed actionable guidance for project teams.

Essentially, the mechanisms of inscription and subsequent representation of the inscribed interests described above highly correlate with the established relationships between the six roles of EA artefacts discussed in detail earlier in Chapter 5 (see Figure 5.8). Understanding these relationships between the roles of EA artefacts, as well as key stakeholders of these EA artefacts, helps understand the general topology of the actor-network standing for an EA practice. A typical topology of the actor-network representing an EA practice based on the developed theory of the roles of EA artefacts is shown in Figure 7.2.

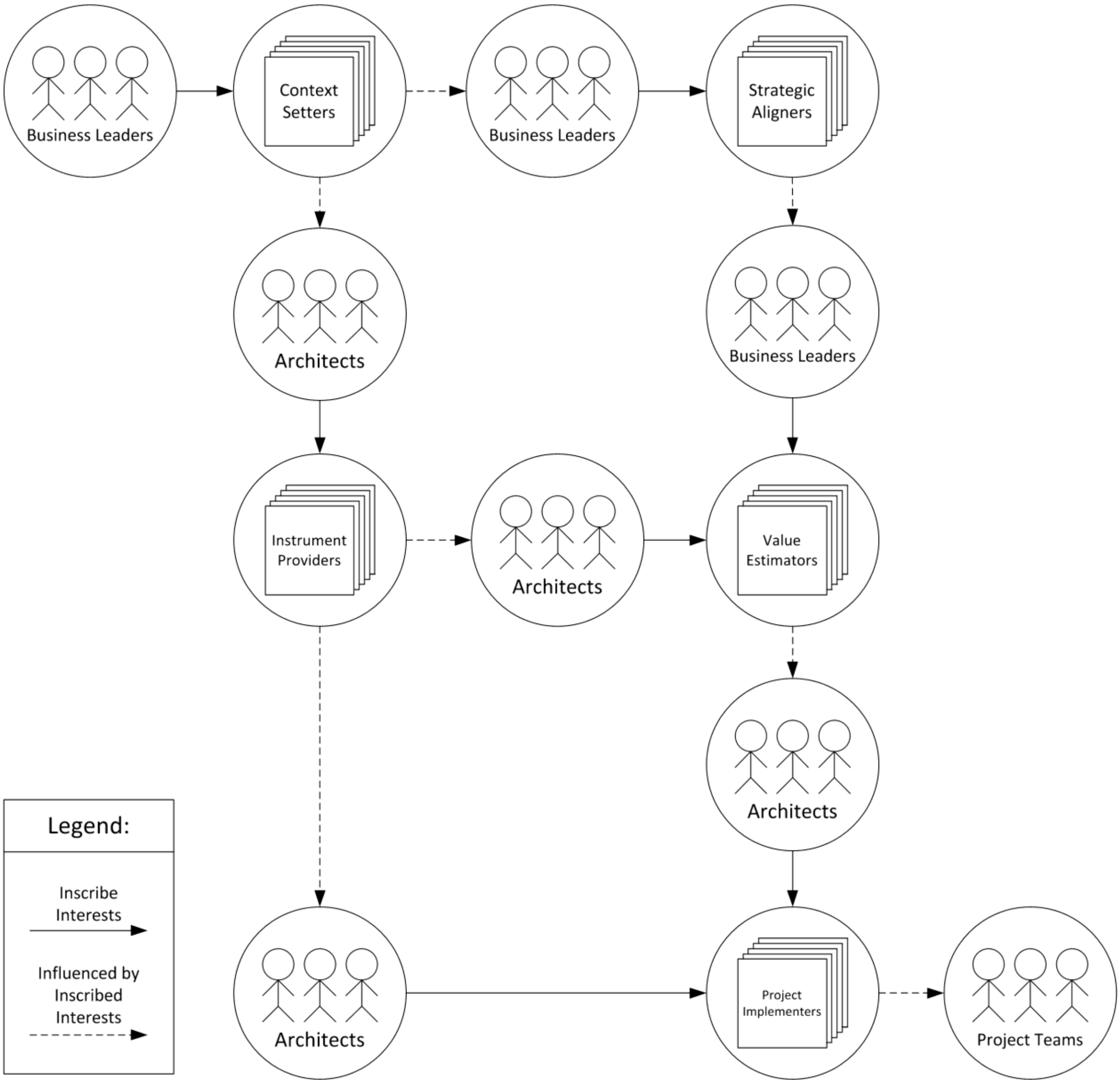

Figure 7.2. Topology of the actor-network representing an EA practice

Therefore, the findings of this study demonstrate that the actor-network theory can provide powerful theoretical lenses for studying the complex phenomenon of an EA practice. Moreover, the developed theory of the roles of EA artefacts elucidates the general topology and organization of the actor-network representing an EA practice, i.e. explains which actors inscribe which interests in which EA artefacts and how these inscribed interests are subsequently represented by these EA artefacts.

7.2.3. EA Artefacts as Blueprints, Decisions, Language and Literature

Smolander et al. (2008) identified four general metaphoric roles fulfilled by software architecture: Blueprints, Decisions, Language and Literature. The studies of Bischoff et al. (2014) and Niemi and Pekkola (2017) suggest that these four roles might be used to understand the roles of EA artefacts as well, even though EA is a more complex, diverse and multifaceted phenomenon than software architecture. As Smolander et al. (2008) demonstrate, Blueprints, as one of the roles of software architecture, provide specifications of IT systems that need to be implemented. Decisions represent different choices and rationales for systems planning. Language provides a shared means of communication enabling mutual understanding. Finally, Literature provides documentation for current and future users and IT specialists. Smolander et al. (2008) argue that software architecture can be considered as an instrument fulfilling all these four practical roles.

The findings of this study show that the practical roles of EA artefacts indeed have significant overlaps with the four roles of software architecture identified by Smolander et al. (2008), however, with appropriate type-specific clarifications taking into account significant conceptual differences existing between EA artefacts and software architecture. Specifically, of all the six general roles of EA artefacts defined by the resulting grounded theory only the role of Project Implementers correlates with the role of Blueprints since all other types of EA artefacts provide some abstract views or planning considerations, but not directly implementable specifications. At the same time, all the general roles of EA artefacts highly correlate with the role of Decisions since all the roles of EA artefacts are closely associated with different types of decision-making, however, with the notable exceptions of Knowledge Repositories which often merely provide an accurate description of the current state and do not imply any real planning decisions. Similarly, all the general roles of EA artefacts highly correlate with the role of Language since they provide a means of communication between different people. However, as discussed in detail earlier in Section 7.2.1, not all types of EA artefacts can be considered specifically as boundary objects, i.e. a means of communication between diverse communities. Finally, only the role of Knowledge Repositories correlates with the role of Literature since all other roles of EA artefacts imply planning the future instead of capturing the present. However, Project Implementers can be also considered as Literature after the corresponding projects are implemented, but mostly for system users and support teams since the descriptions provided by these EA artefacts are often too detailed to be useful as Literature for architects, who normally focus on a "big picture" view.

The relationships between the four roles of software architecture identified by Smolander et al. (2008) and the six roles of EA artefacts identified by the resulting grounded theory are summarized in Table 7.1.

Table 7.1. Relationships between the roles of EA artefacts and software architecture

Role	Blueprints (implementable specification)	Decisions (choices and rationales)	Language (medium of communication)	Literature (documentation of current state)
Context Setters	No, provide only abstract ideas	Yes, the most general decisions	Yes, boundary objects between architects and business leaders	No, typically do not show current state
Instrument Providers	No, provide only general guidelines	Yes, general technical decisions	Yes, a means of communication between architects	No, usually provide "timeless" recommendations
Knowledge Repositories	No, provide only high-level views	No, often describe only as-is state	Yes, a means of communication between architects	Yes, architectural view of the current state
Project Implementers	Yes, provide implementable specifications	Yes, specific project-level decisions	Yes, boundary objects between architects and project teams	Yes, but often too detailed for architects
Strategic Aligners	No, provide only strategic plans	Yes, long-term strategic decisions	Yes, boundary objects between architects and business leaders	No, represent future plans
Value Estimators	No, provide only high-level plans	Yes, key initiative-specific decisions	Yes, boundary objects between architects and business leaders	No, represent future plans

As the analysis summarized in Table 7.1 suggests, from the perspective of the "10000-feet" view, EA roughly fulfils the same roles as software architecture. However, due to its inherent higher complexity, boarder scope and wider diversity of involved actors and activities, different roles of EA artefacts correlate differently with the four typical roles of software architecture identified by Smolander et al. (2008).

7.2.4. Roles of Specific Types of Enterprise Architecture Artefacts

The EA literature provides type-specific analysis of the roles of some narrow types of EA artefacts including principles (Greefhorst and Proper, 2011b; Haki and Legner, 2012; Hugoson et al., 2010), standards (Boh and Yellin, 2007), business capability maps (Khosroshahi et al., 2018) and core diagrams (Ross et al., 2006). The findings of this study largely support and also generalize the roles of these EA artefacts described in literature.

Firstly, the descriptions of the decision-guiding role of principles widely available in the existing EA literature (Greefhorst and Proper, 2011a; Greefhorst et al., 2013; Greefhorst and Proper, 2011b; Hugoson et al., 2010; Proper and Greefhorst, 2010; Proper and Greefhorst, 2011; Winter and Aier, 2011) are naturally supported by the findings of this study. From the perspective of the resulting grounded theory, principles, along with other conceptually similar EA artefacts like maxims or policies, belong to a more general type of Considerations fulfilling the role of Context Setters (see Figure 5.2), which implies setting the overarching mental context for enabling effective and consistent decision-making.

Analogously, the role of standards as the drivers of reduced complexity identified in the available EA literature (Boh and Yellin, 2007) also highly correlates with the propositions of the resulting grounded theory. From the perspective of the developed theory, standards, as well as other conceptually similar EA artefacts such as technology reference models and patterns, can be related to a common general type of Standards fulfilling the role of Instrument Providers (see Figure 5.3), which implies providing standardized reusable means for project implementation and leads, among other benefits, to reduced complexity, exactly as suggested by the existing literature (Boh and Yellin, 2007).

Ross (2004) and Ross et al. (2006) describe in great detail the usage of EA artefacts called as core diagrams intended to enable effective strategic communication between senior business and IT leaders. The analysis of EA artefacts from the five studied organizations suggests that none of the studied organizations used any EA artefacts highly resembling core diagrams recommended by Ross et al. (2006). However, the descriptions of core diagrams and their practical usage provided in literature (Ross, 2004; Ross et al., 2006) clearly suggest that these EA artefacts can be related to the general type of Visions fulfilling the role of Strategic Aligners, along with business capability models, process models and roadmaps, intended to facilitate the strategic dialog between business and IT and provide a long-term direction for future IT investments. This observation suggests that the developed grounded theory is generic enough to explain the roles of EA artefacts missing in the original data set and confirms the external validity of the resulting theory.

However, the findings of this study also demonstrate that some EA artefacts are very helpful and widely used in practice, but still barely discussed in the current EA literature or even not discussed at all. For example, business capability models were widely used for focusing and prioritizing future IT investments in all the five studied organizations, but received little attention in the existing EA literature (Khosroshahi et al., 2018). Similarly, each of the five studied organizations actively used various kinds of Outlines EA artefacts, e.g. solution overviews or conceptual architectures, fulfilling the role of Value Estimators intended to assess the business value of proposed IT initiatives, while the available EA literature arguably does not study any of these EA artefacts altogether.

These facts suggest that the roles of specific types of EA artefacts described in the existing EA literature are generally correct and highly correlate with the roles of some of the general types defined by the resulting grounded theory, but at the same time the roles of many important EA artefacts widely used in organizations still remain largely unexplored, and even the very existence of some of these EA artefacts has not been reported previously by other researchers. This conclusion supports the earlier conclusion of Niemi and Pekkola (2017) that the usage of EA artefacts in practice is insufficiently studied and understood.

7.3. Relationship to Other Theories of Environmental Factors

Besides identifying the key roles fulfilled by EA artefacts in the context of an EA practice, the grounded theory developed in this study also identifies ten environmental factors having articulate influence on these roles: agile delivery, industry, legislative regulation, maturity, outsourcing, size, strategic uncertainty, structure, tools and vendor dependence (see Figure 5.9 and Figure 5.10). Although it is widely acknowledged in the EA literature that EA practices can differ widely depending on a number of environmental and design factors (Buckl et al., 2012; Buckl et al., 2010; Leppanen et al., 2007; Park et al., 2013; Riege and Aier, 2008; Saha, 2009), the contextual design factors discussed in literature relate mostly to an EA practice in general with little or no clear implications for specific EA artefacts and their roles.

For example, EA practices can be classified into (1) business-oriented EA practices characterized by an apparent focus on the business support of EA, (2) IT-oriented (passive) EA practices characterized by the extensive use of EA for IT operations but poor management support and low organizational penetration and (3) balanced (active) EA practices characterized by the high support of IT operations, management and integration with IT strategy (Aier et al., 2011; Aier et al., 2008; Lahrmann et al., 2010; Riege and Aier, 2008; Riege and Aier, 2009). EA practices can be also classified into four general archetypes: (1) modelling-driven archetype distinguished by the focus on a particular modelling tool and notation, (2) strategic IS archetype distinguished by the focus on a particular critical centralized information system, (3) architecture paradigm archetype distinguished by the focus on a particular architectural paradigm and (4) governance archetype distinguished by the focus on complex decentralized governance structures and processes (Haki et al., 2012; Hobbs, 2012). Park et al. (2013) argue that EA practices can be differentiated according to four main EA design factors: (1) centralization as the extent to which EA elements are concentrated in one location, (2) modularity as the degree of interdependence between different subsystems, (3) standardization as the degree of systems heterogeneity and (4) open platforms as the extent of independence from proprietary vendor products. Saha (2009) argues that EA practices can be grouped according to their value proposition (standardization or differentiation) and emphasis (technology or business) into four different EA design models: (1) technology standardization model, (2) business standardization model, (3) technology differentiation model and (4) business differentiation model.

Although some of the factors influencing EA practices described in literature highly correlate with the environmental factors identified in this study (for example, the use of open platforms considered as an important design factor by Park et al. (2013) is evidently related to the vendor dependence factor identified in this study), most design factors mentioned in literature arguably have only indirect, unclear or multifaceted implications for the roles of EA artefacts. From this perspective, the resulting theory contributes a set of design factors, as well as the explanation of their impact on the roles of EA artefacts, to the sub-stream of EA research focused on studying the environment-specific design of an EA practice.

7.4. Relationship to Enterprise Architecture Benefits Theories

As demonstrated in Chapter 2, one of the core streams of EA research is the stream addressing the benefits of EA (Alaeddini and Salekfard, 2013; Foorthuis et al., 2016; Foorthuis et al., 2010; Lange et al., 2016; Park et al., 2013; Schmidt and Buxmann, 2011; Shanks et al., 2018; Tamm et al., 2011; Weiss et al., 2013). All these publications in some or the other form theorize on or establish the statistically significant relationship between using EA and obtaining some valuable organizational benefits, e.g. IT flexibility (Schmidt and Buxmann, 2011) or strategic alignment (Alaeddini and Salekfard, 2013).

However, these studies theorize on the benefits of an EA practice (Park et al., 2013), EA management (Lange et al., 2016; Schmidt and Buxmann, 2011; Weiss et al., 2013), EA services (Shanks et al., 2018), EA projects (Alaeddini and Salekfard, 2013) or even EA in general (Foorthuis et al., 2016; Foorthuis et al., 2010; Tamm et al., 2011), but none of these studies attempts to theorize on the relationship between EA benefits and specific types of EA artefacts. Moreover, none of these studies attempts to logically explain how the realization of these benefits is actually operationalized in organizations at the "ground" level, i.e. describe how exactly EA artefacts as physical documents bring expected organizational benefits through specific planning decisions. In other words, these studies essentially imply that the very existence of EA, EA practice, EA management or EA services somehow benefits organizations without explaining how exactly it happens "inside" at the level of specific actors and activities.

From this perspective, the theoretical contribution of this study to the EA benefits research stream (see Figure 5.11 and Figure 5.12) can be summarized into (1) explaining which specific types of EA artefacts contribute to different organizational benefits, (2) explaining how exactly the realization of these benefits is operationalized in organizations and (3) explaining which internal and external environmental factors can facilitate or undermine the realization of specific organizational benefits. The resulting grounded theory not only supports the earlier claims regarding the benefits from using EA, but also explains how exactly and from which types of EA artefacts these benefits may be delivered in practice. Therefore, the theory of the roles of EA artefacts that emerged in this study makes a significant step forward in our understanding of the EA benefits as well as the opportunities for their practical realization.

7.5. Implications for the Enterprise Architecture Discipline

The grounded theory of the roles of EA artefacts developed in this exploratory study provides the first comprehensive theoretical model explaining the roles of different types of EA artefacts in the context of EA practice. This theory has a number of significant implications for the entire EA discipline.

7.5.1. Transparent Links Between Artefacts, Users, Usage and Benefits

The current EA literature, though with the exception of the studies focused on specific types of EA artefacts (see Table 2.3), typically considers EA merely as a collection of EA artefacts. Even though EA artefacts can be very diverse (see Appendix A), the EA literature often considers EA largely as a set of homogeneous EA artefacts that describe various aspects of organizations, e.g. business, systems and technology (see Table 2.4), however, without distinguishing artefact-specific users, usage and benefits. Unsurprisingly, current streams of EA research discuss the modelling and analysis of EA (see Table 2.5), adoption and use of EA (see Table 2.6), maturity and evolution of EA (see Table 2.7) and benefits of EA (see

Table 2.8) in general, but rarely discuss the same questions in relation to specific EA artefacts, e.g. modelling of specific types of EA artefacts, adoption of particular EA artefacts or benefits of specific EA artefacts. Essentially, current EA research considers EA largely as a "black box" with comprehensive information valuable to diverse users for various purposes. The current view of EA as a "black box" widely adopted in the current EA literature (however, with some exceptions) is shown in Figure 7.3.

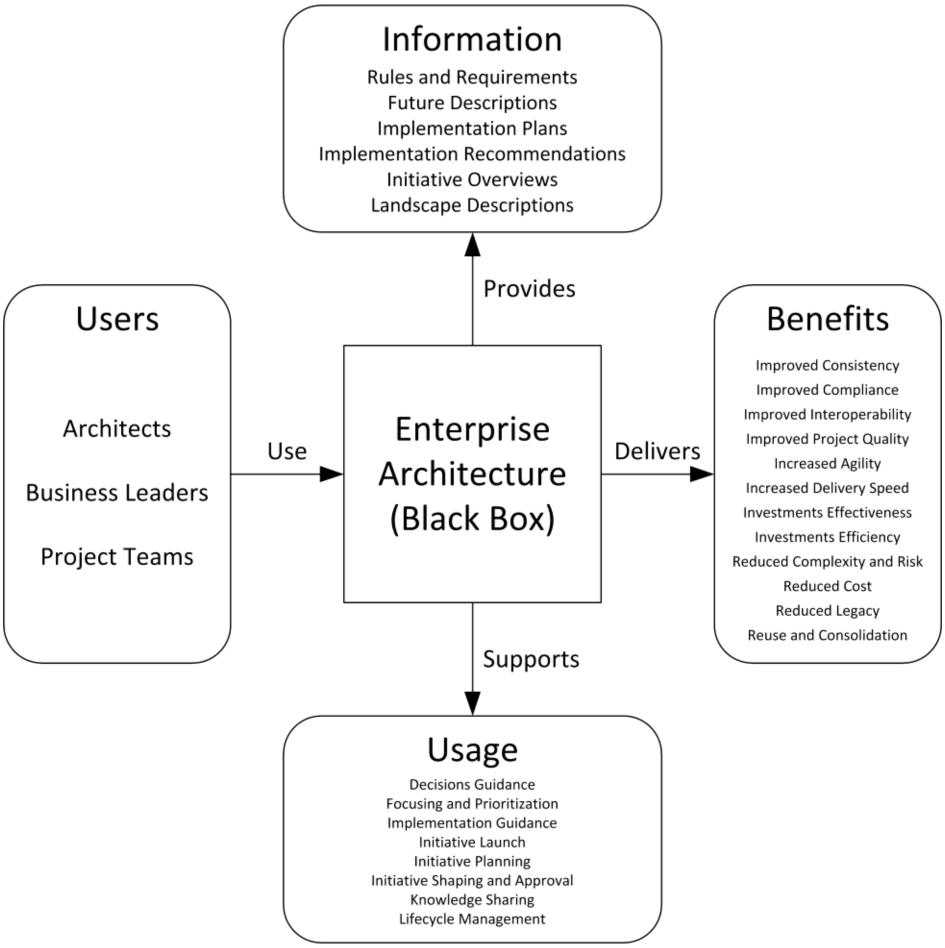

Figure 7.3. The current view of EA as a "black box"

The theory of the roles of EA artefacts developed in this study helps establish the link between different types of EA artefacts, their users, usage and resulting benefits and, thereby, connect various aspects of an EA practice into a consolidated logical picture, which is currently missing in the available EA literature. Instead of considering specific EA artefacts merely as some generic components of EA, the findings of this study allow considering specific types of EA artefacts independently from other types and analysing their essential type-specific properties. Specifically, the resulting theory of the roles of EA artefacts explains which exactly types of EA artefacts are relevant for particular users, convey specific information, support certain use cases and lead to the realization of different types of benefits.

Essentially, this study allows deconstructing the general concept of EA into six core underlying components providing a novel in-depth look at EA and EA practice. In other words, the theory of the roles of EA artefacts developed in this study offers an innovative view of EA as a "transparent box", as opposed to the established view of EA as a "black box" prevalent in the current EA literature (see Figure 7.3). The new view of EA as a "transparent box" demonstrating the links between specific types of EA artefacts, their contents, users, usage and benefits is shown in Figure 7.4.

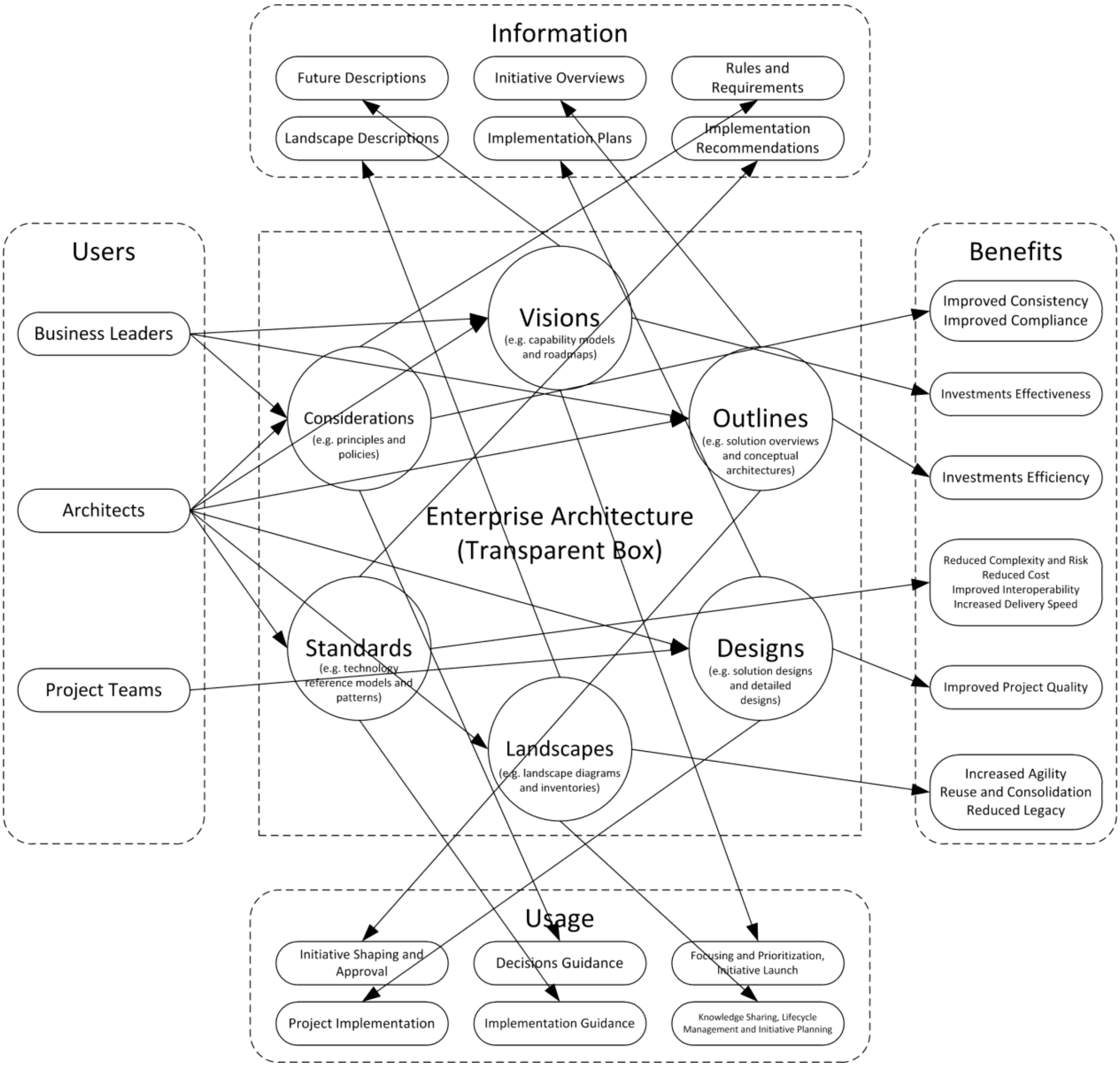

Figure 7.4. The new view of EA as a "transparent box"

7.5.2. Possible Reconceptualization of Enterprise Architecture

In the current EA literature the concept of EA is typically viewed as a holistic description of an organization fulfilling different roles from the planning perspective and structured according to EA frameworks (Bernard, 2012; Niemi and Pekkola, 2017; Simon et al., 2013; TOGAF, 2018). These EA frameworks structure EA, as a comprehensive description or blueprint, into different components according to their abstraction levels (Pulkkinen, 2006; Sowa and Zachman, 1992; Zachman, 1987), interrogatives (Schekkerman, 2006; Sowa and Zachman, 1992; van't Wout et al., 2010), views (C4ISR, 1997; DoDAF, 2007; MODAF, 2005) and segments (Bernard, 2012; FEAF, 1999). However, the most typical way to conceptualize EA is to structure it into four different domains: business, information, applications and technology (Bernard, 2012; Covington and Jahangir, 2009; FEAF, 1999; PRISM, 1986; Pulkkinen, 2006; Schekkerman, 2006; TAFIM, 1996; TOGAF, 2018; van't Wout et al., 2010). The established conceptualization of EA is shown in Figure 7.5.

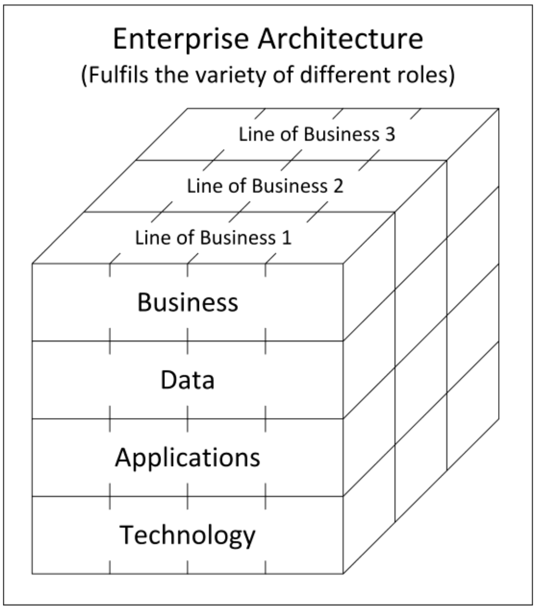

Figure 7.5. Established conceptualization of EA

However, this study provides a number of empirical findings that allow presenting an alternative, more explanatory conceptualization of EA. Firstly, the developed theory suggests that all EA artefacts, as separate components of EA, can be classified according to their unique practical roles into six general types: Considerations, Designs, Landscapes, Outlines, Standards and Visions. Secondly, these six types do not overlap and essentially represent separate groups of EA artefacts. Thirdly, all the six general types of EA artefacts are essential for established EA practices and organization-neutral in nature (though their roles can be influenced by various environmental factors, as shown earlier in Figure 5.9 and Figure 5.10, these factors still do not change their core meaning). Fourthly, the empirical analysis of EA artefacts used in established EA practices shows that individual EA artefacts often describe combinations of multiple different domains and, therefore, can hardly be allocated to any single domain according to the established conceptualization of EA (see Figure 7.5). Fifthly, each of the six general types of EA artefacts distinguished by the resulting grounded theory can describe any combination of domains, though in different proportions.

These five observations taken together suggest that the concept of EA can be also viewed as a set of six non-overlapping general types of EA artefacts, i.e. Considerations, Designs, Landscapes, Outlines, Standards and Visions, describing any combinations of typical EA domains, i.e. business, data, applications and technology, and fulfilling their own type-specific roles in the context of an EA practice, i.e. Context Setters, Project Implementers, Knowledge Repositories, Value Estimators, Instrument Providers and Strategic Aligners respectively. The resulting proposed reconceptualization of EA is shown in Figure 7.6.

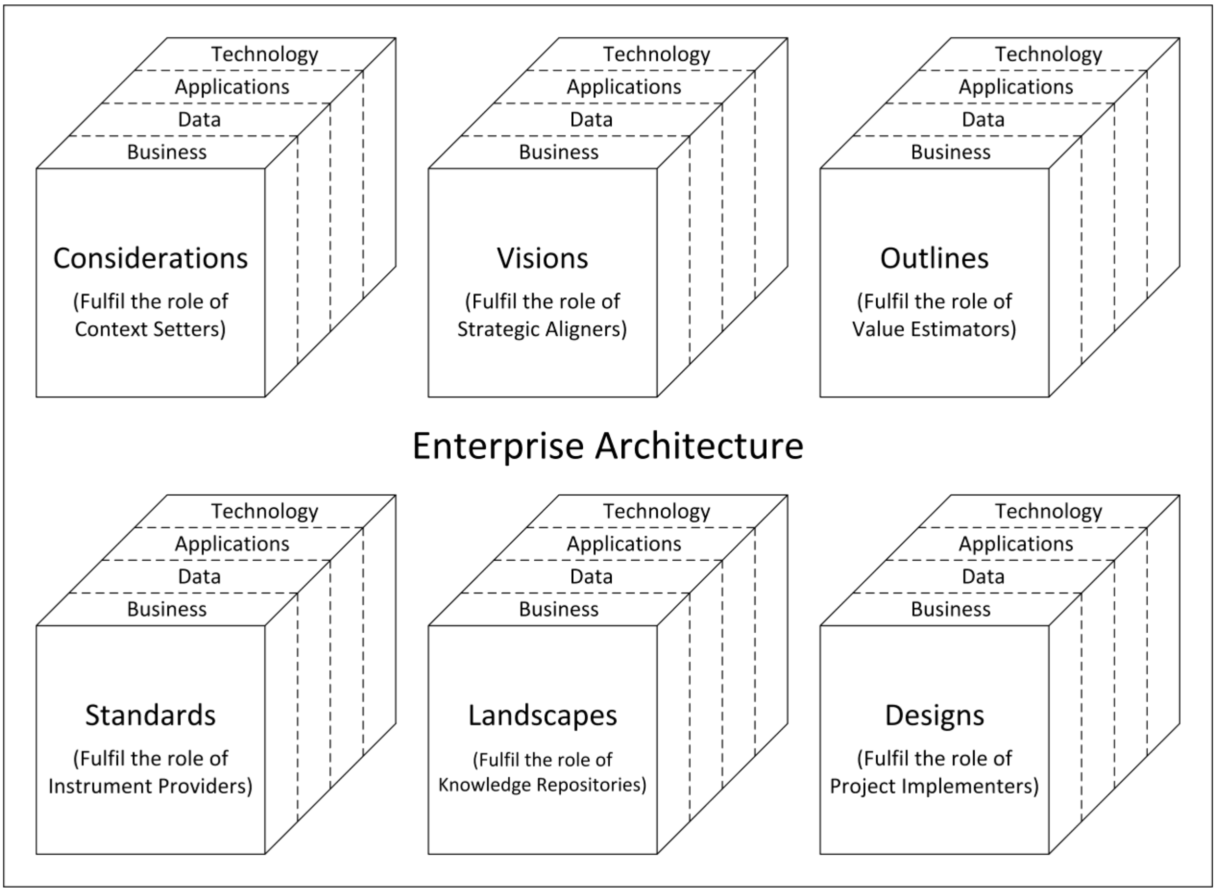

Figure 7.6. Proposed reconceptualization of EA

The alternative view of EA presented in Figure 7.6 provides a more explanatory description of the concept of EA than the established view of EA (see Figure 7.5). While the established classifications of EA artefacts into different abstraction levels, interrogatives, segments or views clarify only the objects of their descriptions, the proposed new classification of EA artefacts into six general types immediately explains their practical roles, as suggested by the developed grounded theory, and therefore clarifies their most essential properties including informational contents, users, usage and resulting benefits.

7.5.3. Refocusing from Enterprise Architecture to Specific EA Artefacts

The EA literature argues that EA consists of multiple EA artefacts (Bernard, 2012; Spewak and Hill, 1992; van't Wout et al., 2010), has many different applications (Bernard, 2012; Lankhorst, 2013), is used by multiple different stakeholders (Niemi, 2007; Thornton, 2007; van der Raadt et al., 2010; Verley, 2007) and brings a number of various benefits to organizations (Alaeddini and Salekfard, 2013; Bradley et al., 2011; Schmidt and Buxmann, 2011). These claims are completely supported by the results of this study.

However, the resulting theoretical conceptualization of the roles of EA artefacts clearly suggests that different types of EA artefacts are used by different stakeholders for disparate purposes and bring different benefits (see Figure 7.4). Moreover, different types of EA artefacts have significantly different properties and features. Some of these differences, especially differences in their informational contents, are relatively obvious. For instance, EA artefacts intended for business leaders (Considerations, Visions and Outlines) are typically brief and use business language in order to be understandable for senior executive audience, while EA artefacts intended only for IT specialists (Standards, Landscapes and Designs) are typically more voluminous and use IT-specific language in order to be useful for architects and other IT staff. However, other differences between different types of EA artefacts can be more subtle and less evident. For instance, the value of Landscapes and Standards is realized mostly from "having" these artefacts since they are used largely as reference materials for IT planning and implementation. On the contrary, the value of Considerations, Outlines and Visions is realized largely during the process of their development since this process implies reaching mutual agreement on strategic questions, achieving a shared understanding of the organizational goals, balancing needs and concerns of various business and IT stakeholders, while the resulting versions of these EA artefacts only document the critical decisions that have already been made in the process of their development. In other words, merely creating Landscapes and Standards is largely meaningless but their subsequent usage brings actual value, while for Considerations, Outlines and Visions the development process itself is equally valuable since merely "having" these EA artefacts does not improve business and IT alignment. Put it simply, for Landscapes and Standards documents themselves are important, but for Considerations, Outlines and Visions the discussion of documents is more important.

Consequently, EA can hardly be considered as a homogeneous description of multiple aspects of an organization that is developed and then used, but rather as a collection of diverse EA artefacts with their own specific purposes, roles, developers, users and lifecycles. The fact that different EA artefacts have different developers, users and lifecycles suggests that the commonly used phrases “developing EA” and “using EA” are essentially meaningless in most contexts and synonymous to “writing a library” and “reading a library”. As the results of this study clearly demonstrate, no individuals or groups of individuals develop and use the entire EA, but only specific EA artefacts or subsets of similar artefacts constituting EA.

Therefore, the results of this study suggest that all the various types of EA artefacts should not be “lumped” together under the single umbrella title of EA, but should be studied separately instead due to the disparity of their roles, purposes and most other critical properties. However, the existing EA literature still typically describes EA largely as a “black box” providing a comprehensive description of an organization (see Figure 7.3), but rarely focuses on the roles of specific types of EA artefacts. Moreover, the EA literature generally poorly describes and distinguishes specific features of the six general types of EA artefacts (see Table 5.1), though some types of EA artefacts are currently studied and understood much better than others. For instance, Considerations are well studied in the EA literature (Broadbent and Kitzis, 2005; Broadbent and Weill, 1997; Davenport et al., 1989; Greefhorst and Proper, 2011a; Haki and Legner, 2013; PRISM, 1986; Richardson et al., 1990; Weill and Broadbent, 1998), limited type-specific information is available on Visions (Khosroshahi et al., 2018; Ross et al., 2006) and Standards (Boh and Yellin, 2007), but the roles of Landscapes, Outlines and Designs in the context of EA practice have not been purposefully studied. Moreover, the inability to recognize the existence of different types of EA artefacts often leads to confusion in the EA literature. For instance, both Ross et al. (2006) and Lankhorst (2013) discuss “enterprise architecture”, but provide very different descriptions of “enterprise architecture” because Ross et al. (2006) in fact discuss the usage of Visions, while Lankhorst (2013) in fact discusses the modelling language suitable mostly for Landscapes and Designs.

To summarize, the results of this study suggest that the EA research community should refocus from studying the properties of EA in general (as a collection of all artefacts) to studying the properties of individual artefacts constituting EA, including their desirable properties, purposes and use cases. As the results of this study demonstrate, the focus on specific types of EA artefacts can lead to a deeper understanding of the concept of EA as well as of the essence of an EA practice in general.

7.6. Important Empirical Observations from This Study

The entire EA discipline is essentially based on EA frameworks (Simon et al., 2013). However, the practical utility of EA frameworks has been questioned earlier by many authors (Bloomberg, 2014; Buckl et al., 2009a; Burton, 2009; Gerber et al., 2007; Holst and Steensen, 2011; Trionfi, 2016; Tucci, 2011) and many companies do not use EA frameworks in any real sense (Basten and Brons, 2012; Buckl et al., 2009a; Evernden, 2015; Fallmyr and Bygstad, 2014; Haki et al., 2012; Lange and Mendling, 2011; Molnar and Proper, 2013; Smith et al., 2012). Buckl et al. (2009a, p. 15) even argue that EA frameworks "appear theoretical and impossible to implement". The results of this study further question the role of EA frameworks in an EA practice as well as the established conceptualizations of EA and EA practice in general.

7.6.1. The Role of Enterprise Architecture Frameworks in an EA Practice

In line with many previous studies (Basten and Brons, 2012; Bloomberg, 2014; Buckl et al., 2009a; Burton, 2009; Evernden, 2015; Gerber et al., 2007; Haki et al., 2012; Holst and Steensen, 2011; Molnar and Proper, 2013; Trionfi, 2016; Tucci, 2011), this study also demonstrates that the practical value of EA frameworks is at least questionable. For instance, two of the five studied organizations (see Table 3.2) used TOGAF as the basis for their EA practices and one of these two organizations was even included in the "official" list of TOGAF users provided by The Open Group (The Open Group, 2016). However, neither of these organizations used the key recommendations of TOGAF in any real sense, e.g. did not follow the steps of its architecture development method (ADM) and did not create the EA artefacts prescribed by its architecture content framework (ACF). Although after the first case study the use of EA frameworks has been identified as a potential internal factor influencing the roles of EA artefacts (see Figure 4.5 and Figure 4.6), further analysis of all subsequent case studies did not show any clear "correlation" between the used EA frameworks and resulting EA practices.

TOGAF is considered by some authors (Brown and Obitz, 2011; Dietz and Hoogervorst, 2011; Gosselt, 2012; Lankhorst et al., 2010; Sarno and Herdiyanti, 2010;

Sobczak, 2013) as a current de facto industry standard EA framework for an EA practice. However, the interviewed respondents from all the five studied organizations reported that their organizations either established their EA practices without using any EA frameworks at all or used TOGAF as a source, but did not implement any particular TOGAF-specific recommendations. For instance, some respondents explicitly replied that no EA frameworks are used in their organizations:

> *"Question: Do you use any specific frameworks for enterprise architecture? Answer: Nothing here, nothing specific at this stage"* (Data Architect from Telecom Institution)

> *"Do we employ any methodology or framework? Good question, but I think the short answer is no"* (Solution Architect from Delivery Institution)

Other respondents reported that TOGAF in their organizations is used only as one of many sources on EA, but without any specific implications or far-reaching consequences:

> *"We use few things including TOGAF. And when there were consultants, who initially shaped up the architecture practice, they developed like a home-grown methodology [...]. So, it is a mixture of many different methodologies, not tightly governed by a methodology. We got something which is customized for the bank. [...] We do not follow ADM steps"* (Enterprise Architect from Financial Institution)

> *"We do not use anything specific, but I think it is a mix of few. For example, we use TOGAF, but not for everything. Some of the concepts we take from here and there, but generally people bring their own practices and they just follow them. As far as it fits into our governance models, everything is fine"* (Lead Architect from Telecom Institution)

The manager of architecture from Retail Institution expressed the opinion that TOGAF can be potentially useful in other industries, for instance in banking, but it can hardly be applicable in retail organizations due to a very specific dynamic nature of the retail business:

> *"Other organizations, like banks, they are little more regulated, they are more slow-paced. So, I think enterprise architecture at [Retail Institution] and at*

retail [in general] is gonna take a very different flavour [...]. TOGAF doesn't quite fit in here" (Manager of Architecture from Retail Institution)

However, the general manager of architecture from Financial Institution also reported that TOGAF can hardly be used directly in his organization without significant modifications and that the only practical value of TOGAF is the general idea of describing business, data, applications and technology aspects in EA:

"Basically TOGAF more informed the framework for thinking about the dimensions of the architecture. [...] What we found is that TOGAF can be a very purist framework, so we have to adapt many things to the organization itself. We do not go too deeply into TOGAF, we used it more as a framework to saying "have we got the elements of the architecture covered?"" (General Manager of Architecture from Financial Institution)

The director of architecture from Educational Institution reported a very similar situation in his organization:

"It [our EA practice] is TOGAF-based. TOGAF is the key framework that we use, but I wouldn't say that we adopted it very fully at this point in time. [...] We do not use very much of TOGAF at all [...]. The key aspect of TOGAF that is really active at the moment is domain partitioning. The domain partitioning that we are using follows the TOGAF type of approach" (Director of Architecture from Educational Institution)

Generally respondents expressed sceptical attitude regarding the real usefulness and value of TOGAF for an EA practice:

"TOGAF really leans itself more to solution architecture rather than enterprise architecture. It tends to go into a lower level and if you are trying to mature it to the business architecture space something like the ADM, which leans itself to the solution architecture space, does not really work" (Director of Architecture from Educational Institution)

"Some enterprise architects within the enterprise architecture group here at [Financial Institution] are TOGAF-certified and like to lean on that particular framework, but I don't. I'm not TOGAF certified, I don't care

> *about TOGAF. [...] I think TOGAF is overly complex, I think it has missed the point a long time ago"* (Solution Architect from Financial Institution)

> *"Just doing the TOGAF course by itself without any real industry experience it's like giving a baker a hammer and saying "can you make a loaf of bread out of that?". It's not terribly useful"* (Principal Architect from Delivery Institution)

> *"No one really works according to TOGAF anywhere. [...] If you are too rigidly following TOGAF you would never get anything done. [...] You cannot blissfully follow the methodology, but you can look at it as a collection of tools that you can use*" (Solution Architect from Educational Institution)

These observations suggest that the perceived theoretical importance and practical usefulness of EA frameworks, and of TOGAF in particular, might be significantly exaggerated in the EA literature. Moreover, these observations regarding the practical use of EA frameworks might have considerable empirical implications for the EA discipline. Firstly, the entire EA discipline is essentially rooted in EA frameworks (Simon et al., 2013). However, the observations of this study support numerously previous conclusions that EA frameworks actually do not play a significant practical role and many organizations practice EA for many years without using any EA frameworks altogether (Basten and Brons, 2012; Buckl et al., 2009a; Gerber et al., 2007; Haki et al., 2012; Holst and Steensen, 2011; Trionfi, 2016).

Secondly, it is widely assumed that TOGAF due to its popularity can be used a general theoretical reference model of an EA practice. For instance, numerous authors (Barateiro et al., 2012; Bischoff et al., 2014; Buckl et al., 2009b; Buckl et al., 2011; Gill, 2015a; Hanschke et al., 2015; Hauder et al., 2014; Lucke et al., 2010; Mueller et al., 2013; Nakakawa et al., 2013; Pruijt et al., 2012; Rohloff, 2011; Svee and Zdravkovic, 2015; Taleb and Cherkaoui, 2012; van der Merwe et al., 2013; Vicente et al., 2013; Zadeh et al., 2012) use TOGAF as a generic conceptual representation of an EA practice in their studies. However, the observations of this study show that even TOGAF-based EA practices might be essentially unrelated to the original TOGAF prescriptions. For instance, ADM steps might be not followed even when the usage of TOGAF is formally declared. Therefore, despite its popularity TOGAF can hardly be used as a general theoretical model of an EA practice without further empirical validation.

Thirdly, it is widely assumed that the EA frameworks lens can be used for studying and analysing EA practices. For instance, many authors (Ambler, 2010; Aziz and Obitz, 2007; Buckl et al., 2009a; Cameron and McMillan, 2013; Dahalin et al., 2010; Gall, 2012; Obitz and Babu, 2009; Schekkerman, 2005; Scholtz et al., 2013) analyse EA practices by means of surveying organizations and asking which EA frameworks they use. Other authors (Bui, 2012; Bui et al., 2015) theorize on the properties of EA practices based on the differences between the underlying EA frameworks. However, the observations of this study show that the fact that a particular EA framework was used as the basis for an EA practice does not necessarily define the real work of the resulting EA practice in any real sense. In other words, there might be little or no correlation between the actual EA practice and the original prescriptions of the EA framework it is based on. Therefore, the EA frameworks lens might be inappropriate for analysing EA practices.

7.6.2. Conceptualization of Enterprise Architecture and EA Practice

The observations of this study regarding the practical usage of EA artefacts also question the established conceptualizations of EA and EA practice. Firstly, EA is typically conceptualized as a comprehensive blueprint of an entire organization structured according to a certain framework and describing its current state, future state and roadmap for transition between these states (Armour et al., 1999; Bernard, 2012; Boar, 1999b; FEA, 2001; Schekkerman, 2008; van't Wout et al., 2010). However, in line with the previous studies (Basten and Brons, 2012; Beeson et al., 2002; Erder and Pureur, 2006; Kim and Everest, 1994; Lohe and Legner, 2014; Schmidt and Buxmann, 2011), the observations of this research also show that the conceptualization of EA as an overarching blueprint might be rather distant from the practical realities. For instance, none of the five studied organizations developed comprehensive descriptions of their future states, as it is often assumed in literature, even though some of these organizations have been practicing EA for more than five years. Additionally, none of the studied organizations deliberatively structured their EA artefacts according to any specific logical frameworks (though their EA artefacts still can be organized according to framework-like dimensions, as it was done earlier after the first case study, see Table 4.3). Moreover, roadmaps developed in the studied organizations were developed based on anticipated long-term needs rather than on the formal gap analysis as recommended by the EA literature. These observations support the analogous observations of Holst and Steensen (2011, p. 20), who previously noticed that "the empirical findings [from four established EA practices demonstrate] an absence of the mechanistic concept of a large formalized documentation framework, and the lack of any theoretically-based concept of gap analysis or detailed as-is and to-be architecture”. The findings of this study also suggest that EA can hardly be conceptualized as a single bundle of artefacts, but rather as a collection of related but diverse artefacts valuable independently of each other and having their own unique usage, lifecycle, stakeholders and purpose. Therefore, the most commonly accepted conceptualization of EA might need to be revised and reconsidered.

Secondly, an EA practice is typically conceptualized as a single sequential step-wise process including documenting the current state, describing the desired future state, analysing the gaps, developing a transition plan and implementing it (Bernard, 2012; Bittler and Kreizman, 2005; Covington and Jahangir, 2009; Spewak and Hill, 1992; TOGAF, 2018; van't Wout et al., 2010). However, the observations of this study show that established EA practices might be hardly described as sequential step-wise processes, as suggested by popular EA frameworks and methodologies. Very similar findings have been also reported earlier, for instance, by Haki et al. (2012, p. 1): “[EA] frameworks have been suggested as guidelines to [EA] implementation, but our experience indicates that very few companies follow the steps prescribed by such frameworks [and methodologies]”. Instead, EA practices in all the five studied organizations represented interrelated sets of relatively independent, continuous and often ill-structured processes around each of the six roles of EA artefacts integrated with other organizational processes (a high-level processes view of an EA practice from the perspective of the six roles of EA artefacts was presented earlier in Figure F.2). As demonstrated earlier by Lohe and Legner (2014), in successful EA practices different EA artefacts are not created in a separate standalone EA lifecycle, but rather produced, updated, used and “consumed” as part of regular organizational processes, which has been clearly observed in all the five studied organizations. Therefore, the most commonly accepted conceptualization of an EA practice as a single iterative step-wise process might also need to be revised and aligned to current industry best practices.

7.7. Chapter Summary

This chapter discussed the main findings of this research and their implications. Firstly, this chapter discussed the resulting theory in the broader context of the IS discipline and related the theory back to the existing studies on the roles of EA artefacts, environmental factors and EA benefits. Then, this chapter discussed the implications of the resulting grounded theory for the EA discipline. Finally, this chapter described important empirical observations of this study and explained their potential consequences for the EA discipline.

CHAPTER 8: CONCLUSION

This chapter provides a general conclusion to the thesis. Firstly, this chapter reviews the conducted research, summarizes its key findings and revisits the original research question and initial expectations. Then, this chapter describes the overall contribution of this research to the EA discipline and discusses its main limitations. Finally, this chapter outlines the directions for future research and concludes the thesis.

8.1. An Overview of the Conducted Research

EA consists of multiple diverse EA artefacts that describe various aspects of an organization, e.g. strategic drivers, business processes and technical infrastructure. The development of EA artefacts requires significant investments of time and money. However, the organizational investments in developing EA artefacts often do not bring the expected benefits because of the usability issues associated with these EA artefacts. At the same time, the available EA literature does not provide comprehensive theories explaining the practical roles of EA artefacts in decision-making and implementation of IT systems.

These common practical problems and theoretical gaps called for an investigation of the specific roles of different types of EA artefacts in an EA practice. To address this issue, this research aimed to develop a comprehensive descriptive theory explaining the roles of EA artefacts. Specifically, the main research question of this study was initially formulated as follows: What are the roles of different types of EA artefacts in an EA practice?

The core intent of this study was to explore the roles of different EA artefacts in an EA practice, which previously received little attention in the EA discipline and remained insufficiently understood despite their significant theoretical and practical importance. Due to the paucity of available theories relevant to the roles of EA artefacts, this study followed the case studies-based grounded theory approach to develop a new theory directly from empirical data. Since this study was highly exploratory in nature and implied a considerable descriptive element, specifically the Straussian version of the grounded theory method had been selected for the purposes of this research. Guided by the core canons of the grounded theory method, i.e. theoretical sampling, iterative coding, constant comparison and linkage between data collection and analysis, this study progressively analysed the usage of EA artefacts in five established EA practices and produced a descriptive theory defining the typical roles of EA artefacts. The practical aspects of the resulting theory were then discussed with ten additional EA experts, including EA practitioners and EA academics, who confirmed its validity and practical utility.

8.2. Key Research Findings

The developed theory suggests that all EA artefacts used in organizations fulfil one of the six general roles in the context of an EA practice: Context Setters, Instrument Providers, Knowledge Repositories, Project Implementers, Strategic Aligners and Value Estimators (see Table 5.1). Context Setters imply setting the overarching mental context for business and IT planning to avoid inappropriate planning decisions. Instrument Providers imply providing proven instruments for implementing new IT systems to avoid "reinventing the wheels". Knowledge Repositories imply capturing, storing and managing knowledge on the technical structure of the organizational IT landscape to leverage this knowledge for IT planning purposes. Project Implementers imply bridging the planning and delivery of new IT initiatives to ensure the connection between high-level architectural plans and low-level system implementation. Strategic Aligners imply showing the overall long-term direction for future IT investments to ensure their close alignment with the business strategy. Finally, Value Estimators imply estimating the overall business value of proposed IT initiatives to justify corresponding IT investments. Each of these six roles is further explained by the theory in terms of underlying EA artefacts, their informational contents, involved users, typical usage and associated organizational benefits (see Figure 5.2, Figure 5.3, Figure 5.4, Figure 5.5, Figure 5.6 and Figure 5.7). The resulting theory also explains the logical relationship and synergy between these roles of EA artefacts (see Figure 5.8) as well as the influence of internal and external environmental factors on these roles (see Figure 5.9 and Figure 5.10).

8.3. Revisiting the Research Question

Since the existing EA literature does not offer any comprehensive theories explaining the practical roles of different types of EA artefacts, the main research question of this study was initially formulated as follows:

- What are the roles of different types of EA artefacts in an EA practice?

As discussed earlier in Chapter 1, the objectives of this study were twofold, theoretical and practical in nature, and included both developing a full-fledged theory explaining the roles of EA artefacts and addressing practical problems with EA via proposing a convenient practical tool for guiding EA practices. Later in Chapter 2 a number of more specific expectations regarding the resulting theory have been also formulated:

- Theory should be comprehensive and encompass the primary roles of all EA artefacts useful in practice
- Theory should be EA-specific and sensitive to the unique context of EA
- Theory should be generic and organization-neutral
- Theory should take into account various environmental factors impacting the roles of EA artefacts
- Theory should distinguish type-specific roles of EA artefacts, but still be abstracted from highly specific narrow types of EA artefacts
- Theory should establish a clear connection between individual EA artefacts and their regular roles

The analysis of the study outcomes from the perspective of the original research question, its objectives and corresponding expectations is summarized in Table 8.1.

Table 8.1. Research question, objectives and expectations revisited

Research question and expectations	How exactly addressed or met
Research question: What are the roles of different types of EA artefacts in an EA practice?	The resulting theory articulates six consistent roles of EA artefacts in an EA practice: Context Setters, Instrument Providers, Knowledge Repositories, Project Implementers, Strategic Aligners and Value Estimators (see Table 5.1)
Objective 1: Develop a full-fledged theory	The resulting theory is overarching in nature and comprehensively describes the six roles of EA artefacts (see Figure 5.2, Figure 5.3, Figure 5.4, Figure 5.5, Figure 5.6 and Figure 5.7), the relationship between these roles (see Figure 5.8), the influence of internal and external environmental factors on these roles (see Figure 5.9 and Figure 5.10) and the EA benefits realization through these roles (see Figure 5.11 and Figure 5.12)
Objective 2: Propose a practical tool for EA	The developed taxonomy for organizing EA artefacts based on their roles (see Figure 6.1 and Figure 6.2 and Figure 6.3) provides a convenient sense-making instrument for addressing typical practical problems associated with EA

Expectation 1: Comprehensiveness	The resulting theory covers the roles of all the 61 EA artefacts identified in the five studied organizations, no significantly "deviating" EA artefacts have been identified during the subsequent theory discussion as well (see Table 6.3)
Expectation 2: Sensitiveness to the context of EA	The six roles identified by the resulting theory are very EA-specific and formulated in "native" terms used in EA practices in organizations
Expectation 3: Generalizability	The six resulting roles of EA artefacts are organization-neutral in nature and proved to be consistent across all the five studied organizations as well as during the concluding theory discussion with EA experts
Expectation 4: Take into account relevant environmental factors	The resulting theory identifies ten relevant environmental factors (agile delivery, industry, legislative regulation, maturity, outsourcing, size, strategic uncertainty, structure, tools and vendor dependence) and explains their influence on the six roles of EA artefacts (see Figure 5.9 and Figure 5.10)
Expectation 5: Abstracted from narrow types of EA artefacts	The resulting theory articulates six generic types of EA artefacts fulfilling highly type-specific roles: Considerations, Designs, Landscapes, Outlines, Standards and Visions
Expectation 6: Establish the link between different EA artefacts and their roles	The resulting theory "connects" each of the six roles with corresponding generic types of EA artefacts: Context Setters with Considerations, Instrument Providers with Standards, Knowledge Repositories with Landscapes, Project Implementers with Designs, Strategic Aligners with Visions and Value Estimators with Outlines

As shown in Table 8.1, all the initial expectations of this research have been successfully met by the developed theory. Therefore, as a result of this study the roles of different EA artefacts in an EA practice have been appropriately explored and the study has fully achieved its original objectives.

8.4. Contribution to the Enterprise Architecture Discipline

This study and the resulting theory of the roles of EA artefacts make theoretical, practical and empirical contribution to the EA discipline.

8.4.1. Theoretical Contribution

The developed theory of the roles of EA artefacts provides the first available theory specifically focused on the phenomenon of EA artefacts, their usage and roles. Following the earlier call for exploring the practical usage of EA artefacts by Niemi and Pekkola (2017), the resulting theory provides a sound theoretical model addressing the most essential questions related to the usage of EA artefacts in practice. While the existing EA literature is largely unable to explain how most EA artefacts are used in organizations, the theory developed in this study explains (1) how exactly different types of EA artefacts are used to benefit organizations, (2) how the roles of different EA artefacts relate to each other and (3) what environmental factors impact, facilitate or undermine these roles.

Moreover, the EA discipline is currently focused mostly on EA in general as a collection of all EA artefacts, but largely ignores the critical fact that separate EA artefacts constituting EA are very diverse from the perspective of their practical roles in almost every aspect. Specifically, the current EA literature describes EA as a collection of numerous EA artefacts (Bernard, 2012; TOGAF, 2018; van't Wout et al., 2010) that support various use cases (Narman et al., 2012a; Radeke, 2011; Ross et al., 2006; van Roosmalen and Hoppenbrouwers, 2008) for multiple different stakeholders (Fairhead and Good, 2009; Niemi, 2007; Thornton, 2007; van der Raadt et al., 2010) and bring a number of benefits to organizations (Foorthuis et al., 2016; Lange et al., 2016; Schmidt and Buxmann, 2011; Tamm et al., 2011) (see Figure 7.3). However, the findings of this study provide a novel in-depth view of this general picture and establish the link between different types of EA artefacts, their stakeholders, use cases and resulting benefits (see Figure 7.4). Essentially, this study represents the first attempt to "deconstruct" the concept of EA into the set of more fine-grained components from the perspective of their roles in an EA practice and understand the internal mechanics of an EA practice through the lenses of these roles. Instead of viewing EA as a complex "black box" with multipurpose information useful for everyone, this study addresses the mechanisms of an EA practice at the level of individual EA artefacts and their practical usage.

The intentional focus on the granular details of an EA practice, e.g. specific EA artefacts, use cases and users, adopted in this study allows reconsidering the concept of EA as a set of Considerations, Standards, Visions, Landscapes, Outlines and Designs EA artefacts (see Figure 7.6). This conceptualization provides a new and more explanatory view of EA, which is complementary to the established view of EA as a description of an organization from the perspective of different domains (typically business, data, applications and technology), abstraction levels or interrogatives (see Figure 7.5).

This study represents essentially the first deliberate effort to analyse EA and an EA practice specifically from the perspective of underlying EA artefacts. As a result, this research provides an innovative and previously unexplored perspective complementary to the existing analytical perspectives on EA. Consequently, an in-depth exploratory analysis of the concept of EA from the perspective of specific EA artefacts presented in the study extends the existing theoretical knowledge base on EA and makes a strong theoretical contribution to the EA discipline.

8.4.2. Practical Contribution

The roles of different EA artefacts in an EA practice have been initially identified as an unexplored area of the EA discipline of significant practical importance (see Section 1.2). Specifically, all the three main practical problems with EA, including the high cost of developing EA (Kim and Everest, 1994; Lohe and Legner, 2014; Roth et al., 2013; Seppanen et al., 2009), incomprehensibility of resulting EA (Blumenthal, 2007; Lohe and Legner, 2012; Lohe and Legner, 2014) and the poor use of EA for decision-making purposes (Ambler, 2010; Hauder et al., 2013; Hobbs, 2012; Janssen, 2012; Levy, 2014), can be attributed to the insufficient understanding of specific roles of different types of EA artefacts. These commonly reported problems served as the practical motivation for this research.

As discussed earlier in Chapter 6, the findings of this study on the roles of EA artefacts help formulate specific recommendations for addressing these practical problems with EA and even have been used for developing a convenient taxonomy for organizing EA artefacts from the perspective of their practical usage and purpose (see Figure 6.3), which represents a helpful design artefact based on the core propositions of the resulting theory. The resulting recommendations for addressing the three main practical problems with EA are summarized in Table 8.2.

Table 8.2. Practical recommendations for addressing the three typical problems

Practical problem	Recommendations based on the findings of this study
EA is hard to develop and maintain	EA practitioners should focus on mastering a reasonable number (ten to 15) of different EA artefacts fulfilling all the six typical roles (Context Setters, Instrument Providers, Knowledge Repositories, Project Implementers, Strategic Aligners and Value Estimators) instead of producing and maintaining heaps of EA artefacts to comprehensively describe their organizations
EA is unusable	EA practitioners should clearly distinguish between business-focused roles (Context Setters, Strategic Aligners and Value Estimators) and IT-focused roles (Instrument Providers, Knowledge Repositories and Project Implementers) of EA artefacts. EA artefacts fulfilling the business-focused roles (Considerations, Outlines and Visions)

	should be represented as simple, intuitive, preferably one-page diagrams convenient for decision-makers. They should provide only the most essential information in a brief summarized form consumable even to executive-level audience. On the contrary, EA artefacts fulfilling the IT-focused roles (Designs, Landscapes and Standards) should provide detailed and specific information with all the relevant details. They can be represented in any form using any reasonable formats or special sophisticated modelling notations, e.g. ArchiMate, UML, ARIS or BPMN. More detailed recommendations regarding the presentation formats of EA artefacts fulfilling each of the six roles can be found in Chapter 6
EA program is isolated	EA practitioners should integrate the processes around the roles of Context Setters and Strategic Aligners with organizational strategic management and decision-making processes, integrate the processes around the roles of Value Estimators and Project Implementers into the regular project lifecycle, while the processes around Instrument Providers and Knowledge Repository can be carried out largely independently from other organizational processes, though the corresponding EA artefacts are also used mostly as part of the project lifecycle

As shown in Table 8.2, the developed theory of the roles of EA artefacts provides conceptual solutions to all the three main practical problems with EA. Consequently, this study makes a significant practical contribution to the EA discipline by formulating actionable recommendations for addressing the most significant EA-related practical problems.

8.4.3. Empirical Contribution

The current EA discipline is essentially based on EA frameworks (Simon et al., 2013) and TOGAF due to its popularity is often considered as a de facto industry standard EA framework (Brown and Obitz, 2011; Dietz and Hoogervorst, 2011; Gosselt, 2012; Lankhorst et al., 2010; Sarno and Herdiyanti, 2010; Sobczak, 2013). EA frameworks typically conceptualize EA as a comprehensive blueprint of an entire organization (Bernard, 2012; FEAF, 1999; PRISM, 1986; Schekkerman, 2006; Sowa and Zachman, 1992; van't Wout et al., 2010), while an EA practice is typically conceptualized as a single sequential step-wise process of creating and then using EA (Bernard, 2012; Bittler and Kreizman, 2005; Covington and Jahangir, 2009; Spewak and Hill, 1992; TOGAF, 2018; van't Wout et al., 2010).

The results of this study question the practical value of EA frameworks as well as the conceptualization of an EA practice based on EA frameworks. Specifically, none of the five studied organizations followed the key recommendations of EA frameworks (even if used them as information sources for an EA practice) and none of the established EA practices studied as part of this research resembled the general conceptualization of an EA practice suggested by EA frameworks. Instead, the studied organizations developed pragmatic sets of EA artefacts fulfilling specific practical purposes, rather than comprehensive EA blueprints describing these organizations in a holistic manner as recommended by EA frameworks. Moreover, different EA artefacts used in practice had independent lifecycles (were developed and used largely independently from each other by different people), rather than were produced and used as part of a single step-wise enterprise-wide EA lifecycle as suggested by the current EA literature.

Therefore, this study identifies "compelling empirical patterns that cry out for future research and theorizing" (Hambrick, 2007, p. 1350). Essentially, the observations of this study suggest that the current EA literature might be inconsistent with the practical realities in many theoretically significant aspects.

> *"In a field that seeks to understand the real world, it makes little sense to always put theory before facts. We must understand at least the broad outlines of 'what' a phenomenon consists of before we try to explain 'why' it occurs. That is, we need research directed toward uncovering empirical regularities [...]. Only then are we in a position to build theory that in turn can serve as the basis for more refined tests and extensions"* (Helfat, 2007, p. 185)

Consequently, this study makes a significant empirical contribution to the EA literature (Agerfalk, 2014; Avison and Malaurent, 2014; Hambrick, 2007; Helfat, 2007; Miller, 2007), i.e. contributes to the EA literature by demonstrating the important empirical facts that question established theories, can stimulate future research and substantially alter the EA discipline.

8.5. Limitations of This Study

This study has four general limitations: potential subjectivity of a single-author qualitative interpretation, reflection of the views of architects, possible country-specific bias in EA practices and the lack of focus on potential culture-specific differences in EA practices.

8.5.1. Potential Subjectivity of a Single-Author Qualitative Interpretation

All the data for this study has been collected, analysed and interpreted by a single author. Despite that a number of measures have been taken in this study to minimize potential bias and subjectivity, e.g. leveraging multiple data sources, using consistent questionaries and formulating interview questions in "real organizational terms", complete objectivity of a single-author qualitative analysis, interpretation and subsequent theory building can hardly be achieved. Other authors possibly could have articulated somewhat different practical roles of EA artefacts in an EA practice, formulated different descriptions of the same six general roles of EA artefacts or proposed different ways of organizing, structuring and interrelating these essential roles of EA artefacts.

Therefore, the potential subjectivity and bias of a qualitative analysis performed by a single author can be considered as a limitation of this study.

8.5.2. Reflection of the Views of Architects

The vast majority of the interviews conducted as part of this study involved representatives of organizational architecture functions, i.e. architects of various denominations and architecture managers (see Table 3.3). Non-architecture stakeholders of EA artefacts proved to be "inconvenient" interviewees for the purposes of this study since they typically used only one or a few closely related types of EA artefacts in their jobs and were naturally unaware of all other EA artefacts existing in their organizations. Moreover, some categories of EA artefacts, e.g. Standards and Landscapes, in most cases are intended only for architects and have no other "external" stakeholders outside of the architecture function.

However, the primary focus on interviewing architects suggests that this study reflects mostly the perspective of architects, rather than the perspective of other EA stakeholders (when these stakeholders existed). Since the descriptions of the usage scenarios of EA artefacts were provided predominantly by architects, these descriptions inevitably contain a certain architecture-centric bias. In other words, the use cases of EA artefacts described in this study for the most part represent use cases in their perception by architects.

Therefore, an architecture-centricity of the collected empirical data can be considered as a limitation of this study.

8.5.3. Possible Country-Specific Bias in the Roles of EA Artefacts

As discussions with the interviewed EA practitioners demonstrate, EA best practices are propagated among different Australian organizations mostly by local EA consulting companies and independent EA consultants. Since the Australian EA consulting market is relatively closed and limited, the same consulting companies and even individual consultants might have significantly influenced EA practices in many organizations. This considerable influence of a small number of local EA consultancies on many EA practices in Australia suggests that the results of this study could be potentially influenced or distorted by some country-specific features promoted by these local EA consultancies.

Even though the key aspects of the resulting theory of the roles of EA artefacts have been validated via discussions with EA experts from other countries (Finland and the Netherlands, see Table 3.11), who confirmed the validity of the core findings, some differences relevant to EA artefacts still have been noticed. Specifically, the naming of different EA artefacts has some clear country-specific features. For instance, the most typical EA artefacts fulfilling the role of Project Implementers are often titled as project-start architectures in the Netherlands, while in Australia other titles have been used by the interviewees for the same EA artefacts (e.g. solution designs, solution architectures, high-level designs and detailed designs).

Therefore, even if no particular country-specific differences in the roles of EA artefacts have been identified during the concluding theory discussion, there is still a certain possibility that the roles of EA artefacts might have some purely country-specific "flavours".

8.5.4. Potential Influence of Culture on the Roles of EA Artefacts

The culture of countries and organizations represents a relatively independent "big" stream of research (Hofstede et al., 2010; Inglehart and Welzel, 2005; Schein, 2010). Due to the highly exploratory nature of this study, this research was focused primarily on the initial identification of the practical roles of EA artefacts, but did not pay significant attention to more advanced and subtle cultural aspects of an EA practice and their possible implications for the roles of EA artefacts.

Moreover, since all the studied organizations were Australian companies, inherent national features of the Australian culture might have some influence on the roles of EA artefacts. For example, low power distance and short-term time orientation prevalent in the Australian culture (Hofstede et al., 2010) might have a rather considerable impact on decision-making processes in organizations and on the corresponding roles of EA artefacts, especially on Strategic Aligners and Value Estimators dealing directly with the prioritization and evaluation of IT investments based on the balance of their strategic and tactical benefits as well as political power of involved decision-makers and sponsors.

Therefore, the inability to take into account, control and theorize on the influence of national country-specific cultural aspects on the roles of EA artefacts can be also considered as a limitation of this study.

8.6. Directions for Future Research

The findings of this study on the roles of EA artefacts allow identifying the directions for further research related to EA artefacts that pose interesting questions and might be important for the EA theory and practice.

8.6.1. Develop a More Detailed Classification of the Roles of EA Artefacts

Firstly, as a result of the initial exploration of the roles of EA artefacts this study articulated six general practical roles and defined six respective generic types of EA artefacts fulfilling these roles in an EA practice. However, a closer scrutiny of all the 61 EA artefacts identified in the studied organizations suggests that there might be an opportunity for developing a more detailed and fine-grained classification of the “sub-roles” of EA artefacts within their established general roles.

For example, all the five studied organizations used business capability models and business-focused roadmaps. Both business capability models and roadmaps provide some high-level descriptions of organizations, both of them represent agreed long-term goals for business and IT, both of them are intended to help achieve the alignment between IT investments and business outcomes and both of them improve effectiveness of IT investments. Consequently, both business capability models and business-focused roadmaps share a number of essential properties and fulfil the common role of Strategic Aligners. However, business capability models and roadmaps also have remarkable differences within the boundaries of the common Strategic Aligners role. Specifically, business capability models help decide *where* IT investments should go, while roadmaps help decide *when* these IT investments should be made (the case of business capability models and roadmaps is arguably the most illustrative example of different sub-roles, while other examples might be much less evident). These notable differences between different EA artefacts fulfilling the same role of Strategic Aligners suggest that a more detailed roles-based classification of EA artefacts might potentially be presented if additional data from multiple different companies is collected and analysed.

Therefore, the first direction for future research is the development of a more detailed list of sub-roles of EA artefacts reflecting different "flavours" of the six core roles identified in this study.

8.6.2. Explore the Processes Around the Six Roles of EA Artefacts

Secondly, as the findings of this study suggest, an EA practice can hardly be described as a single step-wise iterative process of producing and using different EA artefacts, but rather as a set of separate processes "revolving" around specific roles of EA artefacts and forming their independent but interrelated usage lifecycles. Although this study provides a general description of the typical use cases closely associated with different roles of EA artefacts (see Table 5.1) and even proposes a tentative high-level conceptualization of an EA practice from the perspective of its constituting processes (see Figure F.2), this research was not focused specifically on studying EA-related processes and, therefore, detailed theoretical models conceptualizing the lifecycles and processes related to different roles of EA artefacts still remain missing in the available EA literature.

Therefore, the second direction for future research is an in-depth exploration of the processes associated with different roles and forming the lifecycles of respective EA artefacts as well as clarifying the overall picture of an EA practice from the perspective of its underlying processes, for which this study provides only the first tentative model.

8.6.3. Study Specific Tasks Associated with Different Roles of EA Artefacts

Thirdly, as the findings of this study clearly demonstrate, different roles of EA artefacts represent different role-specific use cases of EA artefacts. Even though this study provides a sound conceptualization of the most typical usage scenarios associated with each of the six roles of EA artefacts, detailed lists of specific tasks associated with each role still remain largely unexplored.

For instance, the role of Strategic Aligners implies the collective usage of corresponding EA artefacts by senior business leaders and architects for guiding IT investments, prioritizing IT initiatives and initiating new IT projects (see Figure 5.6), the role of Knowledge Repositories implies using EA artefacts by architects for knowledge sharing, controlling the lifecycles of IT assets and planning new IT initiatives (see Figure 5.4), while the role of Value Estimators implies the collaborative usage of EA artefacts by architects and business leaders for shaping, evaluating and approving specific IT initiatives (see Figure 5.7). However, these use cases provide only general high-level summaries of the typical usage of these types of EA artefacts. The results of this exploratory study do not explain in detail which exactly tasks this general usage supports, includes or implies. In other words, this study does not provide detailed lists of EA-related tasks associated with different roles of EA artefacts. Consequently, the detailed understanding of specific tasks supported by EA artefacts is still absent. Moreover, with the notable exception of the earlier study of Niemi and Pekkola (2017) intended to investigate the use situations of various EA artefacts, essentially no other deliberate studies of specific EA use situations have been attempted in the existing EA research.

Therefore, the third direction for future research is an in-depth exploration of specific tasks of different EA stakeholders supported by different types of EA artefacts as part of an EA practice.

8.6.4. Study in Detail Representation Formats of Specific EA Artefacts

Fourthly, as the findings of this study suggest, different roles of EA artefacts require different informational contents, which are closely associated with their intended usage and purpose. Even though this study provides a general description of the typical informational contents of different types of EA artefacts, more detailed information regarding the specific representation formats best suitable for different EA artefacts still remains missing.

From the perspective of the cognitive fit theory (Smelcer and Carmel, 1997; Vessey and Galletta, 1991), EA artefacts should fit cognitively with the tasks of EA stakeholders they are intended to support. Although the results of this study describe the general match between the typical usage of EA artefacts and their information representation formats (see Table 5.1), this exploratory study does not provide a detailed analysis of the cognitive fit between specific representation formats of EA artefacts and corresponding tasks of EA stakeholders they intend to support (as discussed earlier, these tasks themselves should be also investigated better in the future). Consequently, a detailed understanding of the relationship between different tasks of EA stakeholders and appropriate information representation formats of EA artefacts from the perspective of the cognitive fit theory is currently absent.

Therefore, the fourth direction for future research is an in-depth exploration of the information representation formats used in different EA artefacts as well as a detailed study of the cognitive fit between different representation formats of EA artefacts and respective tasks of EA stakeholders using these artefacts.

8.6.5. Explore the Impact of Culture on the Roles of EA Artefacts

Fifthly, this study identified ten environmental factors influencing the roles of EA artefacts in the context of an EA practice (see Figure 5.9 and Figure 5.10). However, these factors represent mostly some "hard" environmental factors, while more subtle "soft" factors related to country-specific and organization-specific culture still remain unexplored.

On the one hand, different countries have different features of the national culture (Hofstede et al., 2010; Inglehart and Welzel, 2005) that might impact on the practical roles of EA artefacts (as noted earlier, nation-specific power distance and time orientation can be considered as "first suspects" in the EA context). On the other hand, culture also varies significantly across different organizations even in one country (Schein, 2010). Both national and organizational cultures may influence an EA practice and modify the roles of EA artefacts accordingly. Although the cultural aspects of an EA practice recently received considerable attention in the EA literature (Aier, 2013; Aier, 2014; Faller and de Kinderen, 2014; Faller et al., 2016; Niemietz and de Kinderen, 2013; Niemietz et al., 2013), these studies mostly address the influence of culture on an EA practice in general, while from the perspective of specific EA artefacts and their practical roles the impact of culture has been explored only for principles (Aier, 2014). Consequently, cultural aspects of most EA artefacts and their roles still remain unstudied and the fifth potential direction for future research is exploring the influence of national and organizational cultures on the roles of EA artefacts.

8.7. Chapter Summary

This chapter provided a general conclusion to the thesis. Firstly, this chapter reviewed the conducted research, summarized its key findings and revisited the original research question and initial expectations. Then, this chapter described the overall contribution of this research to the EA discipline and discussed its main limitations. Finally, this chapter outlined the directions for future research and concluded the thesis.

APPENDIX A: OVERVIEW OF EA ARTEFACTS

This appendix contains an extensive, but loose list of EA artefacts proposed by different authors. A broad overview of selected EA artefacts is presented in Table A.1.

Table A.1. Broad overview of proposed EA artefacts

Reference(s)	Artefacts	Description
TOGAF (2018)	Stakeholder map matrix	Describes the stakeholders of architecture engagement, their interests, concerns and influence
	Value chain diagram	High-level conceptual view of the organization describing its interaction with external world
	Business footprint diagram	Connections between strategic goals, business units, functions, services and supporting technical components
	Interface catalogue	Interfaces of different applications
Spewak and Hill (1992)	Organization charts	Describe the structure of an organization including departments (names and locations), people (titles, positions and names) and reporting relationships between them
	Relationship matrices	Describe in a matrix form the relationship between different entities or activities, for instance, business processes and organizational functions, applications and data classes, organizational roles and information systems
	Business models	Describe major organizational functions, sub-functions and organizational units performing them
	Application schematics	Describe the interconnection of applications with their inputs, outputs, files and flow of data between them
	Entity-relationship diagrams	Describe organizational entities, their attributes, identifiers and logical relationship with each other
	Impact statements	Describe the impact of proposed software applications of the existing organizational IT landscape
	Data and application distribution tables	Describe conceptual or physical locations for storing data and running applications
Boar (1999b)	System block diagrams	Describe the logical relationship between different information systems components using a formal blueprinting notation

	Platform diagrams	Describe the logical relationship between different platform components using a formal blueprinting notation
	Interoperability diagrams	Describe the logical relationship between different services using a formal blueprinting notation
	Function block diagrams	Describe the logical relationship between different functional blocks using a formal blueprinting notation
	Cut-out diagrams	Describe the logical relationship between selected objects from different domains using a formal blueprinting notation
Longepe (2003)	Ishikawa diagrams	Describe strategic business and IT objectives and their relationship
	Enterprise diagrams	Describe the logical relationship and information flow between different organizational departments
	Processes cartographies	Describe major business processes and capabilities
	Process models	Describe individual business processes
	Functional architectures	Describe major organizational functions and their relationship
	Software cartographies	Describe major information systems and their relationship
Winter and Fischer (2006)	Strategy specifications	Describe hierarchy of success factors and organizational goals, product and service models, targeted market segments, strategic projects and core competencies
	Organization and process specifications	Describe business units, locations, roles, functions, processes and services hierarchies, organizational structures, employees' skills, service level agreements (SLAs), metrics, key performance indicators (KPIs), service flows, information objects, logistics and aggregate flows.
	Application specifications	Describe applications and application components, enterprise services and service components
	Software specifications	Describe software components, functionality, events and messaging hierarchies, data resources, conceptual, logical and physical data models
	Technical infrastructure specification	Describe IT components, hardware units and network nodes

	Specifications of dependencies between layers	Describe dependencies between objects from different domains, for instance, business units and applications, applications and data types, services and software components, information requirements and enterprise services
Bernard (2006), Bernard (2009), Bernard (2012)	SWOT analyses	Describe the strengths, weaknesses, opportunities and threats determining organizational strategic positioning and goals
	Balanced scorecards	Describe the measurement systems for the organizational strategic financial goals and their underlying customer, business processes and learning aspects
	Node connectivity diagrams	Describe operational nodes, activities they perform, their logical relationship and information exchange between them
	Use case diagrams	Describe the interaction of different actors, users and customers with information systems, services and applications
	Knowledge management plans	Describe how knowledge, information and data is shared across the enterprise between various organizational roles
	Data dictionaries	Describe a comprehensive list of data entities used in an organization including attributes, keys and relationships
	System performance matrices	Describe the performance metrics in terms of reliability, availability and maintainability that are important of the strategic direction of an organization
	System evolution diagrams	Describe the evolution of information systems including the relationship and timing of installations, upgrades and retirements
	Capital equipment inventory	Describe all the depreciable capital equipment in different organizational departments
	Cable plant diagrams	Describe physical connectivity between data, voice, video and other media networks in an organization and its partners
	Security plans	Describe physical, data, personnel and operational security procedures and elements on higher and lower abstraction levels
	Technology forecasts	Describe expected changes in organizational technology portfolio
van't Wout et al. (2010)	Context diagrams	Describe the main parts of an organization, their relationship and interaction with the elements of the external organizational environment
	Architecture policies	Describe sets of related standards, principles and guidelines relevant to a particular area of interest

	Architecture constraints	Describe the constraints limiting the potential architectural choices in an organization
	Architecture standards	Describe the established technical standards used in an organization constituting its technology portfolio
	Architecture guidelines	Describe the recommended guidelines for designing and implementing organizational information systems

APPENDIX B: INTERVIEW QUESTIONARY

This appendix contains the interview questionary used in this study. Due to the semi-structured nature of the conducted interviews, this questionary has been used largely as an overall framework for guiding and structuring conversation, rather than as a verbatim questionary. In other words, questions included in the provided questionary represent general points of discussion rather than literal “questions”. These questions have been reordered, reformulated, adapted, modified or even skipped during the interviews based on the theoretical sampling considerations in order to cover all theoretically interesting aspects of EA artefacts. Additional questions have also been added freely when it was necessary to cover the areas of significant interest in a comprehensive manner.

All responses, documents and information gathered from you and your organization will remain confidential and will be used for this research project only.

Interview Protocol

Respondent Background

1) What is your position in the organization?

2) How long have you been working in the organization?

3) Could you briefly describe your responsibilities?

Company Background

1) What is the nature of the business of your organization?

2) How many people does your organization employ?

3) How many IT staff does your organization employ?

4) What is the high-level structure of your organization?

Enterprise Architecture Function

1) How long has your organization been practicing EA?

2) How does your EA function fit into the organizational structure?

3) What types of architects does your organization employ (enterprise, domain, solution, etc.)?

4) How many architects of each type does your organization employ?

5) Could you briefly describe the responsibilities of these types of architects?

6) Whom does your EA function report to?

Enterprise Architecture Artefacts

1) What are the main types of EA artefacts used in your organization?

2) Could you briefly describe these types of EA artefacts?

3) What information do these types of EA artefacts contain?

4) What is the typical volume of EA artefacts of each type (number of pages, diagrams, etc.)?

5) Which types of architects develop each of these types of EA artefacts?

6) What types of EA stakeholders work with these types of EA artefacts?

7) Could you briefly describe these types of EA stakeholders?

8) How do these types of EA stakeholders use EA artefacts?

9) What information do these types of EA stakeholders seek in EA artefacts?

10) What is the purpose of these types of EA artefacts?

11) How do these types of EA artefacts help their stakeholders?

12) What is the value of these types of EA artefacts?

13) Could you briefly describe the sequence of steps in which business decisions get translated into specific IT projects through these EA artefacts?

14) Are there any specific features of your organization that impact its EA practice?

Enterprise Architecture Practice (Optional Questions)

1) Why did your organization decide to practice EA?

2) What benefits does your organization get from its EA practice?

3) How did your organization initiate EA practice (engaged consultants, hired experienced architects, developed in-house expertise from scratch, etc.)?

4) How did your EA practice evolve over time since its introduction?

5) Does your organization employ any EA methodology or framework to organize its EA practice?

6) What tools are used in your organization to develop, store and distribute EA documentation (MS Office, MS Visio, ARIS, Troux, Casewise, Mega, alphabet, etc.)?

7) What modelling languages are used in your organization for EA documentation (ArchiMate, UML, ARIS, BPMN, IDEF0, etc.)?

8) If you have any particular problems with the EA practice, could you describe them?

9) Could you rate your EA practice on a five-point scale and explain your rating?

10) How can your EA practice be improved?

All responses, documents and information gathered from you and your organization will remain confidential and will be used for this research project only.

APPENDIX C: THE SKETCH OF AN EA ARTEFACT

This appendix contains an example of a typical sketch of an EA artefact taken from a real EA artefact as part of the EA documentation analysis. An exemplary sketch of an EA artefact (roadmap) is shown in Figure C.1.

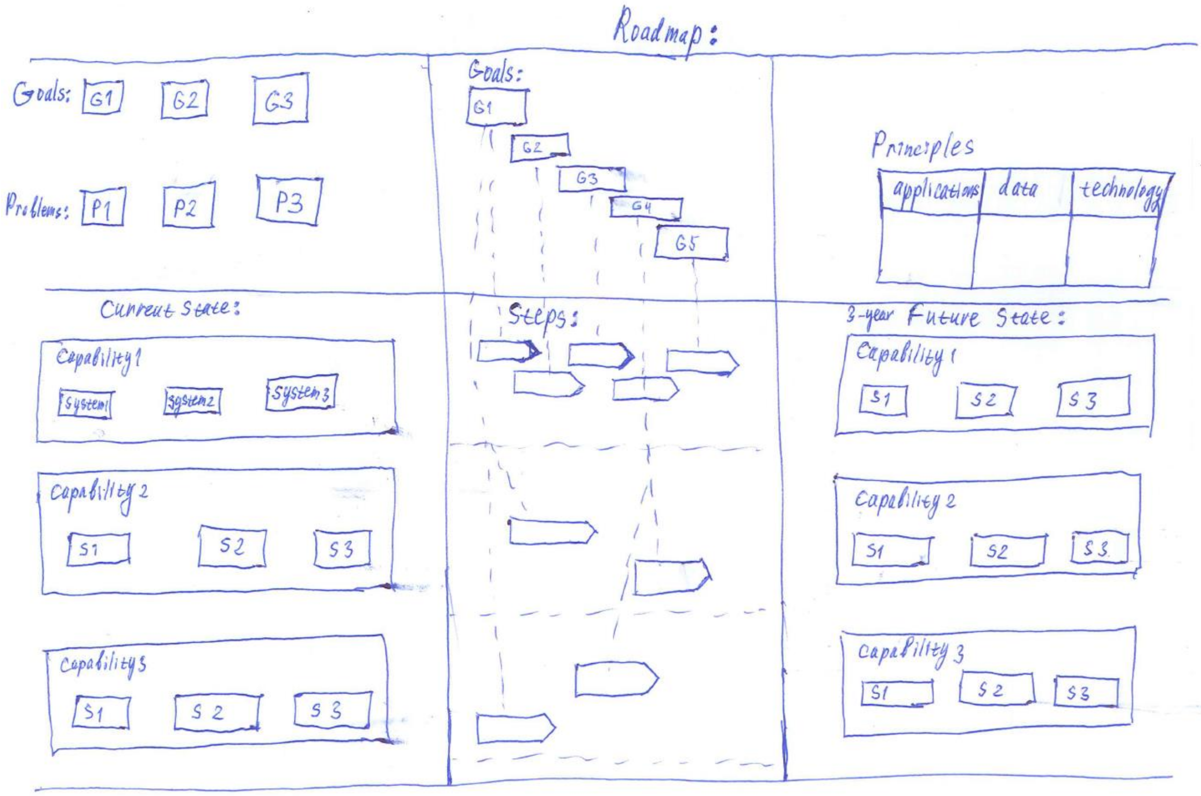

Figure C.1. Exemplary sketch of an EA artefact

APPENDIX D: GROUNDED THEORY ANALYSIS

This appendix contains samples of the grounded theory analysis process, provides the resulting lists of concepts identified in the five studied organizations, shows which of these concepts were newly identified and merged in each organization and, thereby, demonstrates the gradual convergence of the conceptual framework from organization-specific to organization-independent concepts.

D.1. Case Study One: Educational Institution

Selected samples of the grounded theory analysis process for Educational Institution clarifying the conceptualization from original transcripts to low-level codes, higher-level concepts and resulting relationships between them are shown in Table D.1.

Quote	Low-level codes	Concepts	Relationships
"They are roadmaps [1], drafts that you see behind you on the walls. They are basically saying "this piece of work or this capability will be developed [2] in this timeframe [3]", and they link to investment plans that say "in order to establish this capability we need to make this much investment". [...] That's about prioritizing investments [4]"	Roadmaps [1], Planned Work [2], Timeframe [3], Investments Prioritization [4]	Local Roadmaps (Artefacts) [1], Planned Projects (Information) [2, 3], Investments Prioritization (Usage) [4]	Local Roadmaps outline Planned Projects for Investments Prioritization purposes
"These are the proposed [conceptual] designs [1] that will support those [demanded projects] and that enables us to cost out what the solution looks like [2]. So, then it [conceptual design [3]] goes to the [top management] committee [4] as a view of how much those projects are gonna cost [5], how long they gonna take [6], what benefits are associated with that and how that	Conceptual Designs [1], Estimation [2], Conceptual Designs [3], Committee [4], Project Cost [5], Project Duration [6], Project Benefits [7]	Conceptual Architectures (Artefacts) [1, 3], Project Shaping (Usage) [2], Steering Committee (Users) [4], Project Overviews (Information) [5, 6, 7]	Conceptual Architectures provide Project Overviews for Project Shaping purposes and then go to Steering Committee

strategically supports where the university is trying to go [7]"			

Table D.1. Conceptualization process for Educational Institution

All concepts identified as part of the grounded theory analysis in Educational Institution are shown in Table D.2.

Category	Identified concepts (49 in total, 49 new)	Concepts after merging (49 in total, none generalized)
Artefacts	Business Capability Models (new), Conceptual Architectures (new), Global Roadmaps (new), IT Principles (new), Landscape Diagrams (new), Local Roadmaps (new), Principles (new), Solution Designs (new), Standards (new), Technology Reference Models (new)	Business Capability Models, Conceptual Architectures, Global Roadmaps, IT Principles, Landscape Diagrams, Local Roadmaps, Principles, Solution Designs, Standards, Technology Reference Models
Benefits	Improved Project Quality (new), Increased Agility (new), Investments Effectiveness (new), Investments Efficiency (new), Organizational Fitness (new), Reduced Complexity (new), Reduced Cost (new), Reduced Duplication (new)	Improved Project Quality, Increased Agility, Investments Effectiveness, Investments Efficiency, Organizational Fitness, Reduced Complexity, Reduced Cost, Reduced Duplication
External Factors	Accelerating Change (new)	Accelerating Change
Information	Business Capabilities (new), Business Imperatives (new), Implementation Plans (new), Landscape Snapshots (new), List of Technologies (new), Planned Projects (new), Project Overviews (new), Solution Components (new), Technical Imperatives (new)	Business Capabilities, Business Imperatives, Implementation Plans, Landscape Snapshots, List of Technologies, Planned Projects, Project Overviews, Solution Components, Technical Imperatives
Internal Factors	Frameworks (new), Size (new), Tools (new)	Frameworks, Size, Tools
Usage	Approaches Selection (new), Decisions Assessment (new), Investments Focusing (new), Investments Prioritization (new), Knowledge Sharing (new), Project Approval (new), Project Implementation (new), Project	Approaches Selection, Decisions Assessment, Investments Focusing, Investments Prioritization, Knowledge Sharing, Project Approval, Project Implementation, Project Planning, Project Shaping, Technologies

	Planning (new), Project Shaping (new), Technologies Selection (new)	Selection
Users	Enterprise Architects (new), Global Executives (new), Liaisons (new), Local Executives (new), Project Managers (new), Project Team Members (new), Solution Architects (new), Steering Committee (new)	Enterprise Architects, Global Executives, Liaisons, Local Executives, Project Managers, Project Team Members, Solution Architects, Steering Committee

Table D.2. Concepts identified in Educational Institution

D.2. Case Study Two: Financial Institution

Selected samples of the grounded theory analysis process for Financial Institution clarifying the conceptualization from original transcripts to low-level codes, higher-level concepts and resulting relationships between them are shown in Table D.3.

Quote	Low-level codes	Concepts	Relationships
"Business architects [1] produce things like capability maps [2], what capabilities are required to be uplifted [3]. They produce high-level process maps [4], what processes are gonna added or changed [5]. They work with others to produce a high-level solution architecture [6], very high-level, how we're gonna get done. But their predominant focus is around capability, process and to some extent roles because that's really about the change impact, change impact on the... on the business associated [with the initiative] [7]"	Business Architects [1], Capability Maps [2], Business Capabilities [3], Process Maps [4], Business Processes [5], Solution Architectures [6], Impact Assessment [7]	Architects (Users) [1], Business Models (Artefacts) [2, 4], Capabilities and Processes (Information) [3, 5], Solution Architectures (Artefacts) [6], Investments Focusing (Usage) [7]	Business Models describe Capabilities and Processes for Investments Focusing purposes, which involves Architects
"Every year, there is not necessarily a completely new set of overall drivers [1] for the whole bank, not just for technology, but for the whole bank [2]. One of these drivers right now is architecture simplicity, which means	Core Drivers [1], Global Guidance [2], Imperatives [3], Linkage [4], C-Level Executives [5], Linkage [6]	Principles (Artefacts) [1], Business Imperatives (Information) [2, 3], Decisions Assessment (Usage)	Principles provide Business Imperatives to Business Executives for Decisions Assessment

anything you are constructing make it simple rather than make it complex [3]. [...] Every time we are doing a solution or program, we always link it back to these [core drivers] [4]. Because who is looking at this, is actually the CIO, the CTO, the CFO and other C-level executives [5]: "You want us to spend a bunch of money for putting in a new wave of changes, but for what value? What is the benefit?" So, we always have to link [a new change initiative] to those core drivers [6]"		[4, 6], Business Executives (Users) [5]	purposes

Table D.3. Conceptualization process for Financial Institution

All concepts identified as part of the grounded theory analysis in Financial Institution are shown in Table D.4.

Category	Identified concepts (67 in total, 28 new)	Concepts after merging (56 in total, 16 generalized)
Artefacts	Business Capability Models, Conceptual Architectures, Global Roadmaps, Inventories (new), Landscape Roadmaps (new), Local Roadmaps, Policies (new), Principles, Process Models (new), Solution Architectures (new), Solution Designs, Standards	Business Models (generalized), Conceptual Architectures, Landscape Roadmaps, Landscape Views (generalized), Policies, Principles, Roadmaps (generalized), Solution Architectures, Solution Designs, Technical Standards (generalized), Technology Reference Models
Benefits	Improved Compliance (new), Improved Project Quality, Investments Effectiveness, Investments Efficiency, Organizational Fitness, Reduced Complexity, Reduced Cost, Reduced Duplication, Reduced Legacy (new), Reduced Risk (new)	Improved Compliance, Improved Project Quality, Increased Agility, Investments Effectiveness, Investments Efficiency, Organizational Fitness, Reduced Complexity, Reduced Cost, Reduced Duplication, Reduced Legacy, Reduced Risk
External Factors	Legislative Regulation (new)	Accelerating Change, Legislative Regulation
Information	Business Capabilities, Business Imperatives,	Business Imperatives, Capabilities and

	High-Level Implementation Plans (new), High-Level Processes (new), Implementation Plans, Improvement Plans (new), List of IT Assets (new), List of Technologies, Mandatory Rules (new), Planned Programs (new), Planned Projects, Program Overviews (new), Project Overviews, Technical Imperatives	Processes (generalized), High-Level Implementation Plans, Implementation Plans, Improvement Plans, Initiative Overviews (generalized), Landscape Descriptions (generalized), List of Technologies, Mandatory Rules, Planned Initiatives (generalized), Technical Recommendations (generalized)
Internal Factors	Frameworks, Industry (new), Size, Tools	Frameworks, Industry, Size, Tools
Usage	Approaches Selection, Decisions Assessment, Initiative Launch (new), Investments Focusing, Investments Prioritization, Program Approval (new), Program Planning (new), Program Shaping (new), Project Approval, Project Implementation, Project Planning, Project Shaping, Sequencing (new), Technologies Selection	Approaches Selection, Decisions Assessment, Initiative Approval (generalized), Initiative Launch, Initiative Planning (generalized), Initiative Shaping (generalized), Investments Focusing, Investments Prioritization, Knowledge Sharing, Project Implementation, Sequencing, Technologies Selection
Users	Business Architects (new), Enterprise Architects, Global Executives, Investment Committee (new), Local Executives, PMO (new), Program Architects (new), Program Managers (new), Project Managers, Project Team Members, Solution Architects, Technical Architects (new)	Architects (generalized), Business Executives (generalized), Decision-Making Committees (generalized), Initiative Managers (generalized), Project Team Members

Table D.4. Concepts identified in Financial Institution

D.3. Case Study Three: Telecom Institution

Selected samples of the grounded theory analysis process for Telecom Institution clarifying the conceptualization from original transcripts to low-level codes, higher-level concepts and resulting relationships between them are shown in Table D.5.

Quote	Low-level codes	Concepts	Relationships
"Data architect [1] might say "a roadmap for enterprise data integration capability [2] says that we're currently	Data Architect [1], Data Integration Roadmap [2],	Architects (Users) [1], Landscape Roadmaps (Artefacts)	Landscape Roadmaps provide Improvement Plans

using IBM and want to switch to Informatica, because strategically the capabilities that their platform offers [are better] [3]". That is in the data space, data integration, this is what we wanna move towards. We wanna [migrate] from this technology, we wanna move towards that technology [4]. And so at the next opportunity the next project will start to invest in that technology and then we will start the shift [5]"	Migration Plans [3], Migration Plans [4], Project Planning [5]	[2], Improvement Plans (Information) [3, 4], Initiative Planning (Usage) [5]	for Architects for Initiative Planning purposes
"Data model [1] might describe... here I've got a location, I'm gonna have an Australian address for it and that's got these components. One of [them is] street number, street name, [which should] be mandatory, postcode, longitude, latitude, mandatory, mandatory... another line of address might be optional [2]. So, it's those sort of things like you see on a phone, when you're filling out your name and address details, you'll see asterisks for mandatory, if you're filling that out online it will force you to enter a number in this field. That's what a data model does. Data model [3] is working in the background, they're describing what the rules are by which that data must be captured [4]"	Data Model [1], Data Fields [2], Data Model [3], Data Capturing [4]	Rules (Artefacts) [1, 3], Conceptual Prescriptions (Information) [2], Solutions Shaping (Usage) [4]	Rules provide Conceptual Prescriptions for Solutions Shaping

Table D.5. Conceptualization process for Telecom Institution

All concepts identified as part of the grounded theory analysis in Telecom Institution are shown in Table D.6.

Category	Identified concepts (56 in total, 17 new)	Concepts after merging (65 in total, 6 generalized)
Artefacts	Business Models, Conceptual Architectures, Data Models (new), Data Schemas (new), Direction Statements (new), Landscape Roadmaps, Landscape Views, Principles, Roadmaps, Solution Architectures, Solution Designs, Technical Standards	Business Models, Conceptual Architectures, Data Schemas, Direction Statements, Landscape Roadmaps, Landscape Views, Roadmaps, Rules (generalized), Solution Architectures, Solution Designs, Technical Standards, Technology Reference Models
Benefits	Better Partner Management (new), Data Consistency (new), Improved Interoperability (new), Improved Project Quality, Increased Agility, Increased Reuse (new), Investments Effectiveness, Investments Efficiency, Organizational Fitness, Reduced Complexity, Reduced Legacy	Better Partner Management, Data Consistency, Improved Compliance, Improved Interoperability, Improved Project Quality, Increased Agility, Investments Effectiveness, Investments Efficiency, Organizational Fitness, Reduced Complexity and Risk (generalized), Reduced Cost, Reduced Legacy, Reuse and Consolidation (generalized)
External Factors	Vendor Dependence (new)	Accelerating Change, Legislative Regulation, Vendor Dependence
Information	Business Considerations (new), Business Imperatives, Capabilities and Processes, Data Imperatives (new), Data Structures (new), High-Level Implementation Plans, Implementation Plans, Improvement Plans, Initiative Overviews, Landscape Descriptions, Planned Initiatives, Technical Recommendations	Business Considerations, Capabilities and Processes, Conceptual Prescriptions (generalized), Data Structures, High-Level Implementation Plans, Implementation Plans, Improvement Plans, Initiative Overviews, Landscape Descriptions, List of Technologies, Planned Initiatives, Technical Recommendations
Internal Factors	Functional Structure (new), Industry, Outsourcing (new), Size, Tools	Frameworks, Functional Structure, Industry, Outsourcing, Size, Tools
Usage	Approaches Selection, Asset Management (new), Data Structures Selection (new), Decisions Assessment, Initiative Approval, Initiative Planning, Initiative Shaping, Investments Focusing, Investments Prioritization, Knowledge Sharing, Project Implementation, Solutions Shaping (new)	Approaches Selection, Data Structures Selection, Decisions Assessment, Initiative Approval, Initiative Launch, Initiative Planning, Initiative Shaping, Investments Focusing, Investments Prioritization, Knowledge Sharing, Lifecycle Management (generalized), Project Implementation, Solutions Shaping, Technologies Selection
Users	Architects, Business Executives, Delivery	Architects, Business Executives, Decision-

	Partners (new)	Making Committees, Initiative Implementers (generalized), Initiative Managers

Table D.6. Concepts identified in Telecom Institution

D.4. Case Study Four: Delivery Institution

Selected samples of the grounded theory analysis process for Delivery Institution clarifying the conceptualization from original transcripts to low-level codes, higher-level concepts and resulting relationships between them are shown in Table D.7.

Quote	Low-level codes	Concepts	Relationships
"The blueprint [1] itself should be in a fairly high-level language, such that a business person can understand it [2]. [...] Each of these [documents], you know, it's a one pager, but there's a lot of supplementary information that sort of justifies how we arrived at these decisions [3], more detail on the architecture obviously. So, there's lot of supporting information, but a business person [4] will be looking at, you know, what is the strategic outcome we are trying to achieve [5], they obviously have to buy-in to it, the key stakeholders, and to a degree it's used to help us get that funding that's on the roadmap [6]"	Blueprints [1], Business Managers [2], One-Pagers [3], Business Managers [4], Strategic Outcomes [5], Project Funding [6]	Target States (Artefacts) [1, 3], Business Leaders (Users) [2, 4], Investments Effectiveness (Benefits) [5], Focusing and Prioritization (Usage) [6]	Target States are used for Focusing and Prioritization by Business Leaders to improve Investments Effectiveness
"In some areas they [reference architectures] [1] can be quite technically detailed, you know, there's reference patterns [2], reference designs [3] and reference implementations [4]. So, in some cases you go down sort of at a level four, and it's the incredibly prescriptive [5], a solution architect [6] has virtually no [rim] to move, if you're operating	Reference Architectures [1], Patterns [2], Designs [3], Implementations [4], Implementation Prescriptions [5], Solution Architect [6], Solution Architect [7], Technical Guidance	Implementation Standards (Artefacts) [1], Implementation Recommendations (Information) [2, 3, 4, 5], Architects (Users) [6, 7], Implementation Guidance (Usage) [8]	Implementation Standards provide Implementation Recommendations to Architects for Implementation Guidance

down at that level whereas I can just give a high level pattern to a solution architect [7] and they may choose, you know, one or several different technical implementations for it [in a project] [8]"	[8]		

Table D.7. Conceptualization process for Delivery Institution

All concepts identified as part of the grounded theory analysis in Delivery Institution are shown in Table D.8.

Category	Identified concepts (55 in total, seven new)	Concepts after merging (54 in total, 16 generalized)
Artefacts	Business Models, Conceptual Architectures, IT Target States (new), Landscape Roadmaps, Roadmaps, Rules, Solution Architectures, Solution Designs, Target States (new), Technical Standards, Technology Reference Models	Business Models, Conceptual Architectures, Designs (generalized), Direction Statements, Evolution Views (generalized), Implementation Standards (generalized), Landscape Views, Roadmaps, Rules, Target States, Technology Reference Models
Benefits	Better Partner Management (new), Improved Project Quality, Increased Agility, Increased Delivery Speed, Investments Effectiveness, Investments Efficiency, Organizational Fitness, Reduced Complexity and Risk, Reduced Cost, Reduced Legacy, Reuse and Consolidation	Improved Compliance, Improved Consistency (generalized), Improved Interoperability, Improved Project Quality (generalized), Increased Agility, Increased Delivery Speed, Investments Effectiveness, Investments Efficiency, Reduced Complexity and Risk, Reduced Cost, Reduced Legacy, Reuse and Consolidation
External Factors	None	Accelerating Change, Legislative Regulation, Vendor Dependence
Information	Capabilities and Processes, Conceptual Prescriptions, Desired Future (new), Desired IT Future (new), High-Level Implementation Plans, Implementation Plans, Improvement Plans, Initiative Overviews, List of Technologies, Planned Initiatives, Technical Recommendations	Capabilities and Processes, Conceptual Requirements (generalized), Desired Future, Implementation Plans (generalized), Implementation Recommendations (generalized), Initiative Overviews, Landscape Descriptions, Optimization Plans (generalized), Planned Initiatives
Internal	Industry, LoB Structure (new), Maturity	Frameworks, Industry, Maturity, Outsourcing,

Factors	(new), Outsourcing, Size, Tools	Size, Structure (generalized), Tools
Usage	Approaches Selection, Decisions Assessment, Initiative Approval, Initiative Launch, Initiative Shaping, Investments Focusing, Investments Prioritization, Knowledge Sharing, Lifecycle Management, Project Implementation, Technologies Selection	Decisions Guidance (generalized), Focusing and Prioritization (generalized), Implementation Guidance (generalized), Initiative Launch, Initiative Planning, Initiative Shaping and Approval (generalized), Knowledge Sharing, Lifecycle Management, Project Implementation
Users	Architects, Business Executives, Decision-Making Committees, Initiative Implementers, Initiative Managers	Architects, Business Leaders (generalized), Project Teams (generalized)

Table D.8. Concepts identified in Delivery Institution

D.5. Case Study Five: Retail Institution

Selected samples of the grounded theory analysis process for Retail Institution clarifying the conceptualization from original transcripts to low-level codes, higher-level concepts and resulting relationships between them are shown in Table D.9.

Quote	Low-level codes	Concepts	Relationships
"The business capability model [1] is used really just to represent the business [2]. It's key purpose is to facilitate conversation around where the business wants to prioritize its investment [3]. [...] For example, supply chain management, the ability to do frictionless distribution is a core capability, best companies do this, we're currently maturing at level 1, we need to be mature at level 4 if we're able to at least maintain our position in the market. So, therefore, we're recommending that you invest 20 per cent of your IT budget in this capability and this capability is absolutely key and it's being	Business Capability Models [1], Business Representation [2], Investment Prioritization [3], Budget Alignment [4], Business Capability Models [5], Business Managers [6]	Visions (Artefacts) [1, 5], Future Descriptions (Information) [2], Focusing and Prioritization (Usage) [3], Investments Effectiveness (Benefits) [4], Business Leaders (Users) [6]	Visions provide Future Descriptions to Business Leaders for Focusing and Prioritization and achieving Investments Effectiveness

neglected, so it should a number priority on the roadmap [4]. That's how we use our business capability model [5] to facilitate a conversation with our business colleagues [6]"			
"Our application inventory repository [1] is still in its infancy, but it's fully populated. So, it was on a spread sheet, now it's in the CMDB, and it lists all the applications [we have] [2]. So, from an application perspective we [3] do understand what applications we have [4], from an infrastructure perspective we have very good understanding of what our infrastructure is [5], but from an information perspective that we're starting to use [not yet] because that hasn't been [documented up-to-date]"	Application Inventory [1], List of Applications [2], Architects [3], Understanding of Applications [4], Understanding of Infrastructure [5]	Landscapes (Artefacts) [1], Landscape Descriptions (Information) [2], Architects (Users) [3], Knowledge Sharing (Usage) [4, 5]	Landscapes provide Landscape Descriptions to Architects for Knowledge Sharing

Table D.9. Conceptualization process for Retail Institution

All concepts identified as part of the grounded theory analysis in Retail Institution are shown in Table D.10.

Category	Identified concepts (49 in total, four new)	Concepts after merging (48 in total, eight generalized)
Artefacts	Business Models, Conceptual Architectures, Decision Summaries of CAs (new), Decision Summaries of Ds (new), Designs, Direction Statements, Evolution Views, Implementation Standards, Landscape Views, Roadmaps, Rules, Target States, Technology Reference Models	Considerations (generalized), Designs (generalized), Landscapes (generalized), Outlines (generalized), Standards (generalized), Visions (generalized)
Benefits	Improved Consistency, Improved Project Quality, Increased Agility, Investments Effectiveness, Investments Efficiency, Reduced Complexity and Risk, Reduced Cost, Reuse and Consolidation	Improved Compliance, Improved Consistency, Improved Interoperability, Improved Project Quality, Increased Agility, Increased Delivery Speed, Investments Effectiveness, Investments Efficiency, Reduced Complexity and Risk,

		Reduced Cost, Reduced Legacy, Reuse and Consolidation
External Factors	Strategic Uncertainty (new)	Accelerating Change, Legislative Regulation, Strategic Uncertainty, Vendor Dependence
Information	Capabilities and Processes, Conceptual Requirements, Desired Future, Implementation Plans, Implementation Recommendations, Initiative Overviews, Landscape Descriptions, Optimization Plans, Planned Initiatives	Conceptual Requirements, Future Descriptions (generalized), Implementation Plans, Implementation Recommendations, Initiative Overviews, Landscape Descriptions (generalized)
Internal Factors	Agile Delivery (new), Industry, Maturity, Outsourcing, Size, Structure, Tools	Agile Delivery, Frameworks, Industry, Maturity, Outsourcing, Size, Structure, Tools
Usage	Decisions Guidance, Focusing and Prioritization, Implementation Guidance, Initiative Launch, Initiative Planning, Initiative Shaping and Approval, Knowledge Sharing, Project Implementation	Decisions Guidance, Focusing and Prioritization, Implementation Guidance, Initiative Launch, Initiative Planning, Initiative Shaping and Approval, Knowledge Sharing, Lifecycle Management, Project Implementation
Users	Architects, Business Leaders, Project Teams	Architects, Business Leaders, Project Teams

Table D.10. Concepts identified in Retail Institution

APPENDIX E: RESULTING CONCEPTUAL FRAMEWORK

This appendix contains the full description of the final conceptual framework constructed after the analysis of all the five studied organizations. This developed framework provides a rich descriptive view of all the concepts relevant to the practical usage of EA artefacts and underpins the six identified higher-order roles. This conceptual framework is organization-neutral in nature, i.e. generalized from specifics of particular organizations into an abstract picture generally suitable for all the five studied organizations. All the concepts constituting the resulting framework are organization-agnostic in nature.

The final conceptual framework consists of 48 different concepts relevant to the roles of EA artefacts grouped into seven broad categories (Artefacts, Benefits, External Factors, Information, Internal Factors, Usage and Users) and four higher-level theoretical domains (see Figure 4.3). The schematic structure of the resulting conceptual framework is shown in Figure E.1.

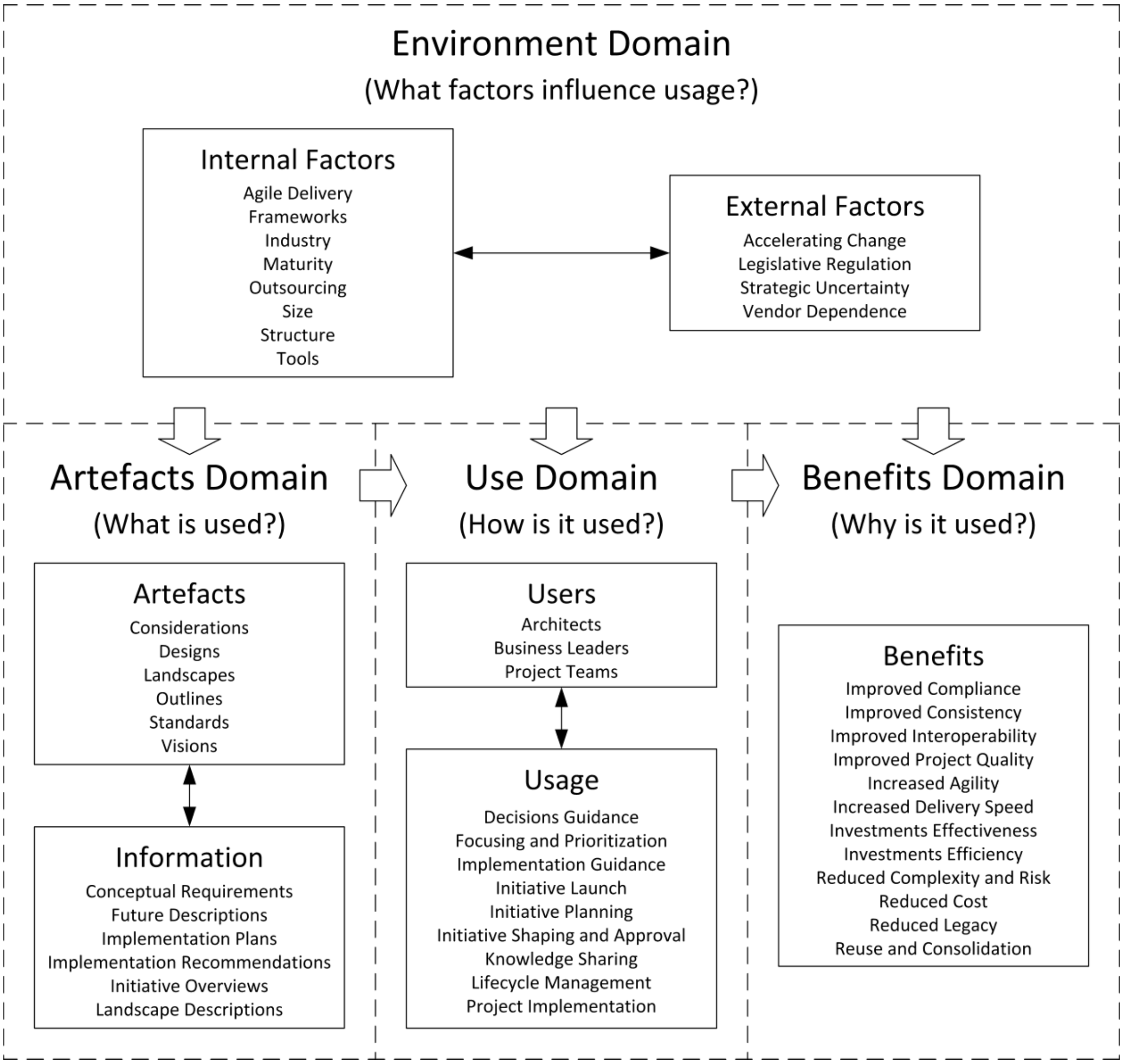

Figure E.1. The resulting conceptual framework

The resulting conceptual framework shown in Figure E.1 provides a generalized comprehensive view of all the significant concepts relevant to the roles of EA artefacts. All the high-level categories with their underlying concepts constituting the conceptual framework are described in detail in the next sections.

E.1. Artefacts Category

The Artefacts category accounts for different types of EA artefacts representing physical documents used for information systems planning. In other words, the Artefacts category conceptualizes what general types of EA artefacts are used in EA practices. All types of EA artefacts used in organizations can be represented by six generalized concepts:

Considerations, Designs, Landscapes, Outlines, Standards and Visions. Each of these concepts is described in detail below in an alphabetical order.

E.1.1. Considerations

Considerations represent all EA artefacts providing some overarching requirements to information systems in an organization. In the five studied organizations these EA artefacts were titled core drivers, data models, maxims, policies, principles, strategic papers and strategy papers. Considerations typically do not contain accurate details, exact numbers or voluminous descriptions. They are usually expressed in simple intuitive formats easily understandable to business audience. For instance, they are often expressed as brief statements written in plain technology-neutral language. Considerations are developed once and then updated according to the ongoing changes in the business environment.

E.1.2. Designs

Designs represent all EA artefacts providing some communication interfaces between architects and project teams. In the five studied organizations these EA artefacts were titled detailed designs, full solution architectures, high-level designs, preliminary solution architectures, solution architectures, solution blueprints and solution designs. Designs are usually expressed as a mix of text, tables and complex diagrams. They can be very voluminous and use any suitable representation formats to provide the required details with the appropriate level of granularity. For instance, Designs often include long textual descriptions, extensive configuration tables and numerous complex IT-specific diagrams. Often they use specialized formal modelling notations, e.g. UML or ArchiMate. Designs are developed at the later stages of IT initiatives to support implementation and then archived.

E.1.3. Landscapes

Landscapes represent all EA artefacts providing some reference materials on the IT landscape. In the five studied organizations these EA artefacts were titled asset registers, domain roadmaps, inventories, one-page diagrams, platform architectures, platform roadmaps, reference architecture models, technical reference architectures, technology blueprints and technology roadmaps. Landscapes are usually expressed in strict formats understandable mostly to IT specialists. They can use any representation formats suitable for capturing the “hard” data. They can be pretty abstract or rather detailed, brief or voluminous, formal or largely informal. Landscapes are purely technical in nature and might be very meticulous, thorough and complex. For instance, they can be represented as extensive "wiring" schemes including all the necessary details of IT systems. Due to these properties, Landscapes are often expressed as complex and dense one-page diagrams with rich technical information using strict and formal modelling notations, often branded ones like ArchiMate or ARIS. Landscapes are developed on an as-necessary basis and updated according to the ongoing evolution of the IT landscape.

E.1.4. Outlines

Outlines represent all EA artefacts providing some overviews and evaluations for proposed IT initiatives. In the five studied organizations these EA artefacts were titled blueprints, conceptual architectures, idea briefs, solution overviews and solutions on a page. Outlines are usually expressed as a mix of textual descriptions and simple diagrams. They typically avoid using long descriptions, complex explanations, sophisticated diagrams and technical details. For instance, textual descriptions included in Outlines tend to provide only the most essential information, while graphical diagrams tend to be rather intuitive and conceptual. Outlines generally avoid using any strict and formal modelling notations, but some of them may still use a simplified version of BPMN understandable to a wide business audience. Outlines are developed at the early stages of IT initiatives to support decision-making and then archived.

E.1.5. Standards

Standards represent all EA artefacts providing some reusable means for IT systems implementation. In the five studied organizations these EA artefacts were titled data schemas, IT principles, patterns, principles, reference architectures, standards and technology reference models. Standards can be expressed in various formats from the perspective of their representation, volume and notation. Depending on the nature of their content, Standards can be textual or graphical, brief or voluminous, formal or informal. They can use essentially any reasonable formats required to convey their meaning in the most accurate way. They often use very IT-specific terminology and strict notations. Standards are developed on an as-necessary basis and updated according to the ongoing technology progress.

E.1.6. Visions

Visions represent all EA artefacts providing some shared views of the organization and its future agreed by business and IT. In the five studied organizations these EA artefacts were titled blueprints, business capability models, business reference architectures, capability models, divisional roadmaps, enterprise investment roadmaps, function roadmaps, process models, programs of work and roadmaps. Visions are usually expressed in brief informal formats easily understandable to executive-level business audience. They typically focus only on the most essential relevant information, rather than on specific details. Visions tend to use simplistic schematic pictures instead of sophisticated full-fledged “wiring” diagrams with numerous boxes and arrows. Moreover, they usually provide full-colored stylish descriptions, rather than monotonous black and white technical drawings. Due to these properties, Visions are often expressed as simple, neat and appealing one-page diagrams with the most critical information. Visions are developed once and then updated according to the ongoing changes in the business strategy.

E.2. Benefits Category

The Benefits category accounts for all benefits associated with EA artefacts. In other words, the Benefits category conceptualizes what benefits result from using different EA artefacts. All benefits associated with the use of EA artefacts can be represented by twelve generalized concepts: Improved Compliance, Improved Consistency, Improved Interoperability, Improved Project Quality, Increased Agility, Increased Delivery Speed, Investments Effectiveness, Investments Efficiency, Reduced Complexity and Risk, Reduced Cost, Reduced Legacy, and Reuse and Consolidation. Each of these concepts is described in detail below in an alphabetical order.

E.2.1. Improved Compliance

Improved Compliance represents achieved regulatory compliance with relevant industry or government policies resulting from the usage of corresponding EA artefacts. For example, if personal data protection policies require to retain personal data for no longer than five years, all IT systems in an organization are implemented according to this regulatory norm. Thereby, the required level of compliance is achieved.

E.2.2. Improved Consistency

Improved Consistency represents improved overall conceptual consistency between business and IT. This consistency ensures that all IT systems in an organization are generally implemented according to how business executives want them to be implemented. For example, if the business of an organization requires IT systems to be highly secure, then all IT systems are implemented in a highly secure manner. The conceptual consistency between IT plans and business needs eventually leads to numerous indirect benefits for the whole organization.

E.2.3. Improved Interoperability

Improved Interoperability represents improved technical and logical interoperability between different IT systems resulting from the usage of corresponding EA artefacts. This interoperability is achieved largely via three complementary mechanisms. Firstly, the technological disparity between IT systems is eliminated. Secondly, common system integration approaches and protocols are leveraged consistently across the entire IT landscape. Thirdly, via establishing common data types and formats, logical data consistency and compatibility is achieved. These three mechanisms are synergistic and enable better interoperability.

E.2.4. Improved Project Quality

Improved Project Quality represents the overall quality of the IT project delivery. Potential risks and possible problems with the future delivery of specific IT projects are identified in advance and appropriate time-proven implementation approaches and risk mitigation strategies are proposed beforehand. Confusion and misunderstanding between various stakeholders of the IT project is avoided. Common reference points for all project participants are provided, which essentially offer a “single source of truth” to different team members. These mechanisms help de-risk IT projects, minimize their deviation from the agreed budgets and timelines, and make their delivery more predictable and smooth.

E.2.5. Increased Agility

Increased Agility represents increased agility from the perspective of information systems planning resulting from the usage of corresponding EA artefacts. This agility is achieved largely via having an accurate baseline of the current IT landscape, which helps more swiftly react to emerging business needs, more quickly evaluate potential solution implementation options and thereby accelerate the general planning speed of new IT initiatives.

E.2.6. Increased Delivery Speed

Increased Delivery Speed represents increased implementation and delivery speed of new IT initiatives. The initiative delivery speed is enhanced largely via three complementary mechanisms. Firstly, the existing technical expertise of IT staff is accumulated and leveraged in new IT initiatives. Secondly, standardized system components or building blocks are established and reused in new IT solutions. Thirdly, unnecessary learning curves associated with using untried technologies and approaches are avoided. These three mechanisms are synergistic and facilitate faster delivery of new IT initiatives.

E.2.7. Investments Effectiveness

Investments Effectiveness represents improved strategic alignment and general effectiveness of IT investments. All IT investments become better aligned to the business strategy and explicitly mapped to tangible strategic business results. Investment effectiveness implies four critical aspects of the alignment between IT expenditures and business results:

- How much money to invest in IT – aligning the magnitude of required or desirable IT expenses to the strategic business demands
- Where to invest IT dollars – focusing future IT investments on the most strategically important business areas while minimizing ineffective or unnecessary IT expenses
- What types of IT investments are needed – identifying the critical types of new IT systems required by an organization to execute its business strategy
- When IT investments should be made – allocating and scheduling future IT investments according to the strategic business priorities and organization-wide investment plans

E.2.8. Investments Efficiency

Investments Efficiency represents increased efficiency and ROI of IT investments. Improved investments efficiency is achieved via filtering out inefficient IT initiatives, which do not deliver reasonable business value for their money, and investing only in IT initiatives with demonstrated qualitative and quantitative returns. Specifically, corresponding EA artefacts help business executives consciously approve each IT investment, understand how the IT budget is spent, control IT expenditures and ensure that each IT dollar is invested wisely and profitably.

E.2.9. Reduced Complexity and Risk

Reduced Complexity and Risk represents reduced complexity and risk. On the one hand, reduced complexity of the organizational IT landscape is achieved largely via three complementary mechanisms. Firstly, the overall technological diversity of the IT landscape is restrained. Secondly, the diversity of adopted implementation approaches is controlled. Thirdly, the number of different interconnection patterns between IT systems is minimized. On the other hand, the mitigation of IT-related technical and compliance risks is achieved largely via three complementary mechanisms. Firstly, proven implementation approaches reducing the typical risks associated with the IT project delivery are reused. Secondly, proven technologies are reused increasing the overall stability of the organizational IT landscape. Thirdly, the requirements of relevant regulatory acts are adhered to reducing the potential compliance risks.

E.2.10. Reduced Cost

Reduced Cost represents reduced IT-related costs resulting from the usage of corresponding EA artefacts. Reduced IT expenditures are achieved largely via three complementary mechanisms. Firstly, the number of supported technologies, products and vendors is limited. Secondly, the license fees for proprietary software are minimized. Thirdly, the skill sets of IT staff are streamlined and the entire workforce is optimized. These three mechanisms are synergistic and help organizations build more cost-effective IT landscapes.

E.2.11. Reduced Legacy

Reduced Legacy represents reduced dependency on legacy IT systems resulting from the usage of corresponding EA artefacts. This reduced reliance on legacy systems is achieved by having an accurate information on the status of different existing IT systems and understanding their future prospects in the organizational IT landscapes. Thereby, all legacy systems are identified and decommissioned in a timely manner, their functionality is smoothly replaced by newer systems without causing excessive dependency on fragile and unsupported systems.

E.2.12. Reuse and Consolidation

Reuse and Consolidation represents increased reuse, consolidation and decreased duplication of IT assets. These benefits generally result from better understanding of the current structure of the organizational IT landscape. Specifically, increased reuse of IT assets is achieved via easier identification of appropriate reusable IT assets that can be leveraged in new IT projects, while increase consolidation and decreased duplication is achieved from easier identification of redundant and duplicated IT assets that can be safely eliminated.

E.3. External Factors

The External Factors category accounts for all the factors of the external business environment influencing the usage and roles of EA artefacts. In other words, the External Factors category conceptualizes what impacts on the roles of EA artefacts from the outside of an organization. All external factors influencing the usage and roles of EA artefacts can be represented by eight generalized concepts: Accelerating Change, Legislative Regulation, Strategic Uncertainty and Vendor Dependence. Each of these concepts is described in detail below in an alphabetical order.

E.3.1. Accelerating Change

Accelerating Change represents the increased pace of change in the external business environment of an organization. Accelerating Change may be manifested in the emergence of so-called disruptive technologies modifying the very business landscape in respective industry sectors.

E.3.2. Legislative Regulation

Legislative Regulation represents governmental regulatory efforts intended to monitor and control the business of organizations operating in certain industry sectors. Legislative Regulation implies a strict set of compliance norms and mandatory restrictive requirements imposed on organizations working in particularly “sensitive” industries, e.g. finance and healthcare.

E.3.3. Strategic Uncertainty

Strategic Uncertainty represents considerable uncertainty and variability of the external market environment. Strategic Uncertainty hinders the long-term planning, blurs strategic vision and is manifested in the constant change of strategic goals and objectives.

E.3.4. Vendor Dependence

Vendor Dependence represents the strategic dependence of an organization on the products, platforms and services provided by a limited number of technological vendors, e.g. SAP, HP or Oracle. Vendor Dependence may be especially critical when vendor offerings include broad product lines covering most business domains and “full-stack” packaged IT solutions.

E.4. Information Category

The Information category accounts for all valuable informational contents of EA artefacts. In other words, the Information category conceptualizes what different EA artefacts describe. All information contained in EA artefacts can be represented by six generalized concepts: Conceptual Requirements, Future Descriptions, Implementation Plans, Implementation Recommendations, Initiative Overviews and Landscape Descriptions. Each of these concepts is described in detail below in an alphabetical order.

E.4.1. Conceptual Requirements

Conceptual Requirements represent all global conceptual rules, overarching requirements and fundamental considerations important for business and relevant for IT. Essentially, Conceptual Requirements describe some significant organization-wide business decisions having direct impact on IT. They usually either do not focus on specific points in time or focus on the long-term future. The most typical examples of information related to Conceptual Requirements are documented architecture principles, e.g. that “all lines of business should share common customer information”, or policies prescribing where the sensitive types of data can be stored. Generally, Conceptual Requirements often convey the following and similar information:

- How an entire organization should work
- What is the general role and purpose of IT in an organization

- What is the attitude towards creating and reusing IT assets
- How an organization should, and should not, use information systems
- Which business processes should be standardized across business units
- Which types of data should be shared organization-wide
- What technology trends may be disruptive for the business of an organization
- What IT innovations may be strategic for an organization

E.4.2. Future Descriptions

Future Descriptions represent all high-level conceptual future views of an organization from the business perspective. Essentially, Future Descriptions depict in an abstract manner how an organization needs to look like in the future and what needs to be done to achieve that. Typically they focus on the long-term future up to 3-5 years ahead. Generally, Future Descriptions often convey the following and similar information:

- How an organization needs to look like
- What is the desired relationship between main customers, processes, data and systems
- What should IT deliver for an organization in the long term
- Which business areas should receive future IT investments
- Which business capabilities should be uplifted with IT in the future
- What types of IT investments should be made in the future
- Which specific business needs should be addressed with IT
- When future IT investments should be made

E.4.3. Implementation Plans

Implementation Plans represent all detailed technical and functional views of specific IT projects actionable for IT project teams. Essentially, Implementation Plans describe what exactly should be implemented as part of a particular IT project and how exactly it should be done. They usually focus on the short-term future up to one year ahead. However, in some cases they can describe time horizons longer than one year for large multi-step IT projects. Generally, Implementation Plans often convey the following and similar information:

- What specific business requirements should be addressed by the IT project
- What infrastructure should be provided to implement the IT project
- What hardware and software should be installed to implement the IT project

- What applications should be developed to implement the IT project
- What data entitles should be used to implement the IT project
- How exactly different components of the IT project should interact with each other
- How exactly the new IT project should interact with the surrounding IT environment
- How exactly current business processes should be modified as a result

E.4.4. Implementation Recommendations

Implementation Recommendations represent all global technical rules, standards, patterns and best practices relevant for IT systems. Essentially, Implementation Recommendations describe how all IT systems in an organization are implemented from the technical perspective. They typically either do not focus on specific points in time or focus on the current state. Generally, Implementation Recommendations often convey the following and similar information:

- What technologies and products should be used in IT solutions
- How exactly the available technologies should be used in IT solutions
- What implementation approaches should be followed in IT solutions
- What best practices should be used in IT solutions
- What system components should be reused in IT solutions
- How all IT systems should be organized and integrated
- What protocols should be used for the interaction of IT systems
- How main data entities should be stored in IT systems

E.4.5. Initiative Overviews

Initiative Overviews represent all high-level descriptions of specific IT initiatives understandable to business executives. Essentially, Initiative Overviews describe what approximately will be implemented as part of a particular IT initiative and what business value is expected from this initiative. They usually focus on the short-term future up to 1-2 years ahead. However, sometimes they can also describe longer timeframes for large IT initiatives in untypical cases. Generally, Initiative Overviews often convey the following and similar information:

- What business need is addressed by the proposed IT initiative

- What solution will be implemented as the result of the proposed IT initiative
- How the proposed IT solution will change current business processes
- What is the tactical and strategic value of the proposed IT initiative
- What is the overall organizational impact of the proposed IT solution
- What financial investments are required to implement the proposed IT initiative
- When the proposed IT initiative can be delivered
- What risks are associated with the proposed IT initiative

E.4.6. Landscape Descriptions

Landscape Descriptions represent all high-level technical views of the organizational IT landscape. Essentially, Landscape Descriptions depict what IT assets exist in an organization, how they are related to each other and how they are used. They often focus on the current state of an organization. Generally, Landscape Descriptions often convey the following and similar information:

- What IT systems, databases and infrastructure are available in an organization
- How existing IT assets are connected to each other
- What is the information flow and interaction between different IT assets
- How existing IT assets are used to support business capabilities or processes
- Which IT assets are duplicated, unused or redundant
- Which IT assets are considered as strategic or legacy
- Which IT assets should be reused or decommissioned in the future
- What technical improvements of IT assets are required in the future and when

E.5. Internal Factors

The Internal Factors category accounts for all the factors of the internal organizational environment influencing the usage and roles of EA artefacts. In other words, the Internal Factors category conceptualizes what impacts on the roles of EA artefacts from the inside of an organization. All internal factors influencing the usage and roles of EA artefacts can be represented by eight generalized concepts: Agile Delivery, Frameworks, Industry, Maturity, Outsourcing, Size, Structure and Tools. Each of these concepts is described in detail below in an alphabetical order.

E.5.1. Agile Delivery

Agile Delivery represents shortened planning cycles for IT initiatives, where only the most significant project-related planning decisions, e.g. preferred technologies, are stipulated upfront, while most less significant planning decisions are made later along the way as part of the project implementation. Agile Delivery is usually manifested in special system implementation approaches and methodologies, e.g. Extreme Programming (XP) or Scrum.

E.5.2. Frameworks

Frameworks represent EA frameworks that an organization used as the basis for establishing its EA practice. The most popular examples of EA frameworks include TOGAF, Zachman, FEAF and DoDAF.

E.5.3. Industry

Industry represents the industry-specific degree of dependence of corresponding organizations on IT and the overall maturity of the culture of the relationship between business and IT. Essentially, Industry factor reflects the general organization-wide "IT savvy"-ness manifested, for instance, in dependence of the business on digital transactions, commitment of business executives to IT and widespread use of the Internet in business operations (Weill and Aral, 2004; Weill and Aral, 2005).

E.5.4. Maturity

Maturity represents the overall maturity of an EA practice, EA-related processes and underlying EA artefacts. Mature EA practices imply consistent and repeatable EA-related processes, established sets of EA artefacts and continuous optimization of these processes and artefacts based on the needs of the business.

E.5.5. Outsourcing

Outsourcing represents the critical reliance of an organization on the outsourcing arrangements with its delivery partners for the implementation of new IT systems. The dependence on Outsourcing requires effective engagement mechanisms, coordination and collaboration between in-house and external IT specialists involved in the implementation of information systems on behalf of an organization.

E.5.6. Size

Size represents the size of an organization from the perspective of IT including the effective full-time equivalent (FTE) number of its IT staff and the overall size of the IT landscape supporting its business processes, e.g. the number of deployed business applications and other information systems.

E.5.7. Structure

Structure represents the highest-level structure of core business units or departments in an organization. Two "opposite" popular forms of corporate structure are functional and line-of-business structures. On the one hand, functional structure is organized strictly according to functional divisions, e.g. production, marketing and sales. From the IT perspective, functional structure implies diversification of business processes and corresponding IT systems across functional business units, but requires full integration of these processes through sharing relevant information between these units. On the other hand, line-of-business structure is organized according to different lines of business, e.g. retail, wholesale and e-commerce. This organizational structure implies considerable autonomy of local decision-making in business units and allows these business units to act largely as independent businesses (profit centres) while leveraging the thin "layer" of common organization-wide supporting functions, e.g. human resources, finance and vendor management.

E.5.8. Tools

Tools represent software tools deployed and used in an organization to create, store, manage and distribute its EA artefacts among architects and other stakeholders including both standard general-purpose tools, e.g. MS Office suite and Google Drive, and specialized software tools for EA, e.g. Enterprise Architect (Sparx Systems) or Troux (Planview).

E.6. Usage Category

The Usage is the core category of the conceptual framework, which accounts for all use cases of EA artefacts. In other words, the Usage category conceptualizes how different EA artefacts are used as part of an EA practice. All usage of EA artefacts in organizations can be represented by nine generalized concepts: Decisions Guidance, Focusing and

Prioritization, Implementation Guidance, Initiative Launch, Initiative Planning, Initiative Shaping and Approval, Knowledge Sharing, Lifecycle Management and Project Implementation. Each of these concepts is described in detail below in an alphabetical order.

E.6.1. Decisions Guidance

Decisions Guidance represents a use case when the corresponding EA artefacts are used to guide and influence all IT-related planning decisions in an entire organization or in its major business units. While staying in background, they provide a sound basis for IT-related planning decisions and continuously underpin all architectural thought processes at different organizational levels. The overall consistency of architectural planning decisions is usually assessed formally as part of regular EA-related processes. Specifically, all other EA artefacts are typically peer-reviewed by other architects and their alignment to the architectural guidance is evaluated during their approval and sign-off procedures. However, reasonable and substantiated deviations from the architectural guidance offered by these EA artefacts are usually tolerated.

E.6.2. Focusing and Prioritization

Focusing and Prioritization represents a use case when the corresponding EA artefacts are used to focus and prioritize IT investments. Firstly, these EA artefacts are used to focus future IT investments on strategically important business areas. They help business executives determine where IT investments should go to support the long-term business strategy. Suggestions provided by these EA artefacts offer a relatively clear guidance regarding the desired direction and type of required IT investments. Secondly, the corresponding EA artefacts are used to prioritize IT initiatives according to their actual importance for the business of an organization. Specifically, they help business executives decide when and in what sequence future IT initiatives should be implemented. As a result, planned IT investments are arranged in the most appropriate order aligned to strategic business priorities.

E.6.3. Implementation Guidance

Implementation Guidance represents a use case when the corresponding EA artefacts are used to influence architectures of all IT initiatives. They are used predominantly as technical reference materials during the planning of new IT solutions. By providing recommended technical means for IT system implementation, these EA artefacts shape architectures of all new IT solutions including their internal structure as well as their integration with the existing IT systems. At the same time, by shaping the structure of specific IT solutions, they eventually shape the overall structure of the entire organizational IT landscape. Adherence to their implementation guidance is typically achieved by means of formal architectural reviews of all the plans for specific IT initiatives and projects. Specifically, the implementation plans of all proposed IT solutions are typically peer-reviewed and approved by other architects to ensure their compliance with the established technical guidelines.

E.6.4. Initiative Launch

Initiative Launch represents a use case when the corresponding EA artefacts are used to determine which IT initiatives should be launched in the near future or immediately. They suggest specific business needs to be addressed at particular moments in time, thereby providing the basis for launching new IT initiatives addressing these planned business needs. Even though these EA artefacts do not offer any detailed implementation guidance, they provide a starting point from which a particular IT initiative can be started and further elaborated towards the implementation.

E.6.5. Initiative Planning

Initiative Planning represents a use case when the corresponding EA artefacts are used to plan the designs of new IT initiatives. They show architects the general structure of the surrounding IT environment and help understand how exactly new IT solutions should be integrated with the existing IT systems. Specifically, during the development of architectures of new IT solutions these EA artefacts provide the information on what systems these solutions can interact with, where the required input data can be taken from, where the resulting output data can be sent to, where the new solutions can be deployed and other similar technical questions. Additionally, these EA artefacts offer some technical suggestions regarding the landscape rationalization opportunities, e.g. to reuse some existing IT assets or decommission some legacy systems, which can be also incorporated into the designs of new IT solutions to improve the overall quality of the IT landscape.

E.6.6. Initiative Shaping and Approval

Initiative Shaping and Approval represents a use case when the corresponding EA artefacts are used to shape and approve proposed IT initiatives at their early stages. Firstly, they are used discuss the general idea of new IT solutions, define their essential executive-level requirements and negotiate the overall desirable effect of the proposed IT solutions on the organizational activities. Specifically, these EA artefacts often help discuss and achieve an agreement on how exactly new IT solutions should modify and improve current business processes.

Secondly, this use case implies using EA artefacts to evaluate, approve and fund specific IT initiatives. Specifically, together with corresponding business cases for proposed IT initiatives they are often discussed at decision-making committees responsible for IT investment decisions. During these discussions they are formally assessed from different perspectives including, but not limited to, the following essential criteria:

- Tactical and strategic business value of the IT initiative
- Expected financial returns from the IT initiative
- Timelines, costs and risks associated with the IT initiative

Based on a comprehensive analysis of these and other aspects of proposed IT initiatives, the final investment decision regarding each IT initiative is made. As a result, the IT initiative is either approved and granted the required funding to implement it, or is rejected as inexpedient and not worthwhile. After being approved, these EA artefacts provide the basis for developing more implementation plans for corresponding IT initiatives.

E.6.7. Knowledge Sharing

Knowledge Sharing represents a use case when the corresponding EA artefacts are used to capture and share the knowledge on the current structure of the IT landscape. They are especially often used by new members of EA practices to get a quick understanding of the organizational IT landscape By showing all the existing IT assets, they help understand how exactly the entire IT landscape is organized. They also help identify which IT systems are duplicated, unused or redundant. Additionally, by showing the connections and dependencies between different IT systems, they help understand which parts of the IT landscape are overly complex, messy or problematic.

E.6.8. Lifecycle Management

Lifecycle Management represents a use case when the corresponding EA artefacts are used to control and manage the lifecycle of the available IT assets. They focus on the lifecycle phases of different IT systems, applications or platforms and help understand which "healthy" IT assets should be reused in new solutions or which legacy IT assets should be decommissioned in the future. They also help identify IT systems based on obsolete technologies or unsupported by their vendors and retire these systems in a planned and timely manner without creating significant disturbance for daily business operations. This understanding of the status of different IT assets also provides the basis for producing technical rationalization suggestions intended to optimize the organizational IT landscape and improve its overall fitness.

E.6.9. Project Implementation

Project Implementation represents a use case when the corresponding EA artefacts are used to implement IT projects. They represent cornerstones of IT projects defining what exactly needs to be done to deliver these projects. They are actively used during the project delivery by all involved parties to coordinate all the implementation-related activities. They can be also used as the basis for developing lower-level technical designs inside the IT projects, which are not considered as EA artefacts. In cases when IT projects are delivered via outsourcing arrangements with external third parties, they serve as the key instruments enabling effective collaboration between internal and external specialists.

E.7. Users Category

The Users category accounts for all users of EA artefacts. In other words, the Users category conceptualizes who uses different EA artefacts. All actors using EA artefacts in organizations can be represented by three generalized concepts: Architects, Business Leaders and Project Teams. Each of these concepts is described in detail below in an alphabetical order.

E.7.1. Architects

Architects represent all denominations of architects as well as some other actors occasionally acting as architects. On the one hand, Architects include all architects in a narrow sense, i.e. all possible organization-specific positions belonging to EA functions and dealing with EA including enterprise architects, principal architects, domain architects, lead architects, solution architects, technical architects, etc. On the other hand, Architects also include all architects in a broader sense, i.e. all organizational actors occasionally involved in information systems planning and essentially fulfilling the role of architects. From this perspective, CIOs and other senior IT managers temporarily acting as architects are also included into the concept of Architects.

E.7.2. Business Leaders

Business Leaders represent all types of senior business stakeholders as well as various committees consisting of these senior business stakeholders. On the one hand, Business Leaders represent all individual decision-makers responsible for strategy development and for IT investment approval decisions, including CEOs, COOs, CFOs, other C-level executives, strategy planners, heads of business units and other organization-specific senior managers. On the other hand, Business Leaders also represent all organization-specific governance and decision-making committees consisting of individual senior business managers.

E.7.3. Project Teams

Project Teams represent all types of project team members working on specific IT projects. Firstly, Project Teams include all rank-and-file IT staff, i.e. software developers, system administrators, infrastructure engineers, database experts and testers doing the actual project delivery work. Secondly, Project Teams include all project managers, program managers and PMOs responsible for allocating necessary resources and coordinating the overall project delivery process. Thirdly, Project Teams include relevant business stakeholders or their representatives, e.g. business analysts, who typically verify and sign off business requirements for new IT projects. Additionally, Project Teams include external IT specialists engaged via outsourcing arrangements to work on specific IT projects as well as specialists of strategic delivery partners and vendors helping internal IT specialists on a permanent basis.

APPENDIX F: THE SIX ROLES AND EA PROCESSES

This appendix contains the theoretical interpretation of process-related aspects of an EA practice from the perspective of the six identified roles of EA artefacts. Although somewhat beyond the scope of the original research intent, an understanding of the activities associated with each of the six roles of EA artefacts as well as the actors involved in each of these roles allows going the "extra mile" further and producing novel theoretical conceptualizations addressing the process-related aspects of an EA practice. Specifically, the six roles of EA artefacts clarify the meaning of the EA-enabled strategy execution process and the overall process view of an EA practice.

F.1. Theoretical Interpretation of the Strategy Execution Process

EA is widely considered as an instrument enabling the effective translation of a business strategy into specific actionable plans for IT (Bernard, 2012; Carbone, 2004; Holcman, 2013; Niemann, 2006; Spewak and Hill, 1992). For instance, Gartner even defines EA as "the process of translating business vision and strategy into effective enterprise change by creating, communicating and improving the key requirements, principles and models that describe the enterprise's future state and enable its evolution" (Lapkin et al., 2008, p. 2). Although this process of translation is described qualitatively in some details, for instance by Tamm et al. (2015), the existing EA literature does not offer any sound theoretical constructs for conceptualizing the overall logic and internal mechanics of this process.

The resulting theory of the roles of EA artefacts provides the appropriate constructs for theorizing on the process of translation of a business strategy into implementable plans for IT. Specifically, interpreting this process from the perspective of the six identified roles of EA artefacts helps understand the general decision-making flow explaining how exactly the business strategy is transformed into specific IT systems enabling this strategy. Each of the six general roles of EA artefact fulfils a specific function at different stages of the general decision-making flow.

From the perspective of the roles of EA artefacts, the strategy execution process can be separated into two distinct phases: strategy-to-portfolio and portfolio-to-execution. As part of the strategy-to-portfolio phase senior Business Leaders and Architects formulate the required future course of action for IT based on the strategic business goals and decide what types of initiatives should be launched to achieve these goals. This phase is supported by Context Setters and Strategic Aligners. Firstly, Business Leaders and Architects develop a set of Context Setters, e.g. principles and policies, providing the general decision-making context ensuring that all further planning decisions are consistent with the established strategic demands. Secondly, Business Leaders and Architects develop a set of Strategic Aligners consistent with Context Setters defining the general future direction for IT investments, e.g. “heatmapped” capability or process models, and eventually develop an overall portfolio of IT initiatives required to improve the “heatmapped” business areas usually reflected in the set of agreed investment roadmaps.

As part of the portfolio-to-execution phase Business Leaders, Architects and Project Teams deliver the IT initiatives envisioned during the strategy-to-portfolio phase in the most technically feasible and tactically desirable ways. This phase is supported by Value Estimators and Project Implementers. Firstly, the short-term business value, key implementation options and financial details of every IT initiative suggested by Strategic Aligners, e.g. future states and roadmaps, are evaluated and approved by Business Leaders based on Value Estimators, e.g. solution overviews and conceptual architectures, developed for these initiatives. Finally, technical implementation details are elaborated for each approved IT project based on Project Implementers, which eventually provide specific actionable plans for ordinary IT specialists working in Project Teams. At the same time, Knowledge Repositories and Instrument Providers also support the portfolio-to-execution phase by providing accurate information on the existing IT landscape (Knowledge Repositories) as well as recommended approaches for project implementation (Instrument Providers).

Consequently, from the perspective of the roles of EA artefacts the strategy execution process can be conceptualized as a four-stage decision-making flow supported by Context Setters, Strategic Aligners, Value Estimators and Project Implementers respectively. Clearly distinguishing the different roles of specific types of EA artefacts in the context of an EA practice allows clarifying the details of the strategy translation process, i.e. explain how exactly the business strategy is translated into a set of executable plans for IT though using EA. The theoretical interpretation of the strategy execution process based on the identified roles of EA artefacts is shown in Figure F.1.

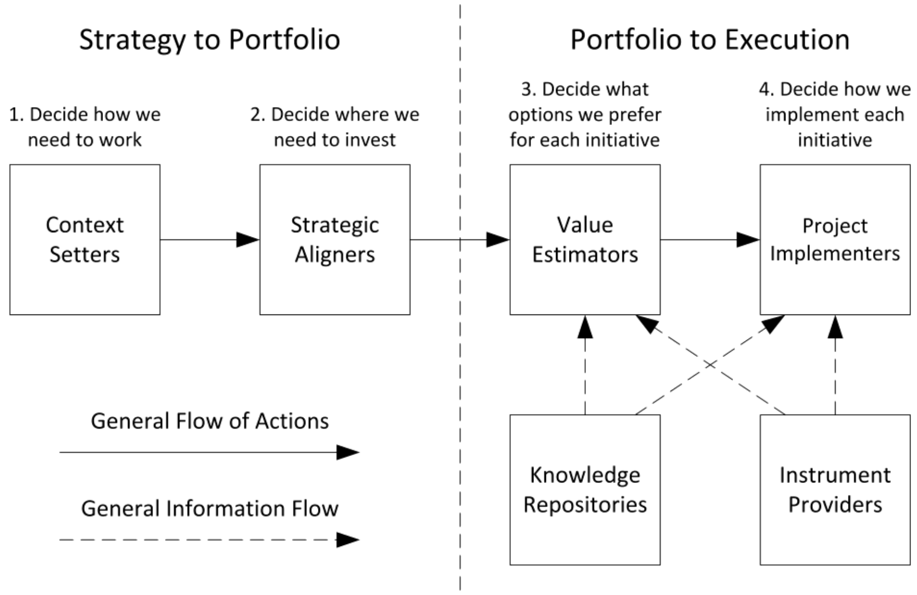

Figure F.1. Theoretical interpretation of the strategy execution process

The theoretical interpretation of the strategy execution process described above demonstrates that the developed theory of the roles of EA artefacts provides useful conceptual constructs for better understanding the internal work of an EA practice and offers powerful theoretical lenses for an in-depth explanation of key organizational mechanisms related to IT-enabled strategy execution and IT planning in general.

F.2. Generic Process View of an Enterprise Architecture Practice

Combining the usage, users and artefacts aspects of the six identified roles, as well as the logical relationships existing between these roles (see Figure 5.8), allows producing a high-level process view of an EA practice based on the six identified roles of EA artefacts. Even though the process-related aspects of an EA practice is not the primary focus of this study, the six identified roles of EA artefacts suggest a rather clear generic process-focused view of an EA practice (tentative process views of EA practices have been also produced earlier for each of the five studied organizations, see for example Figure 4.28 and Figure 4.29).

Specifically, all the activities associated with the roles of Context Setters and Strategic Aligners can be combined into a single process of Strategic Planning involving Business Leaders and Architects and resulting in the set of Considerations and Visions EA artefacts. As part of this process Business Leaders and Architects analyse the external business environment and develop overarching conceptual requirements for IT and the desired future course of action for IT in an organization. All the activities associated with the roles of Value

Estimators and Project Implementers can be joined into a single process of Initiative Delivery consisting of two fundamentally sequential steps: initiation and implementation. Firstly, as part of the initiation step Business Leaders and Architects decide on the high-level implementation options for each IT initiative and achieve a mutual agreement based on Outlines EA artefacts. Then, as part of the implementation step Architects and Project Teams decide on the purely technical details of corresponding IT projects and executive these projects based on Designs EA artefacts. Finally, all the activities associated with the roles of Instrument Providers and Knowledge Repositories can be combined into a single process of Technology Optimization. This process is carried out largely by Architects alone, who analyse the current IT landscape, decide what implementation approaches and technologies should be used by an organization and what IT assets should be leveraged, consolidated or decommissioned in the future based on Standards and Landscapes EA artefacts.

The identified relationships between the six roles of EA artefacts (see Figure 5.8) suggest the fundamental conceptual relationships existing between the corresponding EA-related processes. For instance, the Strategic Planning process "produces" certain planned business needs and requirements to be addressed with IT in the future essentially providing an input for the Initiative Delivery process (however, some IT initiatives still can be launched in an unplanned manner to address urgent business needs incoming directly from the business environment, e.g. critical regulatory changes or competitor moves). The Strategic Planning process also provides strategic directions and requirements for the Technology Optimization process guiding the selection of appropriate technologies and approaches as well as the identification of strategic and legacy IT assets. The Technology Optimization process, in its turn, provides certain technical rationalization suggestions to the Initiative Delivery process as well, e.g. recommended technologies and approaches as well as lists of IT assets that can or cannot be reused in new IT projects. Finally, the Initiative Delivery process does not provide any input for the two other processes, but contributes new working IT solutions to the organizational IT landscape. The generic process view of an EA practice from the perspective of the six roles of EA artefacts described above is shown in Figure F.2.

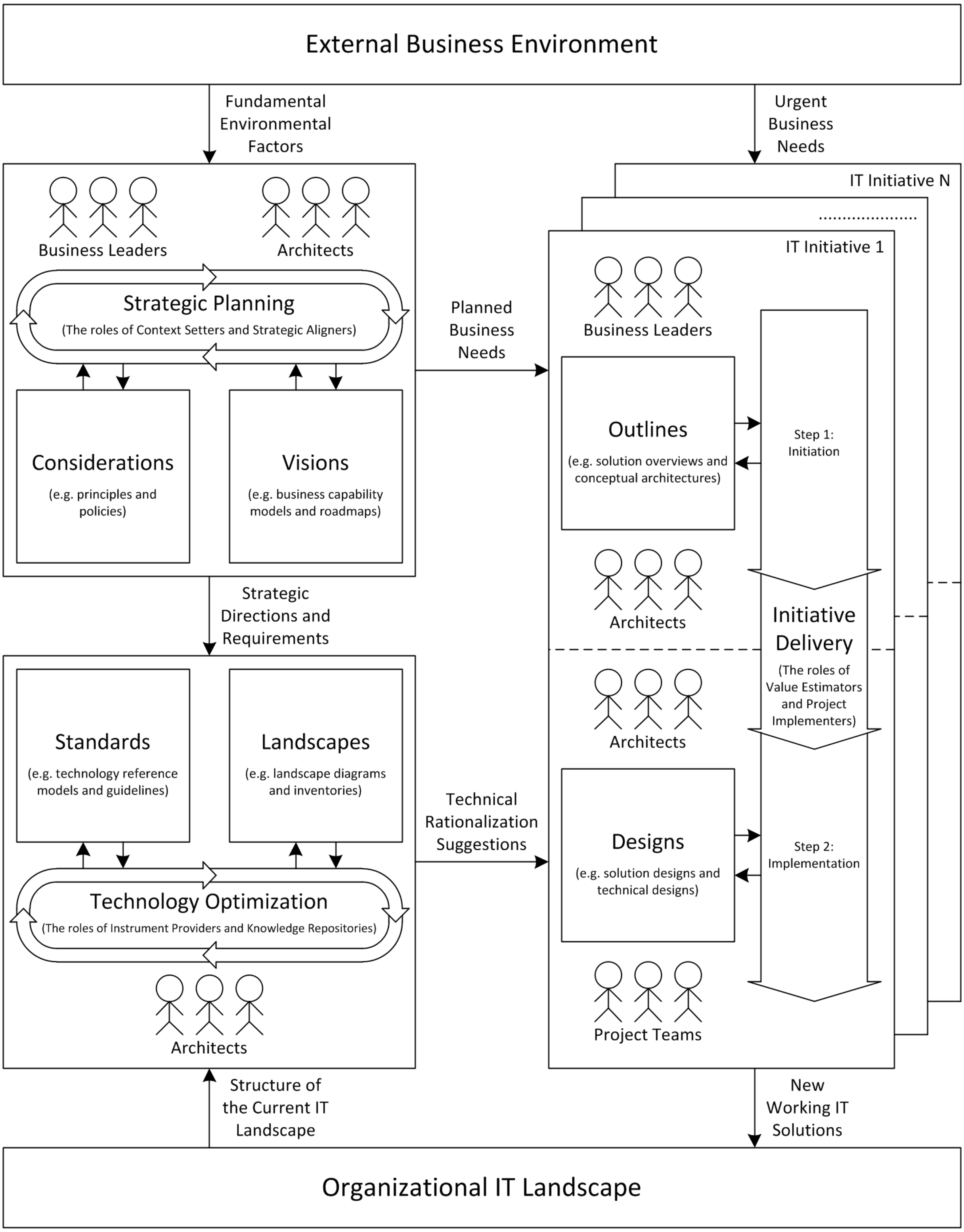

Figure F.2. Generic process view of an EA practice from the perspective of the six roles

The generic process view of an EA practice shown in Figure F.2 provides a comprehensive analytical tool covering multiple aspects of an EA practice including artefacts, people and processes. This view describes the internal mechanics of an EA practice and explains how exactly the organizational IT landscape is shaped according to demands of the business environment through using EA artefacts by different actors.

To summarize, the six roles of EA artefacts articulated in this study together with the underlying concepts related to Artefacts, Information, Users, Usage and Benefits categories (see Figure 5.1) provide useful theoretical constructs and analytical tools for understanding the very “nuts and bolts” of an EA practice and explaining the realization of EA benefits.

APPENDIX G: EXAMPLES OF EA ARTEFACTS

This appendix contains examples, templates or schematic structures of ten EA artefacts used at Educational Institution listed in an alphabetical order: business capability model, conceptual architectures, maxims, one-page diagrams, principles, program of work, roadmaps, solution designs, standards and technology reference model. The total number of all EA artefacts created at the university was estimated to be close to 500. For most types of EA artefacts their real examples cannot be provided due to the strict confidentiality requirements.

G.1. Business Capability Model

The business capability model (BCM) provides a high-level holistic view of the whole university. It shows all the organizational capabilities and sub-capabilities as well as the organizational goals, customers, suppliers, partners and stakeholders in a simple structured manner. The main purpose of the BCM is to serve as a "heatmap" for the ICT steering committee and facilitate investment decisions. The schematic structure of the business capability model is shown in Figure G.1.

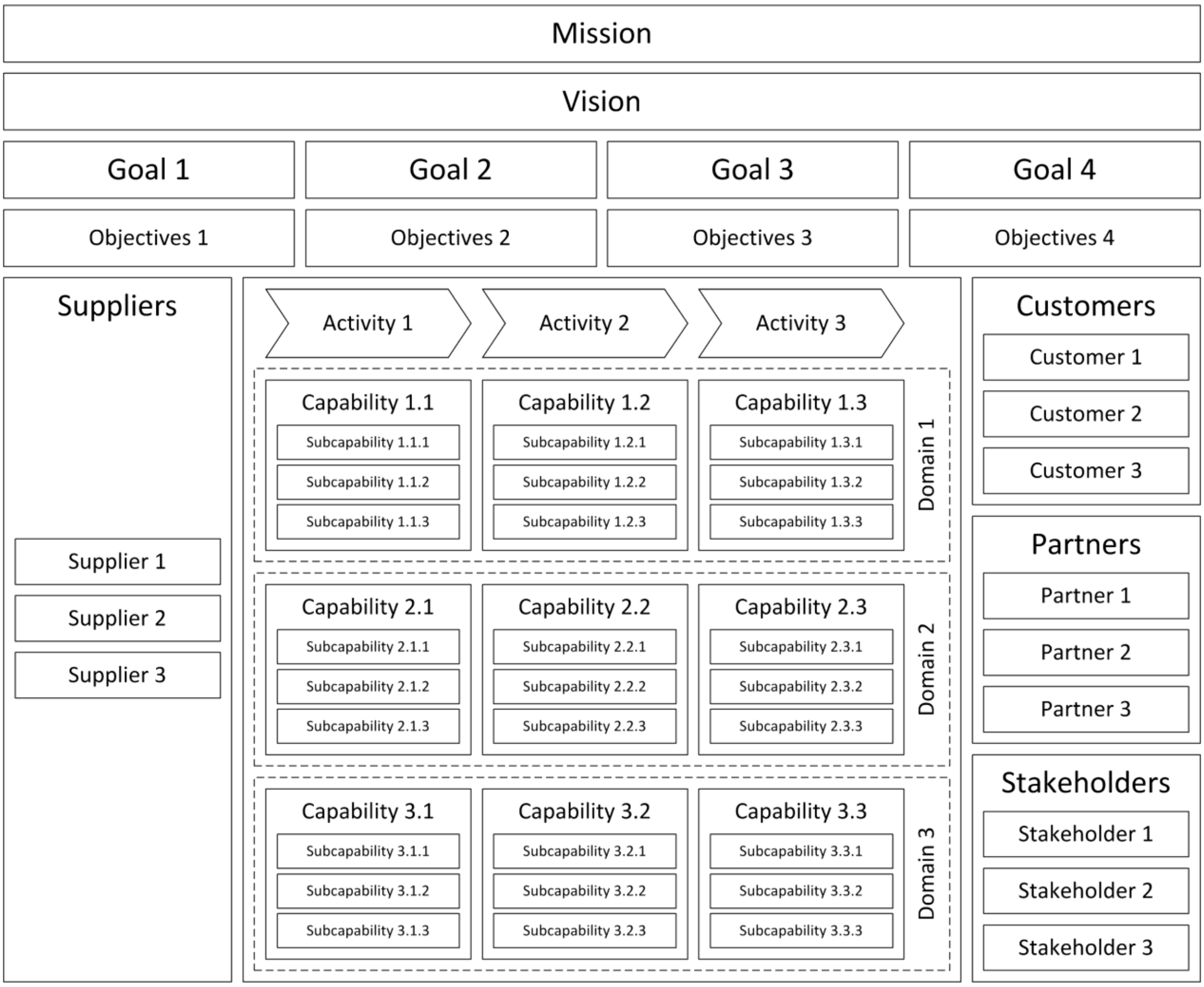

Figure G.1. Schematic structure of the business capability model

G.2. Conceptual Architectures

Conceptual architectures describe goals, objectives, high-level designs and major design options for individual IT projects detailed enough to estimate their size, time and cost. The main purpose of conceptual architectures is to facilitate the estimation of project costs and timelines in order to enable informed and effective decision-making. Typically, conceptual architectures are 20-40 pages long. The structure of the MS Word template for a conceptual architecture is shown in Figure G.2.

Project 1 Conceptual Architecture

1. Introduction	1.1. Document map 1.2. Purpose and scope of document	
2. Architectural Guidelines	2.1. Goals 2.2. Key requirements 2.3. Assumptions	2.4. Constraints 2.5. Risks 2.6. Issues
3. Conceptual Architecture	3.1. Architectural highlights 3.2. Key architectural concepts 3.3. Architectural overview	3.4. Current state 3.5. Future state
4. Appendices	4.1. Options analysis 4.2. Architectural decision	

Figure G.2. Structure of the MS Word template for a conceptual architecture

G.3. Maxims

Maxims are very high-level business and IT principles applicable to all projects. Totally, six business maxims and 14 IT maxims are defined at the university. The main purpose of maxims is to facilitate the alignment of all IT projects to the overall organizational philosophy. The real examples of maxims are described in Table G.1.

Table G.1. Real examples of maxims

Maxim	Type	Description
Equivalent student/staff/partner experience	Business	The University will provide an equivalent experience for current and prospective students, staff, industry and professional regardless of their location and culture
Common business processes	Business	The University will adopt business processes across all points of presence with these processes being transparent and sharing relevant data
Common use of systems and technology	IT	Implementation of systems and infrastructure used across the University is preferred over the development of similar or duplicated systems that are only provided to a particular area
Business continuity	IT	Critical systems and data continue to be available in spite of interruptions

G.4. One-Page Diagrams

One-page diagrams show the relationship and interaction between various information systems depicting different parts of the organizational IT landscape in their current states and sometimes in their planned future states. The total number of all one-page diagrams created at the university was estimated to be close to 200. The main purpose of one-page diagrams is to facilitate project planning by solution architects on earlier stages of the project. The schematic example of a one-page diagram is shown in Figure G.3.

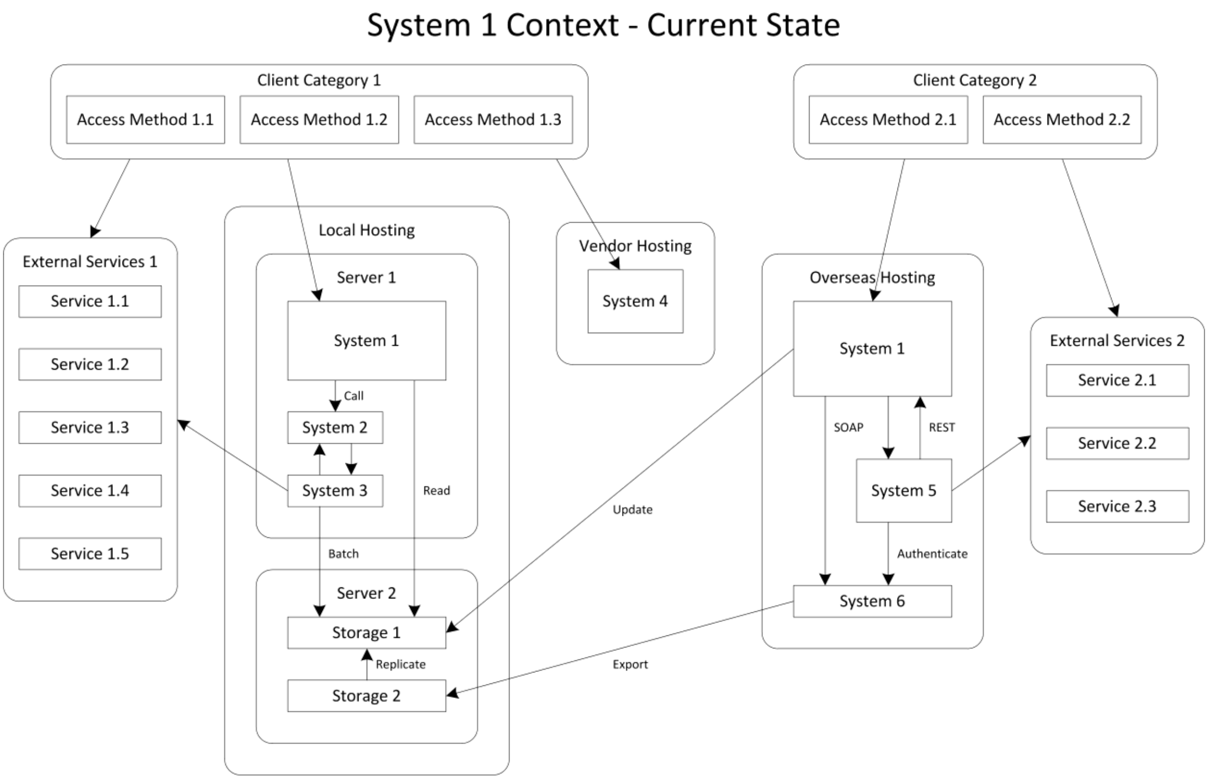

Figure G.3. Schematic example of a one-page diagram

G.5. Principles

Principles are brief reusable implementation-level rules applicable to broad categories of projects. The main purpose of principles is to facilitate the technical homogeneity of solution designs developed for projects by solution architects. The real examples of principles are described in Table G.2.

Table G.2. Real examples of principles

Principle	Domain	Statement	Rationale	Implications
Services must be used to integrate applications	Integration and data	Integration between applications must be done via services, rather than directly	Providing service interfaces allows system interactions to be decoupled and abstracted from the actual systems that	Additional effort associated with the definition of services during project design, but will lower the cost of maintenance over

			implement the services	time
Production and non-production separation and implementation	Infrastructure	Non-production environments are physically or virtually separated from production environments but are as similar as possible	Reduces risk by testing changes prior to deploying to production. Separation helps isolation and reduces any further risk on impacting production	Non production configuration sets to be kept consistent with production. Increased costs associated with deployment of additional environments from a hardware, software and operational perspective
Secure by default	Security	A system's default setting should not expose users to unnecessary risks and should be as secure as possible	System may be released with an insecure default configuration that can be exploited by attackers. Unused features may slow down system performance and open doors for intrusion attacks	All security functionality should be enabled by default, and all optional features which entail any security risk should be disabled by default
Active Directory authentication	Client computing	All authentication for users of Client Computing services will be against the existing Active Directory service	Minimizes management overhead in creating and managing user details in a single source	If systems require an internal authentication process of some type, they must first synchronize any required user information from Active Directory in a one way process

G.6. Program of Work

The program of work is prepared on a yearly basis for the entire university. It contains the list, or mini-roadmap, of all IT projects chosen for implementation in the upcoming year and approved for funding by the ICT steering committee. The schematic structure of the program of work is shown in Figure G.4.

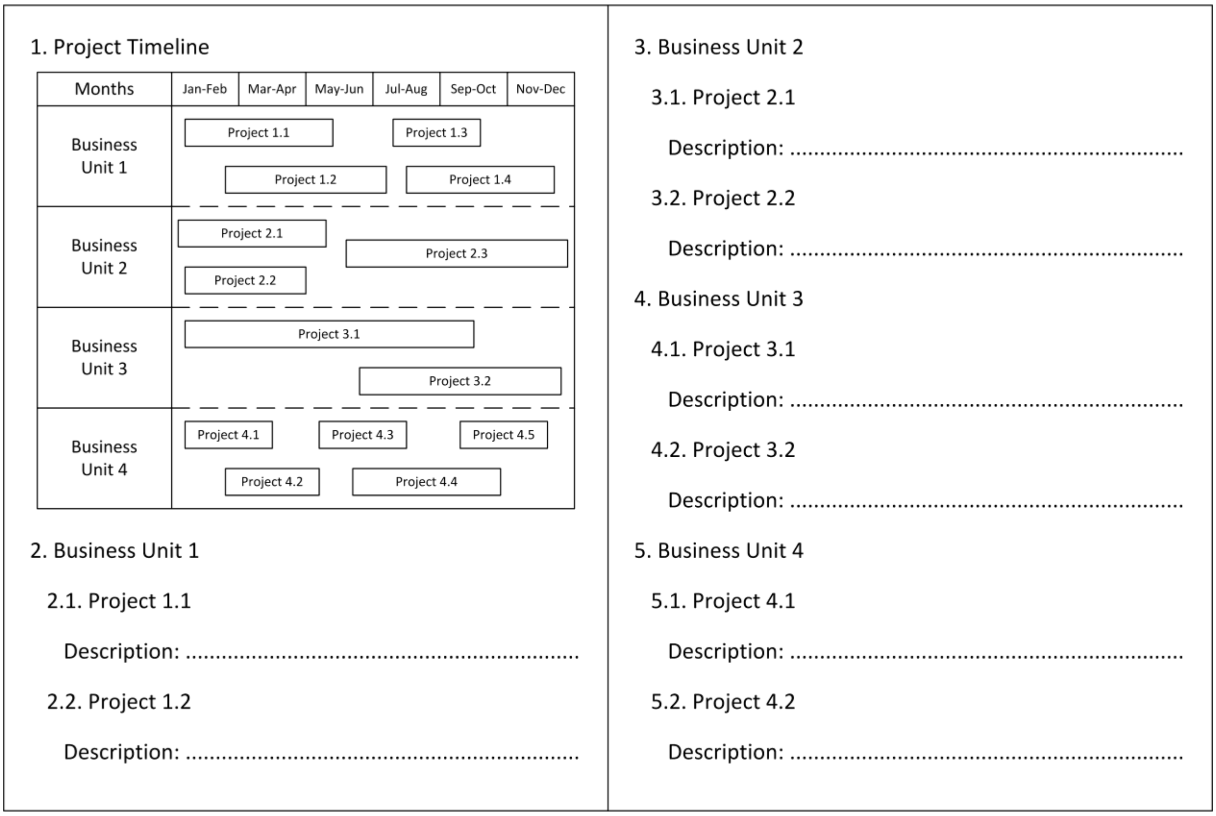

Figure G.4. Schematic structure of the program of work

G.7. Roadmaps

Each business unit of the university has its own roadmap showing all the information systems and technologies relevant to this unit. Totally, more than 30 different roadmaps are maintained for the whole university. Roadmaps show the systems of four different types: (1) implemented systems currently used by the business unit, (2) systems being implemented now, (3) planned systems approved for implementation in the future and (4) systems needed by the business unit, but not yet approved for implementation. They also show expected beginning and completion dates for planned systems and systems in the implementation stage. The main purpose of roadmaps is to facilitate discussions between engagement managers and business customers about their needs for new IT projects. The schematic structure of a roadmap is shown in Figure G.5.

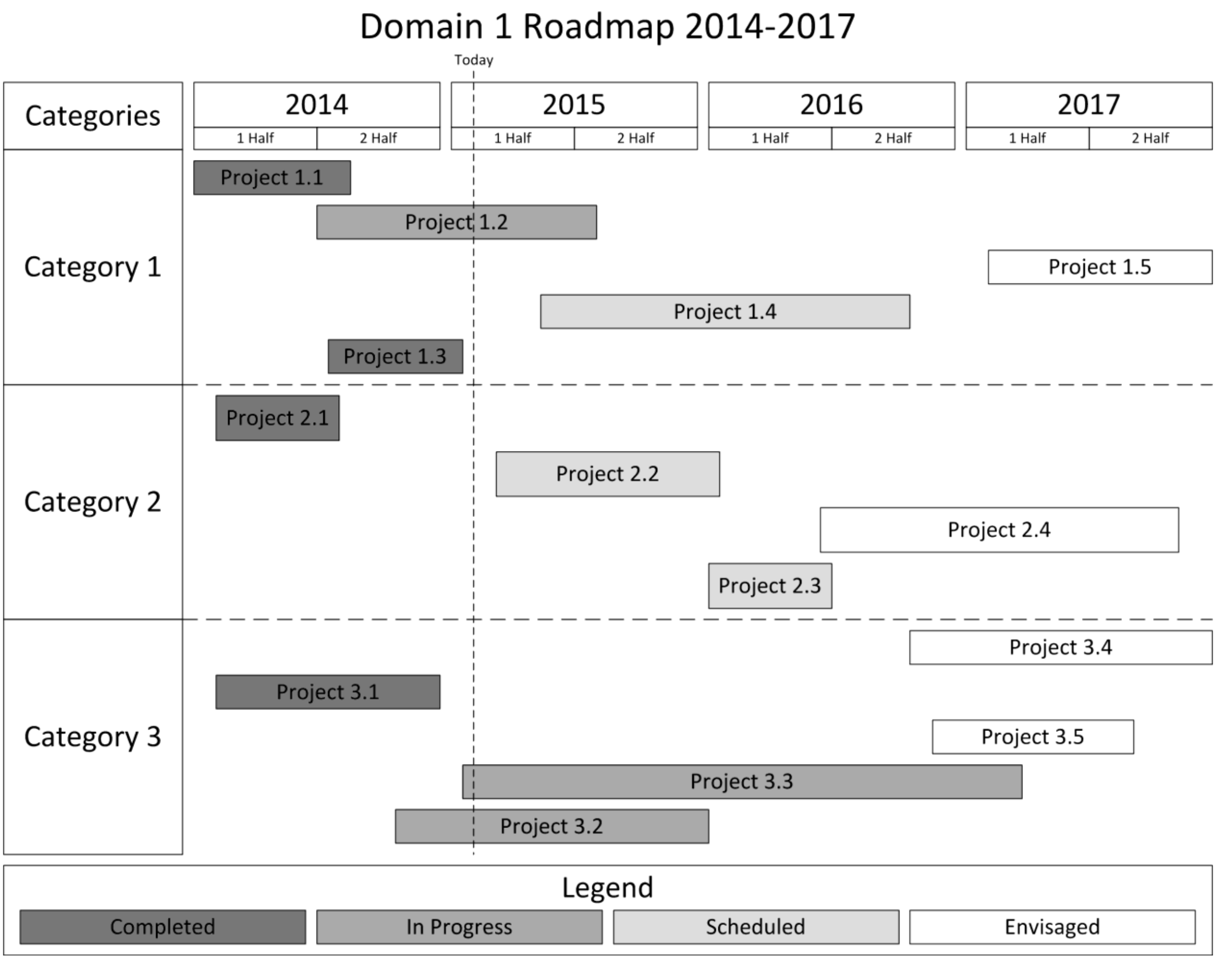

Figure G.5. Schematic structure of a roadmap

G.8. Solution Designs

Solution designs describe detailed designs of individual IT projects actionable for project teams implementing them. The total number of all approved solution designs over the last two years was estimated to be close to 150. The main purpose of solution designs is to serve as cornerstones and common reference points for project managers, project implementers and other project participants working on IT projects. Typically, conceptual architectures are 40-80 pages long. The structure of the MS Word template for a solution design is shown in Figure G.6.

Project 1 Solution Design

1. Document Control	1.1. Document author 1.2. Document revision history 1.3. Authorisation	1.4. Document distribution 1.5. Referenced documents
2. Introduction	2.1. Purpose 2.2. Audience	2.3. Overview 2.4. Glossary
3. Business Problem	3.1. Scope 3.2. Problem overview	
4. Solution Overview	4.1. Application overview 4.2. Products and services 4.3. Data and interfaces overview	4.4. Infrastructure overview 4.5. Security overview
5. Enterprise Architecture Alignment	5.1. Architecture maxims 5.2. Architecture principles 5.3. Architecture standards 5.4. Constraints	5.5. Risks 5.6. Issues 5.7. Key architecture decisions
6. Business Architecture	6.1. End-user experience 6.2. Capability model alignment 6.3. Organisational impact	
7. Data and Integration Architecture	7.1. Key information domains 7.2. Business glossary and key terms 7.3. Data entity/function matrix 7.4. Logical data diagram 7.5. Data security overview 7.6. Data migration	7.7. Data lifecycle 7.8. Logical integration architecture 7.9. Logical component architecture 7.10. Real time interfaces 7.11. Batch interfaces 7.12. Message and file formats
8. Application Architecture	8.1. System components 8.2. Support requirements	8.3. Business continuity and DR 8.4. Application security
9. Technology Architecture	9.1. Logical architecture 9.2. Physical architecture 9.3. Storage 9.4. Network architecture	9.5. Networking infrastructure 9.6. Infrastructure architecture 9.7. Licencing 9.8. Infrastructure security
10. Security	10.1. Information classification 10.2. Threat management 10.3. Security assurance	

Figure G.6. Structure of the MS Word template for a solution design

G.9. Standards

Standards are reusable low-level technical rules and patterns applicable to narrow and specific situations. The main purpose of standards is to facilitate the reuse of standard components, patterns and building blocks for specific recurring problems in solution designs developed for projects by solution architects. The real example of a standard is shown in Figure G.7.

Standard #1: Direct Query Via Crystal Reports

Description:
- Use Crystal Reports as the front-end user-facing application through which operational reporting is produced, utilising raw data from the main application.
- Accesses data sources directly rather than via the application housing that data - typically read-only mode.

Applicability:
- Operational reporting.

Rationale:
- Reporting functionality is not built within the vanilla OOTB product, or not satisfactory enough for reporting requirements.
- Reporting requirements are purely for operational data.
- Cost to utilise is low, as Crystal Reports is already an in-house reporting application and can query the application's database.
- Reporting requirements do not include aggregation or integration of data from any other applications or sources.
- Used to replace MS Excel/MS Access based reporting (if and when applicable).

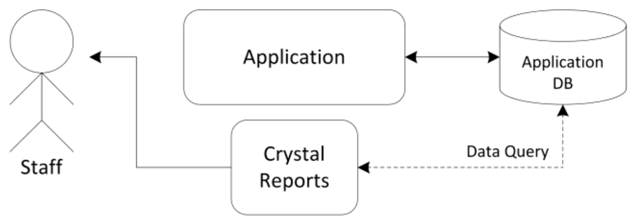

Figure G.7. Real example of a standard

G.10. Technology Reference Model

The technology reference model (TRM) lists all the available technologies that should be used in IT projects including programming languages, application servers, operating systems, database management systems, integration buses and many other technologies. The main purpose of the technology reference model is to facilitate the selection of technologies by solution architects on earlier stages of the project. The schematic structure of the technology reference model is shown in Figure G.8.

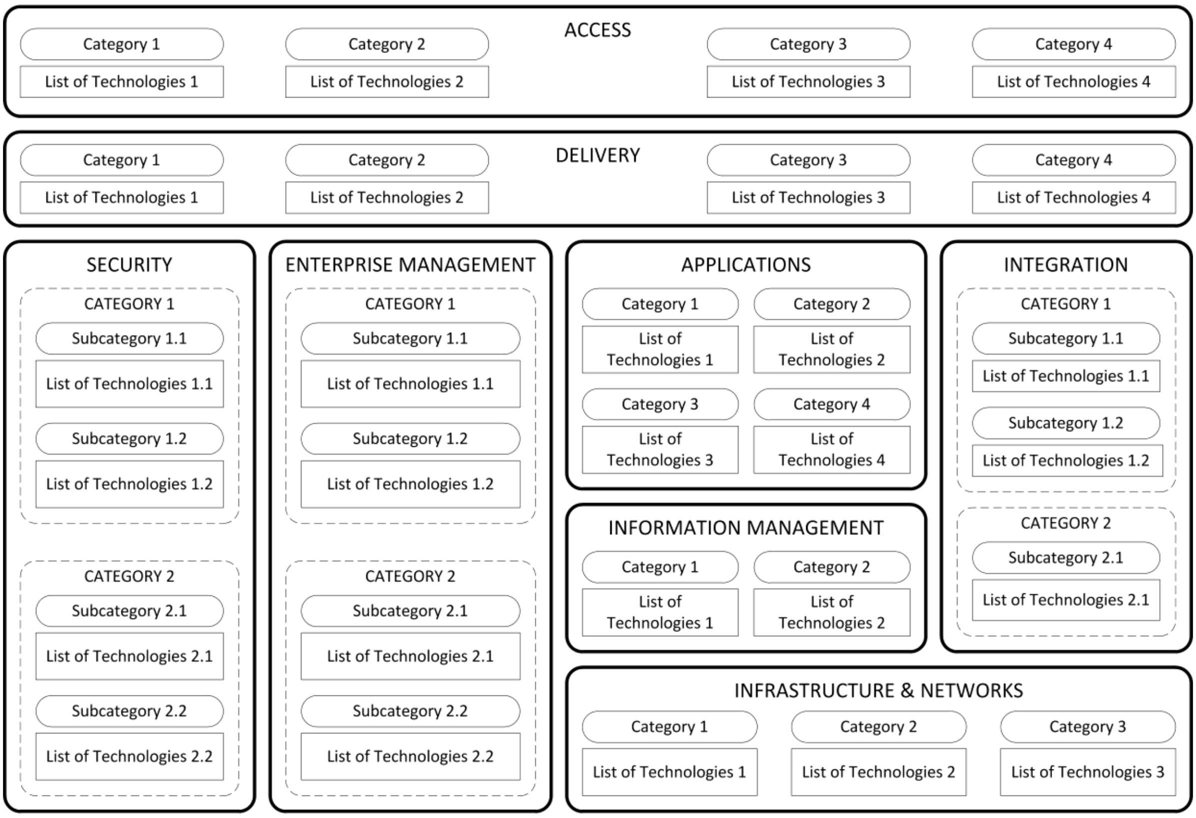

Figure G.8. Schematic structure of the technology reference model

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