Designing a Method for Assessing the Enterprise Architecture Business Value

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Declaration

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List of Abbreviations

Abbreviation	Full Text	Described in
ABC	Artefact Build Cycle	Section 2.1
ADM	Architecture Development Method	
AIB	Assessment Information Base	Section 5.4
AR	Action Research	Chapter 2
BITA	Business-IT Alignment	Section 3.1.5
BPM	Business Process Management	
BPMN	Business Process Modelling Notation	Section 5.4
BSC	Balanced Scorecard	Section 3.2.1
CBB	Capability Building Block	Section 7.3.9
CRISP-DM	Cross Industry Standard Process for Data Mining	
CSF	Critical Success Factor	Section 5.3.3
DSR	Design Science Research	Section 2.1
EA	Enterprise Architecture	Section 3.1
EA BSC	Enterprise Architecture Balanced Scorecard	Section 5.5
EABV	Enterprise Architecture Business Value	Section 3.7
EABV AM	Enterprise Architecture Business Value Assessment Method	Section 4.3
EABV AP	Enterprise Architecture Business Value Assessment Process	Section 5.4
EABV FW	Enterprise Architecture Business Value Framework	Section 5.2
EABV M	Enterprise Architecture Business Value Model	Section 5.3
EAI	Enterprise Application Integration	
EAM	Enterprise Architecture Management	Section 3.1
EOL	End-of-Life	
ES	Engaged Scholarship	Section 2.3
GQM	Goal-Question-Metric	Section 3.2.3
IS	Information System	
IT	Information Technology	
ITBV	Information Technology Business Value	Section 3.4
IT-CMF	Information Technology Capability Maturity Framework	Section 7.3.9
MACE	Measure, Analyse, Communicate, Evolve	Section 4.3.1
MAID	Measurement and Infrastructure Diagnostic	Section 6.5
NPV	Net Present Value	
PLC	Project/Program Life-Cycle	
PoC	Proof of Concept	
POC	Point of Contact	Section 6.5.3
PR	Practice Research	Chapter 2
RBT	Resource-based Theory	Section 3.5.2.1
RBV	Resource-based View	Section 3.5.2.1
ROI	Return on Investment	

SLA	Service Level Agreement
SME	Subject Matter Expert
TCO	Total Cost of Ownership
TOGAF	The Open Group Architecture Framework

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Abstract

Enterprise Architecture (EA) has established itself as a discipline to understand, develop and manage complex information technology landscapes. While EA possesses various value propositions, it is still a discipline which is very difficult to assess in terms of business value. This is reflected in a number of academic contributions and in addition a shared denominator among practitioners. Consequently, in the effort to fully understand the EA function in terms of performance and business value, we design a method to address this issue. Employing a design science research approach, we built our artefacts with an industry partner within an organizational context while regarding design choices and principles. This underpins the practical importance of our research and contributes to the question of how can we design and evaluate a method to assess EA business value within an organizational context. This method addresses the construction, operation, and improvement of four information technology artefacts: The EA business value framework provides a holistic approach to EA performance measurement and EA business value communication. It is based upon an EA business value model defining value within the organizational context, employs the EA business value assessment process to gather relevant data for analytics and makes them visible with the EA balanced scorecard.

Keywords: *Enterprise Architecture, Business Value, Performance Measurement, Assessment Method, Design Science*

1. Introduction

As companies grow in size and personnel, the need for structured and consistent practices for Information Technology (IT) functions becomes evident. Enterprise Architecture (EA) is seen as a suitable approach to manage complex IT structures in alignment to business. In today's companies, we come across heterogeneous architectures composed of self-developed solutions, custom-build outsourced solutions, and commercial systems. An architecture in the context of IT is defined in (IEEE 2007) as *"the fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution"*. Thereby, a firm's IT system is perceived as open, complex, and dynamic (Ferstl and Sinz 2006) and can be defined as "*a collection of components organized to accomplish a specific function or set of functions*" (IEEE 2007). A system is exposed to various stakeholders which are defined as "*an individual, team, or organization (or class thereof) with interests in, or concerns relative to, a system*" (IEEE 2007).

Over the decades, a great variety of EA frameworks have been proposed. In fact so many, that choosing the appropriate is a science in itself (Schekkerman 2006). The purpose of EA frameworks such as Zachman (Zachman 1987), GERAM (Bernus et al. 1996; IFIP IFAC Task Force on Architectures for Enterprise Integration 2003), TOGAF (The Open Group 2011), and ARIS (Scheer 1996; Scheer 1999) is to facilitate the understanding of enterprise complexity by providing various views, allow for modelling parts of the enterprise, and to assist in developing architectures as well as managing those.

Standardization, reusability, and business-IT alignment (BITA) are amongst the major drivers for employing EA (Schöenherr 2008). Throughout the enterprise transformation from As-is to To-be, EA yields a number of benefits (Op 't Land et al. 2009; Ross et al. 2006; van Steenbergen et al. 2011). The assessment of these benefits in terms of EA business value (EABV) constitutes a challenging effort in current research and practice (Meyer and Helfert 2012). This is underpinned by various contributions in that field (Kaisler et al. 2005; Lange et al. 2012; Niemi et al. 2009). With our research, we design a method to assess EA benefits in terms of EA business value. In other words, we examine which and how various EA elements contribute to organizational performance. This research project is conducted in collaboration with an industry partner, a global high-tech company employing an EA practice for several years. Hence, the assessment method or research output respectively, is targeted to be employed by larger corporations having an EA effort established within their organizations. Additionally, we have

the opportunity to regularly exchange expert's opinions with practitioners participating in the Innovation Value Institute (IVI) which is a research consortium establishing a close research collaboration between academia and industry.

1.1. Motivation

As can be elicited from the introduction above, the motivation for our research endeavour stems from the fact that the EA function in an organizational context is not entirely understood in terms of performance and business value (Fotini et al. 2008; Kaisler et al. 2005; Ross et al. 2005; Shang et al. 2002; van Steenbergen et al. 2011). Notably, we measure performance and communicate business value as proposed by (Mitra et al. 2011). A significant part of EA function performance falls into the category of intangible assets (Brynjolfsson et al. 2002) and is therefore difficult to measure. Consequently, another part of this research is the development of appropriate metrics as this has not been done thoroughly enough in literature (Kaisler et al. 2005; Vasconcelos et al. 2007). Metrics are used to evaluate processes, services, projects, etc. as they describe certain aspects and characteristics of those (cf. Sec. 5.3). In addition to defining metrics, we have to align them with appropriate goals according to current strategy (Meyer et al. 2012a). (Office of Government Commerce 2007) lists four reasons why we measure or assess respectively:

- *Validation*: monitoring and measuring to validate previous decisions.
- *Direction*: monitoring and measuring to set direction for activities in order to meet set targets (most prevalent reason).
- *Justification*: monitoring and measuring to justify, with factual proof or evidence that a course of action is required.
- *Intervention*: monitoring and measuring to identify a point of intervention including subsequent changes and corrective actions.

Therefore, our aim is to design a viable method to assess EABV in an enterprise environment in terms of efficiency, integration, and usefulness which impacts the evolution and therefore improvement of EA employment. For the purpose of this work, we define method as an approach to perform an enterprise project, based on specific perspectives, parameters, and principles which is systematically structured in activities and deliverables (Brinkkemper 1996). The criteria for delivering a suitable method are determined by the requirements for our projected solution and are outlined in detail in Section 4.2.3. In terms of method construction, approaches stem from practice and literature and thereby differing from an epistemological and

philosophical viewpoint (Braun et al. 2005). Our method can be considered as hybrid in a sense that it takes elements and characteristics from both, practice and literature.

1.2. Research Questions

The reason to employ such an assessment method is to provide the following insights and results:

- Quality information for management to improve decision support, e.g. improved investment decisions
- Reduced costs
- Analyse current EA techniques and improve them based on obtained information
- Analyse current EA output and update the employed EA framework repository based on obtained information

Information is obtained either quantitative or qualitative. The method is embedded into current organizational practices in order to minimize overhead and increase adoption. Thereby, we have three main research areas to cover: *Enterprise Architecture*, *Business Value*, and *Performance Measurement and Management*. The resulting research focus is illustrated in Figure 1-1. The **main research question** is how can we **design and evaluate a method to assess EABV** within an organizational context. Translating this into further research questions gives us the following result:

RQ1: What is EABV and how can we model it?

- How can we define EABV?
- How can we model EABV in an appropriate way?
- How does EABV relate to other concepts within an enterprise, e.g. strategy?

RQ2: How can we measure EA performance?

- What kind of goals or objectives do we need to measure?
- How can we find adequate metrics for those goals?
- What kind of process do we need to implement in order to measure?
- What are the challenges and problems in measuring EA performance?

RQ3: How can we communicate EABV?

- What is the best way to communicate EABV to various stakeholder groups?

- Can we develop reports or even templates to diffuse?
- Does the communicated EABV affect investment decisions?
- What are the challenges and problems in communicating EABV?

RQ4: Does our solution increase EA maturity?

- How can we increase the EA maturity?
- How can we align our solution and with an EA maturity framework?

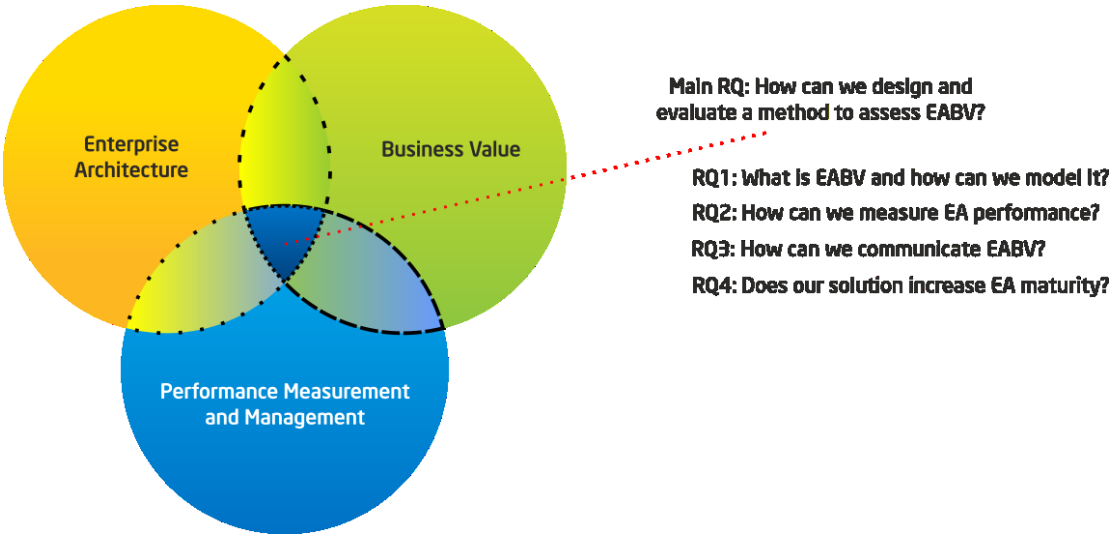

Figure 1-1: Research focus and questions

With our approach, we answer these research questions and present them in an academic and industrial environment. The means to accomplish this is further outlined in Section 5.1.1 where we explain the objectives of our research output. By clarifying business value, EABV specifically, we further contribute to a theory of the firm, namely *Dynamic Capabilities* (Teece and Pisano 1994; Wang and Ahmed 2007) which are based on the *resource-based view* (RBV) or *resource-based theory* (RBT) respectively (Nevo et al. 2010; Wernerfelt 1984) in order enlighten our research with the underlying context and relationships found in modern enterprises. These theories mark one of the most important foundations of strategic management research, which serves as starting point for our research endeavour (Crook et al. 2008). It further explains how competitive advantage can be achieved through available resources (Wade et al. 2004). In addition, we contribute to research methodologies for information system research in collaborative environments. Therein, research between academic researchers and industry practitioners is conducted in the form of *Engaged Scholarship* (ES) (Van de Ven A.H. 2007). In that respect, we regard stakeholder theory (Freeman 2004) as we describe their roles, responsibilities, and expectations in the context of

EA and EA assessments. The contribution to industry practitioners by answering those question with an adequate research output manifest itself in various EA benefits such as improved decision making, cost reduction, and common understanding. As a consequence, we aim to improve the EA function within the organizational environment and hence, all related EA benefits (cf. Sec. 3.1.5.2) that can be achieved as a result mark an important practical contribution.

1.3. Document Structure

We now briefly outline the structure of this Thesis. It is mainly oriented on our adapted research process consisting of four main phases, namely *Analysis*, *Design*, *Evaluation*, and *Diffusion* (cf. Sec. 2.1). Our research methodology, along with the rational for selecting it, is described in more detail in Chapter 2. An overview of the document structure is given in Table 1-1.

Section	Content
Research Methodology (cf. Chap. 2)	Herein, we give a description of the overall research methodology and our adapted research process which determines the rest of this document in terms of structure and content. Additionally, we outline the research context and related work.
Underlying Theories and Concepts (cf. Chap. 3)	The content in this Chapter sets the stage for understanding and positioning our research. For this purpose, we outline all relevant concepts and theories. It is composed as part of the literature review.
Analysis (cf. Chap. 4)	In this Chapter, we describe problems, business needs, and research challenges. Additionally, we present the findings summary based on the literature review. Furthermore, a solution proposal how to solve these problems will be outlined.
Design (cf. Chap. 5)	The design of IT artefacts to answer our research questions is presented in this Chapter. We outline requirements, principles, and objectives as well as concrete artefact descriptions.
Evaluation (cf. Chap. 6)	How we evaluate our artefacts is discussed in this Chapter. We describe evaluation criteria, a concept evaluation, and a comprehensive evaluation method.
Case Study (cf. Chap. 7)	In this Chapter, we explore the instantiation of our approach within the organizational context in the course of a case study with our corporate partner.
Diffusion and Critical Discussion (cf. Chap. 8)	Here we describe how, what, and who publishes and receives information about this project. In addition, we discuss our research from a critical perspective.
Conclusion and Outlook (cf. Chap. 9)	Finally, we give a conclusion and outlook for our research effort.

Table 1-1: Document structure

2. Research Methodology

"If we knew what it was we were doing, it would not be called research, would it?"

Albert Einstein (1879 - 1955)

In general, research aims to find answers to questions about the unknown. Questions can be about a particular problem, a natural phenomenon, a behavioural aspect or an artificial construct, just to name a few. Research is problem-driven which means not knowing the answers poses a problem that needs to be solved by researching. From a philosophical viewpoint, all life can be seen as problem solving (Popper 2001). With that, we argue against the separation of problem solving and research interest. However, we postulate that there is a different interest in the outcome of problem solving. For example, a software development project done by practitioners may not be of interest for researchers since they are concerned with theoretical work and not so much with practical or operational work (Goldkuhl 2011).

In the endeavour to fully understand and solve a given problem, we have to proceed methodically. We necessitate a structured approach on how to conduct our research. For information system (IS) research, we can find a variety of methods. As we are collaborating with an industrial partner and apply our research output within an organizational environment, we require to adopt a research approach suitable for combining the academic and the industrial context. Thereby, we further necessitate clear roles and responsibilities to facilitate such an academic and industry collaboration. A participative form of understanding and solving complex socio-technical problems with key stakeholders is E*ngaged Scholarship* (ES) (Van de Ven A.H. 2007; Van de Ven A.H. 2010). Two forms of ES are of particular interest, namely *Action Research* (AR) and *Design Science Research* (DSR). Another newly proclaimed research methodology is *Practice Research* (PR) which aims to combine AR and DSR (Goldkuhl 2012).

AR contributes to both, practical concerns of people in an immediate problematic situation and to goals of social science by joint collaboration within a mutually acceptable ethical framework (Rapoport 1970). Originating early in the post World War II era, AR is concerned with massive social changes that demand an adequate research method (Lewin 1946). Social change is the prime driver for organizational design and henceforth relevant for conducting research within

modern businesses (Baskerville and Wood-Harper 1996). Consequently, AR may be defined as an emergent inquiry process in which applied behavioural science knowledge is integrated with existing organizational knowledge and applied to solve real organizational problems. It is simultaneously concerned with bringing about change in organizations, in developing self-help competencies in organizational members and adding to scientific knowledge. Finally, it is an evolving process that is undertaken in a spirit of collaboration and co-inquiry (Coghlan and Shani 2013). A difficulty with AR is to some degree owed to sacrificing scientific rigor too easily and hence it suffers from the reputation of being consulting in a research disguise (Baskerville et al. 1996). While it has gained increased acceptance as a qualitative research approach in IS, there still exist many different flavours and further unresolved issues in terms of clarification of the research process (Goldkuhl 2012). The main research activities for AR are outlined in (Susman et al. 1983).

DSR is about creating artefacts which pose the solution to a given problem or business need respectively. DSR is primarily not concerned with the truth, but with utility of an artefact to solve problems (Hevner et al. 2004). Thereby, artefacts can be either constructs, models, methods, or instantiations (Hevner et al. 2004; March et al. 1995). It constitutes not only a research methodology but additionally a complete research framework. Moreover, we come across several research processes in literature (Hevner et al. 2010; Österle et al. 2011; Peffers et al. 2008).

PR marks the evolution of AR to a higher level of abstraction by comprising several research methodologies under this newly coined term (Goldkuhl 2011; Goldkuhl 2012). It is driven by contribution and incorporates the basic attitude to improve existing knowledge. As we outlined in the beginning of this Section, this holds true for research in general. PR thereby creates abstract and useful knowledge. The main target group is practitioners, i.e. PR studies practices. It contributes abstract knowledge to the scientific body of knowledge. In terms of collaboration, PR avoids hard and definitive demands on how a research process should be adapted. In any case, PR is too abstract in our belief and therefore is not the best suited research methodology for our purposes.

Method Engineering (ME) is also relevant to examine as our main research output represents a method. ME is an engineering discipline for designing, constructing and adapting methods, techniques and tools for IS development (Brinkkemper 1996). Thereby, situational method engineering, i.e. engineering a method aligned to an immediate project situation, requires building blocks and guidelines in the form of meta-methods. These assemble those building

blocks. Since we do not dispose of such meta-methods, situational method engineering is not suitable for our purposes. One of the premises of method engineering is the creation and maintenance of a methods base (Harmsen et al. 1994). There is currently no tool support at our corporate partner and the introduction of such tools was not regarded as feasible at this stage. While the term research is not mentioned in the definition, we can perceive ME as a special case of doing DSR since the development of method fragments can be viewed as the design of an IT artefact. Moreover, the feasibility of ME (especially situational ME) is still disputed due to many unresolved research issues based on the inherent complexity and efforts necessary to design, store, retrieve, and assemble method fragments (Hofstede and Verhoef 1997). Consequently, ME is not deemed as suited for all our research and development requirements.

At first glance, AR and DSR seem similar but they are effectively not (Iivari et al. 2009). This especially holds true for a paradigmatic comparison where DSR offers a greater variability. Paradigmatically, AR can be considered as special case of DSR although the latter is focused on building new IT artefacts unlike AR. Notably, combination of those two approaches is possible, for example one can apply an AR evaluation to his DSR research. Both research approaches are concerned with practical relevance (Goldkuhl 2012; Hevner et al. 2004) which constitutes a requirement for our research methodology. Furthermore, AR considers that a complex social setting such as an organization with its information systems cannot be split into variables or components that yield useful knowledge about the organization as a whole (Baskerville 1999). We argue that our approach aims to assess such smaller bits of the organization in order to abstract findings to gain insights about the whole organization and whether its strategic goals and execution on the path to enterprise transformation was successful.

We summarize our findings on suitable research methodologies in Table 2-1. The criteria the comparison is based on are collaboration, research output and main activities. Collaboration is the support for participative research between researchers and practitioners, in other words how appropriate the methodology qualifies for conducting ES research. The research output is crucial for ES. Our approach is problem-driven, meaning that we are solving research problems and satisfying business needs. Consequently, we require appropriate research output that facilitates the fulfilment of objectives of our research efforts. The activities illustrate the basic means of research and what activities are executed in the course of answering research questions. Thereby, all research methodologies are conducted in a project-based manner.

	Collaboration	Research Output	Main Activities/Phases
PR	Varies	• Abstract Knowledge • Useful Knowledge	• Theorizing • Situational inquiry
AR	High	• Particular solution	• Diagnosing • Action Planning • Action Taking • Evaluating • Specifying Learning
DSR	High	• Constructs • Models • Methods • Instantiations	• Analysis • Design • Evaluation • Diffusion
ME	Low	• Method fragments • Methods	• Project environment • Characterization of project • Selection of method fragments and method assembly • Project performance

Table 2-1: Overview of suitable research methodologies

The reason for choosing DSR instead of the others is that the design of IT artefacts is more focused on the artificial creation of solutions to encountered problems and business needs. For that matter DSR, unlike AR, offers clearly defined research outputs in the form of such IT artefacts. In our case, there is no prior assessment approach established in our organizational context and hence, the design of new IT artefacts is deemed the most adequate research output. The design of methods is addressed rarely in literature (Braun et al. 2005) and since the main aim of our research is to close this gap in terms of method design for EABV assessment, we choose DSR as the best suited research option. Furthermore, we deem the DSR guidelines in (Hevner et al. 2004) as valuable. Another reason is that all stakeholders in our project possess prior knowledge of DSR while not savvy about AR. Since EA practitioners are key stakeholders in this research project and are required to know how we conduct research, adopting a new research approach without any clear benefit is simply not feasible in a corporate environment. Although we adapt DSR, we additionally employ other forms of research methods, such as case study research and survey research. These can be used in different research methodologies since methods are the practical application of doing research whereas a methodology is the theoretical and ideological foundation of a method (Wahyuni 2012). This reflects the complementation of DSR and behavioural sciences (Lee 2000).

2.1. Research Philosophy

From a philosophical standpoint, research is perceived along two main dimensions in literature: *ontology* and *epistemology* (Wahyuni 2012). Hereby, ontology is the subjective view on reality whereas epistemology is the view on what constitutes acceptable knowledge. In research literature, (Wahyuni 2012) ponders on the research design maze by describing four fundamental beliefs or philosophical paradigms respectively, namely, *positivism*, *postpositivism*, *interpretivism*, and *pragmatism*.

Positivists view reality independent of social actors and believe that there exists a general truth. Acceptable knowledge constitutes law-like generalisations and reducing phenomena to simplest elements (Wahyuni 2012). Reality is therefore given objectively and can be described by measureable properties independent of the researcher (Myers 1997). It is also termed as naïve realism. *Postpositivists* distinguish themselves from pure positivists in that they challenge the belief of absolute truth. Although generalisation is accepted, it is done so by admitting that knowledge is the result of social conditioning. Postpositivism is also termed as critical realism (Wahyuni 2012). *Interpretive* research philosophy describes the understanding of reality and knowledge as actor-dependent, meaning that the world is not conceived as a fixed constitution of objects and therefore requires social actors to make sense of it (Orlikowski and Baroudi 1991). The meaning is therefore subjective and socially constructed (Wahyuni 2012). Consequently, it is also known as *constructivism*. *Pragmatism* orients itself toward solving problems in the real world (Feilzer 2009). It starts off with the research question before determining the research framework (Tashakkori and Teddlie 1998). This is exactly how our research project is set up and consequently we choose this philosophical stance. As we will learn in Section 2.5, we require a flexible research approach and therefore the freedom in terms of philosophy is facilitated by a pragmatic stance. This means, that ontologically, our reality is constructed and subjective based on the perceptions of stakeholders with a focus on how to best answer the research questions. Epistemologically, we focus on the subjective meanings and actions including the details behind them. In other words, our research does not postulate a single truth (cf. Sec. 3.5.1) but rather utility as perceived by various stakeholders. The focus hereby lies on practical applied research integrating different perspectives. Our philosophical viewpoint is nevertheless biased toward interpretivism.

From a pragmatic viewpoint, we allow for mixed methods research approach, i.e. data collection during research is conducted qualitatively and quantitatively (Kaplan et al. 1988). We therefore integrate these methods within our research process. The method of information

gathering regarding our research marks mostly qualitative research which allows for various underlying philosophical assumptions (Myers 1997). Qualitative data comes from survey research, i.e. stakeholders are asked for their expert opinion (Pinsonneault et al. 1993). Thereby, we gather qualitative data by interviewing relevant stakeholders or subject matter experts respectively, which is done on a regular basis. This happens partly in the form of semi-structured interviews. We start this procedure in the Analysis phase (cf. Chap. 4) and continue it throughout the research process. The quantitative part is relevant once our approach is instantiated and we require data to analyse EA performance in the course of our EABV assessment. We now take a closer look at our adapted research process in the following Section.

2.2. DSR Methodology Adaptation

For our work, we employ the slightly adapted research framework proposed in the seminal work by (Hevner et al. 2004). This framework is depicted in Figure 2-1 and describes the environment from where we derive business needs and problems respectively. Those ought to be relevant. IS research itself is about designing artefacts and developing theories with an appropriate methodology for which an existing knowledge base can be rigorously exploited. The environment in our case is organizational, and therefore we require input from stakeholders benefitting from the research output, organizational business processes including the set strategy, as well as the current EA function comprising of all EA services, processes, practices, standards, and relevant frameworks. Regarding the knowledge base, we resort to a combination of academic literature and relevant enterprise resources.

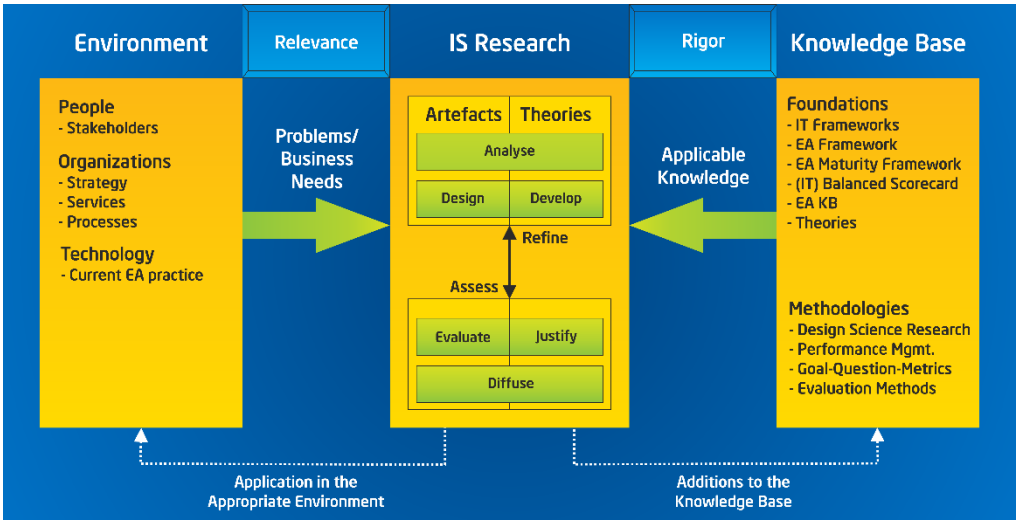

Figure 2-1: Design science research framework (based on (Hevner et al. 2004))

As research process, we employ an *Artefact Build Cycle* (ABC) (Meyer et al. 2012b; Meyer et al. 2012c) which supports the often necessary step back from one phase to another in order

to accommodate dynamic requirements or changes not initially considered. The main phases of the ABC are based on (Österle et al. 2011) and enriched with other approaches as circumstantiated by (Hevner et al. 2010) and (Peffers et al. 2008). The ABC is illustrated in Figure 2-2. In each of the phases we produce deliverables as research requires some form of output. As already mentioned in Section 1.3, the ABC serves as basis for the structure of this Thesis. Consequently, we now give a short summary of this process and describe it in more detail in the relevant Chapters throughout this document. For further reading on the ABC, the reader is advised to consult (Meyer and Kenneally 2012; Meyer et al. 2012).

The starting point of the ABC constitutes the *Analysis* phase where we identify the problem, gather relevant information to solve it, and then, after synthesizing the findings advertise the projected solution proposal to business and technical audiences. Deliverables for the analysis phase are the *Problem Description*, the *Findings Summary*, and the *Solution Proposal*. A gap analysis represents a helpful technique to derive strategies and goals from an As-is to To-be enterprise transformation. The As-is state thereby reveals problems or business needs respectively whereas the desired To-be state determines high level goals of what the enterprise wants to achieve. A gap analysis is an important step in our project and therefore crucial for our DSR approach. We gather perceptions of value from various stakeholders. This happens mostly by conducting expert interviews. On a higher level of abstraction, the gap analysis in our ABC can be found in the Analysis phase starting from the problem description as the as-is state and the solution proposal as the to-be state.

Once the solution proposal gets approved, we proceed to the *Design* phase where we build and instantiate the IT artefacts. For the Design phase, we produce the *Artefact Specification* (objectives and requirements) as well as a comprehensive *Artefact Description* including details about the instantiation. Additionally, we outline principles for our research effort.

Thereafter, we evaluate IT artefacts during the *Evaluation* phase where we deliver *Preliminary Results* and after a more in-depth evaluation an *Evaluation Report*. Evaluation follows a specific method and is conducted in terms of appropriate criteria.

Our ABC further clarifies the role of the *Diffusion* phase which can actually be carried out throughout a research project. As already mentioned in Section 1.3, the structure of this Thesis is strongly aligned to the main phases of the ABC. Consequently, we describe all these phases in more detail in the relevant Chapters of this document.

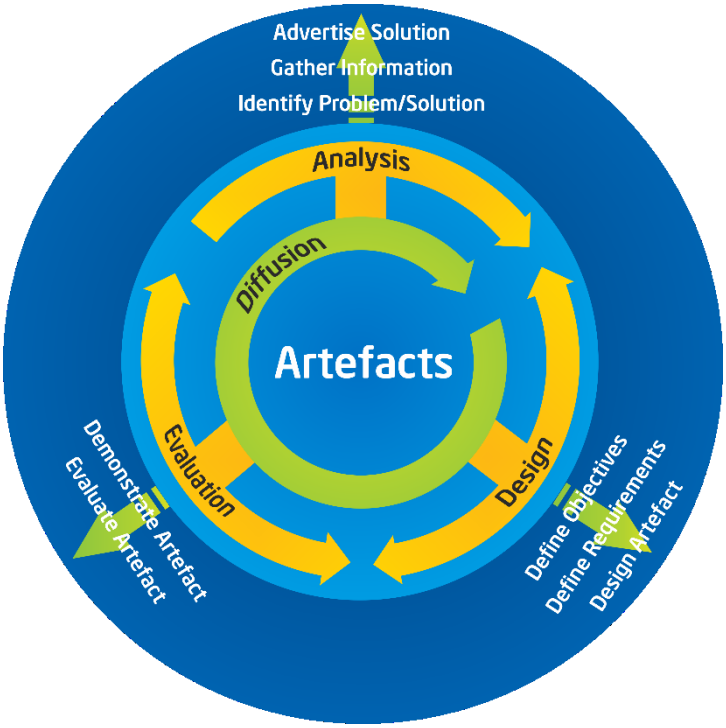

Figure 2-2: DSR Artefact Build Cycle (ABC) (cf. (Meyer et al. 2012b; Meyer et al. 2012c))

2.3. Engaged Scholarship and DSR

Information systems (IS) are in some cases prone to insufficiently delivering the desired impact on practice (Kawalek 2008). Several studies underline failings in IS to achieve adequate outcomes resulting in unsatisfying return on investment (Lam and Chua 2005; Pan 2005). While these analyses yield recommendations that operate at a high level of abstraction, they fail to outline detailed means to create actionable solutions. Such recommendations or findings respectively offer very limited assistance for the capability of practitioners to achieve their goals, and limited contribution to the theoretical knowledge IS research is based on. Consequently, a more contextual aware approach in an organizational problem-solving environment engaging with IS practitioners marks a requirement for addressing the before mentioned shortcomings (Costello et al. 2011).

A research approach satisfying this requirement is *Engaged Scholarship* (ES). It is a participative form of research whereby the views of key stakeholders are obtained to understand a complex problem (Van de Ven A.H. 2007, 2010). Taking on the viewpoints of various stakeholders, the differences are exploited to produce knowledge that has more impact on theory as well as practice in contrast to researchers working alone. The particular stages of such an engagement are illustrated in Figure 2-3 and are summarized as follows (Van de Ven A.H. 2007):

- *Problem formulation*: Situate, ground, diagnose, and infer the research problem by determining who, what, where, when, why, and how the problem exists up close and from afar.
- *Theory building*: Create, elaborate, and justify a theory by abductive, deductive, and inductive reasoning.
- *Research design*: Develop a variance or process model for empirically examining the alternative theories.
- *Problem solving*: Communicate, interpret, and apply the empirical findings on which alternative models better answer the research question about the problem.

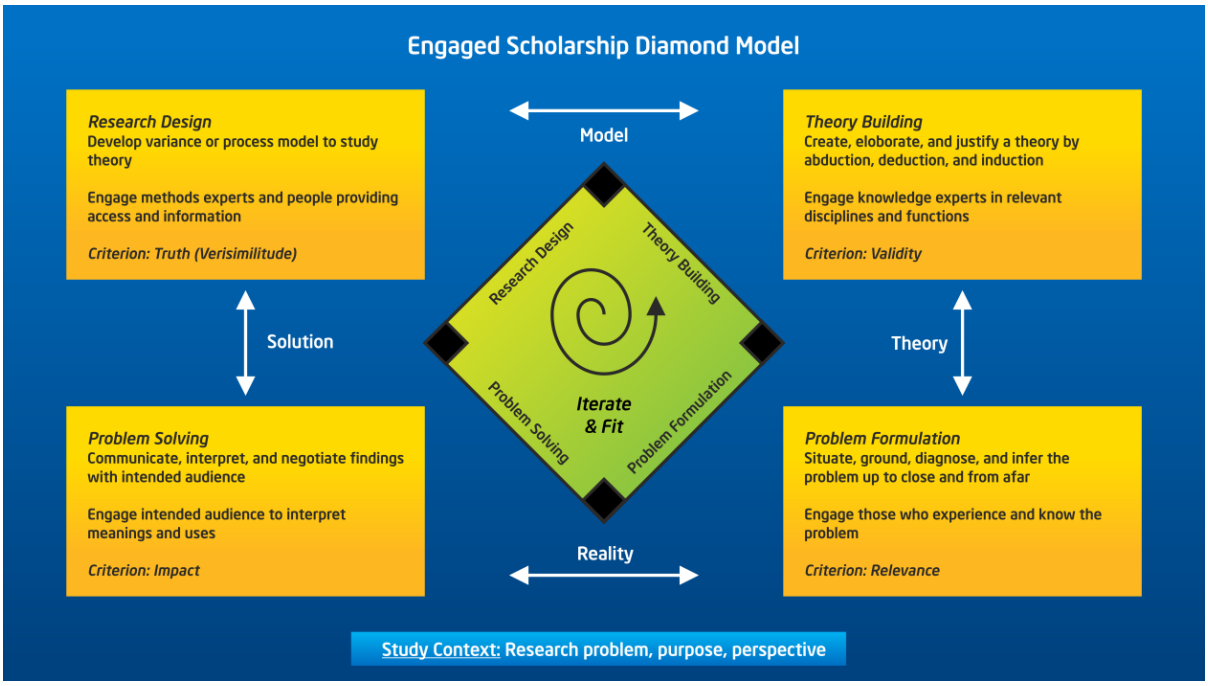

Figure 2-3: Engaged scholarship diamond model (cf. (Van de Ven A.H. 2007))

But how does DSR come into play? Figure 2-4 shows how DSR is located within the scope of ES (Van de Ven A.H. 2007) and identifies four forms of Engaged Scholarship:

- *Informed basic research* is undertaken to describe, explain, or predict social phenomenon.
- *Collaborative basic research* entails a greater sharing of power and activities among researchers and stakeholders than informed research.
- *Design and evaluation research* is undertaken to examine normative questions dealing with the design and evaluation of policies, programs, or models for solving practical problems of a profession in question.

- *Action/intervention research* takes a clinical intervention approach to diagnose and treat a problem for a specific client.

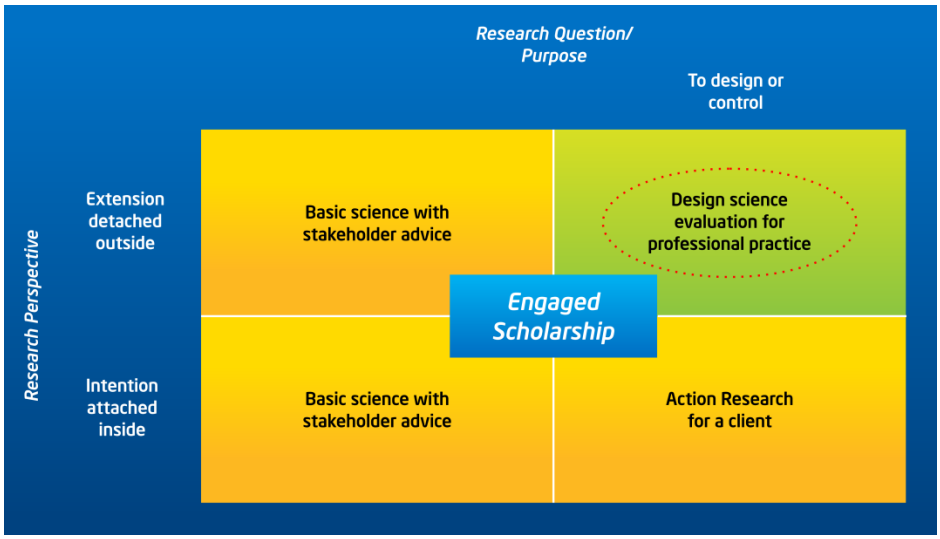

Figure 2-4: Types of Engaged Scholarship (cf. (Van de Ven A.H. 2007))

The DSR phases of our ABC correlate with the stages of Engaged Scholarship mentioned earlier (cf. Figure 2-2). Consequently, we can map them together in order to further clarify the research context and also contribute to the understanding of what the differences are to other research methodologies such as AR. For example, diffusion is a key part in DSR which is directly evident in AR (Costello et al. 2011). As we can perceive from Table 2-2, we can represent the four stages of Engaged Scholarship with the four basic design science research process phases. Evidently, ES places emphasis on the evaluation as it is part of three of the stages. The difference to DSR is that we want to evaluate the actual IT artefact to solve a problem, i.e. we assess the practical instantiation in an organizational context.

Furthermore, we were interested in how Engaged Scholarship criterions for each stage can be expressed with the principles of DSR (Österle et al. 2011). This mapping is outlined in Table 2-2. Notably, the abstraction principle is not a criterion for Engaged Scholarship, i.e. that a solution must be able to solve a class of problems. As a matter of fact, these criteria and principles are basic to scientific research but other important principles can be applied, e.g. deductive reasoning (Österle et al. 2011). Notably, truth as research criterion is the domain of behavioural sciences in contrast to utility aimed for in DSR (Hevner et al. 2004). Nevertheless, DSR is complemented by behavioural sciences and therefore we can map truth to the justification principle. Regarding the abstraction principle, our assessment can be conducted for all kinds of business value, not only in the context of EA.

Engaged Scholarship		Design Science Research
Process Stages to Process Phases		
Problem formulation	➔	Analysis
Theory building	➔	Design, Evaluation
Research design	➔	Design, Evaluation
Problem solving	➔	Diffusion, Evaluation
Criteria to Principles		
Relevance	➔	Originality
Validity	➔	Justification
Truth	➔	Justification
Impact	➔	Benefit

Table 2-2: DSR in the context of Engaged Scholarship

2.4. Roles and Responsibilities

An inter-organizational process without human involvement at some stage is still far from achievable, which is especially true for a research process. In the domain of Engaged Scholarship, we therefore need clearly defined roles and responsibilities which are necessary to understand researcher-practitioner relationships (Bartunek 2007). Common understanding between two distinct audiences is crucial. Combining the two worlds of industry and academia accounts for a challenging environment in terms of research collaboration. We can find a high level description of engaged activities during the research design process in (Ven and Johnson 2006). While this is indeed helpful, it serves more as a general guideline for conducting the research itself and not the actual contribution of each of the engaged scholars. ES case studies, including ones that more clearly identify stakeholder contribution, are scarce (Medaglia and Business 2012).

We therefore present our view on roles and responsibilities in the course of a practical DSR application in the context of Engaged Scholarship. Notably, these can change for different types of research projects. Furthermore, various roles can be unified in one particular actor or employee respectively. In some cases, a company employs its own researchers. However, this is not reflected in our summary outlined in Table 2-3. As can be perceived, main research outputs are produced by industry practitioners and academic researchers, while others are concerned with management and stakeholder feedback.

Group	Role (Project specific)	Responsibilities
Stakeholders (Industry)	*Industry manager* (EA manager); may be a subject matter expert	• Decision makers in terms of financial support
	Industry practitioner (EA practitioner); must be a subject matter expert	• Main source of industry contribution • Provide access to knowledge base • Analyse and identify problems • Gather information

		• Design and evaluate artefacts • Facilitate awareness and adoption of solution
	Industry customer (EA customer); usually not a subject matter expert	• Provide feedback at various stages
	Industry project manager; may be a subject matter expert	• Provide contacts to other stakeholders (interface to academia) • Organize infrastructure and meetings • Monitor and track progress • Facilitate awareness and adoption of approach • Approve publications
Researchers (Academia)	*Academic Researcher*; subject matter expert	• Main source of academic contribution • Literature review • Gather information • Diffuse deliverables • Documentation • Design and evaluate artefacts
	Academic Research Supervisor; may be a subject matter expert	• Monitor and track progress • Provide insights and feedback on approach • Approve publications

Table 2-3: DSR as ES: Roles and Responsibilities

2.5. DSR Profile

With our detailed research methodology which addresses some of the recommendations (cf. Sec. 2.3) to prevent common failures in the IS discipline, we now investigate the so called DSR profile. It determines the general direction the research is carried out in terms of various criteria. Criteria can be emphasized and balanced differently and therefore shape research outputs. Dovetailing on the debate about rigor versus relevance, we bring other criteria to the table that in our opinion shape a successful research endeavour in addition. In our effort to execute effective design science research, we need to balance the following criteria:

- **Rigor versus relevance:** Rigor is the thorough and comprehensive application of already available knowledge from industry and academia. Applying minimum amount of rigor is a prerequisite to achieve a quality solution as research output. The relevance marks the importance of the examined topic for both, the academia and the industry. In case it is crucial to satisfy a complex business need, a research project can be initiated.
- **Flexibility versus rigidity:** Flexibility is understood as the quick adaptation of research to a changing environment without major efforts (Duncan 1995). If there is a change in business needs, we must be able to react quickly enough to provide an actionable solution within the projected timeframe. Thereby, the research process must allow for a comfortable way to address this issue while still being in line with project requirements and management. Rigidity is therefore the opposite and does not allow for quick

adaptations. It impedes reacting to dynamic changes in organizational environments. Rigid research can be beneficial in organizations that employ a standardized research process where outputs are largely independent of such dynamic environments.

- **Simplicity versus comprehensiveness:** Simplicity is the criterion for a research approach that stands for the understandability of the research methodology as whole, i.e. the actual process phases and corresponding deliverables as well as the roles and responsibilities. In addition, a simpler approach is easier and faster to execute. A comprehensive approach, while slower and more complicated to understand, may impede the overall research performance by introducing too much overhead. This constitutes an arduousness especially in large corporate environments. Comprehensive research processes may be beneficial for very complex and large research projects in order to accommodate all contingencies.
- **Practicality versus conformance:** Practicality marks the criteria for getting a research approach to a designated end. Simply spoken, the research methodology employed has to deliver the intended solution. Again, if an approach is practical, we assume it entails only a fair amount of overhead. Conformance on the other side indicates the adherence to certain rules, regulations, or autochthonous practices. Usually, such approaches are in line with the company's standardization efforts but are prone to introducing too much overhead at the cost of speed and flexibility.
- **Evolvement versus new developments:** Evolvement represents an intended life cycle whereby the research processes including its outputs are subject to continuous improvement or amelioration respectively. For example, this can contribute to the reusability of certain artefacts. New developments on the other hand are more cost intensive and bear a higher risk of failure then already validated and proven solutions. Nevertheless, new developments may contribute to the innovation process and may produce an even better suited solution for a given business need.

In our case, we balance these criteria based upon our perception of an effective and sustained interaction between researchers and practitioners. The resulting DSR profile is illustrated in Figure 2-5. We emphasize the flexibility, simplicity, practicality, and evolvement supported by our ABC and the resulting deliverables. Regarding rigor, we apply sufficient to provide for a high solution quality while the relevance is given from the corporate environment and the gaps in the academic literature. In other words, we aim for a balanced trade-off between those two criteria. Notably, research criteria can change from project to project but we deem it adjuvant to be aware of the general characteristics under which the research is carried out. Accordingly,

the DSR profile accounts for the research orientation as it further impacts the specification of requirements and principles.

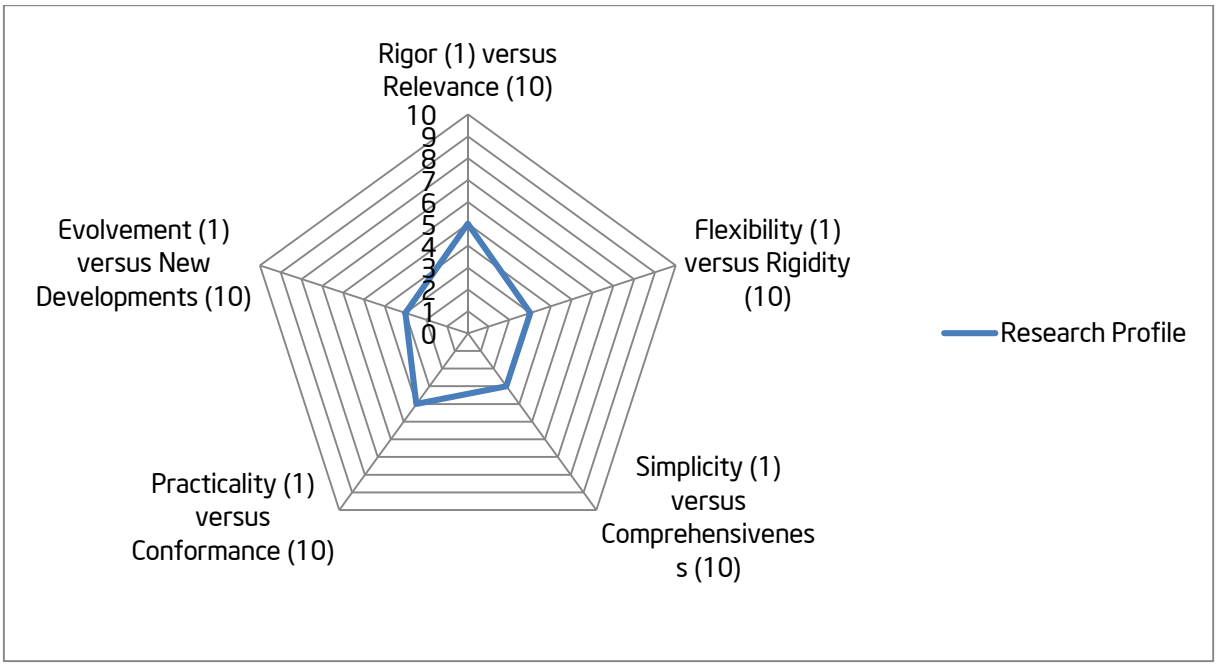

Figure 2-5: DSR profile

2.6. Research Context and Contributions

Our *theoretical context* regarding relevant theories is illustrated in Figure 2-6. As we will argue in Section 3.6, EA is a dynamic capability. Our research focus is the assessment of EA business value; hence we are assessing a dynamic capability in terms of business value. The output of our designed method provides input for other dynamic capabilities such as strategic decision making. This input consists of reports that improve the process of decision making and the consecutive management of decision outcomes.

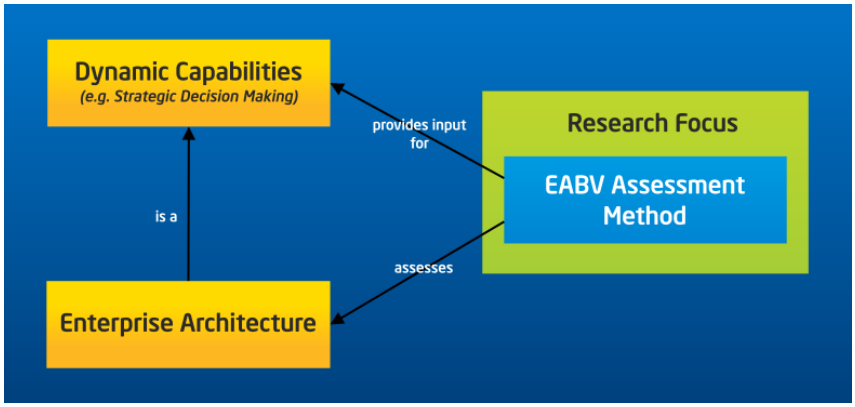

Figure 2-6: Research context regarding relevant theories

Specifically, we assess EABV, i.e. the impact and contribution to organizational performance. For this purpose, the method we design conduces to conduct continuous EA assessments. This

happens concomitant to periodic EA maturity assessments. Our corporate partner employs such periodic assessments for several years now using the IT Capability Maturity Framework (IT-CMF) (Curley 2006; Curley 2009). As a consequence, we distinguish between two types of EA assessments which are described as follows (Meyer et al. 2012a):

- ***Periodic Assessment:*** Here we are interested in the overall EA capability and evaluate maturity for certain criteria, e.g. practice, planning, and stakeholders including collaboration and communication. Such assessments are conducted, for example, only once a year and the results impact the long term strategy to improve the EA function.
- ***Continuous Assessment:*** As the name suggests, such assessments are integrated into current EA practices and measure the operative EA performance in respect to processes, services and deliverables. The scope varies within companies, e.g. assessment on a project-level. To undertake continuous assessments, we need a measurement process instantiated. Continuous EA assessments can also be termed as EA performance measurement.

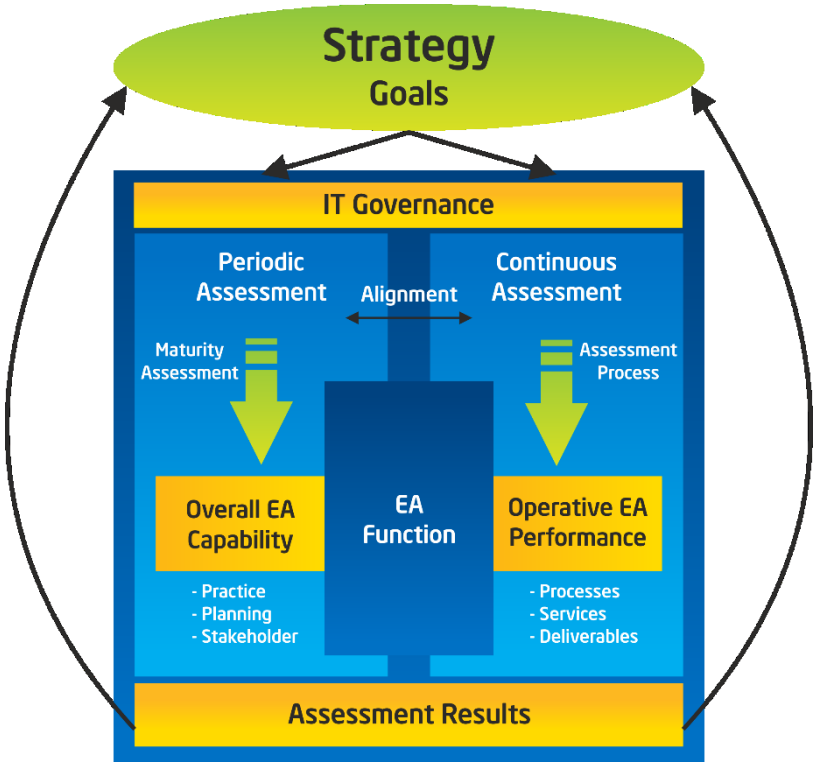

Figure 2-7: EA assessment overview

The overview of the general EA assessment concept is illustrated in Figure 2-7. As we can see, the assessment results impact decision making in the course of strategic planning. It has to be noted that we assess the current state in periodic assessments which assigns an EA maturity level. This level indicates which areas in the EA function need to be improved and what

strategies need to be employed for that purpose. EA performance is continuously assessed where the results are communicated as benefits or business value to management and strategic planners. Notably, we are measuring performance and communicating business value as it is proposed in (Mitra et al. 2011). Furthermore, these assessments should be aligned, i.e. the periodic assessment determines which goals and metrics make sense for the continuous assessment in order to improve the overall EA function and vice versa. IT Governance plays a substantial role in assessing EA (cf. Sec. 3.1.3).

We now take a closer look at the *organizational context* our research is conducted in. For designing and building a practical solution in collaboration between industry and academia, it is absolutely crucial to understand the organizational context or environment respectively. We are dealing with a global company which has an ongoing EA effort for almost ten years by employing an adapted EA framework based on TOGAF (The Open Group 2011). EA is undergoing constant evolvement, i.e. as strategic planning drives changes to the organizations' directions while EA practices and methods need to adapt and accommodate such alterations to successfully enable this transformation. This leads us to the question of what is actually derived from this context. In other words, what is the actual organizational input? This input is summarized this in Table 2-4. We will further explain the corporate setting in the course of our case study in Section 7.

Organizational Input	Description
Problem/Business Need	The motivation for the actual research is triggered by a problem or business need respectively. There exists a shortcoming in the As-is state that needs to be addressed and improved. With the outcome of the research, the To-be state meets the desired needs and solves the current problems (cf. Chap. 4).
Principles	The principles that are in place in the company must be adhered to, which means that design choices made throughout the research must satisfy the motivation and desired outcome of at least one principle. They shape the way we design and build our artefacts. Additionally, we derive principles specifically for our research.
Requirements	Requirements impact not only the design, but the overall outcome of this research. They are necessities that must be considered during the design and instantiation (cf. Sec. 4.2.3).
EA function	The current EA practice including EA processes and services, EA frameworks, and the EA strategy along with already available goals and metrics.
Projects	Projects serve as input for our case study since we apply our approach on a real world example. A focus project is chosen for our proof-of-concept or evaluation respectively (cf. Sec. 7.2).

Table 2-4: Research input from the organizational environment

Since our approach measures performance, we need to answer seven key questions as proposed by (Cameron and Whetten 1983). The questions and corresponding answers are given in Table

2-5. This gives a good overview and general direction of how our assessment approach is designed.

Question	Answer
1. ***From whose perspective will the measurement result evaluated?***	EA stakeholders, with emphasis on EA managers
2. ***What is the domain of measurement?***	Enterprise Architecture
3. ***What is the scope of analysis?***	Project-level assessment (operational-level assessment)
4. ***What is the purpose of assessment?***	Understanding EABV and improving the EA function and its outputs, therefore increasing EABV
5. ***What time frame is employed?***	Method for continuous assessment, although on-demand assessments are supported
6. ***What types of data is used?***	Operational data (process and project data)
7. ***Against which referent is measurement result judged?***	Strategic goals and critical success factors

Table 2-5: Questions to answer when measuring organizational performance (cf. (Cameron and Whetten 1983))

We further explore our underlying concepts and theories relevant for our work (cf. Figure 1-1) in Chapter 3. Now, we examine the actual levels of contribution for our research scope (Figure 2-8). The top level is *theory* to which we contribute in the context of dynamic capabilities by arguing that EA is a dynamic capability and therefore, on a higher level of abstraction, present a method to assess a dynamic capability (cf. Sec. 3.6). Furthermore, we contribute to the understanding of business value in the EA context. Although there is no actual theory on IT or EA business value (Schryen 2012) in existence, our contribution may impact the development of one (cf. Sec. 3.7). The next level is the *research methodology* which is outlined in this Chapter. What we contribute here is an adapted research process including its application and learnings. More specialized is the next level, *principles*. We contribute several principles on what needs to be considered or followed when designing an assessment method as part of our theoretical contribution (cf. Sec. 5.1.3). Furthermore, we bring different types of principles into context and explain which have the most impact on our work. At this stage we have to mention guidelines which are prescriptive steps to achieve a desired outcome. We derive such guidelines as deliverables for our industry partner. Following then is *design and development* which is all about how to solve business problems and satisfy business needs. We accomplish this, as already mentioned by designing and building IT artefacts. In a collaboration effort, we exploit the (industry and academic) knowledge base to create these artefacts which constitute our main contribution since they are directly linked to our research questions (cf. Chap. 5). As most specialized level, we find the current *practice and instantiation*. As the corporate environment dictates specific principles and requirements for their practices, we need to adapt and customize

IT artefacts to satisfy these. In addition, we elaborate on the adequate evaluation of these artefacts (cf. Chap. 6).

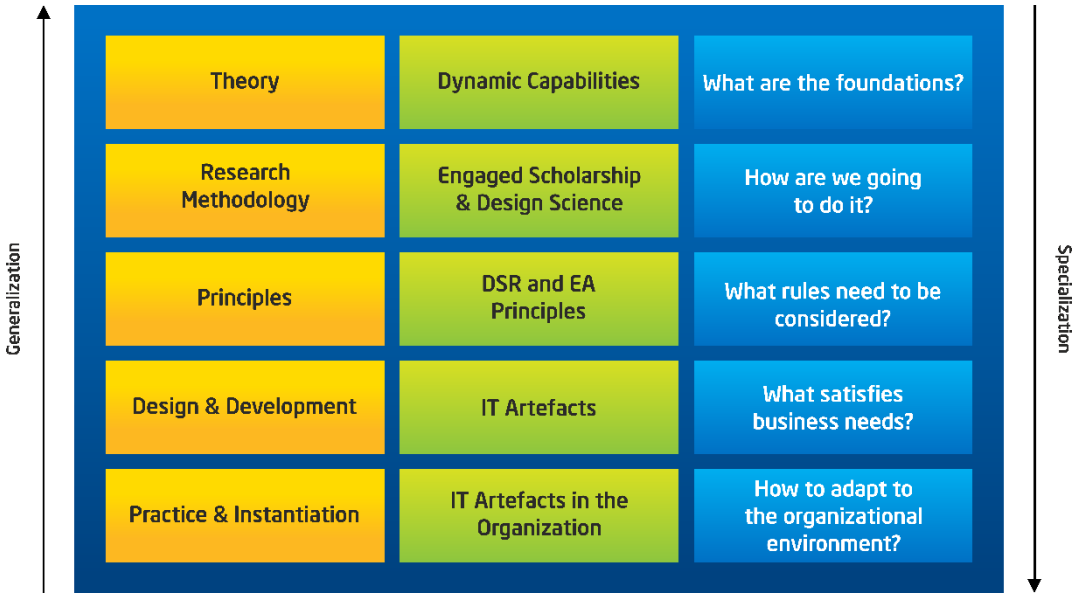

Figure 2-8: Research scope and levels of contribution

2.7. Related Work

Topics related to EA and the benefits of EA are manifold and with this Section we provide an overview of this subject matter. The discussion in information systems literature concerning value and value assessments is dominated by the discussion on business value of IT (ITBV) as a whole, e.g. (Curley 2007; Kohli et al. 2008; Melville et al. 2004; Mitra et al. 2011). Assessments of IT have been investigated in literature, e.g. in (Gammelgard et al. 2007) where an IT assessment framework is proposed. This is further developed to an assessment method in (Gammelgard et al. 2010). Another assessment framework for enterprise system benefits is provided by (Shang et al. 2002). The influence of IT management on firm performance is presented in (Mithas et al. 2011). From a software measurement perspective a good overview is provided by (Ebert et al. 2005). ITBV from a strategic level is discussed in (Tallon 2007). IT benefits for management and the relationship to IT investments is covered in (Ward et al. 2006). IS success in general is elaborated with the DeLone and McLean model (DeLone et al. 1992; DeLone et al. 2002).

Specific to the discussion on EA, the DeLone and McLean model is adapted by (Dietzsch et al. 2006; Niemi and Pekkola 2009). (Schelp et al. 2007) employ a Balanced Scorecard approach for EA measurement. How certain EA practices and techniques influence EA benefits is discussed by (van Steenbergen et al. 2011) and how EA adds value to the organization in (Tamm and Seddon 2011). The consequences of architectural decisions in terms of quality attribute

requirements are assessed by the Architecture Tradeoff Analysis Method (ATAM) (Kazman et al. 2000) although it is more targeted at software architectures.

The concept of maturity models is also applied to the domain of EA and there exist several frameworks and approaches for these kinds of assessments (Meyer et al. 2011). A general view on EA maturity is given in (Ross 2003) and the link of EABV and EA maturity is described in (Bradley et al. 2011). Critical problems in EA are described in (Kaisler et al. 2005) although the Sections about assessments and metrics are very limited. EA measurement drivers and enablers are discussed in (Murer et al. 2011) without going into detail about challenges and problems. EA management challenges in terms of agile solutions is examined in (Buckl et al. 2011). As business-IT alignment (BITA) is a major EA driver, the assessment of it is discussed by various contributions (Luftman 2000; Masak 2006; van der Raadt et al. 2005; Zimmermann 2008).

There has also been some work on actual metrics viable for EA assessments, e.g. an EA context is used to derive SOA evaluation metrics in (Aier et al. 2009). Another contribution to EA metrics is presented in (Vasconcelos et al. 2007). Issues regarding software metrics are discussed in (Kitchenham et al. 2007). Measures for EA effectiveness are discussed in (Morganwalp and Sage 2004). General IT metrics are described in (Kütz 2011).

Another related topic with value discussion is the realm of performance measurement and management where many challenges have been discussed (Neely et al. 1995; Taticchi 2010). The same is true for Business Intelligence (BI), where the retrieval of performance relevant data strengthens our understanding of EA assessments (Elbashir et al. 2008; Williams et al. 2007). With this research, we also enter the sphere of analytics, e.g. (big) data (LaValle et al. 2011; Tyagi 2003) and business analytics (Kohavi et al. 2002).

In order to summarize the literature in the contexts of our research questions we provide Table 2-6 as an overview. As we can perceive, the method category is the scarcely populated with references for each of the research questions and therefore we want to fill this gap with our research output, a method to assess EABV. Numerous models for business value can be found in literature, although none of them actually captures all dependencies and relationships in the EABV context. This marks our *RQ1*. Methods for measurement are very scarcely available in literature and EA assessment approaches are rarely adopted in practice (Lange and Mendling 2011). In addition, appropriate metrics and how to actually measure EA performance are still scarce (Kaisler et al. 2005) (*RQ2*). Another gap is that the communication part is not really

connected to these research efforts (*RQ3*). In practice, we find the discipline of Business Intelligence responsible for reporting (Williams et al. 2007). The last gap is the alignment between maturity and EABV assessments (*RQ4*). Despite a variety of EA maturity frameworks (Meyer et al. 2011), there is no instantiated alignment between continuous and periodic EA assessment available. Apart from a few similar approaches, e.g. (Gammelgard et al. 2007; Shang et al. 2002), there is no overall method of conducting continuous EA assessments which is also aligned to a periodic EA assessment (Main RQ). As performance measurement is a crucial part of our research, we describe three of the most known frameworks or approaches respectively in Section 3.2.

EABV Assessment (Research Output)	RQ1: Definition	RQ2: Measurement	RQ3: Communication	RQ4: Maturity
Model (Metamodel)	(Cao 2010; Gammelgard et al. 2010; Joukov et al. 2009; Leem et al. 2007; Melville et al. 2004; Mooney et al. 1996; Popovic et al. 2010; Tian et al. 2007) (Dietzsch et al. 2006)	(Joukov et al. 2009; Mitra et al. 2011)		(Bradley et al. 2011; Ross 2003)
Method		(Gammelgard et al. 2010; Langsten 2011; Mandic et al. 2010)		(Carnegie Mellon University Software Engineering Institute 2011)
Process		(ISO/IEC 2007; Niemi et al. 2009)	(ISO/IEC 2007)	
Framework	(Mitra et al. 2011)	(Elbashir et al. 2008; Gammelgard et al. 2007; Kaplan et al. 1996; Kaplan et al. 2000; Kütz 2011; Neely et al. 2002; Niemi et al. 2009; Ross et al. 2005; Shang et al. 2002; Williams et al. 2007)		(2010; Curley 2009; IT Governance Institute 2007; National Association of State Chief Information Officers (NASCIO) 2003; Office of Management and Budget 2009; Office; 2010; U.S. Department of Commerce 2007)
Instantiation (Tool)	(Tian et al. 2007)			

Table 2-6: Literature Overview

2.8. Chapter Summary

This Chapter shed light on how we conduct our research. We gave an overview of suitable research methodologies, explain our research philosophy and argue why we chose DSR as our research approach. Thereby, we illustrated our adapted research framework and introduced our research process in the form of an IT artefact build cycle (DSR ABC). Moreover, we explained how DSR fits in a greater research context by examining Engaged Scholarship that describes various ways of collaboration between industry practitioners and academic researchers. As such, a collaboration involves a variety of stakeholders and hence, we defined different roles and responsibilities for it is critical in the course of research to be aware of which stakeholder is responsible for which activities. Furthermore, it is relevant to know how to shape the research effort. We therefore introduced the concept of DSR profiles that determine the chosen emphasis on particular research criteria which influence design choices. Notably, we focused on practicability and simplicity, balanced rigor and relevance, identified flexibility as research requirement, and stressed the importance of evolvement within our approach. Thereafter, we highlighted our research context and what we contribute on various levels such as theory, research methodology, principles, and IT artefacts and their instantiation. Finally, we outlined related work that impacts our research and helps us to identify the actual research gap, namely a comprehensive method to assess EABV while aligned to EA maturity assessments.

3. Underlying Theories and Concepts

"If you have built castles in the air, your work need not be lost; that is where they should be. Now put the foundations under them."

Henry David Thoreau (1817 – 1862)

In this Chapter, we explore underlying theories, concepts, and practices in order to define and describe the scope and context of our work. These represent the fundamental building blocks to understand our research output. The content is mostly extracted from the knowledge base by means of literature reviews and is in fact a result of the gather information step of the analysis phase of our DSR ABC (cf. Sec. 2.1). In other words, this Chapter is part of the findings summary deliverable (cf. Sec. 4.2) and is organized as follows: Firstly, we explain Enterprise Architecture in Section 3.1 since this is the discipline we design the assessment method for. Then in Section 3.2, we elucidate a prominent field in terms of assessments, namely performance measurement and management. Thereafter, we will examine strategy and enterprise transformation in Section 3.3 as this forms one of the major inputs for our work. What we are assessing is described afterwards when we elaborate on the business value discussion in Section 3.4. Next, we explicate underlying theories that are relevant and applied for our research in Section 3.5. After that we argue that EA is in fact a dynamic capability in Section 3.6. This represents a major theoretical contribution and describes the foundation of the research context. Following are the insights we gained on EA business value in Section 3.7. Finally, we give a short summary of this Chapter in Section 3.8.

3.1. Enterprise Architecture

An Enterprise Architecture (EA) is a conceptual blueprint that defines the structure and operation of an organization. The intent of an EA is to determine how an organization can most effectively achieve its current and future objectives (Meyer and Helfert 2014). For the purpose of this work, we adopt the definition found in (IEEE 2007): *"The fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution."* To underline the comprehensiveness of this discipline, we give more examples of definitions as this allows the reader to better understand the nature and purpose of EA. Another definition is given by the *Open Group's*

Architectural Framework (TOGAF) (The Open Group, 2009), which defines (Enterprise) Architecture as:

1. *"A formal description of a system, or a detailed plan of the system at component level, to guide its implementation."*
2. *"The structure of components, their inter-relationships, and the principles and guidelines governing their design and evolution over time."*

From the first two definitions, we can learn that EA is not only about providing an as-is model of the enterprise but also setting and enabling the path to desired future states (to-be). This is an important characteristic of EA as it encompasses means to facilitate and guide an evolutionary enterprise transformation in accordance to vision and strategy. A further definition is given by the *ArchiMate Foundation* and in (The Open Group 2012): *"EA is a coherent whole of principles, methods, and models, that are used in the design and realisation of an enterprise's organisational structure, business processes, information systems, and infrastructure."* The *Gartner Group's* recent definition is: *"EA is the process of translating business vision and strategy into effective enterprise change by creating, communication, and improving the key principles and models that describe the enterprise's future state and enable its evolution."* Critical to EA is the reference to structure and relationships which refer to a set of governing principles providing guidance and support for directions and decisions (Op 't Land et al. 2009). Therefore, the role of EA can be classified into three different perspectives: a *regulation-oriented perspective* which focuses on principles, leading to rules, guidelines, and standards manifesting itself as a prescriptive notion governing the design of an enterprise. Then, there is the *design-oriented perspective* which emphasises the comprehensive and cohesive specification of an enterprise as a whole, generally on a higher level of abstraction. The last is the *patterns-oriented perspective*, which makes use of design patterns and forms a bridge between regulative and the design perspective. With these perspectives, (Op 't Land et al. 2009) give the following definition for EA: *"EA is a coherent set of descriptions, covering a regulation-oriented, design-oriented, and patterns-oriented perspective on an enterprise, which provides indicators and controls that enable the informed governance of the enterprise's evolution and success."*

Concluding, Enterprise Architecture is a discipline consisting of methods, processes, models, and principles which aims to design, develop, manage, and evolve all relevant components of

an enterprise, including its business and operating model, organizational structure, business processes, data, applications and technology. In the next Section, we give an overview of EA.

3.1.1. Overview

EA evolved into its own research domain, and various ways of positioning and organizing EA emerged (Ahlemann et al. 2012a; Dern 2009; Hanschke 2010; Op ’t Land et al. 2009; Ross et al. 2006; Scheer and Nüttgens 2000; Schmidt and Buxmann 2011; The Open Group 2011a). Early work on architectures model aspects of systems, often referred to as IS or system architectures. These architectures do not emphasize strategic directions or business aspects strongly (Kim and Everest 1994). Given a need for IT and business alignment and coming from early system-oriented concepts, a widely adopted approach emerged that organizes EA along various organizational layers and emphasizes an IT business alignment paradigm. The purpose is to relate strategic aspects to application and technology. Layering helps researchers and managers understand and describe the scope and function of EA as they relate to boundary points from business strategy to technical infrastructure. Figure 3-1 illustrates both architectural layers and the contexts with which they interact (Meyer and Helfert 2014). Usually, strategic planning serves as input for EA, especially when EA is viewed as a strategy-driven enterprise function. Core layers represent business architectures, application architectures (including data/information architectures), and technology architecture, all used with EA processes and services to design, develop, govern, and manage them. EA produces some form of content or output such as artefacts (Winter and Fischer 2006) and principles (Greefhorst and Proper 2011). In addition, EA uses frameworks and tools.

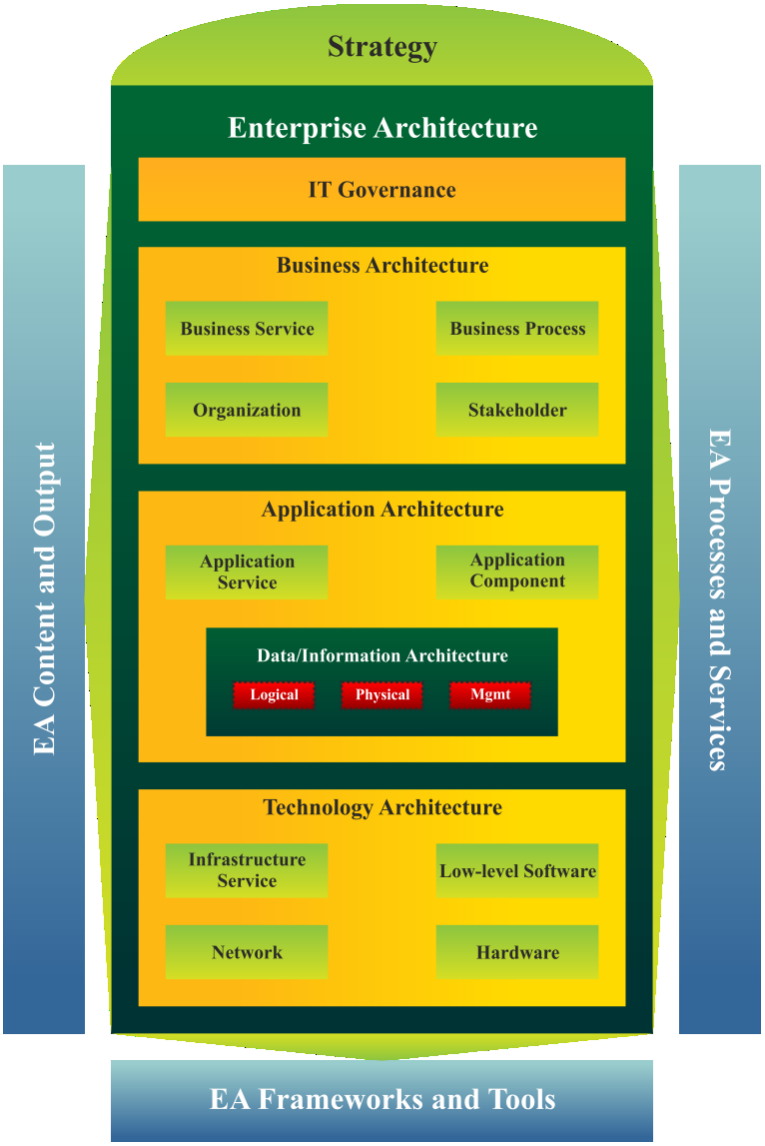

Figure 3-1: Enterprise architecture overview (cf. (Meyer and Helfert 2014))

We view EA from a service perspective; each layer offers a service to the business, and the service-oriented paradigm occurs in each architectural layer. For example, the technology architecture offers infrastructure services in the form of hardware and networks. The application architecture provides services centred on software applications and data. The business architecture is concerned with business processes and services. The business architecture, through business processes, emphasizes the dynamic aspects of workflows and activities supported by application components and infrastructures. Examples in the literature present simple, three-layered frameworks with which to view EA (Hasselbring 2000; The Open Group 2012) to multi-layered EA frameworks (Winter and Fischer 2006). Approaches that include enterprise strategy as a separate layer are also documented (Godinez et al. 2010). Whether or not strategy is a dedicated EA layer, it initiates a discussion of whether EA is solely an IT or also a business function. Due to the strategic importance of business IT alignment, we argue

EA is a hybrid enterprise function (Ahlemann et al. 2012b). EA can also be viewed as an instrument to outline an enterprise's future direction, i.e. develop roadmaps to achieve certain strategic goals, while additionally serving as management mechanism for coordinating and steering the actual enterprise transformation (Greefhorst and Proper 2011).

In the following Sections, we describe EA processes and services, the role of IT Governance, architecture principles and core architectural layers. In addition, we take a look at why to employ EA and investigate EA maturity, which informs us about the current state of a company's EA practice.

3.1.2. EA Processes and Services

EA services provide benefits to stakeholders within an organization and may consist of several EA processes. An EA service model can be introduced to document the service delivery of EA. A service model based on (Robertson 2008) is described in Table 3-1. Notably, there are more processes in relation to these fundamental EA services, and EA services need to be adapted to specific enterprise contexts. Regarding roles, we have the enterprise architect which can have specializations according to the type of architecture he is mostly involved in, i.e. we have the business architect, data architect, application architect, and the technology architect.

EA Services	Design	Development	Management	Training & Support
EA Processes	• Define standards • Define guidelines • Define principles	• Build • Implement	• Governance • Planning	• Consulting • Training • Support
Roles	• Mostly Business Architect	• Application and Data Architect	• Mostly Business Architect	• All
Outcomes (Deliverables)	• Standards • Guidelines • Principles	• Strategic architecture • Solution architecture • Artefacts	• Reports	• Training material
Benefits	• Standardization	• Reduced complexity • Improved integration	• Improved decision support • Improved risk management • Reduced costs	• Common understanding • Improved skills • Improved knowledge

Table 3-1: EA service model based on (Robertson 2008)

3.1.3. The Role of IT Governance

In the context of EA, the role of IT Governance is important since it provides a means for management to direct and govern IT toward desired outcomes (IT Governance Institute 2007).

IT Governance is a tool that provides necessary means to achieve strategies and goals. EA is crucial for effective IT Governance because it provides methods to measure success (Weill and Ross 2004). However, a holistic model that describes IT Governance in an enterprise context has not surfaced due to the complexities and diversity of perspectives inherent in the domain (Rüter et al. 2006). EA Governance is a sub-discipline of IT Governance that focuses on the principles, decision rights, rules, and methods that drive architecture development and alignment in an organization (Greefhorst and Proper 2011). EA Governance is concerned with standardization and compliance with current and future practices and is therefore crucial for a strategic enterprise transformation (cf. Sec. 3.3).

3.1.4. EA Principles

The challenges companies face in everyday business has an impact on how the they are designed, ranging from various organizations, products and services and the business processes that are involved, to the IT infrastructure that supports all of those. And all this in an environment prone to constant change or in other words an evolvement in the form of an enterprise transformation (Greefhorst and Proper 2011). There is no accepted definition of the term enterprise architecture principles. TOGAF (The Open Group 2011a) defines principles as *"general rules and guidelines, intended to be enduring and seldom amended, that inform and support the way in which an organization sets about fulfilling its mission."* For our purposes, architecture principles are statements that express how your enterprise needs to design and deploy information systems across the enterprise to connect, share, and structure information and allow for evaluation of such systems by means of setting goals according to strategy and requirements. At their core, architecture principles are concerned with the rules and guidelines on how to use and deploy IT resources or IT assets respectively. As we learn later in this Chapter, the treatment of IT resources marks an important theoretical foundation for our work (cf. Sec. 3.5.2).

Most articles in literature about architecture principles give definitions that just regard the design (Stelzer 2010a). An exception can be found in (Richardson et al. 1990), where principles also guide the evaluation in addition to design. This is especially interesting for us since we align our evaluation with the principles and requirements (cf. Chap. 6).

We now take a look of what makes a good principle in terms of quality. TOGAF lists five relevant characteristics for a good set of principles:

- **Understandable:** The underlying tenets are quickly understood and the intention is clear and unambiguous, so that violations are minimized.
- **Robust:** Enable good quality decisions about future architectures and plans, and enforceable policies and standards. They must support good decision-making in a complex and changing environment.
- **Complete:** Principles should cover every situation perceived as important for governing the management of information and technology for the organization.
- **Consistent:** Different principles should not be contradictory, which means that adhering to one principle would violate another. The wording of a statement should be consistent but flexible enough in terms of interpretations.
- **Stable:** Principles should be long lasting and sustainable yet able to accommodate changes.

From the principle definition, we observe that principles can be applied to numerous contexts to regulate and guide a wide variety of practices. Hence, we want to shed some light on what types of principles can be distinguished as well as what category they can belong to. We can distinguish between the following types of architecture principles (Stelzer 2010b):

- **Construction principles**: Support the design and construction of architectures such as modularity, loose coupling, or high cohesion.
- **Description principles**: Support modelling, representation, and documentation of architectures such as employing particular modelling methods, traceability, or common understanding.
- **Process principles**: Support structuring the EA development process, such as integration into other processes.

Principles in TOGAF are categorized into *business*, *data*, *application*, *technology,* and *governance* principles which are in line with the architectural levels (apart from governance). However, finding a clear distinction between EA principles, IT principles and business principles is a difficult task (Stelzer 2010a). Nevertheless, architecture principles should reinforce business principles (Hawley 2008). It has to be mentioned that some principles fall into several categories (Greefhorst and Proper 2011). All categories of principles can be of the three principle types mentioned above. To summarize, the type of principle tells us about what the principle is set out to achieve while the category determines the context and architectural level.

In literature, we can find several format recommendations on how to represent architecture principles. In TOGAF, we need a *name* for the principle, the *statement* which communicates the fundamental rule in a succinct and unambiguous way, the *rationale* that emphasizes the business benefits of adhering to the principle, and finally the *implications* that elaborate on the requirements for both, business and IT, to carry out the principles. (Greefhorst and Proper 2011) also includes *quality attributes* that are impacted, such as reliability, efficiency, or maintainability. In the following Table 3-2, we list some example principles (Hawley 2008) with their statements:

Principles	Statement
Business	
Maximize Benefit to the Enterprise	Every IS-related decision is made to maximize the benefit to the enterprise as a whole.
Compliance with Law	All IS-related processes are in accordance with and comply with all relevant laws, rules, and regulations.
Data	
One Source	For each type of data stored, there should be only one source.
Custodianship	Data that is personal, private, or sensitive shall not be disclosed improperly.
Application	
Reuse	Reuse rather than acquire new solutions or build new ones.
Technology	
24/7 IT System Support	All IT systems must have a 24/7 support.
Governance	
Standardization	For each use of IT there is a standard and non-standard uses require specific authorization.

Table 3-2: Categories with example principles

A company is well advised to employ architecture principles along with their EA practice as this leads to a reported increase in value (Fischer et al. 2010). EA principles also have an impact on the management of IT investments. (Hugoson et al. 2011) identified four aspects that are impacted: (1) the responsibility of IT investments, (2) time to value, (3) long term alignment, and (4) coordination of investments in IS and changes of business processes.

Since the purpose of this work is how to design a method to assess EABV, we are interested in what kind of architecture principles are relevant and what impact they have on our approach. We can find more comprehensive lists of architecture principles in (Greefhorst and Proper 2011; Hawley 2008; Lindstrom 2006). Guiding principles for organizing the IT function, which

encompasses substantial contribution from EA are described in (Agarwal and Sambamurthy 2002).

3.1.5. Reasons for EA

3.1.5.1. EA Drivers

EA drivers are the primary reasons for enterprises to employ EA, and one of the most important drivers is business IT alignment (Schöenherr 2008). Critical aspects are described in detail when aligning business and IT by (Henderson and Venkatraman 1993; Luftman 2003; Mahr 2010; Pereira and Sousa 2005). Modern EA is closely tied to management paradigms as it aims to transform and therefore affects the enterprise in a holistic, unambiguous, and consistent way by aligning firm assets and capabilities with its strategy (Stettiner and Messerschmidt 2012). Cost reductions and managing complexities are other important EA drivers. For example, dismantling legacy systems and components reduces costs, and EA reduces complexity by providing a streamlined and manageable system landscape described through various models. In addition to these important and frequently mentioned drivers, some external drivers do not originate within the enterprise. An example is regulatory compliance requirements issued by legal organizations or governments to which the enterprise must adhere.

3.1.5.2. EA Benefits and Value Contributions

Outcomes and benefits depend on context and the extent to which an enterprise uses EA. Usual EA output is described in the form of principles, models, and architecture views. Less tangible outputs in the form of common understanding and improved communications are benefits of EA. In the literature, a number of researchers discuss EA contributions in terms of direct benefits and business value (Ahlemann et al. 2012b; Meyer and Helfert 2012; Ross et al. 2006; van Steenbergen et al. 2011; Tamm and Seddon 2011). We summarize some of the typical EA benefits in Table 3-3 (Ross and Weill 2005). We will take a more detailed look at EA benefits in Section 3.7 when we discuss the concept of EABV.

Technology-related Benefits	
IT Costs	When reducing non-value-added variations of technologies, a company can reduce IT operations unit and application maintenance costs.
IT Responsiveness	Through standardization, decision-makers spend less time choosing the right technologies or dealing with recurring errors; thus, development time is reduced, increasing overall IT responsiveness.
Risk Management	IT infrastructure clean up improves manageability, and thus, contributes to reduced business risk, improved regulatory compliance, increased disaster tolerance, and reduced security breaches.
Business-related Benefits	
Shared Business Platforms	Through data and process standardization, greater data sharing and integrated process standards emerge.

Managerial Satisfaction	Although subjective, satisfaction indicates the confidence of business executives in the ability of IT to deliver business value; an increase in senior management satisfaction and business unit IT leadership results from effective EA.
Strategic Business Impacts	EA enables: • Operational excellence • Customer intimacy • Product leadership • Strategic agility

Table 3-3: Benefits of EA

3.1.6. EA Maturity

Companies adapting EA in their enterprise functions need to be aware of the scope and impact of doing so. Furthermore, EA must continuously evolve and therefore we need to somehow measure the progress. For this purpose, the concept of maturity was employed for EA which assigns different levels of achievement by means of a maturity assessment to artefacts, processes, or characteristics respectively. These levels indicate how advanced such entities are in their current stage of evolvement. In the end, a higher maturity is sought after in order to increase the value creation from IT assets.

Maturity in the IT domain is often seen as part of Quality Management. More mature solutions possess better quality in terms of operational efficiency. The higher a company's EA maturity, the more improved its BITA and risk management will become (Bradley et al. 2011). Typically, maturity models are designed for a specific domain in order to measure the current state of the achieved competence level by means of a maturity assessment (de Bruin et al. 2005). Consequently, when speaking of maturity we refer to a measure. An EA Maturity level is a value obtained through the aggregation of assessing different enterprise components. EA Maturity models support the improvement of the EA domain. Assessing EA maturity still poses a great challenge for industry and academia. It is critical to choose the adequate characteristics of a good EA and how to match those (Lagerström et al. 2009). Specific EA maturity approaches are still a scarce resource in literature and therefore there is not a common definition available (Kaisler et al. 2005). EA Maturity, as an approach, delivers a measure to indicate the enterprises' current stage of development in terms of IT capabilities relevant for the scope of EA.

(Ross 2003) identify four different stages of architecture maturity: (1) *application silo architecture*, where the architecture is characterized through isolated and individual applications rather than an enterprise-wide architecture, (2) *standardized technology architecture*, where the architecture is enterprise-wide by means of standardization and centralization, (3) *rationalized data architecture*, where the enterprise-wide architecture

includes standardization of data and processes, and finally (4) *modular architecture*, where the architecture is based on enterprise-wide global standards with loosely coupled applications, data and technology components. For the purpose of our work, we are interested in how our approach will impact EA maturity which we will discuss in Sections 7.3.9 and 7.5.2.2. A more detailed look on EA maturity is given by (Meyer et al. 2011).

3.2. Performance Measurement and Management

Measurement of business performance has a long research tradition and serves as basis for countless management decisions (Otley 1999). What gets measured, gets attention, especially if rewards are tied to the measures (Eccles 1991). Performance measurement can be defined as the process of quantifying the efficiency and effectiveness of action (Neely et al. 1995). It is further seen as the development and deployment of suitable multidimensional indicators to reveal the performance of enterprise relevant objects (Gladen 2014). Looking beyond the measurement performance means to inspect the management of performance and the question of to whom performance is delivered (Otley 1999). Performance management precedes performance measurement and gives it meaning (Lebas 1995). From a literature evolution standpoint, performance management is the consequence of performance measurement (Folan and Browne 2005). It additionally includes management decisions, and therefore, performance measurement is part of performance management (Gladen 2014).

The design and implementation of performance management systems is a crucial business decision to achieve competitive advantage and to enable a company's overall success (Packová and Karácsóny 2010). Regarding the design of management information systems and performance measurement and management systems, five assumptions – in most cases not justified – lead to major deficiencies in the resulting systems (Ackoff 1967): (1) A lack of relevant information is a critical shortcoming for managers, (2) the manager needs the information he wants, (3) the manager's decision making is improved once he gets the information he needs, (4) better communication between managers improves organizational performance (or business value respectively), and (5) a manager does not need to know how his IS works, just how to use it. These deficiencies are addressed by modern performance measurement and management systems (Schreyer 2007).

As performance measurement and management systems are prone to lose their effectiveness over time, they need to be adapted and redesigned to better cope with new environmental and organizational demands (Neely 2005). This demand in design evolution is reflected in our DSR

ABC (cf. Sec. 2.2). Innovative PMS possess the following characteristics (Toni and Tonchia 2001):

- Value-based
- Performance compatibility
- Customer-oriented
- Long-term orientation
- Prevalence of team measures
- Prevalence of transversal measures
- Improvement monitoring
- Aim at evaluating and involving

Approaches for performance measurement are manifold (Schreyer 2007). We pick three of these for further examination as they are well known in literature and industry, namely the Balanced Scorecard (Kaplan et al. 1996), the Performance Prism (Neely et al. 2002), and the Goal-Question-Metric approach (Basili et al. 1994).

3.2.1. Balanced Scorecard

One of the best covered performance measurement approaches in literature is the Balanced Scorecard (Kaplan et al. 1996). It provides a distinct view on the company in that it not just offers a traditional financial perspective, but also a customer, an internal process, and a learning and growth perspective. All these perspectives are in line with the company's vision and strategy. The benefit of introducing these additional perspectives is that management is able to elaborate the values hidden within the organizations. The BSC can be seen as a strategic management system that can be employed to accomplish the following critical management processes (Kaplan et al. 1996):

- Clarify and translate vision and strategy
- Communicate and link strategic objectives and measures
- Plan, set targets, and align strategic initiatives
- Enhance strategic feedback and learning

The BSC, originally conceived for business, was also transferred to other areas, e.g. information technology. Updates were provided throughout its existence leading to three different generations of BSCs. Notably, the introduction of Strategy Maps (Kaplan et al. 2000) brought a lot of attention to the performance measurement community since it clarifies the relationships

between different goals in the form of a cause-effect diagram over all perspectives. The Balanced Scorecard approach was chosen to become our performance measurement technique because it is widely employed, well researched, and supported by internally used Business Intelligence tools by our corporate partner. In Section 5.5, we will examine it in more detail.

3.2.2. The Performance Prism

The Performance Prism (Neely et al. 2002), as with the BSC explained in the previous Section, provides different perspectives on the company, specifically the stakeholder satisfaction, the stakeholder contribution, strategies, processes, and capabilities. It thereby adopts a stakeholder centric view of performance measurement as can be seen in Figure 3-2. This is the same intention as with our EA BSC approach as we will see later in Section 5.5 since the top-most perspective is the stakeholder. The five perspectives indicate a multidimensional model which captures all relevant contributions to the organizational performance (2004). Over 200 measures have been developed and are available in a catalogue to be used as a reference guide by people seeking information on how they might measure specific dimensions of performance. This catalogue resembles the Measurement Experience Base as outlined later in Section 5.4.

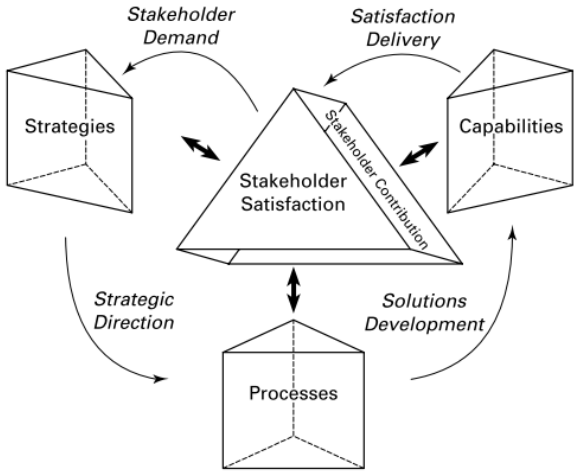

Figure 3-2: Performance Prism Delivering Stakeholder Value (cf. (Neely et al. 2002))

3.2.3. Goal-Question-Metric

The Goal-Question-Metric (GQM) (Basili et al. 1994) approach was developed to define goals in a context-aware manner which means specific goals are stated, then questions whose answers help to achieve these goals will be asked after which metrics can be defined. It was further developed to the GQM+Strategies approach (Mandic et al. 2010) which introduces several new concepts, such as multi-level goals, strategies, context/assumptions, and an enhanced interpretation model. This approach is illustrated in Figure 3-3.

One of the main strengths of GQM is the actual identification of appropriate metrics. Starting from a particular goal, several questions lead to such metrics. We employed this method in our case study and we will describe it in more detail in Chapter 7.

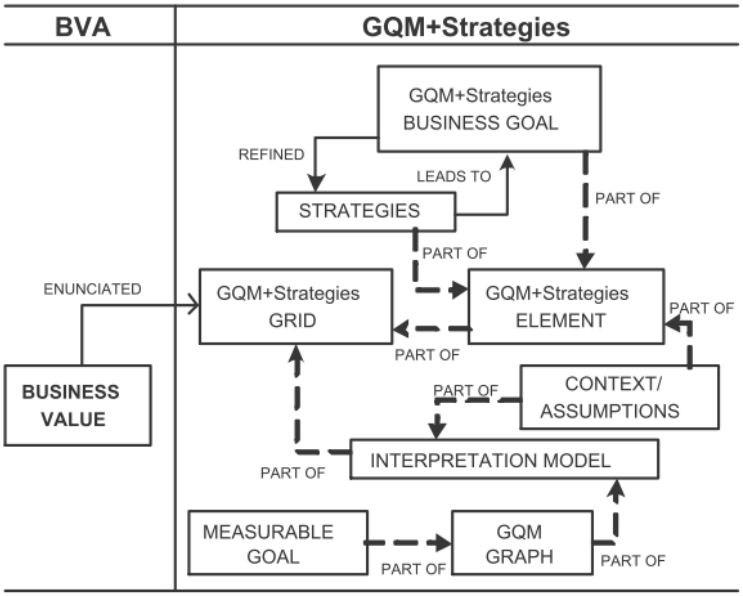

Figure 3-3: Terminology and GQM+Strategies Concepts (cf. (Mandic et al. 2010))

3.3. Strategy and Enterprise Transformation

As a major driver for EA, strategy and the resulting enterprise transformation forms a significant input for our work. Generally, strategy can be defined as a pattern in a stream of decisions (Mintzberg 1978). This view disregards the common practice of planning and shaping the future for a company in order to achieve desirable ends with available means (Mckeown 2011). An earlier and more comprehensive definition is given by (Andrews 1971): "*Corporate strategy is the pattern of decisions in a company that determines and reveals its objectives, purposes, or goals, produces the principal policies and plans for achieving those goals, and defines the range of business the company is to pursue, the kind of economic and human organization it is or intends to be, and the nature of the economic and non-economic contribution it intends to make to its shareholders, employees, customers, and communities*". Hereby, corporate strategy applies to the whole enterprise whereas business strategy, applied for diversified firms, is concerned about a product or service in a given market for individual businesses within that firm. Business strategy sets the stage for how a particular business of the firm competes against others. It thereby determines in what respect this business can best achieve competitive advantage (Porter 1980). Thereby, the purpose of strategy is not only to win but also to endure (Viardot 2011). Many of the strategic and management thinkers have espoused the cause of handling change and continuity together (Sushil 2013). This happens in

an environment of uncertainty, and developing more sophisticated strategic tools will not bring the hoped for certainty. Instead, all stakeholders are required to live by the values to enable enterprise transformation with managers serving as role models (Schwenker and Spremann 2009).

In our view, strategy drives the company's transformation from As-is to To-be. When speaking of strategy from a conceptual point of view, we include the business strategy, IT strategy and the EA strategy. Each stakeholder can contribute to elaborating the strategy. To sum it up, every kind of strategy embarked on is relevant in the context of our assessment. Regarding EA, the business architecture is essential in strategic management (Simon et al. 2013). The essence of formulating a strategy is to relate the enterprise to its environment (Porter 1980) which is accepted to be uncertain (Schwenker and Spremann 2009). In other words, strategy is always context-aware and contingent (cf. Sec. 3.5.1). Strategy is concerned with the future performance of the firm. But we also need to consider strategy implementation, a field still neglected in current literature (Huber 2011) although challenges and barriers have been largely identified (Boiko 2013). Regarding enterprise transformation, which represents strategy implementation, we want to point out the different levels where an actual transformation can take place which is summarized in Table 3-4 (based on (Ackoff 1990)). Most importantly, we achieve the transformation by aligning and integrating. A common way of organizing these levels is to start at the *strategic transformation*. It sets the path for a long-term (above three years) transformation affecting the whole enterprise. For example, a business strategy could be to enter a new market by expanding the company's product portfolio with the goal to achieve a certain market share within a set time frame. This has an impact on the IT strategy, which has to support this endeavour. IT strategy could therefore be that processes and services are more agile and flexible to accommodate market dynamisms. EA strategy is a special case here for it sets the boundaries for the whole enterprise in terms of standardization and integration. This is done by building strategic architectures which guide further developments from a conceptual point of view. Moreover, it has an impact by introducing principles along with its role in governance. As a result of strategic planning, we get high-level goals that we need to achieve. These goals can be business, IT, or EA goals. These goals need to be translated to a more detailed level which is why we have the *tactical transformation*. It targets programs and portfolios. For example, there could be a program to improve service delivery in terms of time and quality. A portfolio could be an aggregation of projects or solutions that transform the enterprise or particular organizations and practices to the desired state. The tactical level can be set out to achieve its goals in mid-term time frames, i.e. one to two years. The daily work stakeholders

are involved in is crucial to achieve goals on any level. Such goals are very specific and detailed to the context. We speak of *operational transformation* which is attained by various projects and processes. On this level, we actually transform the enterprise to what we planned it to be on the above levels. Operational transformation can occur in a short-term time frame (up to one year). This level is also the focus of our work since we are assessing the operational level of the EA function within the enterprise, i.e. projects and processes that have a form of EA contribution.

Level	Description	Scope
Strategic Transformation	Set long-term path for enterprise and derive high-level goals.	Strategy
Tactical Transformation	Break down high-level goals to programs and portfolios that achieve these goals.	Programs, Portfolios
Operational Transformation	Further break down goals to projects and processes that support the tactical transformation as well as the operational transformation.	Projects, Processes

Table 3-4: Enterprise transformation levels

3.4. Business Value and IT Business Value

The notion of general value in economics is described in (Aityan 2013). It is compared to energy in physics due to having a similar role and hence is perceived as "economic energy" for it constitutes a more comprehensive economic foundation since it comprises not only monetary value as proposed by classical and neoclassical approaches. The main difference is therefore a distinction of monetary value and non-monetary value. Both these components represent two perceptions on value. This general value concept introduced by (Aityan 2013) provides an economical foundation for analysis by also emphasizing the role of utility, the main concern of IT artefacts in context of DSR. Another conceptualization of value is presented in (Normann and Ramírez 1993) which states that value is a set of products and services that are combined into activity-based "offerings" from which customers can create value for them. This perception is relevant for us when we examine the expected stakeholder benefits when they consume an EA service.

Business value is generally considered as a type of economic value (or general value in economics). Business value as a concept has no commonly accepted definition. For several decades, business value and more recently value-add are buzz words in literature and especially industry. The main question is what needs to be done to increase business value as this will

increase revenue and profit. Simply put, business value is the sum of contributions to firm performance that yield monetary and non-monetary benefits to the firm.

The business value of IT or IT business value (ITBV)[1] has been investigated in research extensively over the last decades. Still, there is no actual theory on ITBV in literature (Schryen 2012). ITBV can be defined as the impact of investments in particular IT assets on the multidimensional performance and capabilities of economic entities at various levels, complemented by the ultimate meaning of performance in the economic environment (Schryen 2012). Thereby, economic impact can be examined on firm level, industry level, and economy level.

Looking back, a major outcry in industry and literature was caused by the famous IT productivity paradox (Brynjolfsson 1993). Despite major investments in IT, the projected value could not be leveraged to increase productivity, especially in the service industry. In other words, IT is perceived everywhere but in productivity statistics. As argued, the reasons for this are measurement errors (Smith and McKeen 1991), lag effects, redistribution, and mismanagement. For the first wave of research on computerization and productivity, it can be postulated that computerization does not automatically increase productivity but is an enabler for comprehensive enterprise transformations that yield an increase in productivity (Brynjolfsson and Hitt 1998). The rather provoking question *"Does IT pay off?"* (Farhoomand and Huang 2009) was elaborated in a study by investigating the financial sector, or more precisely two large banks. The conclusion was that the question must rather be *"How does IT pay off?"* as the actual impact of IT on investments is still not entirely understood (Dehning and Richardson 2002). Also, the question how to view IT as an asset in a traditional sense was not explored in detail for it is largely considered as an intangible (Brynjolfsson et al. 2002).

Meanwhile, the common opinion in literature leaves no doubt about the operational and strategic relevance of IT to deliver business value. IT investments are considered to have a substantial and statistically significant contribution to firm output (Brynjolfsson and Hitt 1996). (Dehning et al. 2003) find empirical evidence that IT investments result in positive returns when aligned with the strategic level transformation. (Chatterjee et al. 2002) provide empirical evidence that investment in IT infrastructure establishes a platform for generating firm growth and revenue. Literature reviews on ITBV support the conclusion of IT providing benefits to firm performance (Kohli and Grover 2008; Schryen 2012). The productivity paradox apparently

[1] Sometimes also referred to as information system business value.

has been resolved on firm level due to evolved measurement, data analysis, and improved IT management (Dedrick et al. 2003).

To better understand the reality of ITBV, several models have been proposed in literature (Dedrick et al. 2003; Dehning and Richardson 2002; Melville et al. 2004). From an industry perspective, (Smith et al. 2006) define a ITBV model that is based upon the business aspects of demand management, supply management, and support services for which it provides a set of indices to assess business value. Based on academic literature, a synthesized ITBV model is presented in (Schryen 2012) and is illustrated in Figure 3-4. This ITBV model serves as basis for our EABV research and therefore constitutes the boundaries of our high-level concept of EABV (cf. Sec. 3.7).

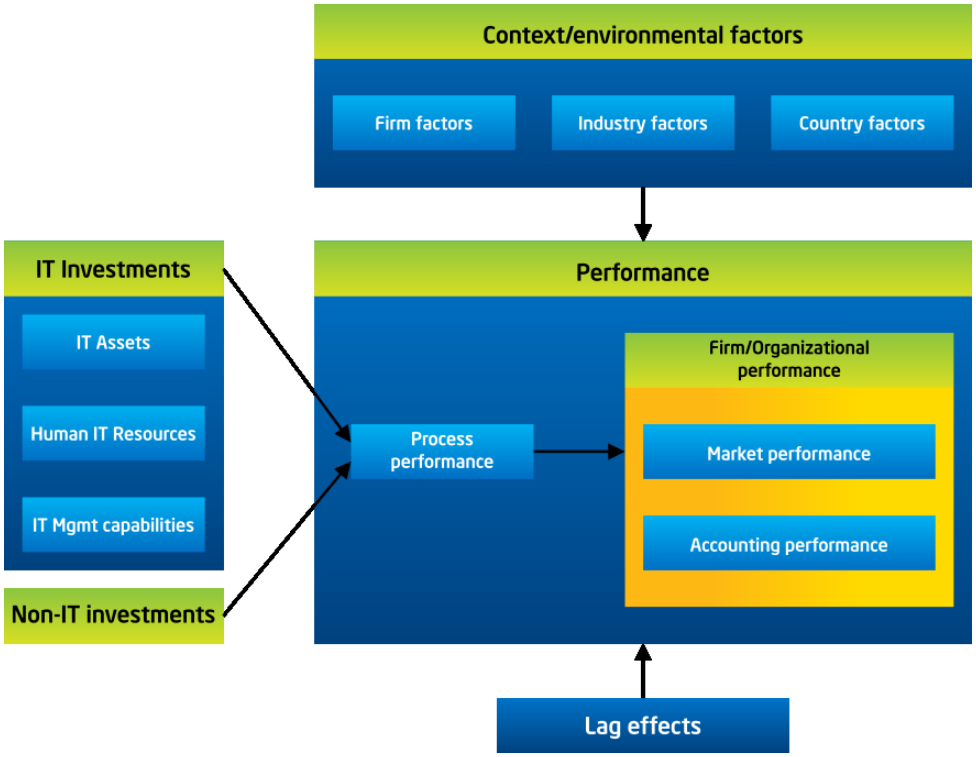

Figure 3-4: IT business value model (cf. (Schryen 2012))

As pointed out in literature, performance is influenced by several factors (Melville et al. 2004). From a macro perspective, we need to regard *country factors* such as rules and regulations specific to particular regions or countries respectively. A firm operating globally must adhere to the laws of the country it operates in. For example, there are major differences in taxations in every country. In addition, the region's technological infrastructure can impact a firm's performance. *Industry factors* mark influences typical for a particular competitive environment which also includes market characteristics. In order to predicate a firm's performance in relation to its competition we need some form of benchmarking capabilities. *Firm factors* include all

relevant practices and functions that deliver performance and can be additionally examined at an organizational level to allow for more detailed measurements. Examples for firm factors are cultural topics, adoption of new practices and technologies, corporate strategy, organizational capabilities and practices, as well as management practices. One of the most important and often discussed firm factors is the alignment of business and IT or business-IT alignment respectively (BITA) (Henderson and Venkatraman 1993; Luftman 2000; Versteeg and Bouwman 2006).

Lag effects are impacts on performance that are only visible after a certain time and are not always possible to capture. Usually, shortcomings in the employed business value assessment methodology result in a faulty or inaccurate measurement that does not reveal delayed effects on performance (Brynjolfsson and Hitt 1996; Brynjolfsson 1993). Lag effects can occur due to learning and adaption and hence were one of the major reasons to postulate the IT productivity paradox.

Firm performance comprises market performance, accounting performance, and organizational performance which is all achieved by process performance, apart from context/environmental factors and lag effects. Positive effects on accounting performance, such as returns on sales, investments, or assets can be found in (Dehning et al. 2005; Dos Santos et al. 1993; Tam 1998).

3.5. Theories

In this Section, we explore underlying theories that influence our work. We outline how these theories are incorporated in our approach and we also explain how we contribute to theory building through our research efforts. First, we need to look at what is actually a theory. Traditionally, theories try to explain and understand the world, and are testable. This view historically originates from natural sciences. But which world are we actually talking about in this context? We can distinguish between three worlds: (1) the objective (material) world; (2) the subjective (mental, perceived) world; and (3) the socially abstract world of human-created entities, such as language, art, and science. The latter again is objective and this is the world which we conduct our research in.

In IS literature, we can find three different views on theories according to (Gregor 2006) with his influential journal article. A theory can be seen as (1) statements that say how something should be done in practice; (2) statements providing a lens for viewing or explaining the world; and finally (3) statements of relationships among constructs that can be tested. Furthermore, a

detailed taxonomy of theories in IS is given by (Gregor 2006) where we can find five different types of theories which are characterized as follows:

1. *Theory for Analysing:* Such a theory states what something is. It does not go beyond analysis and description. Casual relationships between entities or phenomena are not specified and no predictions are made.
2. *Theory of Explaining:* Such a theory states what something is, but in addition how, why, when and where. Still, it does not aim to give any precise predictions and there are no testable propositions.
3. *Theory of Predicting:* Such a theory states what something is and what it will be. It provides predictions and has testable propositions although lacking well-developed justificatory casual explanations.
4. *Theory of Explaining and Predicting (EP Theory):* Such a theory states what, how, why, when, where something is, but also what it will be. It provides predictions and has testable propositions as well as casual explanations.
5. *Theory for Design and Action:* Such a theory says how to do something. It gives explicit prescriptions (e.g. methods, principles of form and function, techniques) for constructing an artefact.

All these types of theories are interrelated and we will elaborate on them later in the Section once we have explained all relevant foundations. Theories in context of design science are part of the body of knowledge (Hevner et al. 2004). As mentioned in the beginning of this Section as well as in Chapter 2, we contribute to the body of knowledge with our research. The actual levels of contribution are more thoroughly explained in Section 2.6. Our approach mostly contributes to a theory of design and action as we describe a method to assess EA business value. We will take a closer look at the relevant theories in the following subsections.

3.5.1. Contingency Theory

Contingency theories state that there is no single best way to achieve certain goals from a firm's perspective. For example, all business (and corporate) strategy theories are by default contingency theories (Hofer 1975). (Dubin 1976) goes even further by stating that every theory is a contingency theory due to the fact that for a proposition to hold, assumptions about premises, system states, and boundaries have to be made. The reason for this is rather simple. Arguing that e.g. strategic theories are not contingent would mean to postulate that there is actually a strategy or set thereof which is optimal for all businesses (corporations) regardless of resources, market, as well as rules and regulations (Hofer 1975). Consequently, an important

building block of contingency theories is the fit between the organization and its contingency factors (Drazin and Ven 1985; Mahr 2010). For example, the strategic fit has been investigated by (Henderson and Venkatraman 1993). Contingency factors are for example organizational environment, technological factors, collaboration setting, and rules and regulations. Another important contingency factor is the market including the competition. Since our approach is a more intra-enterprise information gathering and producing method, we do not consider the impact of this factor in our work. Contingency factors are relevant when creating principles (cf. Sec. 5.1.3), deriving requirements (cf. Sec. 4.2.3), and evaluating our approach in terms of organizational fit (cf. Sec. 6.3.3). In addition, we view our contribution as a contingency approach as there is no single best way of organizational management and leadership (Fiedler 1964; Weill et al. 1989). We can postulate some propositions for EABV assessments although we should be aware that there are many more ways to assess EABV and how insights gained from this are exploited during strategic management.

3.5.2. Theory of the Firm

A theory of the firm is an attempt to address the shortcomings of economic theory building by clarifying the foundations of on which is was erected. It aims to explain and predict the nature of a firm, company, or corporation in terms of existence, behaviour, structure and its relation to the market (Dietrich and Krafft 2012). A firm, therefore, consists of a system of relationships which comes into existence when the direction of resources is dependent on an entrepreneur (Coase 1937). The entrepreneur is a firm's driver and by configuring the firm's resources in an effective way achieves competitive advantage. A basic description, that holds true for various theories of the firm (Mishra and Zachary 2013). A myriad of contributions to the "theory of the firm" can be found in literature, although many of them are actually not a theory of the firm. Instead, they are a theory of markets where firms participate in (Jensen and Meckling 1976). Today, theories of the firm are most commonly part or adopted in strategic management research (e.g. (Wernerfelt 1995)). For our purposes, theories that are based on resources and their effective configuration pose the most adequate view since enterprise architecture is the discipline of configuring IT resources in alignment with business resources in the best possible way to ensure the long-term wealth of the firm in terms of management, sustainability and competitive advantage amongst others. While traditionally, such theories use the term "firm", it is very common to use terms such as company, enterprise, business or corporation interchangeably. In our case, our corporate partner is a multinational enterprise, and more specifically a public company.

3.5.2.1. Resource-based View

The resource-based view (RBV) is a traditional theory of the firm with roots dating back to the late 1950s. (Penrose 1959) was significantly involved in viewing the firm as a set of resources. This view breaks with the traditional product view in order to provide a basis for formulating a firm's strategy. From that perspective, products can be expressed as a set of resources. Thereby, the objective of the RBV is to analyse a firm's resource position or mix respectively in order to derive strategic decisions based on such analysis (Wernerfelt 1984). Notably, firms in that respect are considered as diversified which means they expand to new products and markets. The question on a business level of whether the firm is competitive or can achieve competitive advantage is dependent on the actual resources, more specifically if they fulfil certain criteria. To be competitive means to have resources that are valuable, rare, inimitable, and non-substitutable (VRIN attributes). These are the foundation of implementing value-creating strategies to achieve sustainable competitive advantage. Consequently, when formulating a strategy, we inherently aim for competitive advantage. Regarding the creation and sustainability in a dynamic context, we perceive that the low substitutability and imitability sustains value and rarity (cf. Figure 3-5) (Wade et al. 2011).

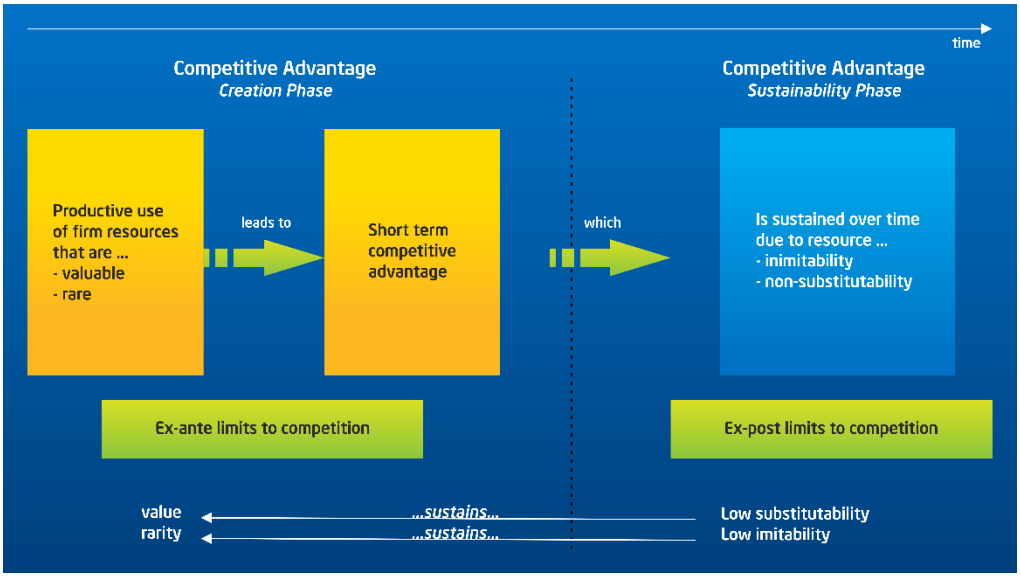

Figure 3-5: Competitive advantage over time (cf. (Wade et al. 2011))

We argue, that EA creates, manages, and improves IT resources or assets respectively in order to achieve a better strategic business-IT alignment (BITA). In other words, we want to analyse IT resources in an EA context and elaborate the outcome and impact of the EA function in terms of BV which in turn is crucial for strategic decision making. Another way to put it is that EA is an instrument to configure the mix of IT resources or assets respectively. We will explain that EA actually goes beyond that (cf. Sec. 3.1) and offers a broader variety of services and

processes. Nevertheless, from a theoretical standpoint, the development and management of EA artefacts (or enterprise building blocks) poses the main concern of our research as these are the most common contribution to projects that we assess. A continuation of RBV considering the market dynamism is represented by dynamic capabilities. We will take a closer look at those in the following Section.

3.5.2.2. Dynamic Capabilities

The theory of dynamic capabilities has its roots in RBV theory. As a matter of fact, RBV received criticism in literature for not being a theoretical structure, for its assumption of market stability, and for imprecise definitions (Priem and Butler 2001; Wang and Ahmed 2007). In addition, RBV is neglecting the competitive environment and is a static perspective on the firm. Dynamic capabilities aim to address these issues. An often cited definition of dynamic capabilities is given by (Eisenhardt and Martin 2000) and will be used for the purpose of this work as it best describes our perception on what a dynamic capability is:

"The firm's processes that use resources – specifically the processes to integrate, reconfigure, gain and release resources – to match and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die."

For example, dynamic capabilities that integrate resources are product development routines by which managers and product designers create revenue-creating products and services combining their skills and functional backgrounds. Dynamic capabilities that reconfigure resources are transfer processes including routines for replication and brokering of especially knowledge-based resources. Other dynamic capabilities deal with the gain and release of resources, such as knowledge creation routines whereby new thinking and innovation is crucial for organizational performance. In other words, it is the ability to achieve new forms of competitive advantage whereby *dynamic* in this context means the renewal of competences accounting for a changing business environment. *Capabilities* hereby denote the ability to adapt, integrate, and reconfigure skills, resources, and functional competences. Strategic management has a key role as it aims to satisfy the requirements for the changing business environment (Teece et al. 1997). Our work is not focused on market dynamisms depending on the type of market. (Eisenhardt and Martin 2000) shed more light on how dynamic capabilities behave within moderately dynamic markets and high-velocity markets. Many characteristics are shared between dynamic capabilities and enterprise agility, although enterprise agility is

focused on the actual environmental change as opposed to all firm processes that constitute dynamic capabilities making it a much broader concept (Overby et al. 2006).

(Wang and Ahmed 2007) distinguish between three types of dynamic capabilities: (1) *Adaptive capabilities* are characterized as a firm's ability to identify and capitalize on emerging market opportunities (Chakravarthy 1982). (2) *Absorptive capabilities* are characterized by a firm's ability to identify and exploit the value of new, external information to do business (Cohen and Levinthal 1990). Absorptive capabilities are reconceptualized in (Zahra and George 2002) with dimensions, components, and roles. (3) *Innovative capabilities* refers to a firm's ability to develop new products, services, and/or markets by employing innovative processes and practices aligned with an innovative strategic transformation (Wang and Ahmed 2004).

For the purpose of our work, the focus is on dynamic capabilities theory as it best underlines our research effort. In addition, we provide our insights and contribute in that way to further bolster the theory within our chosen research context. We will elaborate on this in the following Section 3.6.

3.6. Enterprise Architecture as Dynamic Capability

Assets are resources that possess a certain value for the organization and have an ownership. In financial accounting, an asset is a resource having an economic value. Consequently, when we are talking about assets, we are also talking about resources in a RBV meaning. IT assets that are valuable and inimitable have been studied by (Ross et al. 1996). Several categories have been identified: (1) the *human (or people) asset* is the IT staff that solves business problems and addresses business opportunities through IT. Therefore, it comprises knowledge, skills, and also the motivation of the IT knowledge workers; (2) the *technology asset* consists of all components that make up the IT infrastructure such as hardware, networks, middleware and databases; (3) the *relationship asset* is the communication and collaboration effectiveness between business and IT in terms of trust and shared responsibility. Extending on this, (Curley 2007) provides (4) the *IT intellectual capital* as business processes and the codified knowledge within enterprise solutions and applications, business data and the information flow throughout the company's digitized platforms. This also includes architecture principles, EA artefacts, and EA services and processes. Perceived as intangible, we can find further proposals of structuring intellectual capital (Gkinoglou 2011).

All of these resources have the potential to be valuable, rare, inimitable, and non-substitutable. For example, the people are unique in every organization. Some of them, depending on skillset

are rare and very valuable and therefore also inimitable as well as non-substitutable. The same holds true for relationships since there are also people involved. Technology, mostly software, is specifically developed and customized for a particular business process which makes it clear that technology and IT intellectual capital can possess the VRIN attributes as well. Consequently, the best possible configuration of these assets leads to competitive advantage, as this is achieved by improved BITA, faster solution delivery, and high-quality and cost-effective support among others (Ross et al. 1996).

We now need to peer at the actual resources that are integrated, reconfigured, gained and released in the EA domain. So which resources or assets respectively are relevant for EA? Looking at EA services (cf. Sec. 3.1.2), we give examples of IT assets that are integrated, reconfigured, gained and released in Table 3-5. Principles perceived as an IT intellectual capital asset can be integrated by the EA service design after they are created or gained respectively. Reconfiguring could target existing guidelines as they might need to be changed due to regulative, technological, or business alterations. Guidelines also belong to the IT intellectual capital assets. An example would be a new corporate identity and the consequential new guidelines for user interface design. Standards, again IT intellectual capital assets, can be released or dismissed respectively, also due to changes in the environment. In the context of the EA development service, we can integrate newly acquired vendor solutions that are customized accordingly to fit in the current IS landscape. Such integration is a comprehensive effort and usually includes all types of assets. Reconfiguring could mean a change in the application portfolio which means that interfaces between various applications need to be adapted to better support the business. Such a reconfiguration can be viewed as a technology asset, although it also encompasses IT intellectual capital, as well as people and relations due to the substantial nature of application portfolios. An application portfolio reconfiguration could follow the paradigm of application pace layering. Gartner's pace-layered application strategy breaks with the traditional focus on "built to last" and replaces it with a process-enabled focus on "built to change". A new ERP system encompasses a lot of architecture development, which is mostly concerned with technology although we can argue that we build up IT intellectual capital during the development, as well as new relations. Additionally, we might need to hire or train people not only for the development, but also for the actual operation and support. Projects can be released or ended due to several reasons. For example, a successfully finished project needs to free its resources in order to reconfigure or redistribute them. The integration of an assessment method, a performance measurement approach, or similar needs to be integrated into current management practices which encompasses the adequate knowledge of executing it, and hence

the crucial asset here is IT intellectual capital which happens to be the content of this Thesis. Management reconfigures every kind of asset using its IT budget. Our approach assists in decisions on investments and budgetary distributions by showing where there is a gap in effectiveness of the EA function. Notably, not only the amount and size of investments are of importance to achieve IT benefits, but even more so the effective management and converting these expenditures into business value (Jurison 1996). Gaining a resource could mean hiring a new Enterprise Architect which is naturally a people asset. Management is also responsible for deciding whether or not to dismantle a legacy system that might have become unfeasible and a dead weight. This equals the release of a technology asset. The training & support EA service could integrate a new training plan for people. This might go hand in hand with the acquisition or development of a new solution. Under some circumstances, it might be necessary to give people a chance to further develop or change their skillset. For example, a role for an Enterprise Architect possesses a certain skill matrix. This can be reconfigured or specialized in order to develop skills needed to become a Business Architect. A new training module could mean the creation of new course material, i.e. IT intellectual capital that allows an increase in expertise for knowledge workers or people respectively. New solutions might encompass new relationships between organizations to provide proper technical support and therefore we gain a new relation asset. If a company decides to release a certain solution (e.g. a vendor change negates the necessity to keep knowledge and skills up for their specific product) an existing training plan for that solution also becomes obsolete and therefore a release in IT intellectual capital. This is just a small sample of examples to show how IT assets are treated from a dynamic capability perspective by utilizing EA services. Notably, a myriad of other examples can be found to support this connection.

	Design	Development	Management	Training & Support
Integrate	Principles (IT intellectual capital)	New vendor solutions (all)	Assessment Method (IT intellectual capital)	Training plan (People)
Reconfigure	Existing guidelines (IT intellectual capital)	Application portfolio (Technology)	IT budget (all)	Skill set (IT intellectual capital)
Gain	New principle (IT intellectual capital)	New ERP system (Technology)	New Enterprise Architect (People)	New training module (People), New support opportunity (Relationship)
Release	Dismiss standard (IT intellectual capital)	Projects (all)	Legacy systems (Technology)	Training plan (IT intellectual capital)

Table 3-5: Example IT assets and their treatment according to dynamic capabilities in the context of EA services

When looking at dynamic capabilities over time, we perceive a conceptual evolution (indeed dynamic capabilities are dynamic in themselves). This contrast in conceptions is outlined in Table 3-6 based on several criteria (Eisenhardt and Martin 2000). For our purpose, we are also interested in knowing if there are any EA specific characteristics from a dynamic capability perspective. We added these in Table 3-6. As we learnt from the definition, dynamic capabilities evolved from being routines to learn routines to specific organizational and strategic processes. EA for example, might provide the necessary knowledge to learn about a new process that needs to be implemented in order to accommodate a change in business and hence in architecture. EA processes and services aim to improve organizational performance either directly by contributing an EA artefact to a business service, or indirectly by enforcing standardization and adherence to principles. The heterogeneity shifted from idiosyncratic (firm specific) to commonalities with some firm specific details. Commonalities are in essence best practices. For EA, such commonalities result in numerous EA frameworks. Adopting a framework usually encompasses firm specific adaptations. The heterogeneity among most firms hence is a result of the adapted EA framework and how it is implemented within the organizations. This implies also that building the EA capability takes a different starting point for different firms and also different paths of evolution. The pattern is largely dependent on the markets and their dynamisms. For example, moderately dynamic markets where change occurs in a predictable manner rely extensively on existing knowledge. Hereby, detailed, analytic routines fulfil their purpose as they draw from existing knowledge on how to behave and act under given circumstances. But when considering high-velocity markets, effective dynamic capabilities are simpler in order to focus on the most important aspects of fast-moving markets. Despite being simple, dynamic capabilities are far from totally unstructured. So, what about EA and the market? We argue that EA is largely market-independent. This is because the processes for developing architectures usually do not change because of the market, but architectures do. Additionally, the majority of principles are designed independent from market dynamism. In other words, market dynamism triggers a change in the firm's blueprint which is reconfigured by the EA capability without necessarily changing that capability. Nevertheless, a firm could adopt different forms of architecture development, complex and detailed ones as well as simple ones if faster time-to-market is crucial. Experimental routines in the context of EA could come in the form of prototyping. Prototype architectures can eventually become reference architectures. The outcome of dynamic capabilities was traditionally viewed as predictable due to market considerations. This again changes in high-velocity markets where the outcome is unpredictable. As for EA, the outcome in the form of deliverables (or EA artefacts) is

predictable although some of the content might be unpredictable. For example, a firm wants to develop a new strategic architecture in order to accommodate doing business in a high-velocity market. It thereby draws from existing knowledge how to create the architecture, but the actual outcome, the new strategic architecture is not predictable. The creation of this new architecture relies on situation-specific knowledge. For example, the conceptual business architecture could involve more stakeholders and organizations than was originally anticipated. This could be the case if it turns out that entering such a market requires a proper risk management process attached to it which needs to be accommodated for in the resulting solution architecture. In addition, this could have implications for IT and EA governance that have to be considered, such as particular rules and regulations. As already mentioned (cf. Sec. 3.5.2), competitive advantage is achieved by effectively managing a firm's assets possessing certain attributes (VRIN). This is also true for EA, as we aim to find the best possible asset mix to achieve competitive advantage mainly by speeding up the business. Hereby, faster time-to-market is of major concern. Again, the market dynamism does not really matter here as the decision to enter the market has been made, regardless of market type. EA supports business in bringing a product or service to market more quickly. As for the evolution, dynamic capabilities in the traditional view and the reconceptualization are characterized by a unique path. Consequently, starting point, stakeholders, and organization specifics form a unique evolutionary path. The modern view suggests that this path is shaped by several learning mechanisms, such as practice, mistakes, codification, and pacing. This is also true for EA, although EA has a large impact on shaping the path for itself and other dynamic capabilities. Key words here are standardization and principles. In other words, EA is a dynamic capability that evolves on its own whereby it has the methods to change not only the way of the EA practice, but additionally the surrounding environment in the form of architectures, and therefore contributes to shaping the path of other dynamic capabilities.

	Traditional View	**Reconceptualization**	**EA specific**
Definition	Routines to learn routines	Specific organizational and strategic processes	Specific EA processes and services that aim to improve organizational performance either directly or indirectly
Heterogeneity	Idiosyncratic (firm specific)	Commonalities (best practices) with some idiosyncratic details	Commonalities (best practices) with some idiosyncratic details
Pattern	Detailed, analytic routines	Depending on market dynamism, ranging from	Largely market-independent, from simple to

		detailed, analytic routines to simple, experimental ones	detailed, experimental routines as prototyping
Outcome	Predictable	Depending on market dynamism, predictable or unpredictable	Outcome (e.g. deliverable) predictable, content may be unpredictable
Competitive Advantage	Sustained competitive advantage from VRIN Dynamic capabilities	Competitive advantage from valuable, somewhat rare, equifinal, substitutable and fungible Dynamic capabilities	Competitive advantage mainly from flexibility and agility, i.e. quick adaption. Time-to-market as main criterion
Evolution	Unique path	Unique path shaped by learning mechanisms such as practice, codification, mistakes, and pacing	Unique path by employing standardization and principles

Table 3-6: Conceptual evolution of dynamic capabilities and EA specific amendments

As we described earlier in Section 3.5.2.2, we can distinguish between three types of dynamic capabilities. We outline the characteristics of each of these dynamic capabilities and can argue what and how EA fits into this picture in Table 3-7. As we can see, EA is not an adaptive or innovative capability although it supports them. EA is an absorptive capability as it not only is able to identify the potential value of information, but more importantly exploit it in order to build principles, standards, and architectures that benefit the business. EA absorbs information from within the firm, from other companies through benchmarking, best practices usually in the form of EA frameworks, and academic literature and research. Basically, this makes EA an absorptive capability while supporting all types of dynamic capabilities.

	Adaptive	**Absorptive**	**Innovative**
Ability	Identify and capitalize on emerging market opportunities	Identify and exploit the value of new, external information to do business	Develop new products, services, and/or markets by employing innovative processes and practices aligned with an innovative strategic transformation
EA examples	None, although EA supports other adaptive capabilities	(Ross et al. 2006) (Simon et al. 2013) (Hugoson et al. 2011) (Bradley et al. 2011) (Smith 2012) (Saha 2009)	None, although EA supports other adaptive capabilities

Table 3-7: Types of dynamic capabilities and EA

Now we are interested in how we can actually compare a firm's EA capability with others. A way of doing that is to assess EA in terms of maturity. Firms that want to benchmark their

maturity need to conduct assessment using the same framework. We can find several EA maturity frameworks in practice and literature (Meyer et al. 2011). An example framework that assesses EA maturity is the IT-CMF (IT Capability Maturity Framework) (Curley 2009). A critical capability is the demonstrated ability to serve a need through effective integration and application of assets (e.g., people, processes, IT systems, data, facilities, equipment, raw materials, financial assets, reputation) which is essentially equivalent to dynamic capabilities. In this framework, we can find a critical capability Enterprise Architecture Management (EAM). It is part of the macro capability "*Managing the IT Capability"*. Our approach supports managing the IT capability aligned to business strategy by providing the crucial information to improve decisions and the consecutive strategic management.

As proposed by (Wang and Ahmed 2007), we adapt their research model for dynamic capabilities which is illustrated in Figure 3-6. In contrast to the original model, we focus on EA as dynamic capability. We also include principles as important entity along with a new proposition. Additionally, we have a different view on the underlying processes. For example, (Wang and Ahmed 2007) list renewal and recreation as one of these processes. We understand that this falls under the reconfiguration processes while the model misses out on actual new acquisitions and/or developments, as well as the release of various assets (cf. (Eisenhardt and Martin 2000)). Moreover, we changed the firm performance aspect for our purposes according to the EABV model described later in Section 3.7. This encompasses yet another proposition.

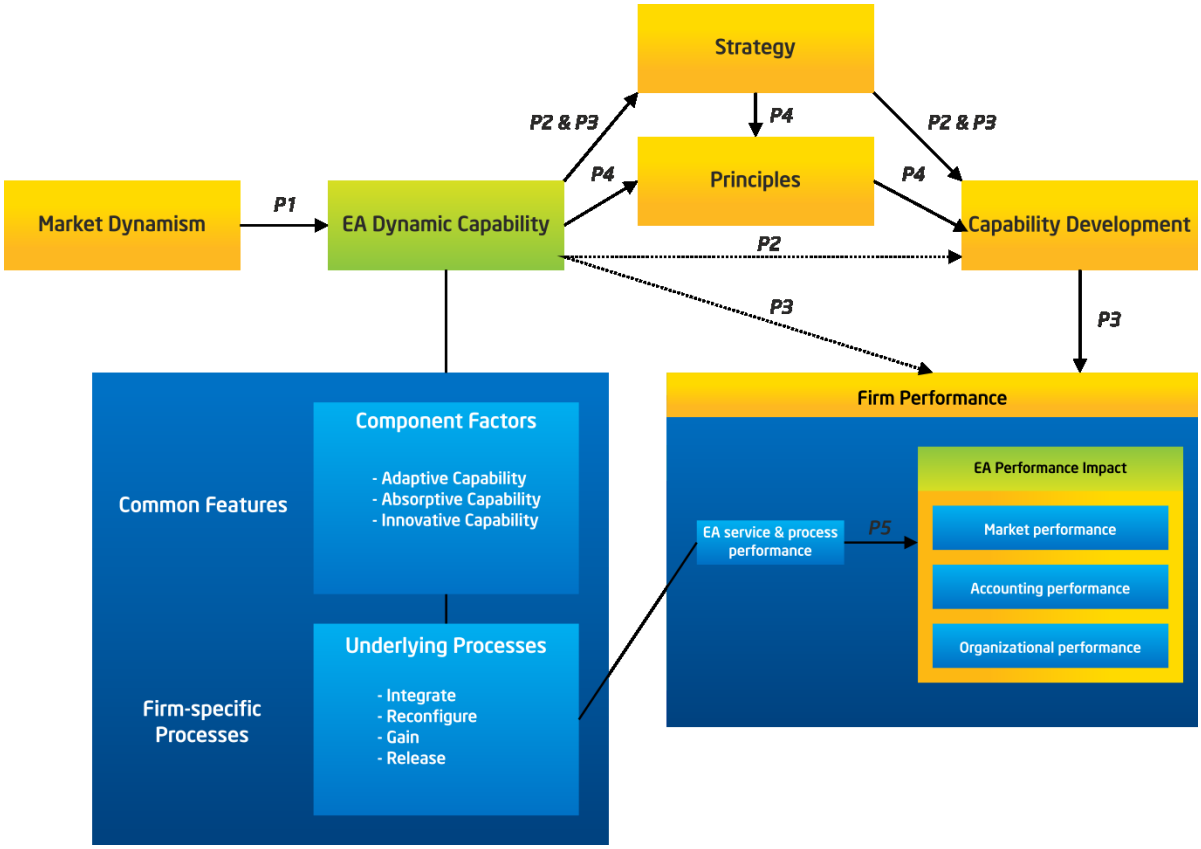

Figure 3-6: EA dynamic capability research model

Looking at the model (whereby regular arrows denote a direct relationship whereas dotted arrows denote indirect relationships), we can describe five different propositions:

- *Proposition 1*: Market dynamism does not necessarily change or impact the EA capability itself but rather its output in the form of architectures. These accommodate such dynamic environment.
- *Proposition 2*: The higher the dynamic capabilities a firm demonstrates, the more likely it is to build particular capabilities over time; the focus on developing particular capabilities is dictated by the firm's overall business strategy (Wang and Ahmed 2007).
- *Proposition 3*: The EA dynamic capability is conducive to long-term firm performance, but the relationship is an indirect one mediated by capability development which, in turn, is mediated by firm strategy; dynamic capabilities are more likely to lead to better firm performance when particular capabilities are developed in line with the firm's strategic choice (Wang and Ahmed 2007).
- *Proposition 4*: The EA capability provides means to create, maintain, and govern principles that are conceived in alignment to current strategy. Principles impact further capability development, as other dynamic capabilities must adhere to them.

- *Proposition 5*: EA services and process have an impact on firm performance in terms of business value.

As we have proposed, EA is a dynamic capability (cf. Figure 2-6). Our EA Business Value Assessment Method (thoroughly explained in Section 4.3) – the answer to our main RQ (cf. Section 1.2) – assesses a dynamic capability and provides input for a dynamic capability. Specifically, we assess EA and output to strategic decision making. For us, proposition 5 is of major concern in that respect. Consequently, the reasons for choosing dynamic capabilities as a relevant theory are the following:

- EA itself is a dynamic capability that takes input and delivers output from strategic management. Thereby, EA is meanwhile perceived as a strategic management function (Ahlemann et al. 2012b; Simon et al. 2013).
- Dynamic capabilities are concerned about (sustainable) competitive advantage by integrating, reconfiguring, gaining, and releasing resources. EA specifically deals with IT assets to achieve this.
- EA inherently is a discipline that considers evolution and environmental changes, such as organizational, market, and business changes. Hereby, it supports the enabling of such changes which constitute an integral part of enterprise transformation.

3.7. Enterprise Architecture Business Value

EA contributes to value in four different ways. Consequently, we obtain four perspectives that either facilitate cost reduction or value generation (Schekkerman 2005). This concept is illustrated in Figure 3-7. *Business effectiveness* means to improve current business process (As-is) by designing business processes (To-be) to successfully implement and execute corporate strategy to gain competitive advantage. It marks the execution of enterprise transformation by employing EA for increased benefits. Consequently, IT assets are more effectively integrated, reconfigured, gained, and released. Business innovation enables the creation of new services and products to achieve new ways of business value generation by adequately managing IT assets. Technology efficiency is concerned with keeping current costs low, for example the Total Cost of Ownership (TCO) which is a method of cost analysis to identify all direct and indirect costs of a product or system (David et al. 2002). Thereby, technology is used in such a way that it supports business efficiently by adapting adequate ways to organize and manage an organization's information and technology architecture and therefore relevant IT assets. Technology enabling facilitates means for technology to add value to the organization, for example by improving the quality and the efficiency of processes. Current and future

technology thereby enables improved execution of business processes especially in terms of cost. This constitutes the adequate treatment of IT assets.

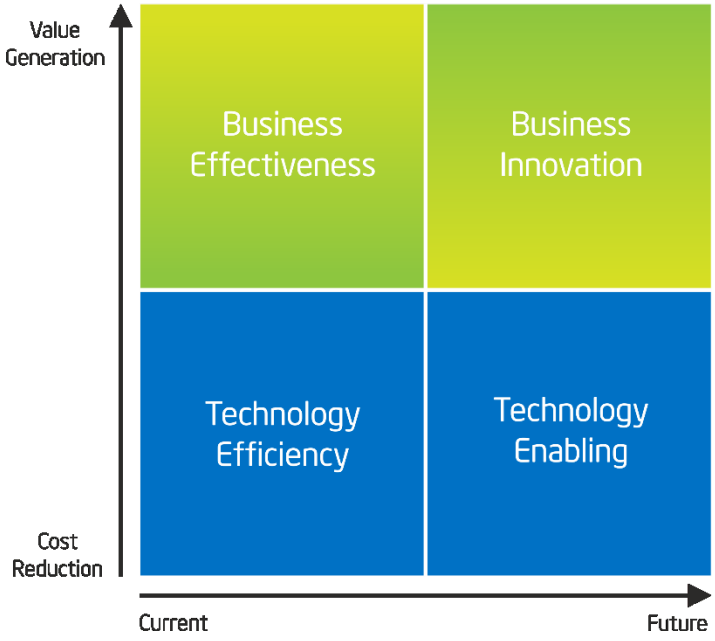

Figure 3-7: High level EA value model (cf. (Schekkerman 2005))

The question that arises now is what the actual contributions of EA constitute and how they fit in the overall performance of the organization. Based on the ITBV model presented in Section 3.4, we can extend and focus on the EABV model (cf. Figure 3-8) which is based on the ITBV model by (Schryen 2012) (cf. Figure 3-4). The main differences here are the inclusion of strategy and derived goals and conceptualizing EABV as direct outcome or impact respectively of EA performance yielding benefits. We argue, that for achieving business value in any form, we must have a goal (or more) even if it is just an implied one. Speaking of performance, we need to be able to measure goals with the appropriate metrics in order to learn about the actual performance. Goals determine management and investment decisions that integrate, reconfigure, gain, and release assets through EA services and processes that impact firm performance. Goals are a prerequisite to investments. Firm performance is impacted by those investments as well as context/environmental factors and lag effects.

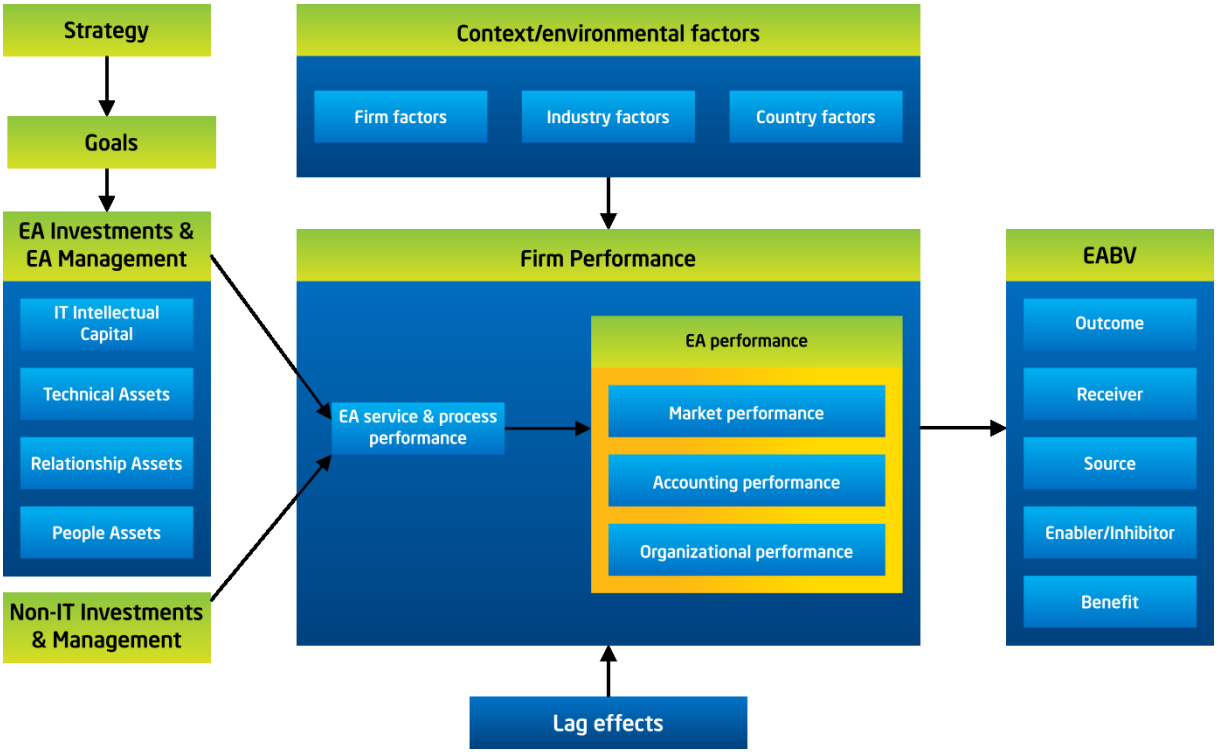

Figure 3-8: Conceptual EABV model (based on (Schryen 2012))

In our view, EABV can be characterized by several attributes. The *outcome* is the result of an EA service or process. This outcome can happen on different levels. As already mentioned, we are interested in project outcomes. Consequently, the result of projects with EA contribution constitutes our research focus. *Receiver* is the stakeholder that actually benefits from EABV which can be a particular EA practitioner or a part of the IT organization. This connection is useful for tracking benefits and for future reference during decision making. The same is true for *source* where we keep track of stakeholders achieving the benefit. *Enablers* are stakeholders, capabilities, or events that enable the creation of EABV, while *inhibitors* impede it. A simple example of a stakeholder enabler is a manager investing in particular IT assets. Other enablers are organizational alignment, information availability, resource portfolio optimization, and resource complementarity (Tamm and Seddon 2011; Tamm et al. 2011). An example for an inhibitor is a projected cut in EA budget. *Benefits* are measurable improvements based on the impact of outcomes. In other words, the *impact* of an outcome can yield particular benefits and can be seen as the effect caused by the results of EA contributions. Benefits impact firm performance directly and are of major concern for communicating EABV. Notably, we also use the notion of disbenefit, which allows for negative result reporting since not every project is successful. Example direct benefits are lower costs, increased revenue, competitive advantage, improved decisions, etc. (Tamm and Seddon 2011). We will examine EA benefits in more detail after we give a definition of EABV in accordance with the model in Figure 3-8:

"Enterprise Architecture Business Value is the impact of the contribution from EA services and processes to firm performance aligned to strategic goals that benefit the health of organizations, the satisfaction of stakeholders, and the capabilities of the enterprise by integrating, reconfiguring, gaining, and releasing assets or resources respectively in order to ensure adequate leveraging of these benefits to achieve sustainable competitive advantage." EA quality is seen as a prerequisite for enabling organizational benefits (Tamm and Seddon 2011). Thereby, EA quality constitutes various characteristics such as flexibility, effectiveness, and efficiency that enable a high level of excellence employing EA. But not only organizational benefits can be achieved through EA. For example, (Ross and Weill 2005) distinguish between business-related and technology-related benefits. For our purposes, EA benefits can be categorized as follows (Shang and Seddon 2002): (1) *Operational benefits* involve day-to-day activities such as projects and process that are usually repeated periodically that mostly acquire, consume, and reconfigure IT assets. Early success stories were reported by streamlining and automating various simple and repetitive operations. (2) *Managerial benefits* are activities that deal with allocation and control of IT assets. (3) *Strategic benefits* are achieving sustained competitive advantage through building effective architectures that enable innovative action strategies. (4) *IT infrastructure benefits* allow for standardized and reusable IT assets that constitute the basis for business applications. (5) *Organizational benefits* can be achieved in terms of focus, cohesion, adoption, learning, and execution of set out strategies.

We summarize relevant EA benefits using the enterprise system benefit framework proposed by (Shang and Seddon 2002) in Table 3-8. This framework was developed by analysing numerous cases published by major ERP (Enterprise Resource Planning) software vendors. In other words, when talking about ERP we are talking about integrating, reconfiguring, gaining, and releasing of IT assets (cf. Sec. 3.6) resulting in various benefits. We want to emphasize that methods on how to achieve these benefits are limited and not very detailed in literature which is why we address this research gap with our approach (cf. Sec. 2.7). In addition, yielded benefits are dependent on the approaches adopted for evaluation, selection, and project management for in the ERP context, and therefore impacting EA benefits (Al-mashari 2003).

EA Benefit	Example	References
Operational	• Cost reduction • Cycle time reduction • Productivity improvement	• (Kamogawa and Okada 2005; Lyzenski 2008; Ross and Weill 2005) • (Lyzenski 2008)

	• Quality improvement • Customer service improvement	• (Kamogawa and Okada 2005; Lyzenski 2008; Ross and Weill 2005) • (Doucet et al. 2008) • (Kamogawa and Okada 2005)
Managerial	• Better resource management • Improved decision making and planning • Improved risk management • Reduced complexity	• (Lyzenski 2008) • (Ross and Weill 2005) • (Ross and Weill 2005) • (Boh and Yellin 2007)
Strategic	• Support business alliance • Building business innovation • Faster time-to-market • Achieving competitive advantage • Increase strategic agility • Improve business-IT alignment	• (Ross and Weill 2005) • (Kamogawa and Okada 2005) • (Lyzenski 2008) • (Ross and Weill 2005) • (Doucet et al. 2008; Hoogervorst 2004; Kamogawa and Okada 2005; Weill 2002) • (Doucet et al. 2008; Pereira and Sousa 2005; Plazaola et al. 2008; Whittle 2004)
IT Infrastructure	• Building business flexibility • Reducing TCO • Increase IT infrastructure capability • Increase system integration	• (Ross and Weill 2005) • (Lyzenski 2008; Ross and Weill 2005) • (Gustafsson et al. 2009; Lyzenski 2008) • (Anaya and Ortiz 2005; Boh and Yellin 2007; Hoogervorst 2004; Ross and Weill 2005)
Organizational	• Improve collaborations • Improve stakeholder skills • Empowerment • Improve organizational change • Building common understanding • Increased stakeholder satisfaction	• (Choi et al. 2006) • (Op ’t Land et al. 2009) • (Lyzenski 2008; Ross et al. 2006; Winter and Schelp 2008) • (Hoogervorst 2004) • (Armour et al. 1999; Rood 1994) • (Kamogawa and Okada 2005; Ross and Weill 2005)

Table 3-8: Categorization of EA benefits (based on (Shang and Seddon 2002))

3.8. Chapter Summary

We presented the main theories and concepts that underpin our work in this Chapter. Our work is a contingent approach which means that it does not claim to be the only means of conducting EABV assessments as the organizational environment and its influencing factors are unique and therefore various approaches could lead to success in meeting the business needs of clarifying, understanding, and assessing EABV. An important aspect of our work is that our application domain EA lacks a concrete underlying theory for the purpose of examination which is why we presented it through the lens of dynamic capabilities. This theory explains the integration, reconfiguration, gaining, and releasing of resources or assets respectively. We argued that this is what EA is about in the context of enterprise transformation in alignment to strategic objectives. In order to understand EABV, we need to be aware what assets are contributing to performance.

4. Analysis

"It requires a very unusual mind to undertake the analysis of the obvious."

Alfred North Whitehead (1861 — 1947)

In this Chapter, we focus on the problems and business needs that arise from the organizational environment, investigate challenges to meeting those needs, and present a proposal to solve those problems. Based on the findings in Chapter 3, we now have an adequate research context, clear definitions, and a sound theoretical background. This knowledge is the foundation to start with the Artefact Build Cycle (ABC). Thereby, the *Analysis phase* is the first step in our ABC (cf. Sec. 2.2). We produce three different outputs here: the *Problem Description*, the *Findings Summary*, and the *Solution Proposal*. These will be explained in the following Sections. As already mentioned, the analysis phase is the equivalent to a gap analysis where we analyse the status quo or As-is state and find out what needs to be done to achieve the desired To-be state. This happens naturally in accordance with strategy and is a part of the ongoing enterprise transformation and evolution (cf. Sec. 3.3).

4.1. Problem Description

The first step to finding an adequate solution is understanding the status quo regarding shortcomings and identify problems and business needs within the organizational environment. To elaborate all of the insufficiencies, we conduct a series of teleconferences and meetings with EA stakeholders employed at our corporate partner. These happen in the form of expert interviews with a versioned list of questions document. Consequently, this is a qualitative research method within our research methodology. Furthermore, we conduct a survey to incorporate the opinions of EA stakeholders on the matter of EA improvement opportunities and their current perception on EA and EA benefits. The individual roles and responsibilities during our research process were described thoroughly in Section 2.4. The *Problem Description* is the output of the *Identify Problem/Solution* phase in our ABC (cf. Figure 2-2).

4.1.1. Problems and Business Needs

Numerous meetings and discussions in the form of expert interviews take place in order to pinpoint the issues regarding the current benefits assessment of EA as well as a concurrent literature review. We thereby identify several shortcomings, e.g. that there is no concise

definition of EABV in existence. Another issue is the actual identification and measurement of EABV and what assets and capabilities contribute to it. Probably the most challenging is the improvement of current practices which is based on the conducted EABV assessments by means of selecting adequate future goals in the course of value-added strategic planning. The problem description summary along with the corresponding research questions is outlined in Table 4-1. Notably, we are speaking of problem classes, as the DSR abstraction principle states that artefacts must be applicable to provide a solution to several problems or classes thereof respectively (Österle et al. 2011). This clustering is based on stakeholder input and literature review.

Problem Class	Questions	Research Questions
Perception/ Definition Problem	• What is EABV? • How is EABV perceived? • How do we model EABV?	*RQ1*
Visibility/ Transparency Problem	• Where can we find EABV? • What performance can be measured and communicated as EABV? • What capabilities, stakeholders, and assets contribute to the EA maturity and EABV?	*RQ2, RQ3*
Improvement/ Optimization Problem	• How can we improve/optimize the following? o EA adoption o Decision making o EA services and processes o EA maturity o BITA	*RQ3, RQ4*

Table 4-1: Identified Problem Classes

The first problem class is a perception or definition problem respectively which is solved by *RQ1*. It starts with no present definition of EABV. Thus, no common understanding on what EABV actually is prevails. One reason for this constitutes different perceptions on EABV. Different stakeholders have different perceptions on EABV. Consequently, we need to agree on a common definition regarding different perceptions and how to model it. The second problem class is represented by visibility and transparency problems solved by *RQ2* and *RQ3*. We do not know where to find, express, and leverage EABV. This problem is caused by not knowing what EA performance to measure and communicate as EABV. Additionally, we are not aware of which stakeholders, capabilities, and assets contribute to EABV. The third and last problem class is concerned about how to improve and optimise the current EA function and is solved by answering *RQ3* and *RQ4*. All four research questions, which are composed of

problems from the organization and the literature gap, are answered with our main research question on how to design a method to assess EABV.

4.2. Findings Summary

The *Findings Summary* is the output of the *Gather Information* sub-phase (cf. Figure 2-1). The findings summary can be perceived as the information and insights gained from literature reviews, stakeholder interviews, and surveys in a concise form. The first part of our findings is related to the actual research context and our research contributions which we already described in Section 2.6. This is very important due to the fact that we need to know how to shape and scope our research. Additionally, we presented the related work for our approach where we can perceive the literature gap we address (cf. Sec. 2.7). Furthermore, our insights on EA, performance measurement and management, and strategy and enterprise transformation were presented in Chapter 3. Since we apply dynamic capabilities as the underlying theory, we presented how EA is related to it in Section 3.6. The key findings about EABV are found in Section 3.7. Due to the fact that our research happens within the context of ES, we additionally employ a survey or questionnaire respectively to gain insights about the current and desired future state of EA within the organizational context. In the following subsections, we present the results of our survey, what we learn about requirements, and what challenges need to be met.

4.2.1. Survey Results

Parts of our findings are derived from an exploratory survey we conduct within the company. The respondents (*n=30*) are nominated according to internally available criteria. Thereby, we distinguish three types of stakeholders: (1) *EA Customers* are stakeholders that consume EA services and request architectural work. (2) *EA Practitioners* are stakeholders designing and developing the architectural work and (3) *EA Managers* are concerned with managing the EA function. Notably, we use the same questionnaire for practitioners and managers as they are both aware of how EA works within the organization. The questionnaires target the stakeholder perception on benefits and improvement suggestions for the EA function. It is implemented using Qualtrics[2] as an online survey. The structure and items of these are available in the Appendix F. We evaluate the results using the average score on questions to highlight any significant findings. For the open questions, we process the input in order to find arguments and suggestions for certain topics, e.g. what is to be improved for the overall EA function.

[2] www.**qualtrics**.com

The evaluation of the survey leads us to the conclusion that the main things to improve are the speed and the simplicity of EA services, or in other words, make them faster to execute or consume respectively, and simpler in terms of understanding and provisioning. The complete list of the most important EA benefits relevant for our approach is illustrated in Table 4-2 and is aligned to the EA benefits framework employed in Section 3.7. Thereby, the majority of benefits fall into the operational and managerial category.

EA Benefit	Category
Cost reduction	Operational
Cycle time reduction	Operational
Productivity improvement	Operational
Better resource management	Managerial
Reduced complexity	Managerial
Improved decision making	Managerial
Faster time-to-market	Strategic
Building common understanding	Organizational
Increased stakeholder satisfaction	Organizational

Table 4-2: Most important EA benefits relevant for our focus

4.2.2. Challenges

Conducting EA assessments, both continuous and periodic pose various challenges (Meyer and Helfert 2012). To be aware what stakeholders need to consider while assessing EA, we compile a list of issues or problems respectively that account for these challenges. They are partly taken from literature (cf. references in (Meyer and Helfert 2012)) but predominantly from industry practice. We identify a set of categories for which different challenges and problems exist for both, continuous and periodic EA assessments (Meyer and Helfert 2012). The summary of challenges is outlined in Table 4-3 and further explained in the following subsections.

Category	Challenges and Problems
Business Need	• Perception/Definition problem • Visibility/Transparency problem • Improvement/Optimization problem
Technical	• Technical infrastructure support for assessment and measurement • Data quality
Managerial	• Assessment feasibility • Assessment support
Cultural/Social	• Introduced overhead of conformance and measurement • Adoption and scope of conformance and measurement • Nomination of stakeholders
Alignment	• Goals and metrics alignment • Alignment between EA maturity and EA performance assessments

Table 4-3: Challenges and Problems for the Continuous EA Assessment

4.2.2.1. Technical Issues

Periodic assessments usually are conducted survey-based which is done by identifying the respondents who answer the questionnaire (Meyer et al. 2011). This can be done using a web-based application where respondents submit their results to the assessment owner which in turn evaluates all the results and assigns a maturity level. The system support for such assessments in terms of scalability and performance pose a minimal technical challenge for a global company. In contrast, continuous assessments demand a much higher degree of system support. It must be properly integrated into existing infrastructure. The big question here is: Do we have the necessary IT infrastructure to conduct continuous EA assessments? Of course this question requires that we already know how the solution would look like because we need to know about system's performance, accuracy, and scalability. Additionally, decisions regarding the best possible implementation in terms of available and supported technology might be challenging. Introduction of a continuous measurement system might also involve the change of existing processes to incorporate the projected measurement capabilities. The technical problems and corresponding questions are summarized in Table 4-4.

Technical Problem	Periodic	Continuous
Infrastructure	• What kind of systems do we need to conduct a periodic assessment?	• Do we have the necessary infrastructure in terms of capacity and performance to conduct continuous EA assessments?
Implementation	• How do we conduct the survey, e.g. web-based?	• How do we implement the measurement process? • Which technology is available and which one will be used? • Can we automatically collect data from projects and processes?

Table 4-4: Technical problems of EA assessments

4.2.2.2. Managerial Issues

When introducing some kind of measurement within an enterprise, it is crucial to get support from (senior) management. Without their backup, initiatives in that area will likely fail. Assessments and measurements are not free. They consume time and money and therefore it is essential to get management backup. Consequently, managers are concerned about the return of investment (ROI). Both assessments, periodic and continuous, must be feasible. This is a requirement. Managerial problems and corresponding questions are summarized in Table 4-5.

Managerial Problem	Periodic	Continuous
Financial	• Will the assessment be financed?	• Will the assessment be financed?

	• Will it pay off to make an EA maturity assessment?	• Will it be feasible to run a continuous EA assessment?
Support	• How do we get management support and backup for assessments?	• How do we get management support and backup for assessments?

Table 4-5: Managerial problems of EA assessments

4.2.2.3. Cultural and Social Issues

As EA is an overarching discipline in terms of scope, certain stakeholders seem to have difficulties seeing the big picture and the benefits provided for the whole organization itself. Consequently, certain EA artefacts and the EA compliance process are perceived as overhead for their personal work. At a certain sphere of influence, stakeholders are not aware of the impact of holistic measures and are therefore not willing to adapt as easily as hoped. Hence, adoption is a major concern in a global company as the goal is to get all organizations in line with current architectural practices including assessments. Introducing assessments, whether periodic or continuous require the appropriate nomination of stakeholders that are accountable and participate in those. We want to get the right information from the right people at the right time. Regarding scope, we do not want to measure a single person in every aspect. This leads to some kind of Big Brother experience and is not desirable. However, we want to measure the organizational performance, especially with continuous assessments and therefore the appropriate stakeholders and teams within the organization need to be targeted. Table 4-6 summarizes cultural and social problems and corresponding questions.

Cultural/Social Problem	Periodic	Continuous
Adoption	• How will stakeholders adopt to periodic assessments?	• How will stakeholders adopt to continuous assessments? • How can we maximize stakeholder participation?
Nomination	• Who are the appropriate respondents for a survey-based assessment? • Who will be responsible for conducting the assessment?	• Who are the appropriate respondents for survey-based metrics? • Who will be held accountable for the assessment process and the metrics?
Scope	How do we find the right scope of assessment in terms of individual stakeholders and teams?	• How do we find the right scope of assessment in terms of individual stakeholders and teams?

Table 4-6: Cultural and social problems

4.2.2.4. Alignment Issues

Many companies struggle with choosing the right metrics for their goals. Goals should be measured in a reasonable way in order to improve strategic decisions. Even choosing the right

goals poses a challenge as they need to fulfil certain criteria (Doran 1981). This problem is not specific to EA but can be found in various efforts to measure organizational performance. The goal-metric alignment is crucial for the assessment of BITA as business goals need to be assessed in terms of IT fulfilment, i.e. how well IT supports business goals. The literature on BITA and the incurred challenges is exhaustive, e.g. (Luftman 2000; Masak 2006; Parker et al. 1988; van der Raadt et al. 2005) The importance of goal – metric alignment is also described in (Ebert et al. 2005). In practice, we can also find the phenomenon that metrics are sometimes substituted as goals, meaning that stakeholders just work to achieve what the metric measures without keeping the actual goal in mind. We already mentioned that periodic and continuous assessments should be aligned. The reason to align these assessments is that they impact each other. For example, the introduction of a continuous measurement alone could result in an increased EA maturity. The alignment problems are outlined in Table 4-7.

Alignment Problem	Periodic	Continuous
Goal – Metric	• Are our goals reflected with the right metrics to determine EA maturity?	• Which metrics will be assigned to which goals? • Can we continuously track and monitor our goals with the chosen metrics? • Are our business goals aligned with our IT goals?
Assessment	• What input and output needs to be aligned with continuous assessments?	• What input and output needs to be aligned with periodic assessments?

Table 4-7: Alignment problems for EA assessments

4.2.3. Requirements

Another important part of our findings in order to establish a continuous EA assessment is the awareness of the necessities to achieve goals in a desired manner, namely requirements. They state what functional and constructional properties an artefact should have dependent on stakeholder goals (Greefhorst and Proper 2011). Additionally, they form the basis for evaluation criteria (cf. Sec. 6.5.1) and are closely related to EA principles which drive requirements design and conversely impact the design of architecture principles (cf. Sec. 5.1.3). These requirements are part of the method design and therefore part of our main research question. Requirements management plays a central role in the TOGAF Architecture Development Method (ADM) (The Open Group 2011b) as it is continuously driven by a requirements management process. Thereby, the ability to cope with changes in requirements is crucial. Stakeholders have goals that are supported by requirements. When defining requirements, we need to take assumptions, constraints, principles, policies, and standards into account as these are present in the organizational environment. Incorrect requirements are largely responsible for failure of

information system projects (Hsu et al. 2012). We need to be aware of the fact that despite properly defining requirements, there exists a gap in practice between requirements fulfilment and user acceptance and hence adoption for different stakeholders (Gohmann et al. 2013). Requirements impact the definition of principles (cf. Sec. 3.1.4) which ensure their attainment. Moreover, requirements impact the design of EABV assessment approaches whereas principles guide their design. The resulting view on requirements in context is depicted in Figure 4-1.

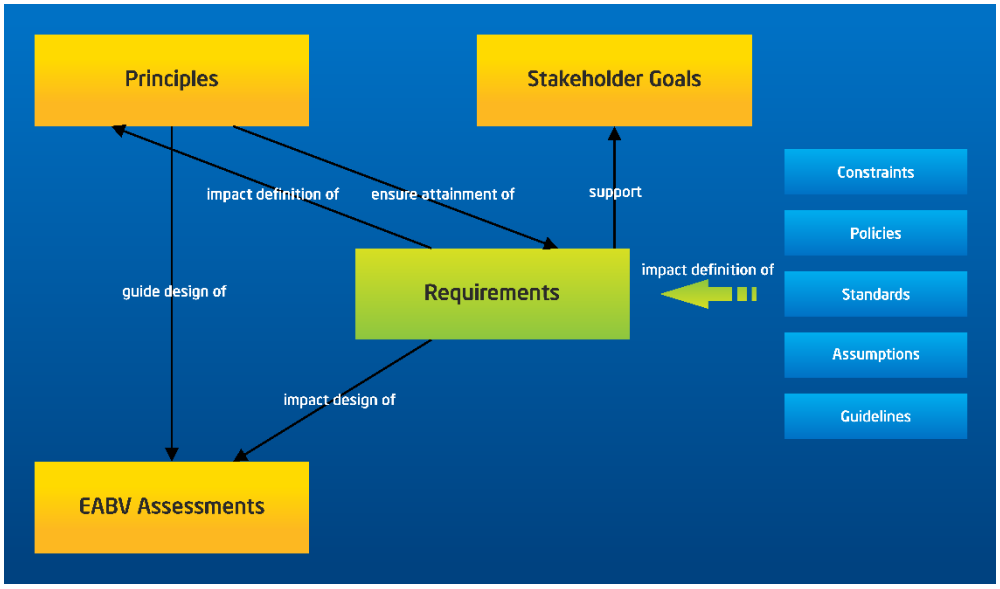

Figure 4-1: EABV requirements in context

(Bernus and Nemes 1997) distinguish between strategic and technological requirements. For our purposes, we discern four types of EABV assessment requirements (Robertson et al. 2006) which also comprise strategic and technological requirements:

- *Business requirements* capture the needs from a business managerial perspective and deal with financial and strategic issues as well as organisational aspects and participating stakeholders.
- *Architectural requirements* frame the scope and integration issues for assessments. In addition, the adherence to architecture principles, policies, and standardisation is handled.
- *Functional requirements* target the actual execution of process-based assessments and define the necessary specifications for users, i.e. stakeholders conducting the assessments. Additionally, they are concerned with technological intricacies. Functional requirements are handled by many methodologies, especially in software architectures (Chung et al. 1999).
- *Non-functional requirements* elaborate qualitative issues regarding the input and output of the assessments, e.g. data quality and reasonable reports.

When looking at related work, we can find few well defined requirements. Hence, we want to formulate requirements for continuous EA assessments. When designing IT artefacts for an organizational context we need to be aware of what our method needs to achieve in what manner given this context. In Table 4-8, we summarize the requirements for our EA assessment method. For each type of requirements, we list several requirement statements that can be subsumed to a particular requirements class. A requirement class is the quality of an IT artefact that a given requirement will impact to achieve and sustain its intended purpose or objective respectively. Architectural qualities are often expressed as requirements (Gross and Yu 2001) which therefore can be stated for IT artefact qualities. Our DSR profile (cf. Sec. 2.5) effects these IT artefact qualities which become especially relevant when choosing DSR evaluation criteria (cf. Sec. 6.3).

Type	Requirement Statement	Requirement Class	DSR Profile
Business	• Must be feasible	• Feasibility	• Practicality
	• Must integrate into current practices	• IT flexibility	• Flexibility
	• Overhead must be minimized	• IT efficiency	• Practicality
	• Must improve decision making	• Utility	• Practicality
Architectural	• Must be adequately scoped	•	• Simplicity
	• Must integrate into current practices	• IT flexibility	• Flexibility
	• Must adhere to EA principles and IT Building Codes (Policies)	• Conformance	• Conformance
	• Must be aligned with the EA framework	• IT flexibility	• Evolvement
Functional	• Must provide user interface	• Utility	• Practicality
	• Must be supported by current tools	• IT flexibility	• Flexibility
	• Must close feedback loop on project scope	• Utility	• Practicality
	• Must be aligned with periodic (maturity) assessment	• Utility	• Flexibility
Non-functional	• Results must possess a certain quality	• Data quality	• Rigor
	• Results must be meaningful	• Data quality	• Rigor
	• EABV assessment must be understandable	• Understandability	• Simplicity

Table 4-8: Requirements for continuous EA assessments

Feasibility is an important requirement class for all IT artefacts since it determines whether a project or a set of activities in general is able to be executed within given constraints such as budget and personnel availability. Feasibility is a consequence of the practicality demand in the DSR profile (cf. Sec. 2.5). Moreover, feasibility becomes relevant for our evaluation and will be discussed in Section 6.3.1. *Flexibility* is of major concern for our approach. In management literature, it is defined as the ability of a resource (asset) to be used for more than one end product (Duncan 1995). In that regard, IT artefacts are in fact assets. As we outlined in our DSR profile (cf. Sec. 2.5), flexibility in terms of design science means that we must employ a research process that is able to cope with a change in requirements or the organizational environment respectively. Hence our DSR ABC inherently embraces dynamic environments and allows for defining and revising requirements for each of the IT artefacts as part of their design. In an information system context, flexibility is conceptualized along two dimensions (Byrd and Turner 2000): (1) *modularity* which is the capability to add, remove, or change IT artefacts easily avoiding major drawbacks, and (2) *integration* which is the capability to connect IT artefacts (connectivity) and to exchange information (compatibility). *Efficiency* is the ability to build and operate an IT artefact without wasting resources or assets respectively. In other words, it represents the relationship between the IT artefact output and the invested efforts to build it (Schmidt and Buxmann 2011). Efficiency is impacted by practicality in terms of the DSR profile. *Conformance* is characterized by the adherence of IT artefacts to certain rules, policies, or regulations. This is most relevant in the domain of IT and EA governance (cf. Sec. 3.1.3) and is also a criteria for the DSR profile. *Utility* means that an IT artefact must assist in some way to achieve business goals and benefit the organization (Österle et al. 2011). We also employ utility as one of our evaluation criteria (cf. Sec. 6.3.4). It is impacted by both, practicality and flexibility regarding the DSR profile. *Data quality* refers to the degree data represents the real-world construct and is fit for its intended uses. It is impacted by rigor. More on information and data quality including its dimensions can be found in (Heinrich et al. 2007; Pipino et al. 2002; Wang and Strong 1996). *Understandability* as a quality is the ability to grasp or know the meaning of built IT artefacts. It is greatly impacted by complexity or its antipode simplicity that determines how comprehensive an IT artefact is in terms of certain criteria, such as involved components and the nature and number of their relationships. Understandability is also a DSR evaluation criteria for our approach (cf. Sec. 6.3.4). It is impacted by a simplicity demand in terms of the DSR profile.

Since the list of requirements, qualities, and DSR research profile dimensions are adaptable, we need to mention that these may vary depending on the business need and organizational

environment. In the next Section, we describe our solution proposal and how to address the business need regarding all requirements.

4.3. Solution Proposal: The EABV Assessment Method

The *Solution Proposal* is the output of the *Advertise Solution* sub-phase of the ABC (cf. Section 2.1). When advertising a solution, we need management support for a Proof of Concept (PoC). The projected solution in the form of several IT artefacts represents the concern of this sub-step. Connecting to the desired output of our research effort in Section 1.1, we develop the *EABV Assessment Method* (EABV AM) as the overarching IT artefact in terms of DSR. Thereby, a method can be either a guideline for design practice from a meta-design viewpoint, or as part of a situational system or process (Goldkuhl et al. 2010). The scope of this work focuses on the guideline aspect. A method was perceived as the most appropriate solution for our purpose as it best captures our research and organizational requirements in alignment with the research profile. As already mentioned in our research methodology in Chapter 2, IT artefacts must provide the needed utility to solve a relevant business problem by employing rigorous methods and tools from the existing knowledge base. In order to cope with the problems currently at hand (cf. Sec. 4.1.1), the EABV AM constructs, operates, and improves four different artefacts, namely the *EABV Framework* (EABV FW), the *EABV Assessment Process* (EABV AP), the *EABV Model* (EABV M), and the *EA Balanced Scorecard* (EA BSC) which will all be described in the next Chapter 5. The EABV AM, as top-level IT artefact enables the construction of the EABV FW including the other artefacts, the actual operation, and their improvement by specifying necessary activities. Furthermore, it describes the necessary roles and responsibilities to achieve an effective EA assessment. In contrast to (Gammelgard et al. 2010), we are not assessing specific business scenarios but strategic goals or objectives respectively that are found in projects with EA contribution (cf. Sec. 5.5). In other words, we need goals to measure if we have been successful or not.

The EABV AM overview is depicted in Figure 4-2. The environment including the current EA function and the knowledge base are the basic source of input. From there we get strategic goals to assess, as well as stakeholder input to provide data for metrics. As a matter of fact, the current EA environment generates an information need which poses the question: how does the EA function perform? The answer is provided by the method (and the other artefacts) in the form of an information product (ISO/IEC 2007). In the following Section, we describe the individual phases of the EABV AM.

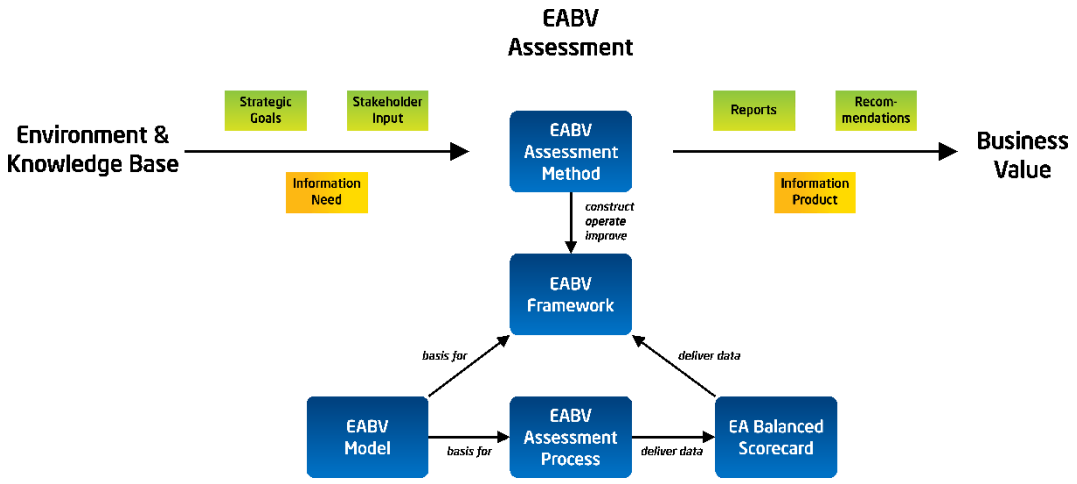

Figure 4-2: EABV Assessment Method Overview

4.3.1. Method Phases

The EABV AM is outlined in Table 4-9. As we can see, we have three main phases: (1) *Construction* is the phase that builds our IT artefacts by employing the ABC (cf. Sec. 2.1). It takes stakeholder input, strategic objectives, the environment, and the knowledge base Notably, IT artefacts need to be adapted or customized for every company during instantiation although the basic structure and purpose remains as originally intended. (2) *Operation* describes the use of the method in daily practice. Operational data will be transformed into meaningful reports which serve as basis for improvement in terms of various criteria depending on the actual strategy. (3) *Improvement* serves as means of evolving the method. During Improvement, we actually revise the strategy which translates into new or updated strategic objectives. These serve not only for particular aspects of the EA function itself, but also can lead to a new construction phase of the EABV AM. This is a necessary conceptual requirement since the dynamic organizational environment could change the way we assess EA. Notably, this Thesis is focused on the Construction phase. We will describe the phases in more detail in the following subsections.

	Input	Output	Actions/Techniques/Methods

Construction	• Stakeholder input
	• Strategic objectives
	• Environment
	• Knowledge base
		• EABV M
		• EABV AP
		• EABV FW
		• EA BSC
			• Design Science Research
			  ○ Analysis
			  ○ Design
			  ○ Evaluation
			  ○ Diffusion

Operation	• Operational data • Stakeholder input	• Information product • Report	• Measure, analyse, and communicate according to EABV AP and EA BSC

Improvement	• Information products • Reports	• Guideline • Recommendation	• Evolve • Revised strategy • Decision support techniques

Table 4-9: EABV Assessment Method overview

4.3.1.1. Construction

The focus of our Thesis lies on the *Construction* phase since it encompasses all relevant DSR research activities which resemble the phases of the DSR ABC. In other words, this phase describes how to build the EABV AM without prior means of EABV assessments. This phase may vary for every organization or enterprise respectively, especially the design phase. The summary of this phase is illustrated in Table 4-10.

	Input	**Output**	**Actions/Techniques/Methods**
Analysis	• Stakeholder input • Information need • Environment • Knowledge base	• Problem description • Findings summary • Solution proposal	• Identify problem/solution • Gather information • Advertise solution
Design	• Stakeholder input • Information need • Environment • Knowledge base	• Artefact objectives • Artefact requirements • Artefact description	• Artefact adaption • Artefact customization • Artefact design
Evaluation	• Stakeholder input • IT artefacts • Environment • Knowledge base	• Preliminary results • Further research agenda	• Evaluation method (cf. Sec. 6.4)
Diffusion	• Relevant documentation • Literature review	• Publication • Various documents	• Authoring • Presenting

Table 4-10: EABV Assessment Method: Construction phase

4.3.1.2. Operation

Operation is putting the method into the daily work practice in the organizational environment. This means, that is has passed the Construction phase and the evaluation was successful. It has to be mentioned that in order to evaluate the method, we need to operate it after instantiation. In other words, the basic activities of this phase already happen during Construction in order to get insights about the utility and viability of the approach. Operation is depicted in Figure 4-3.

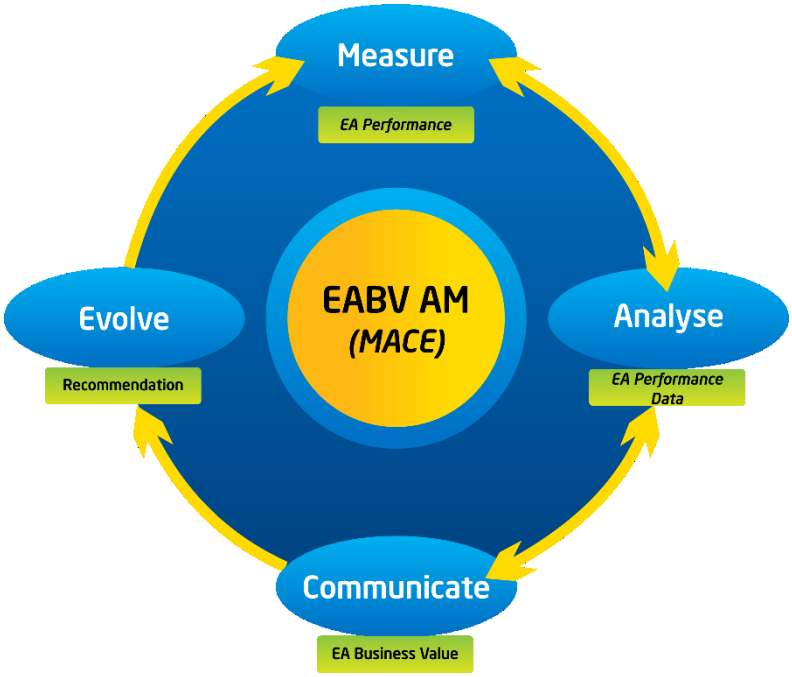

Figure 4-3: EABV AM Operation — main phases (MACE)

The Operation phase is characterized by four main phases. In the first phase, *Measure*, we take EA performance (in our case EA projects or projects with EA contribution respectively) as input and measure it. IT artefacts involved in this phase are the EABV AP and the EA BSC as they guide involved stakeholders on how to conduct such measurement. Next, we have the *Analyse* phase where we take EA performance data as input and analyse it according to the EABV AP. Thereby, stakeholders are rather free to choose which kind of analysis approach they want to employ. Thereupon, we generate an EA performance data report. This report serves as input for the next phase, *Communicate*. Here, we generate an information product with the actual insights about EABV. Hence, we translate EA performance data and report it as EABV. IT artefacts involved here are the EABV FW, the EABV AP, and the EA BSC. The last step is called *Evolve*. We take information products, reports, and an information need as input in order to revise goals and objectives and give recommendations for improving the EABV AM itself as well as the EA function. This can lead to an evolved or revised assessment. The notion evolve here is to be understood as maturing the measurement itself. For example, we could find out that a certain point of data collection is more efficient, or that a particular form of analysis is better suited to inspect EA performance data. The IT artefact involved here is the EABV FW. All phases together constitute the so called *MACE scheme*. It is summarized in Table 4-11.

	Input	Output	Actions/Techniques/Methods
Measure	• Stakeholder input • Goals and objectives	• EA performance data	• Measurement according to EABV AP and EA BSC

	• EA performance • Information need		
Analyse	• EA performance data	• EA performance data analysis report	• Analysis according to EABV AP
Communicate	• EA performance data analysis report	• Information product • EA Business Value insights	• Translating EA performance data to EABV • Reporting
Evolve	• Information products • Report • Information need	• Revised goals and objectives • Recommendations	• Recommendations for o Improving EABV AM o Improving EA function • Evolve/revise measurement

Table 4-11: EABV Assessment Method: Operation phase

4.3.1.3. Improvement

Improvement is the last phase of the EABV AM. It allows for major changes of the EABV AM. Improvement can happen either by employing the ABC design/evaluate phases or even by employing a completely different approach, such as the Continual Service Improvement in ITIL (Office of Government Commerce 2007; Schmidt 2009). An improvement can be triggered from the Evolve phase during Operation. In short, Improvement follows the Design and Evaluate steps of the DSR ABC. In contrast to Operation, research is only involved in Construction and Improvement due to major changes needed for evolving the method.

4.3.2. Method Scope

Having described the method overview, it is now time to describe what kind of assessments we can undertake. The levels of assessment are in line with the levels of strategic transformation explained in Table 3-4. As depicted in Figure 4-4, we distinguish between three kinds of assessments. The first is the *strategic level* assessment which is closely tied to strategic planning, an enterprise function to define and plan an organization's strategy. Notably, we enter the domain of strategic management at this point which is where the EA function can unfold its true value (Ahlemann et al. 2012) (cf. Section 3.3). On this level, we find the architectural principles we discussed in Section 3.1.4 as they affect the organization as a whole. On a *tactical level* assessments can be conducted by aggregating project level assessments by means of grouping projects into programs and assessing the programs instead. As we can see, we focus on the *operational level* although from a design point of view, our approach is applicable on all levels. Nevertheless, in order to evaluate this method, we choose to focus on a project rather than a strategy since relevant data is better accessible as well as being more flexible in terms of time and budget. Strategy and tactical evaluation can take several years and is out of scope for this Thesis.

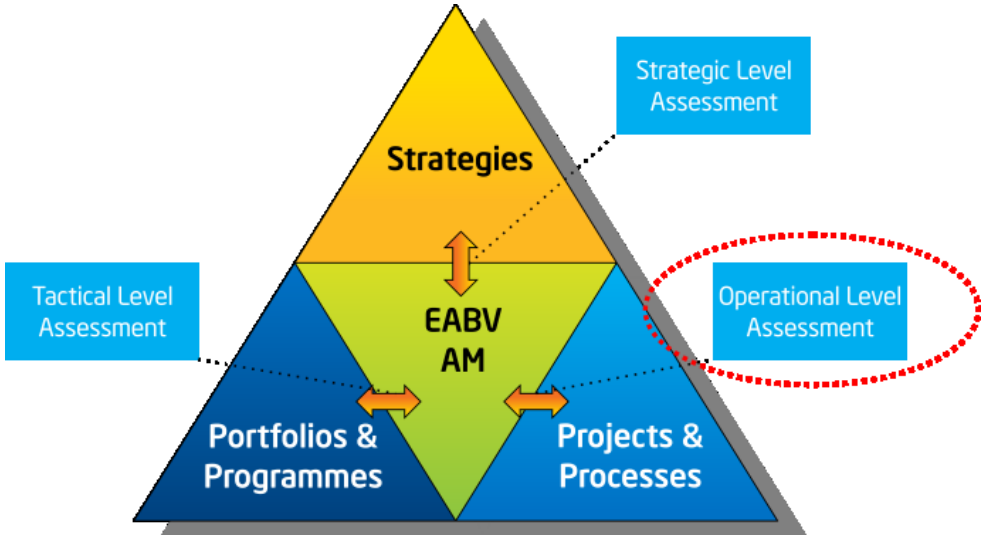

Figure 4-4: EABV AM — Assessment Scope

4.4. Chapter Summary

In this Chapter, we described the first phase of our DSR ABC, namely *Analysis*. The first output of this step is to provide a problem description stemming from a business need. This identification was triggered by our corporate partner and underpinned through findings in literature that confirms the struggle on how to understand and assess EABV. Further findings included survey results from industry stakeholders that yielded the perception that EA needs to perform more efficiently with less complexity as this would have the most impact on EABV. In addition, we found out about requirements and challenges that influence our work. Finally, we proposed a solution based on findings in literature and information received from our corporate partner. This solution is therefore an information synthesis with innovative content extensions based on the organizational environment and the corporate and academic knowledge base. We outlined the concept and phases of the EABV assessment method with the construction, operation, and improvement of four additional DSR artefacts, namely the EABV framework, the EABV model, the EABV assessment process, and the EA balanced scorecard that address identified business needs.

5. Design

"Design is not just what it looks like and feels like. Design is how it works."

Steve Jobs (1955 — 2011)

We now examine another main phase of our ABC, namely the *Design* phase. Here we build our artefacts and instantiate them. First, we need to deliver an artefact specification which describes the objectives and requirements of each IT artefact as well as principles that guide our design. After that, we give a description of our artefacts and explain relevant design choices. Since we are not only measuring performance with our assessment approach but also provide means to manage it, we need to address a set of questions as proposed by (Otley 1999):

1. What are the key objectives for the organization's overall success, and how does it evaluate this success?
2. What strategies and plans has the organization developed and what are the processes and activities to implement these successfully? How is the performance of these activities measured?
3. What level of performance does the organization need to achieve in the areas defined in the above two questions, and how does it set adequate performance targets for them?
4. What rewards will stakeholders gain by achieving these performance targets (or penalties for failing to achieve those respectively)?
5. What are the information flows (feedback and feed-forward loops) that are required to enable the organization to learn from its experience, and to adapt its current behaviour based on those learnings?

As already mentioned in Section 4.3.1, the EABV AM constructs, operates, and improves the remaining artefacts, namely the *EABV Framework* (EABV FW), the *EABV Assessment Process* (EABV AP), the *EABV Model* (EABV M), and the *EA Balanced Scorecard* (EABV BSC) which is illustrated in Figure 5-1. Therein, the arrows denote the relations between those artefacts. The EABV M serves as basis for the EABV FW and the EABV AP. The latter delivers relevant EA performance data to the EA BSC which in turn delivers EA performance data to the EABV FW in the form of relevant goal and metric information.

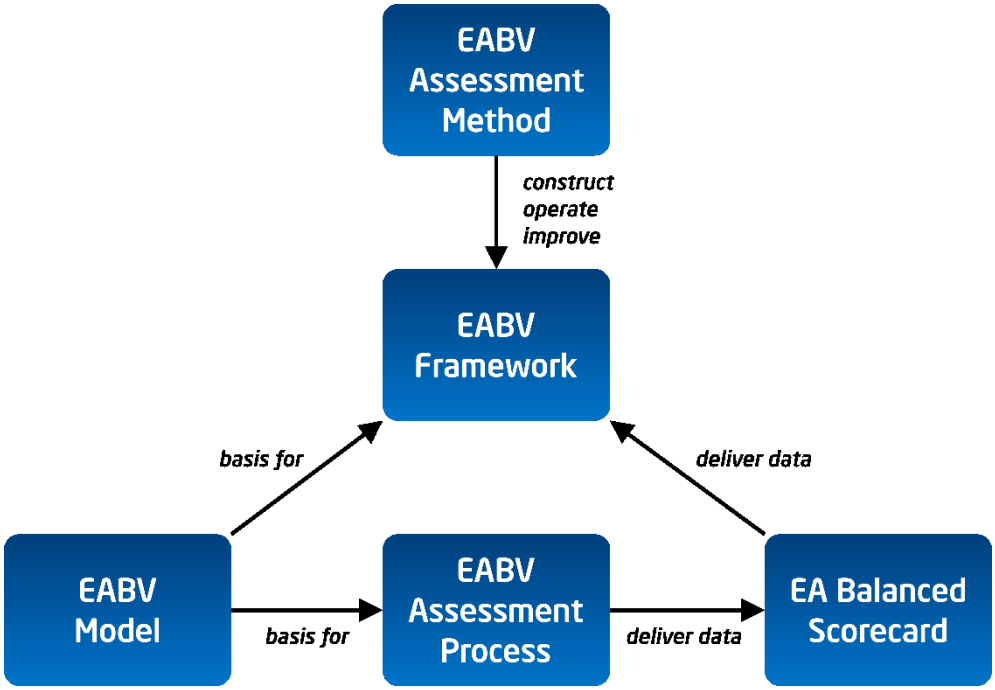

Figure 5-1: DSR Artefact Overview

Now, we describe each artefact and how they are related together in the bigger context, A summary of how each of the artefacts is instantiated is described in Section 7.3.

5.1. Artefact Specification

An artefact specification consists of the artefact objectives and artefact requirements. This forms the basis for the actual artefact design. The actual form of how objectives and requirements are defined and classified can vary for each research project although we deem it crucial to align the objectives with the research questions. In addition, we need to mention that architecture principles already in place from our corporate partner guided our design. To generate the artefact specification, we follow a scheme based on Figure 4-1 and (Greefhorst and Proper 2011). Stakeholder have goals or objectives respectively supported by stakeholder requirements which need to be agreed to. These agreed to requirements ensure the attainment of design principles which are refined with design instructions. All artefacts are versioned in order to better keep track of the evolution and also to better support evaluation.

5.1.1. Artefact Objectives

Connecting to the problem description given in Section 4.1.1 we can determine the objectives of our artefacts. This means that these objectives should be the solution to the encountered problems and business needs. Since we have overarching or general goals when introducing our assessment method, the artefact objectives need to be linked to the research questions. The

objectives for each of our artefacts and the corresponding research questions (cf. Sec. 1.1) answered are outlined in Table 5-1.

Artefact	Objectives	Answers
EABV Framework (EABV FW)	Improve EABV, EA adoption, EA collaboration, EA Governance, BITA, EA practices and EA maturity	*RQ3, RQ4*
EA Assessment Process (EABV AP)	Improve EABV, EA adoption, EA collaboration, EA Governance, EA practices and EA maturity, find the EABV within the organizational context and represent it according to the value model	*RQ2*
EA Balanced Scorecard (EA BSC)	Improve IT decision making, provide measuring of KPIs for various views	*RQ2, RQ3*
EABV Model (EABVM)	Define integrated business value model for EA in an organization consistent way	*RQ1*

Table 5-1: Artefact objectives

5.1.2. Artefact Requirements

It is important that we are aware of the requirements originating from the artefact objectives and therefore from stakeholders and the enterprise context (cf. Sec. 4.2.3). We now present a summary of the requirements for each of our artefacts in Table 5-2.

Type	Requirement Statements	Artefacts
Business	• Must be feasible.	All
	• Must provide business value.	All
	• Must support decision making.	All
Architectural	• Must fit in with the current EA function, tools and frameworks.	All
	• Must be flexible to cope with architectural changes.	EABV FW, EABV AP
Functional	• Capture EABV in predefined output.	EABV AP
	• Provide deliverables at various stages.	EABV AP
	• Deliverables must be usable for strategic planning process.	EABV AP
	• Must be executable as a process.	EABV AP
	• Must be executable on-demand.	EABV AP
Non-functional	• Deliverables must be reliable and accurate.	EABV AP
	• Execution must be ease-of-use.	EABV AP
	• Must be secure and compliant.	EABV FW, EABV AP
	• Must be scalable.	EABV FW, EABV AP

Table 5-2: Artefact requirements

5.1.3. Artefact Principles

We already explained several types of principles, namely DSR principles and EA principles. Since we can find various other types of relevant principles, it is time to put them in context and illustrate their relationship along with the contribution from our research endeavour. Notably, most large companies have EA principles in place. This is also the case for our industry partner. We are not constructing a new architecture, but rather we integrate a new method into the current architecture. Hence, architecture principles apply to our approach. Besides the principles we adhere to from our corporate partner, we derived several other EA principles that are crucial for the design and employment of an EABV assessment approach based on identified requirements. Contingency factors such as the organizational environment, technology, collaboration setting (stakeholders), and rules and regulations (in the form of already existing principles) impact the creation of our principles as well as the academic knowledge base. In other words, EA principles are given and further EA principles are created that guide and regulate the construction, operation, and improvement of an EABV assessment approach. Notably, such EA principles must be able to guide and rule any form of EABV assessment approach and fulfil all of the EA principle qualities outlined in Section 3.1.4. As a result, we created the following set of EA principles that drive the behaviour for the construction, the operation, and the improvement for an EABV assessment method, and therefore all of our IT artefacts.

1. An EABV assessment approach shall ultimately generate value.
2. Constructing, operating, and improving an EABV assessment approach shall be feasible.
3. Common definitions and understanding of an EABV assessment approach shall be facilitated.
4. An EABV assessment approach shall be flexible.
5. An EABV assessment approach shall be goal-driven.
6. An EABV assessment approach shall generate good quality output.
7. Output of the EABV assessment approach shall be made persistent.
8. Output of the EABV assessment approach shall be communicated to all relevant stakeholders (feedback loop).
9. An EABV assessment approach shall integrate with current practices.
10. An EABV assessment approach shall integrate with current technologies.

The full list of EA principles including statements, rationales, and implications is outlined more detailed in the Appendix E.

5.2. EABV Framework

The *EABV Framework* (EABV FW) serves as overarching artefact which comprises all other artefacts that are considered as its components. It takes strategic objectives, EA services and processes, and stakeholder information such as feedback as input. The project level data is here assumed to be included in the EA services and processes information since we are only interested in projects with EA contribution. The main objective of this framework is to reveal and finally increase the EABV as well as storing relevant assessment information. Increasing EABV can be achieved by fostering EA benefits such as BITA or cost reduction. For this purpose, we increase EA adoption and EA maturity by means of employing this framework.

- Structure and align EABV AM components
- Provide integrated access to relevant assessment information
- Increase common understanding
- Reveal and increase EABV

The EABV FW is depicted in Figure 5-2. The *Repository* serves as information base for the framework as it stores various goals, key performance indicators (KPIs) and metrics, an implementation guide on how to best instantiate the EABV FW including its components, and models and methods. Thereby, the Repository stores entities from its sub-artefacts, e.g. the goals, KPIs and metrics are taken from the Assessment Information Base (AIB) of the EABV Assessment Process (cf. Sec. 5.4) which is based on the EABV Model (cf. Sec. 5.3) from the model sub-component. The reason for designing a repository is that we need an integrated and transparent information structure which is based on various the approaches described in Section 3.2 as well as the alignment with an EA framework such as TOGAF (The Open Group 2011). The repository is actually the core of the framework as it stores all relevant information in order to assess the EA function.

The results from the continuous assessment are presented in the form of reports. Such reports summarize the EA performance data of a particular project and contain the communicated business value. The EA Balanced Scorecard is the user frontend for real time information in that matter and complements these reports. Furthermore, the EABV FW provides guidelines on how to improve strategy and increase business value from EA contributions. In our case, these recommendations are aligned with the IT-CMF (Curley 2006; Curley 2009) maturity levels,

specifically in the EAM critical capability. Both, recommendations and reports are deliverables as they need to be diffused within the company according to a certain format and due date. Recommendations are the drivers for architecture principles, which bridge the gap between high-level intents and concrete designs (Greefhorst et al. 2011). At this point, we want to mention that this framework as well as EA in general aims to successful execute the given strategy in a closed management loop manner (Kaplan et al. 2008). At the time of this writing, the EABV FW is built in version 1.0.

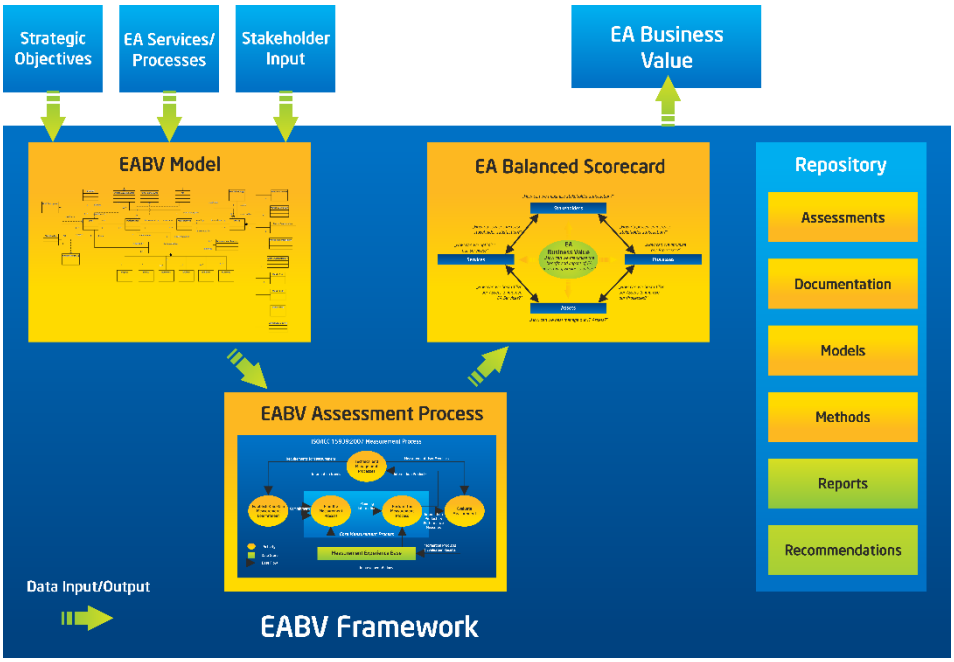

Figure 5-2: EABV Framework

5.2.1. Framework Input and Output

The EABV FW has three major input sources (cf. Figure 5-2). First, strategic goals or objects are necessary in order to conduct an assessment in the first place due to the fact that our method is a goal-driven approach. We need those goals for aligning it with adequate measures in order to capture the performance. Then, we have the EA services and processes, which are contributing to a certain project. This contribution is what we want to assess in project level context. Another very important input source is the stakeholders. They provide constant feedback and help to shape, mange, and conduct the assessment, or better, they make it possible in the first place. The output of the framework is the insights about the EABV. In other words, we know what value the EA contribution was to the firm's performance.

5.2.2. Repository

The EABV FW *Repository* is a logical container to store various components used to employ the EABV FW. In practice, this repository is a web-based portal linking to relevant documents.

In our case, it is integrated with an already available EA portal. Basically, the repository contains IT intellectual capital that is employed by the EA function to better fulfil its objectives. We will explain these components in the following subsections.

5.2.2.1. Assessments

Here, we store particular assessments with all goals, metrics, and results as well as the involved stakeholders. From a design perspective, this allows for benchmarking and aggregate reports. Additionally, we can provide historical analysis based on past assessments. Again, the EABV M serves as foundation to make assessments persistent which is in line with the concept of the Assessment Information Base of the EABV AP (cf. Sec. 5.4). We also capture the data retention policy for assessments depending on the frequency of data collection for a specific metric. The shorter the interval, the shorter the retention. Project or process performance data is generally stored from one month to one year, consolidated information products (EABV reports) are stored indefinitely for benchmarking purposes.

5.2.2.2. Documentation

Documentation is the home of descriptions, guidelines, and links to other relevant information resources. For example, it contains guides that explain how to instantiate and implement the EABV AM and its artefacts in the organizational context. Some general guidelines (principles) for instantiation hold true for every organizational context, but naturally no context is exactly the same and hence guidelines must be adapted and customized accordingly. It also includes documentation of the software implementation project of the IT artefacts. In addition, we can find relevant references to academic literature that alleviates the understanding of particular concepts. This Thesis forms a major part of this documentation.

5.2.2.3. Models

Here, we store the all relevant models that are needed to operate the EABV AM. Most importantly, we store the EABV M. This means we keep information about the high-level model as well as the conceptual, logical and physical data model. Additionally, the EABV AP process model is available here. This occurs on the conceptual level as well as a BPMN model. Moreover, links to other relevant data and process models currently in place within the organizational environment are referenced.

5.2.2.4. Methods

Here we find a list of all the methods used to construct, operate, and improve the EABV AM. Additionally, we link to relevant methods which interface with it, e.g. the company's

architecture development method. Notably, we also include our EABV AM in here. It makes itself persistent. Since it evolves over time, we want to keep track of it as a whole in this repository. Other methods include the GQM method (cf. Sec. 3.2.3) as it is used for defining goals and metrics. In addition, our evaluation method is linked here.

5.2.2.5. Reports

In this part of the repository, we provide a list of suitable reports for different stakeholders. These reports are based on the EABV M and communicate EABV based on the assessment results. We report results to three different types of stakeholders (cf. Sec. 5.5.1). For example, a report for EA managers is more focused on the financial aspects while a report for EA practitioners is more technical. In any case, we aim to report or communicate EABV in such a manner, that stakeholder value interests and expectations are considered and presented accordingly. For this endeavour, stakeholder input is crucial.

5.2.2.6. Recommendations

The design choice of including a repository for recommendations is twofold. First, our method is evolving over the years. And so is the EA function itself. Such evolvement resorts to recommendations on how to improve the EABV AM or particular artefacts. Since we are focusing on operational level assessment in this work, we can also give and store recommendations for specific projects. Second, we are interested what can be done in terms of EA maturity based on the information we assess. Therefore, we conduct an EA maturity assessment by employing the IT-CMF. This framework already offers some recommendations to improve EA maturity and therefore we want to interface with it in a way that allows us to incorporate these recommendations. We will elaborate on this alignment in Section 7.3.9. Recommendations are given towards the end of an assessment cycle as we will see when we describe the EABV AP.

5.3. EABV Model

The *Enterprise Architecture Business Value Model* (EABV M) clarifies the concept of EA business value by defining it and describing it in a greater context. Furthermore, it serves as basis for storing assessments along with goals and metrics in the in the EABV FW Repository. The need for such a model stems from the fact that no clear definition or common understanding for EABV exists within our partner company, and even in literature. We already gave the definition and the description of the conceptual EABV model in Section 3.7 whereupon the EABV M is based. The problems which are to be solved with this model are outlined in Section

4.1.1. From this needs, we can derive the objectives for this artefact which are summarized as follows:

- Define EABV in an integrated and consistent way throughout the organization by providing an EABV metamodel
- Provide a basic way to support a common understanding of EABV
- Provide a basis for storing assessments including goals and metrics that are reusable

As we can see, this artefact possesses mainly informative character besides being a reference for implementation purposes. The EABV M is illustrated in Figure 5-3 as a conceptual UML class diagram in order to convey the fundamental concept of our approach. The importance of conceptual modelling is further discussed in (Wand and Weber 2002). While employing an UML class diagram notation on a conceptual level, it has to be noted that alternate modelling languages could be adopted. This conceptual class model marks the starting point for the subsequent data modelling approach described in Section 5.3.1. The key points of this model are formulated as follows:

- *Strategy* from *Stakeholders* defines *Goals*
- *Goals' Performance* is measured by an *Assessment* by employing *Metrics*
- *Goals* have *Critical Success Factors*
- *Key Performance Indicators* are *Metrics* to measure *Critical Success Factors*
- *Performance* determines and is translated into *Business Value*
- *Goals* drive *Business Value*

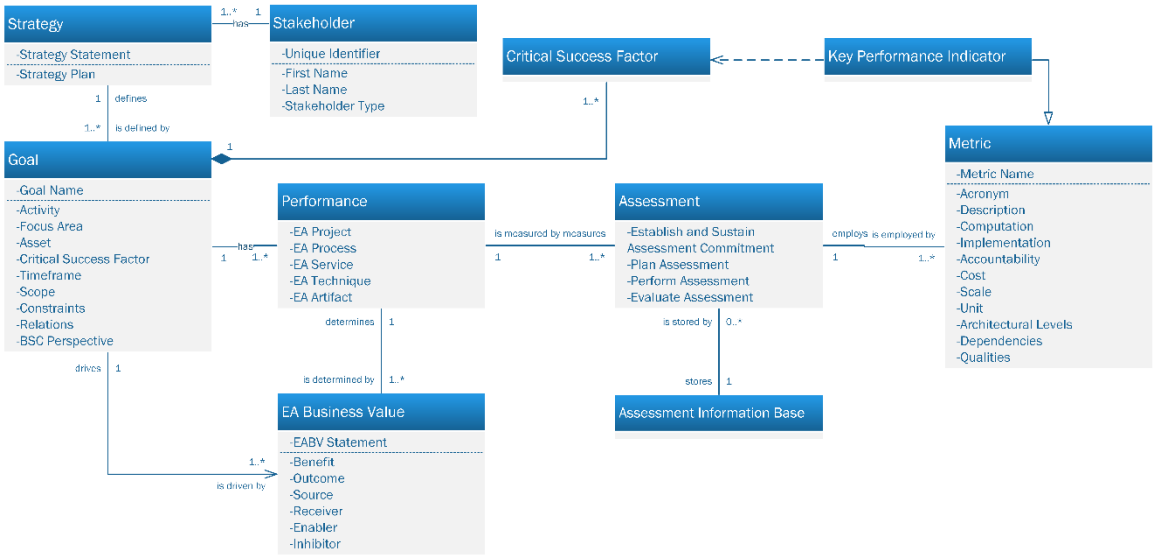

Figure 5-3: EABV Model as conceptual UML class diagram

As we can perceive from the model, the set of attributes constitute a template for goal, metric, and business value. We will describe those in the next sections along with the conceptual data model.

5.3.1. Conceptual Data Model

Our data modelling efforts start with the conceptual data model. Herein, we choose the most important entities to explain the basic nature and layout of our approach. It is a high level description for what is relevant to the business. In our case, how EABV is assessed. The conceptual data model is depicted in Figure 5-4 using the Crow's foot notation. Although the choice of notation is arbitrary, we opted for this notation as the data architects of our corporate partner employ it and therefore alleviates common understanding in this given organizational environment. As we can see, an assessment is conducted by stakeholders which have different forms of participation depending on their roles and responsibilities. An assessment yields results. These resemble communicated EABV, the satisfaction of the information need. Communicated EABV results are considered as information products in the form of EABV reports. It comes to no surprise that we need various stakeholders to conduct an assessment. An assessment needs goals as it is driven by them. For these goals, we need several metrics that measure those goals. Consequently, we designed a goal-driven approach to assess EABV. Just employing metrics alone without the relation to any sort or goals is rather likely to be a failure (Dekkers 1999). We will further define these entities in the following subsections and take a closer look at the EABV M when instantiating it by describing the logical data model and physical database in Section 7.3.1 and in Appendix A.

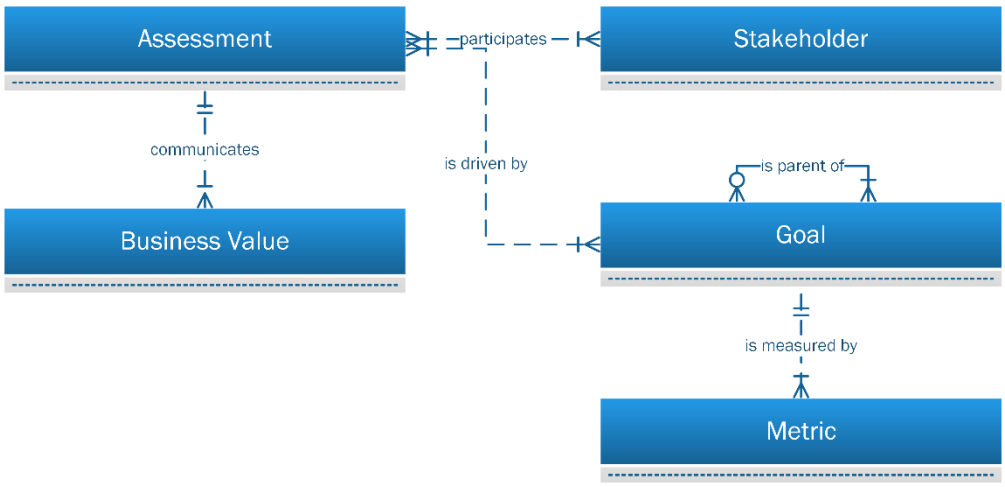

Figure 5-4: Conceptual data model

5.3.2. Assessment

An assessment is a method or process that informs us about current performance of an enterprise function or components thereof. Performance can be described as purposeful actions taken today to produce meaningful results tomorrow (Neely 2004). Assessment is not only about measuring performance. It also comprises the activities of analysing performance data, communicating results, and the evolvement that is triggered by setting actions towards an improvement based on those results (cf. Sec. 5.3). As already mentioned in Section 2.6, we are focusing on continuous EA assessments.

5.3.3. Goals

A goal is a statement of intent to direct an organization which is used to measure an organization's (stakeholder's) success, and serves as time-bounded milestone for an organization (stakeholder) to demonstrate progress. This definition is based on the definitions of goals and objectives in (The Open Group 2011a). For our purposes, objectives are sub-goals that are measured. Our model give us the goals' structure and the description of content based on the software-level goal formulation by (Basili et al. 2009). Basically, by using this template, we can insert new goals that are precisely described and can be reused. Additionally, it determines how goals are stored. Every goal has a *name* usually stating the basic intent. *Activity* describes what needs to be done to achieve this goal. The *focus* further explains the key aspect of this activity. The *asset* clarifies which resource or asset respectively is integrated, reconfigured, gained or released. This is in alignment with the activity description. The *critical success factor* constitutes the target or magnitude that stating whether the goal was successfully achieved or not. Success can be defined in terms of making progress towards strategic goals, but often success is simply the repeated, periodic achievement of an operational goal (e.g. 99% server uptime).

We also need to be aware in which *timeframe* this goal needs to be achieved. The *scope* limits the activity to certain domains, areas of application, or objects. *Constraints* give a description what kind of limits or boundaries will be encountered while aiming to achieve this goal. For example, we might have a limited budget or personnel availability. *Relations* inform us about which goal is impacted by this goal and vice versa. This reflects the content of a strategy map as we will describe later in Section 5.5.5.

When focusing on operational level assessment, we can opt to choose already defined project goals if appropriate. This is the usually the case when we have pure EA projects. In case of projects with only partly EA contribution, it proves to be useful to choose goals that are aligned

to project goals, but emphasize on the actual EA contribution and the objectives related to this effort. An example goal is outlined in Table 5-3. We will revisit goals as part of our case study in Section 7.3.5.1.

Name	Name of the goal
Activity	Increase
Focus Area	Customer satisfaction
Asset	Product X
Critical Success Factor	15% reduction of customer complaints
Timeframe	12 weeks after release
Scope	SAP products
Constraints	Product price and functionality
Relations	Can conflict with…/Has synergies with…
Perspective	EA BSC perspective (cf. Sec. 5.5)

Table 5-3: Example goal

5.3.4. Metrics

In general practice, the terms metric, measure and indicator are often confused or used interchangeably. In some instances, this may pose no problem due to their actual similarity. Nevertheless, we want to distinguish between those terms by providing clear definitions (Bundschuh and Dekkers 2008).

Measure – The aim of measures is to describe certain aspects and characteristics of business functions. Measures are mainly used for reporting and controlling purposes. Consequently, they are quantitative and are applied to processes, services, projects, etc. Measures are considered as absolute measures as they can be retrieved from business data without the need of prior calculation.

Metric – Metrics are used to evaluate processes, services, projects, etc. and thereby enable benchmarking capabilities. They serve as common denominator for comparisons between two or more observed measures. They are usually calculated and therefore are considered as relative metrics. The aim of metrics is to deliver decision support, i.e. they should incorporate the capability to let decision makers infer future performance as well as assist in various planning processes. Metrics can be critical success factors which inform the stakeholders what conditions and requirements must be met in order to achieve a certain goal. Moreover, they can indicate how effective that particular goal was achieved.

Indicator – An indicator, similar to metrics, are used to compare performance to a baseline or particular result. They are collected over time and are mostly used to predict or understand

trends. A key performance indicator is an indicator (or metric respectively) that is tracked against a critical success factor.

Notably, we decided to use the term metric for our conceptual model as it encapsulates measures. Moreover, depending on the context a metric can be used as an indicator. During the definition of our metrics for our metrics template based on (Vasconcelos et al. 2007), we came across special cases, namely a Boolean metric which simply indicates whether a certain condition is satisfied. By definition, this would be a measure due to its absolute character but we deem it not very practical to provide a separate measures template for such cases and therefore, some metrics are actually (basic) measures. As with the goal template, the metric template defines the representation of a metric within our assessment approach. It is illustrated in Table 5-4 and described more detailed in the Appendix A.2.19 Furthermore, we outline the goal-metric alignment for our focus project in Appendix B.1.4.

Name	Name of the metric
Acronym	Acronym of the metric
Description	Description of the outcome of the EA contribution
Computation	Formula or algorithm of the metric to specify how it is computed
Implementation	Describes how this metric is implemented and used
Accountability	Stakeholder responsible for this metric
Cost	Cost of employing the metric
Scale	Possible values for the metric
Unit	Unit of the metric
Architectural levels	Relevant architectural levels, i.e. where is the metric used (e.g. business architecture)
Dependencies	Describes dependencies to other metrics
Qualities	Related EA qualities, such as conceptual integrity, simplicity, cost etc.

Table 5-4: Metric template

5.3.5. Business Value

We defined EABV already in Section 3.7. The business value template is the actual representation of EABV and is the core of what will be reported. It is illustrated in Table 5-5 while described more detailed in the Appendix A.2.11. Notably, influencing factors on performance and lag effects are reflected in the enabler and inhibitor attributes. Outcome can be linked to specific projects, services, or processes and also describes the impact of the outcome. For the actual report, we also include the date of the data collection, which method was used to analyse data, and what tools were employed.

EABV	Short statement of EABV
Benefit	Description of the benefit (cf. Sec. 3.7)

Outcome	Description of the outcome of the EA contribution
Source	Description or link to the sources of the EABV, e.g. an event or stakeholder. If applicable, we also describe lag effects here.
Receiver	Description or link to the receiver of the EABV, e.g. an event or stakeholder
Enabler	Description or link to the enabler of the EABV, e.g. an event, a stakeholder, or an external factor
Inhibitor	Description or link to the inhibitor of the EABV, e.g. an event or stakeholder, or an external factor

Table 5-5: Business value template

5.4. EABV Assessment Process

In order to conduct continuous EA assessments, we need to adapt an appropriate assessment process. Therefore, we employ the process outlined in the ISO/IEC 15939:2007 standard (ISO/IEC 2007) which defines a measurement process with the purpose of collecting, analysed, and reporting data related to a product or process within an organization in order to facilitate effective management as well as providing information about the quality of those. The reason for naming it assessment process is because we are not just measuring, but also analysed, reporting, and evolving the EA contribution. The objectives of this artefact are summarized as follows:

- Plan assessment by also integrating assessment procedures into the current environment
- Collect and analyse performance data
- Evaluate performance measurement results
- Report results or communicate EABV respectively

The reasons of building on this process are that the outcomes of a successful implementation are as follows (ISO/IEC 2007):

- Established and sustained organizational commitment for EABV assessments
- Identified information needs of EA contributions
- Identified and/or developed an appropriate set of metrics, driven by the information needs
- Identified and planned assessment activities
- Collected, stored, analysed required data, and interpreted results
- Decisions are supported by information products which provide an objective basis for communication
- Evaluated assessment process and metrics
- Communicated the improvements to the assessment owner

In addition, it describes important steps that need to be considered when integrating it into the current environment. In practice, the organizational environment greatly varies and therefore the actual instantiation does as well. The adopted process is illustrated in Figure 5-5.

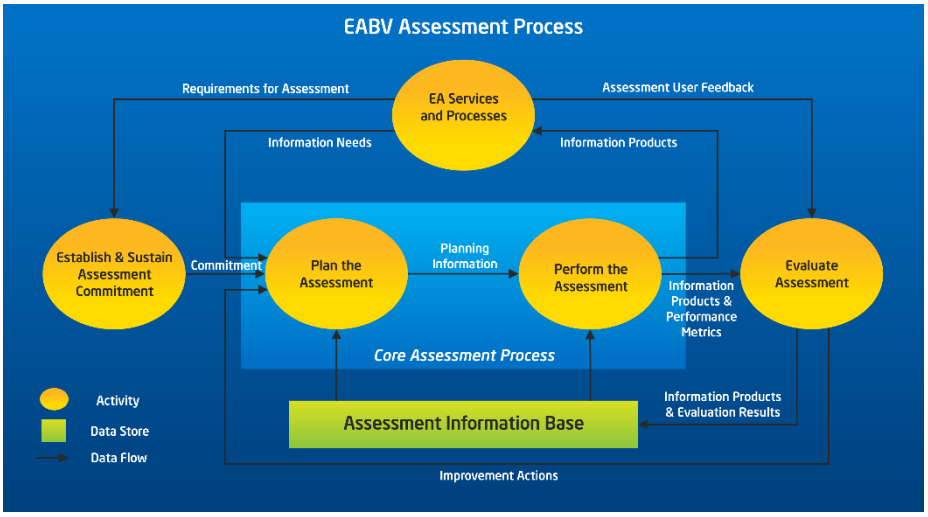

Figure 5-5: EABV Assessment Process (cf. (ISO/IEC 2007))

As we can perceive, *Information Needs* arise from *EA Services and Processes* which directly influence the *Plan the Assessment* activity. Additionally, EA services and processes set the requirements for the *Establish and Sustain Assessment Commitment* that serves as initiation for the planning which together with the *Perform the Assessment* activity mark the core assessment process. This relies on information from the *Assessment Information Base* (AIB). After the core process it's time for the *Evaluate Assessment* activity and for delivering *Information Products* to the EA services and processes. It has to be noted, that this information is also delivered to project managers for which an EA contribution in the form of an EA service or process was provided. The evaluation of the assessment provides the information products also to the AIB in addition to the evaluation results. Furthermore, improvement actions (recommendations) are delivered to the planning activity. Notably, an information need is satisfied by an information product according to the measurement information model (ISO/IEC 2007). This basically states that an entity is a measureable concept. The attributes of an entity are measured by certain methods using certain metrics. The data collected is analysed using a certain model or method and communicated to produce an information product.

How does the EABV AP act within the EABV AM? As a matter of fact, we are talking about continuous assessments and therefore need to operate our approach aligned to the daily operations of the company. Hence, the EABV AP is aligned with the operation phase of the EABV AM (cf. Sec. 4.3.1.2). As depicted in Figure 5-6, the main phases of the EABV AP act

as activities on the transitions on the operational assessment cycle of the EABV AM. We measure EA performance which is basically the combination of goals and metrics by executing the plan assessment activity. The resulting EA performance data gets analysed during the perform assessment activity. The evaluate measurement phase is applied for communicating EABV and providing recommendations for evolvement. This leads to either establishing or sustain measurement commitment as in the EABV AP phase. Notably, EA performance, EA performance data, EA business value, and recommendations are stored in the AIB.

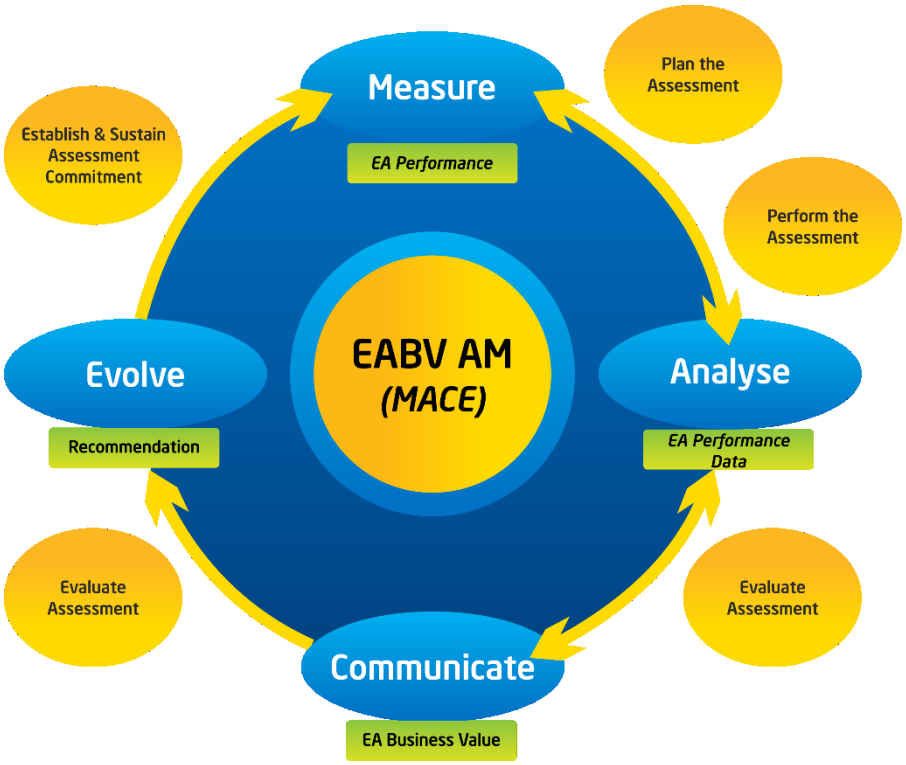

Figure 5-6: EABV AM and EABV AP

For modelling the EABV AP, we use the Business Process Modelling Notation 2.0 (Business Process Management Initiative 2011). The main aim of modelling the EABV AP is to enable common understanding on a business level and to facilitate the basis for eventual application development. Figure 5-7 depicts the EABV AP BPMN model in its most current version 1.0. As we can perceive, the pool EABV AP is organized into the main phases of the EABV AM, *Measure*, *Analyse*, *Communicate*, and *Evolve* (cf. Figure 5-6). Additionally, we added a swim lane to underline the importance of persistence. The data store is the *Assessment Information Base* (AIB). The core assessment process consists of the activities *Plan the Assessment* and *Perform the Assessment*. *EA Services and Processes* require *Establish & Sustain Assessment Commitment* to continue with planning. In case we already have the commitment, we can start with the core assessment process right away, which can be executed

as a parallel multi-instance. We also illustrated the data flows in this model. Moreover, the termination or end state can trigger the start event. This demonstrates the evolutionary cycle of the EABV AM (MACE scheme) during operation.

Notably, in a more complex scenario, given that BPMN models for additional organizational services and processes are available, we need to adapt our model accordingly. This encompasses adding another pool for those services and processes. We do this in the course of our project at our corporate partner but disclose this information as more detailed internal process information is firstly not within the parameters of our contract, and secondly it is not important to convey the concept and operation of our EABV AP. In the following subsection, we will describe the process in more detail. We also outline the differences to the standard and what needed to be adapted and how.

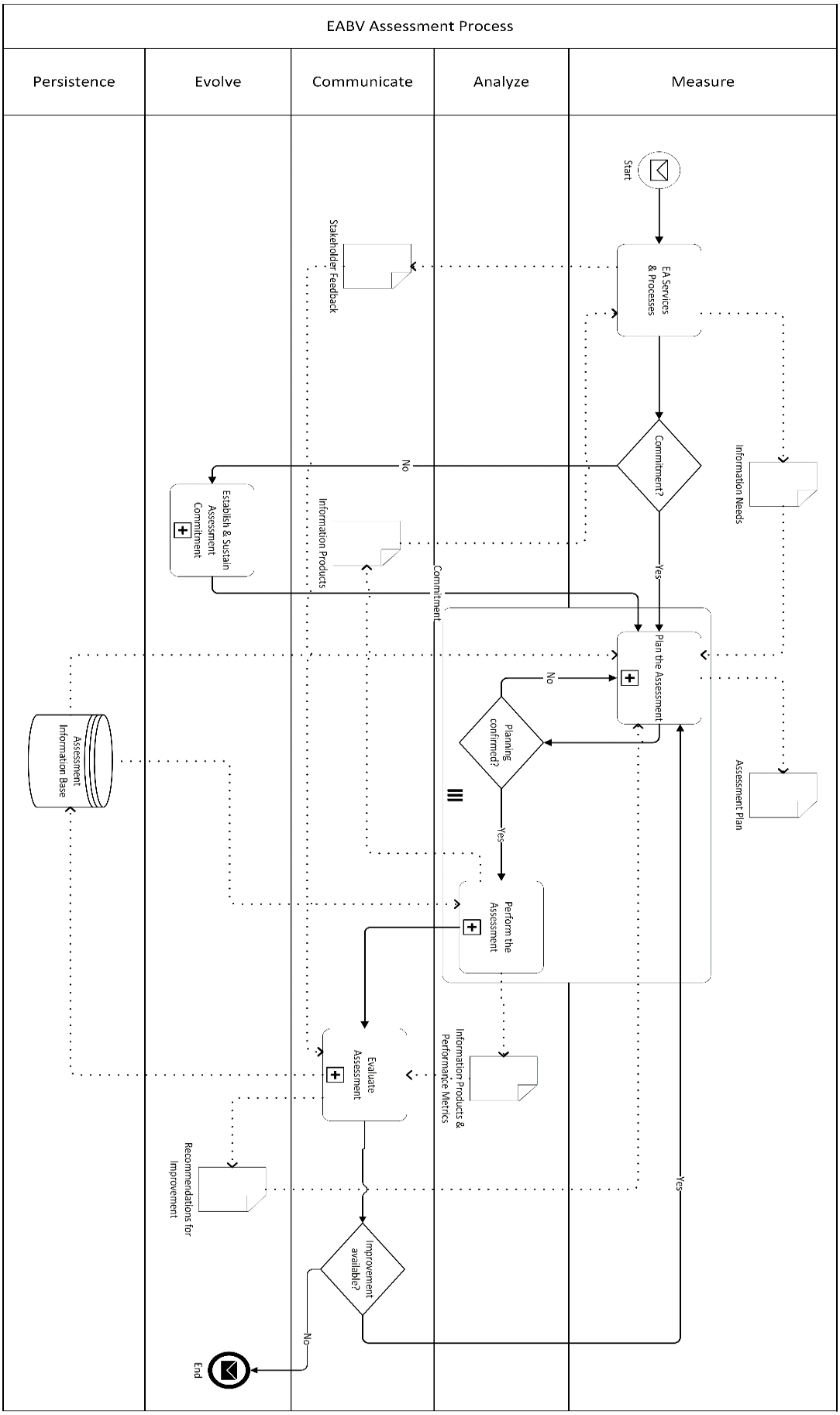

Figure 5-7: EABV AP: BPMN Model

5.4.1. Establish and Sustain Assessment Commitment

Without management support and commitment, it is hardly possible to adapt a comprehensive performance measurement practice (Ebert et al. 2005). EA services and processes set the requirements for assessment and trigger the assessment process. In our case, these are the EA processes outlined in Section 3.1.2. In other words, any kind of EA contribution that happens in any kind of project triggers the EABV AP. Thereby, requirements differ from project to project. For example, a small project would have a smaller set of requirements in terms of scope and involved stakeholders. Notably, general measurement requirements are consistent with the requirements described in Section 4.2.3. This step consists just of two activities.

Accept the Requirements for Assessment is the activity where we need to define the scope of the assessment. We therefore resort to our types of assessments (cf. Sec. 2.6) and the scope of our EABV AM (4.3.2). Consequently, it is an operational level assessment for projects with EA contribution that usually comprises several organizational units. Since EA is responsible for the blueprint of the company, the scope information should generally be available without having to put much effort into stakeholder interviews and document inspection. Secondly, we need to define the stakeholders that are involved in the assessment. These have assigned roles and responsibilities throughout this process. They also identify the purpose of the assessment, which translates into the information need. The purpose of the overall assessment is outlined in Sections 1.1 and 4.1.1. Another important task here is to actually communicate the commitment to assess throughout the organizations. Among practitioners, this is generally coined as creating awareness and is very important in terms of adoption.

Align Resources is the activity where we need assign responsibilities to the stakeholders. Thereby, the owner of the process or sponsor respectively should assign competent individuals in terms of knowledge of principles of measurement, data collection and analysis, and communication of information products. Roles and responsibilities for the EABV AP will be defined in Section 5.4.5.

5.4.2. Plan Assessment

For effective assessment, we need to plan it. The output of this step is a so called measurement plan. The template of this plan in Table 5-6 is partly based on (ISO/IEC 2007) and on input from the company. This measurement plan is strongly focused on data collection. In some cases, a measurement process needs a schedule, i.e. the interval in which data is collected. Since we are having a continuous assessment and the measurement is implemented on project level along the project life-cycle, the schedule depends on project progress such as milestones.

Element	Description
Scope	Involved organizational units
Objectives	Business and project objectives, EA specific objectives
Information needs	Prioritized; how they link business, organizational, regulatory, product and/or project objectives
Measures/Metrics	Definition and how they relate to the information needs
Responsibilities	Stakeholders responsible for data collection and sources of data
Schedule	Project-specific (e.g. milestones)
Tools	Tools that are used for data collection
Procedures	Procedures used for data collection
Process changes	Changes to processes to implement measurement plan
Organizational changes	Changes to organizational units to implement measurement plan
Evaluation criteria for information product	Choose criteria to evaluate information products; outcome based evaluation; align with chosen evaluation method
Evaluation criteria for measurement process	Choose criteria to evaluate the measurement process; align with chosen evaluation method
Confidentiality	Ensure confidentiality on data and information products
Configuration Management	Data, AIB, data definitions

Table 5-6: Basic measurement plan (based on (ISO/IEC 2007))

For our purposes, we further refine the measurement plan, align it with the planning activities of the EABV AP and call it *assessment plan*. Goals serve as basis for such plan and not as a substitute (Tosi et al. 1970) and drive the information need. Nevertheless, an information need can result in defining a goal. We choose to provide six interrogatives for each of the tasks as this approach answers all relevant questions regarding the assessment plan and therefore it provides the necessary depth and detail to actually perform the assessment. These questions are outlined in the following list:

- What needs to be done by this particular task?
- Why do we need to execute this task?
- How do we execute this task?
- Who is responsible for executing the task including all inputs and outputs?
- Where do we execute the task?
- When do we execute this task?

We retain the roles defined in Section 5.4.5 when we ask about who is responsible for a particular task and the corresponding outputs. Notably, the roles can change once such an assessment approach is no longer within the boundaries of ES which means that the academic

stakeholders don't need to contribute anymore since the EABV AM is past the construction phase in the operation phase. The template for the assessment plan is illustrated in Table 5-7. Selecting goals and metrics encompasses defining them in case there is no previous template stored in the AIB.

Task	What?	Why?	How?	Who?	Where?	When?
Identify Information Need	Identify the target of assessment, e.g. the particular EA contribution	Rationale for assessment	Means of assessment, e.g. methods, processes, techniques	List of stakeholders that conduct the assessment	Context of assessment, e.g. a particular organization	Time and frequency of assessment
Select Goals	Goals that drive the information need or are a result of it	Rationale for selecting goals	Means of selecting relevant goals	List of stakeholders that select goals	Lists the context where we find these goals, e.g. project goals	Time when we define or choose goals
Select Metrics	List of metrics that measure goals	Rationale for selecting metrics	Means of selecting relevant metrics	List of stakeholders that select metrics	Lists the context aligned to goals, can contain implementation information	Time and frequency of metric usage
Collect Data	Lists the type of data this is collected, e.g. EA performance data	Rationale for collecting that data	Means of collecting that data, e.g. automated or manually	List of stakeholders that collect the data	Lists the location where to collect the data, e.g. which database	Time and frequency when data is collected
Analyse Data	Lists the type of data to be analysed, i.e. the data collected	Rationale for analysing the data	Means of analysing the data, e.g. list of methods	List of stakeholders that analyse the data	Lists the context and location where the data is analysed	Time and frequency when the data is analysed
Communicate Results	Lists the findings, e.g. the EABV	Rationale for findings	Means of reporting findings, e.g. which template or tool	List of stakeholders that report the findings	Lists the location where the findings are reported	Time and frequency when the findings are reported
Evaluate Information Product	Lists the information products that are evaluated	Rationale for evaluation	Means of evaluation	List of stakeholders that evaluate	Lists where the information product is evaluated, e.g.	Time and frequency when the information

					as part of a project	product is evaluated
Acquire and deploy supporting technologies	List supporting tools and applications	Rationale for certain technology	Means of implementation	List of stakeholders that acquire and deploy	List of context and systems	Time and frequency of acquisition and deployment

Table 5-7: Assessment plan template

5.4.3. Perform Assessment

Performing the assessment comprises four different tasks which have to be in accordance with the assessment planning. As part of the core assessment process, information products and evaluation results in the AIB should be consulted for conformance und reusability reasons.

Integrate Procedures is the first task of this process step. Since employing our method and hence also this adapted process in an organizational environment, we need to integrate data generation and collection to the relevant processes and projects. At this point, it is very important to mention that this integration varies for each organizational context or enterprise respectively, and therefore this task can be done in a wide variety of ways. Since this is a very practical topic, we collaborate closely with subject matter experts on-site to achieve the best possible integration while being aware of the involved architectural principles. This task is especially important in terms of artefact requirements since it interfaces with the current EA function including stakeholders. If the integration is not executed thoroughly, the whole assessment could take too long, become too expensive, or simply be too complicated. Integration can be done for projects, portfolios, frameworks and capabilities, and strategic planning as well as any processes used within those. This means that we are able to abstract our whole method in a flexible way to satisfy design science research principles. Another important activity in this task is to actually communicate the data collection procedures by means of workshops, meetings, or even some form of training. The reason for this is that data providers need to know what kind of data is required in order to provide an adequate quality of data. Moreover, the frequency of collection, the required format, employed tools, and when to provide data is of importance for these stakeholders, hence our revised assessment plan. Since data analysis and reporting will be performed continuously or in short time intervals, procedures that facilitate this are included into the current processes. It is important to have a full data cycle (i.e. input and output of relevant data over the course of the life cycle of the measured entity) employed in order to exploit the full potential of our approach. Since our focus is on a project-level the integration is closely tied to the project management practices of the organizational

environment. Basically, this task can be seen as an important setup phase in order to instantiate the EABV AP.

Collect Data is the step where we actually collect, store, and verify the data. Data collection happens either automatically or manually. In our case, the latter since we finish a prototype during our project which is not required to collect data automatically. Regarding storage, our EABV M serves as basis by providing the necessary data models. Verification happens along a checklist that is constructed to identify missing data or just learn if a certain value makes sense.

Analyse Data and Develop Information Products is the next step, where we analyse collected data. This analysis is performed by various data analysts that employ a wide variety of statistical methods. We will further explore this topic in the course of our case study in Section 7.3.5.2. The output or interpretation of this analysis is constructed to information products. These are reviewed in order to ensure that they are meaningful.

Communicate Results follows the data analysis. Information products as an output of the measurement that satisfy information needs not only have to be evaluated but also properly communicated. In industry, this process is typically coined as reporting based on various criteria. Example criteria are awareness of the limitations of the results, number of observations that yield a particular result, or statistical methods used (including limits). Notably, not all of the criteria have to be included in the main body of a report but rather as an Appendix. Too much information can be overwhelming in practice and does not satisfy the actual information need. Generally, an information product should be simple enough while not missing the central information needed by the target audience. We will elaborate on actual EABV communication in Section 7.3.7.

5.4.4. Evaluate Assessment

The activity in the EABV AP is concerned about the evaluation of the assessment and the information products. This evaluation is done against certain criteria that are aligned with the evaluation criteria identified for our evaluation method 6.5.5. For more on the evaluation of our approach refer to Chapter 6.

5.4.5. Roles and Responsibilities

For us, it is crucial to have clear roles and responsibilities for a process that is integrated into the company's operations. Recent performance models focus on stakeholders (Kloot and Martin 2000) which underlines the importance of considering people and their relations as asset to deliver performance and consequently business value. These are defined and identified in the

first step of the EABV AP described in Section 5.4.1. Now, that we have outlined all other steps, it is time to examine what various stakeholders have to do in order to perform this assessment in Table 5-8. As can be perceived, we have four different roles for every phase of the EABV AP as well as the related responsibilities. First, we have the *project manager*, which apart from usual project manager tasks for the assessed project with EA contribution, is responsible that the actual assessment is carried out and therefore must monitor and track it. He takes on the role as the assessment librarian according to the measurement standard ((ISO/IEC 2007)). The scope of this depends where the actual data points, i.e. the input and output for data to the EABV AP, are located over the course of the project. Moreover, a project manager assures adequate project members that are able to collect and provide data. He helps developing the assessment plan and identifying information needs. Additionally, he evaluates the information products and assessment process.

Next, we have *project members*, responsible for scoping the assessment. In terms of the measurement standard, they are perceived as assessment users. They need to assure they possess the necessary skills to collect and provide data. As with project managers, they assist in creating the assessment plan and identifying information needs. Furthermore, they are responsible for selecting and documenting goals and metrics. Also, they collect and analyse data with predefined and integrated procedures. Finally, they also take part in the evaluation of information products and the assessment process.

EA Managers are responsible for the overall assessment commitment. They secure financial support and allocate adequate EA practitioners to conduct the assessment. EA managers are the equivalent to assessment analysts in terms of the measurement standard. They assure the communication and documentation of information needs and also take part in the development of the assessment plan which they also approve. Moreover, EA managers collect and analyse data and communicate results. As the roles before, they evaluate information products and the assessment process.

EA practitioners assist in identifying the assessment scope and need to be aware of the actual EA contribution. They, like all roles, help to develop the assessment plan. Furthermore, they collect and analyse data after which they are able to develop information products. In addition, they evaluate information products and the assessment process. EA practitioners are, as project members, assessment users according to the measurement standard.

Typically, we find an inter-organizational project setup during an assessment where stakeholders working on the assessed project (project managers and project members, both EA customers) consume EA services and therefore collaborate with stakeholders (EA managers, EA practitioners) providing those services.

EABV AP	Role (Project specific)	Responsibilities
Establish and Sustain Assessment Commitment	*Project manager (assessment librarian)*	• Overall responsibility that the assessment is conducted • Define and identify scope of assessment • Allocate relevant project members to collect and provide data • Assure that project members are able to collect and provide data in an adequate manner • Assure communication and initiate contacts between project members and EA practitioners
	Project member (assessment user)	• Define and identify scope of assessment • Assure that skills are appropriate for data collection and providing the data
	EA manager (assessment analyst)	• Decision makers in terms of financial support and overall assessment commitment • Assign EA practitioners to take part in the assessment
	EA practitioner (assessment user)	• Define and identify scope for the assessment • Assure that skills are appropriate for data collection and providing the data • Be aware of the actual EA contribution
Plan Assessment	*Project manager (assessment librarian)*	• Make assessment context explicit, including assumptions and constraints • Identify information needs • Prioritise and select information needs • Assure communication and documentation of information needs • Develop and approve assessment plan • Define information product evaluation criteria • Acquire and deploy supporting technologies
	Project member (assessment user)	• Identify information needs • Select and document goals and metrics • Define data collection, analysis, and reporting procedures • Develop assessment plan • Define information product evaluation criteria
	EA manager (assessment analyst)	• Assure communication and documentation of information needs • Develop and approve assessment plan • Define information product evaluation criteria • Acquire and deploy supporting technologies
	EA practitioner (assessment user)	• Select and document goals and metrics • Define data collection, analysis, and reporting procedures

		• Develop assessment plan • Define information product evaluation criteria
Perform Assessment	*Project manager (assessment librarian)*	• Communicate integrated data collection procedures • Communicate results
	Project member (measurement user)	• Integrate data generation and collection • Integrate data analysis and reporting • Collect and analyse data • Develop information products and communicate results
	EA manager (measurement analyst)	• Communicate integrated data collection procedures • Collect and analyse data • Communicate results
	EA practitioner (measurement user)	• Integrate data generation and collection • Integrate data analysis and reporting • Collect and analyse data • Develop information products and communicate results
Evaluate Assessment	*Project manager (measurement librarian)*	• Evaluate information product and assessment process
	Project member (measurement user)	• Evaluate information product and assessment process
	EA manager (measurement analyst)	• Evaluate information product and assessment process • Identify potential improvements • Communicate potential improvements
	EA practitioner (measurement user)	• Evaluate information product and assessment process • Identify potential improvements

Table 5-8: EABV AP Roles and Responsibilities

Notably, these roles and responsibilities are relevant once the EABV AP is instantiated and working in daily operations. During the design and build phase of this approach, we have different stakeholders and types thereof involved that are responsible for different tasks as previously outlined in Section 2.4.

5.5. EA Balanced Scorecard

The Balanced Scorecard (Kaplan et al. 1996) is a well-established tool for performance measurement which combines different perspectives on the company in order to achieve measurement of otherwise neglected areas which are mostly intangibles. We already described the basics in Section 3.2.1. The objectives of this artefact are outlined in the following list:

- Structure EA strategy and make it measureable
    - Strip down strategies into smaller goals and objectives
    - Goals differ depending on the actual scope of the assessment, but should be aligned to the strategy nevertheless

    - Provide multiple assessment perspectives
    - Link goals and metrics
    - Link goals to goals over several perspectives
- Tool and front-end for management to view performance
- Integrate and receive data from the EABV AP

For employing the EA BSC, we first need to determine appropriate perspectives in order to place relevant goals and metrics. As with the other DSR artefacts, we take inputs from various subject matter experts from the company as well as the academic literature. From a design perspective, we distinguish between an overall EA BSC and, depending on the organizational environment and application, several others, e.g. one for a particular project and an aggregated one for more projects. A certain set of projects can be aggregated to a portfolio and also assessed. This all is dependent on the actual strategy and what goals are defined on a higher level of abstraction. Notably, we focus on operational level assessment and hence, we describe the EA BSC in this regard. Consequently, a project with EA contribution is the smallest unit we can assess by employing all perspectives. When it comes to project size, very small projects could just have one goal in each of the perspectives. For example, if the EA contribution to a project is just a data model (which is an EA artefact and therefore in the Asset perspective), we want to ensure that the process to create it and the actual delivery from a service viewpoint to the customer is according to the specified goals while targeting an improved stakeholder satisfaction which is the typical goal in the Stakeholder perspective.

Our EA BSC is illustrated in Figure 5-8. Each perspective contains goals and associated metrics. The *Stakeholder* perspective is the top-most because to satisfy stakeholders where customers, practitioners, or managers is our highest priority because creation of shareholder value is not possible without creating stakeholder value (Clarkson 1995). Within this perspective, we can further distinguish between the aforementioned types of stakeholders, e.g. customers and practitioners. The next perspective is the *Service* perspective, which comprises the services that are offered by the EA function and can be consumed by various stakeholders, mainly (internal) customers. We need to improve services in order to increase stakeholder satisfaction. The same is true for processes, which are naturally in the *Process* perspective. Several processes can form a service and make use of various assets while also producing them, e.g. EA artefacts. These can be found in the lowest *Asset* perspective. In each of these categories we have various goals to allow for finer granularity when it comes to goal-driven strategy.

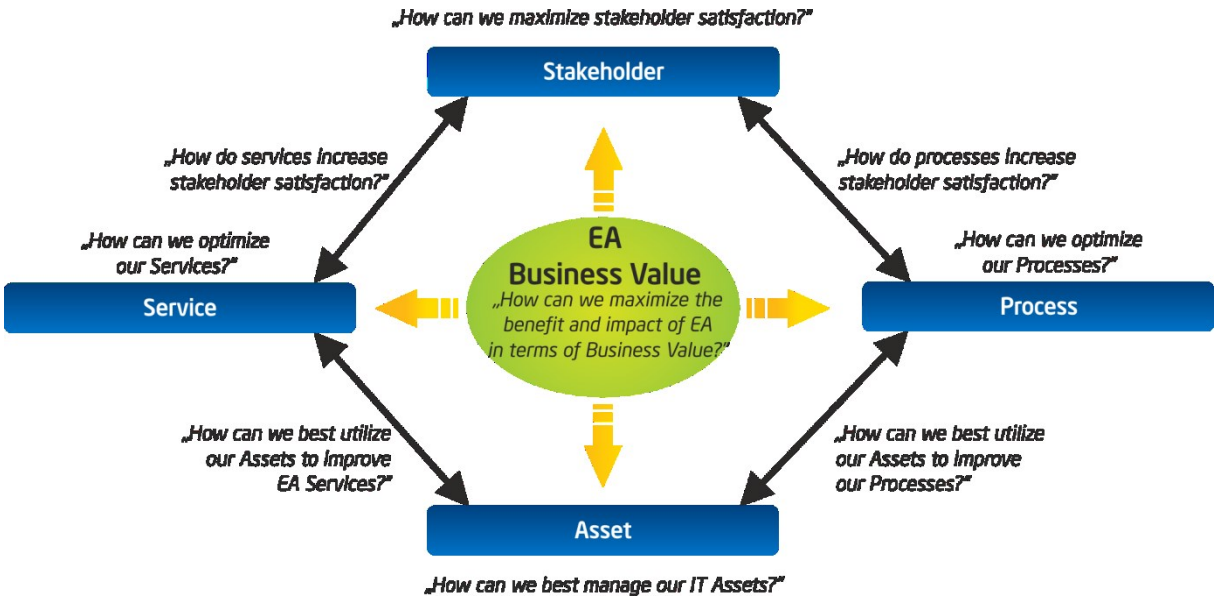

Figure 5-8: EA Balanced Scorecard

Why did we do not choose Business Value as top-most perspective? First, EA within a specific company is mainly thought as an internal function, i.e. its services are not offered to external consumers to generate revenue. Secondly, we elaborate the EABV from every perspective, i.e. we measure the performance in each perspective and communicate EABV thereafter. The BSC approach received some criticism regarding the selection of perspectives. One does not know what the competition is doing. As a matter of fact, this holds true for every performance measurement approach. It boils down to the selection of KPIs and the access to competitors' performance information in order to achieve a somewhat meaningful benchmarking environment. How such an environment works is depicted in Figure 5-9. Benchmarking is possible for every perspective based on the communicated EABV. Nevertheless, benchmarking EA performance with the competition is out of scope for this work, but we find it useful to provide the conceptual interface in terms of good design practice. The EA BSC is versioned with 1.0.

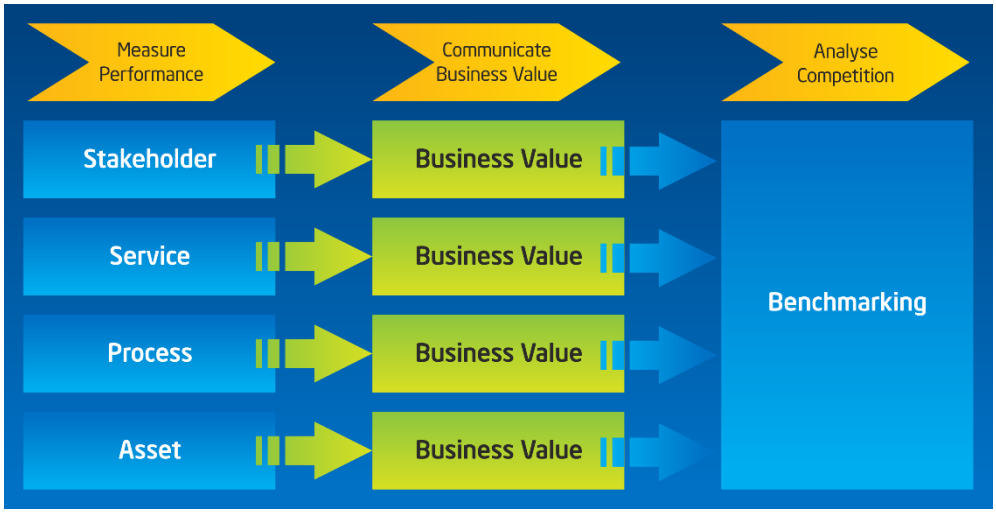

Figure 5-9: EA BSC and the relationship to EABV and the competition

5.5.1. Stakeholder Perspective

The topmost perspective is concerned about goals and metrics for different types of stakeholders. Meeting stakeholder expectations poses a great challenge because goals and motivations are not always transparent. And once we know the motivations we must satisfy these stakeholder needs. Stakeholder theory states that all stakeholders act upon the premise to achieve individual benefits and that there is no prima facie priority on one set of interests and benefits over another (Donaldson and Preston 1995). Although stakeholders expose different levels of knowledge about information systems and possess accountability for decision making, there may exist distinctively different perspectives on the employment of such systems (Ruohonen 1991) and therefore the expected benefits. As the economic and social purpose of the enterprise is creating and sustaining value for all primary stakeholder groups, managers ought to abrogate conflicts arising by distributing value where fairness and balance are necessary to ensure continued participation of each stakeholder group (Clarkson 1995). Managers respond differently to stakeholder groups with no apparent trade-off in stakeholder performance, which leads to a shift in perception to not only regard managerial performance in terms of financial performance (Wood and Jones 1995). This is yet another reason for us to employ a BSC approach to ensure additional perspectives and putting Stakeholder as top perspective.

For this purpose, we identified several stakeholder groups appropriate for our case study which are immediately affected by EA and are part of the EA assessment. *EA Managers* are concerned about the strategy and high-level impact of EA. They are responsible for justifying the investments made and the overall quality of the EA outcome. *EA Practitioners* are Enterprise Architects at various levels of experience and are concerned about delivering quality output that

is used by the *EA Customers* for their projects and programs. EA customers are sometimes referred to as EA business partners to accommodate the business-to-business (B2B) domain, even within the same enterprise. These stakeholder types form the categorization that is used to place goals and metrics to better reflect the strategy from which these goals are derived from. For example, the focus of a certain strategy can be that EA customers should be more satisfied with the delivery of a certain service. Goals and metrics here will in most cases be aligned with service level agreements (SLAs). SLAs are part of a service contract and are concerned about service performance (Office of Government Commerce 2007) which in turn affect stakeholder satisfaction. Apart from the actual satisfaction, stakeholders expect different benefits that EA will deliver. How this benefits are created can be explained by employing a stakeholder model as found in (Strong et al. 2001). Satisfaction can be broken down into expected information and actual information, and expected outcome and actual outcome. Hence, we can distinguish between satisfaction with information and satisfaction with outcome, both of which constitute the overall satisfaction.

5.5.2. Service Perspective

There is a trend in the industry to view EA as service delivering discipline and hence it is important to know which kind of services EA can offer to which stakeholders. From a design perspective, we must agree to a common EA service model to categorize and describe all relevant EA services. We have done is in Section 3.1.2. To summarize, EA services are design, development, management, and training and support. In each of these categories, we can define goals with their according metrics. For example, the strategy to improve the design practice can results in goals that address a faster design of EA artefacts. Here, we align with SLAs since relevant goals and metrics provide us the needed information to measure and analyse service performance and performance data respectively.

5.5.3. Process Perspective

An EA process is a set of tasks that is necessary to deliver a particular EA service to one or more stakeholders. A typical EA process is the development of architectural artefacts by employing an architecture development method such as described in TOGAF (The Open Group 2011a). Another typical process is EA governance as part of the EAM service. An EA process can be supported by Business Process Management (BPM) tools and frameworks and as such, can and should be modelled in a process modelling language such as BPMN (Business Process Management Initiative 2011). In our opinion, EA processes can be categorized into the same categories as EA services because they are closely related. From a theoretical standpoint, a

particular EA process is not a dynamic capability, but rather the enterprise-wide EA function as a whole.

5.5.4. Asset Perspective

We outlined what we understand under assets in Section 3.6 when we argued that EA is a dynamic capability. Assets can be categorized as follows: *People, Relationships, Technology, and IT Intellectual Capital*. This perspective is the lowest because we identify goals and metrics directly for IT assets as fundamental entities that are integrated, reconfigured, gained, and released. A good example for an IT intellectual capital asset is an EA artefacts, such as a data model or a business interaction model.

5.5.5. Strategy Map

A strategy map provides useful means of illustrating the relationship of goals over the different perspectives (Kaplan and Norton 2000). It thereby can be viewed as a cause-effect diagram depicting which goals impact other goals. In practice, it is advised to employ the map as a top-down approach, i.e. start with the destination and elaborate the routes that lead there. Simply put, a strategy map shows how an organization plans to convert various assets into desired outcomes (Kaplan and Norton 2000). Thereby, it also serves as valuable tool to identify gaps in strategy implementation on lower levels of the organization. We will examine strategy maps more detailed in our case study in Section 7.3.4.

5.5.6. Cascading Scorecards

We already mentioned the concept of cascading scorecards in the previous Sections. Since this concept is rather important in the overall employment of this tool, especially in large scale organizational environments, we describe how such a cascade is constructed (as illustrated in Figure 5-10). In practice, we can instantiate the EA BSC for projects, programs, portfolios, capabilities, and strategies. A company-wide or corporate BSC derives its goals from the overall corporate strategy. This has an impact on the IT function and hence new goals for an IT BSC. Now there is a special case in regard to EA as a pure IT function. Although historically it is, it nowadays shifts much more towards a strategic management function and therefore is more closely tied to business strategy and not only IT strategy (Ahlemann et al. 2012a). All EA related scorecards are aggregated to the EA Strategy BSC which allows a strategic level assessment (cf. Sec. 4.3.2). Two or more EA Project BSCs can be aggregated to the EA Program BSC of which two or more can be aggregated to an EA Portfolio BSC. Depending on the actual usage of the notions of portfolio, program, and projects within the company, we understand the

necessity of being able to aggregate projects and put them in scope and common goal of the bigger organizational context.

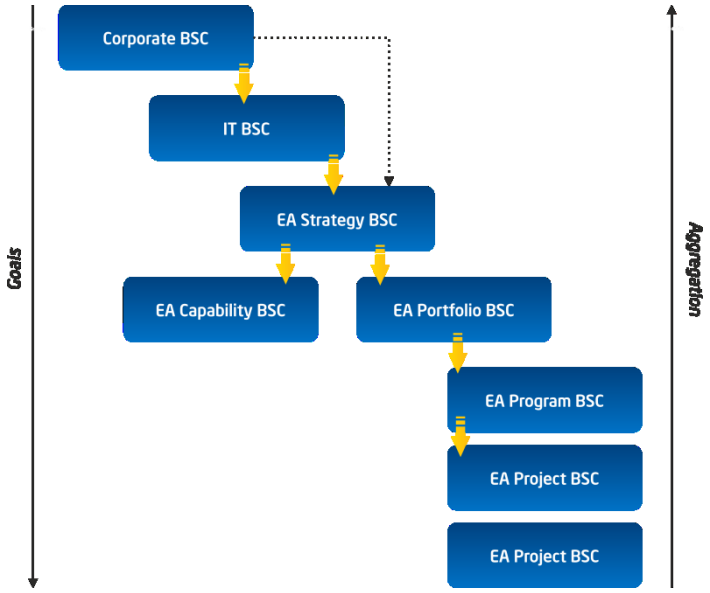

Figure 5-10: Cascading balanced scorecards

For example, part of a corporate strategy is to reduce the overall business risk. This translates to the goal of reducing the risk of IT investments for the coming years because there were a lot of failed IT investments during the last accounting period. Therefore, the EA strategy BSC could derive goals for developing a better architecture to facilitate this reduction of risks. This could have an impact on the EA capabilities, e.g. the employment of certain IT frameworks, or it could have an impact on a certain EA portfolio, such as the EA governance program and the EA development program and therefore all the related EA projects that deal with these topics. An EA project could be one that integrates heterogeneous software systems in order to reduce the risk of having poor data quality due to spread out information not visible to all relevant stakeholders in an investment decision process.

5.6. Chapter Summary

In this Chapter, we described the objectives and requirements for each of the artefacts. Moreover, we presented several principles that guide constructing an EABV assessment method. Artefacts solve business problems and answer our research questions. We elaborated on the actual artefact design and explained the reasons for various design choices. The EABV FW is the main artefact resulting from the EABV AM creation phase. It relies on stakeholder input, strategic objectives, and current EA practices as input and translates this information into logical form based on the EABV M. Furthermore, the EABV FW repository stores reference information for employed models and methods, goals and metrics, and also links to relevant

implementation guidelines. Moreover, we store the recommendations for improvement in this repository. The means of measuring, analysing, communicating and evolving the EABV AM is executed by employing the EABV AP which feeds its current information to the EA BSC to track and monitor current performance. Consolidated information products are then communicated as EABV reports.

6. Evaluation

"The ends must justify the means."

Matthew Prior (1664 — 1721)

The evaluation of IT artefacts, which are in fact socio-technical entities within a certain environment, is of crucial importance (Hevner et al. 2010; Peffers et al. 2012). The purpose is to validate or confirm our artefacts respectively and thus our solution. It is necessary to justify the design and ensure that the intended approach satisfies stakeholder and business needs. In its simplest form, evaluating a novel IT artefact means it is just working or producing adequate results (Niederman et al. 2012).

In literature, we can find many different approaches for evaluations in a DSR context which are commonly bifurcating into ex ante and ex post evaluations. Thereby, ex ante evaluation happens before the decision to acquire or implement a new technology. A good example would be an investment decision based on such ex ante evaluation. Such decisions are further classified in (Bannister et al. 2000). A whole evaluation framework is proposed in (Pries-Heje et al. 2008). A classification of various evaluation methods based on a limited literature review is presented in (Peffers et al. 2012). By far the mostly employed method was the technical experiment to evaluate the technical performance rather than the real world performance. The reason for this lies in the specific selection of literature which delivers algorithms as most frequently built artefact type.

Nevertheless, what we did not find in the literature is an aggregated or combined evaluation, i.e. the evaluation of connected artefacts. These are not necessarily in a hierarchy as described in (Simon 1996). We therefore develop our evaluation framework which also considers the actual organizational context in which we undertake our evaluation and the relationship between evaluated artefacts by assigning evaluation criteria in a flexible and adequate way (Meyer and Helfert 2013a, 2013b). In this Chapter, we further discuss threats to validity in regard to our evaluation.

6.1. Evaluation Perspectives

Each stakeholder or stakeholder group respectively possesses a different view on each IT artefact, i.e. he or she would have different preferences, opinions, and uses for a particular

artefact (Hevner et al. 2010). Generally spoken, each stakeholder has different expectations of benefits he or she will receive. In addition, those expectation will be subject to change due to the dynamic nature of the competitive environment (Pouloudi 1999). Meeting stakeholder expectations poses a great challenge because goals and motivations are not always transparent and once known we must satisfy the stakeholder needs.

For this purpose, we identified several stakeholder groups which are immediately affected by EA and are part of the EA assessment (cf. Sec. 5.4.5 and 5.5.1). These groups are based on previous periodic assessments conducted by our corporate partner. *EA Managers* are concerned about the strategy and high-level impact of EA. They are responsible for justifying investments made and the overall quality of the EA outcome. *EA Practitioners* are Enterprise Architects at various levels of experience and are concerned about delivering quality output that is used by the *EA Customers* for their projects and programs. These stakeholder groups and their expected benefits are outlined in Table 6-1.

Stakeholder Group	Expected Benefits
EA Managers	• Positive ROI • Improved quality of EA function and corresponding output • Improved strategic decisions
EA Practitioners	• Reduced complexity in creating EA deliverables • Improved processes for service delivery
EA Customers	• Faster Time-to-Market for their services and products where EA services are consumed • Reduced complexity for their services and products

Table 6-1: Expected Stakeholder Benefits from EA

This example list of perceived and reported benefits from EA is certainly not exhaustive but should demonstrate what benefits stakeholders anticipate regarding the EA function and is based on the results of our survey as well as the literature review (cf. Sec. 3.7). An example how different stakeholder groups perceive different EA benefits is illustrated in Figure 6-1. As we can see, expected benefits overlap for chosen stakeholder groups. The perspectives determine the relevant goals stakeholders have regarding the EA function. As one of the main drivers for EA, the Business-IT Alignment (BITA) has been a major concern in recent literature (Magoulas et al. 2012; Schöenherr 2008) and is a shared goal for all of our stakeholder groups. Notably, different EA customers have different perspectives on EA benefits (cf. Sec. 3.7). A more detailed take on stakeholder perception of EA is given in (van der Raadt et al. 2008).

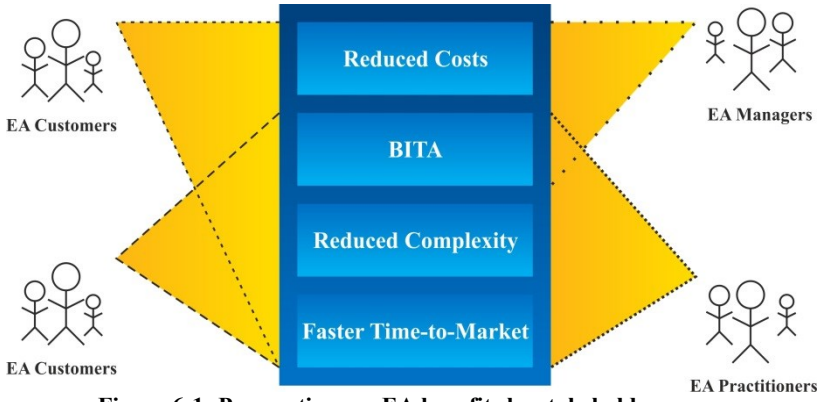

Figure 6-1: Perspectives on EA benefits by stakeholder group

We argue that all EA stakeholders determine their own value of EA benefits (Keen and Williams 2013). In addition, EA managers have reality 4, which means that they find new ways of generating value by effectively employing EA. The generation of value fits into the business effectiveness and innovation perspectives outlined in the high level EA value model in Section 3.7.

6.2. Evaluation Methods

Evaluation of design-based solutions poses two major challenges. Firstly, a single individual cannot know all the criteria and constraints. Secondly, we must evaluate from different, sometimes conflicting, perspectives (Bonnardel et al. 1996) as we described in the previous Section. Before evaluating our approach, we need to choose the appropriate criteria to do so, e.g. functionality, completeness, consistency, accuracy, performance, reliability, usability, fit with organization, and others more (Hevner et al. 2004). Generally, these criteria are derived from artefact objectives (Österle et al. 2011). We choose our criteria based on artefact objectives and requirements. Different output has different criteria for different perspectives, e.g. we can view our artefacts as either products or processes (Pries-Heje et al. 2008). This leads to a different perception of our chosen stakeholder group and therefore different evaluation criteria apply (cf. Table 6-1). Evaluating artefacts raises questions of what we want them to achieve. As a matter of consequence, these questions are aligned to the research questions and also to the artefact objectives. Sample evaluation questions would be:

- Is the EABV M correctly reflecting the environment?
- Does the EABV AM increase maturity?
- Does the EABV AP deliver good quality output?
- Does the EABV AP introduce minimal overhead?
- How well does the EABV FW assist managers in decision making?
- Is the EA BSC practical from a usability standpoint?

- Does the EABV AM provide the projected improvement?

Our evaluation is mainly an ex post evaluation, i.e. we evaluate the artefact after the design (Pries-Heje et al. 2008). Ex ante, i.e. before design, is the part where we get management approval during the analysis phase when we advertise the solution. In other words, there must be some form of initial evaluation to determine if the approach is viable to go into a "Proof of Concept" stage. Moreover, we conducted a concept evaluation described in Section 6.4. As for the evaluation methods, we can distinguish between a wide variety as can be found in (Hevner et al. 2004; Khan et al. 2013; Peffers et al. 2012). We summarize our evaluation methods for each artefact along with the criteria in Table 6-2. It has to be noted, that the main evaluation is done with the Measurement and Analysis Infrastructure Diagnostic (MAID) method (Kasunic 2010a) which will be outlined in Section 6.5. Overall, our evaluation happens in the form of case study research (Yin 2013) whereby the case is given by our corporate partner where we instantiate our artefacts. Now, we take a closer look at the DSR evaluation criteria in the next Section.

Artefact	Evaluation Method	DSR Evaluation Criteria
EABV AM	Case study, survey, MAID	Feasibility, utility, organizational fit
EABV FW	Case study, expert interviews, MAID	Understandability, completeness
EA BSC	Tool evaluation, user survey, MAID	Usability
EABV M	Model evaluation, expert interviews, MAID	Completeness, consistency
EABV AP	Process evaluation, expert interviews, MAID	Accuracy, performance, organizational fit

Table 6-2: Evaluation method and criteria for each artefact

6.3. DSR Evaluation Criteria

In this Section, we examine DSR evaluation criteria that are relevant for validating our approach. The selection of those is partly taken from our list of requirements (cf. Sec. 4.2.3), literature (Hevner et al. 2004; Peffers et al. 2012; Pries-Heje et al. 2008), but most of all in collaboration with our corporate partner. They are relevant for our selection of MAID criteria (cf. Sec. 6.5.5) which can be perceived as statements about the quality and status our artefacts. We'll explain these DSR evaluation criteria in the next subsections.

6.3.1. Feasibility

Feasibility is not only a requirement, but also a criteria for evaluation when it comes to determine whether an effort or action is capable of being carried out or executed respectively. Entering an organizational context where budgeting is emphasized almost above all, it comes to now surprise that every initiative, program, or project must fall within predetermined financial boundaries, in other words, they must be feasible in terms of monetary expenditures.

Another important aspect of feasibility is the personnel availability. Stakeholders need to find time and possess the necessary skills to make a project feasible. We can find many other examples of what makes a project or effort feasible, but we want to point out, that based on an estimate, our approach was seen fit to be funded and supported.

6.3.2. Utility

Utility represents probably the most famous DSR evaluation criterion since the DSR paradigm postulates for its outputs to be useful above all in contrast to truth in behavioural sciences (Hevner et al. 2004). Useful means that whatever is built must have a potential place within the organization and increase the benefit to do business in a certain way which is dependent on the nature of the artefact. In other words, an artefact must assist in some way to achieve business goals and benefit the organization (Österle et al. 2011).

6.3.3. Organizational Fit

Organizational fit indicates whether an IT artefact is suitable for a specific purpose or not. EA provides means to create a better fit between the organization and its environmental contingencies as this results in an increase of overall firm performance (Drazin and Ven 1985; Venkatraman 1989; Volberda et al. 2012). Consequently, fit is a key predicator of firm performance. Organizational fit can be for example further categorized into data fit, process fit, and user fit (Hong and Kim 2002). Organizational fit or fit with the organization respectively is listed as one of the possible DSR evaluation criteria by (Hevner et al. 2004). It further has a significant impact on Enterprise Resource Planning (ERP) implementation success (Hong and Kim 2002). For our purpose, we are interested in suitability in terms of integration. In other words, how well does our approach can be integrated into current practices and organizational culture while regarding the environment. Integration thereby is a dimension of the IT artefact quality IT flexibility (cf. Sec. 4.2.3). This fit related to feasibility and utility. This means that if it doesn't fit it is not feasible in its current state and might need to be adapted. If it is not useful, it should have no place within the organization which again means it doesn't fit. Furthermore, fit impacts overall firm performance.

6.3.4. Understandability

Understandability is the ability to grasp or know the meaning of built IT artefacts. Two factors are relevant in that regard (Reijers and Mendling 2011): (1) model factors, such as structure, complexity, and notation; (2) personal factors, such as training, skill, and personal viewpoint. All those factors determine whether our approach is understandable for all stakeholders. This means we must build our artefacts simple enough for stakeholders to quickly understand them.

Understandability has an impact on adoption and is further relevant for teaching and training. For this purpose, we ensure that all relevant definitions and the terminology are properly explained.

6.3.5. Completeness

Completeness is a criteria that informs us whether the concept and the instantiation is comprising all necessary information and functionality it was conceived for. Conjointly, this is the most important criteria for our evaluation based on the opinions of participating stakeholders. This is because we start this project from scratch with no current EABV assessment in place. And thus, we want to fill the gaps that were identified as business need and therefore, our solution must be complete in that regard. Completeness indirectly affects utility since additional features can contribute to a better overall usefulness. Nevertheless, if a feature is present but of poor quality, it also can have a negative effect. Completeness is an important concept for information quality (Delone 2003; Wang and Strong 1996).

6.3.6. Consistency

Consistency indicates whether all parts of the EABV AM correspond and work together without contradiction. Also, we want to make sure that every process or procedure triggered and executed leave employed systems in a consistent state from start to the end. Notably, consistency will play a greater role in upcoming evolutions since an improved tool support, i.e. higher digitization, naturally is more error-prone to leave systems in an inconsistent state after interaction or transaction respectively. Consistency is somewhat related to accuracy in terms of error-free operation. It is also an important concept in data base design and part of the ACID scheme (Gray 1981) and information quality in terms of IS success (Delone 2003).

6.3.7. Accuracy

Accuracy in our case means that information products (EABV reports) are exact, correct, and precise. This comprehends an error-free report that is reliable. Accuracy is a criteria most relevant in data quality where it is partly responsible for individual impact in terms of decision-making performance (Delone 2003). It is thereby viewed as a dimension of intrinsic data quality (Wang and Strong 1996).

6.3.8. Other Criteria

In this Section, we want to mention other criteria that could become relevant as the approach evolves. For example, *performance* says something about how well the EABV AP is executed in terms of efficiency regarding resources or assets respectively. Naturally, this criterion is

closely related to all criteria since each of them can impact performance. Nevertheless, for a small-scale prototype implementation, this evaluation criterion was not of relevance. Another criterion is *reliability*, closely related to accuracy. We want that receivers of information products can count on correct content that is presented to them. *Usability* should not be confused with utility or usefulness. It is the capability using an IT artefact in an appropriate way by stakeholders to achieve their business or project goals respectively. In literature, we can find a myriad of usability studies but this would be out of scope for our evaluation at this time. More criteria can be found in the field of information and data quality (Heinrich et al. 2007; Pipino et al. 2002; Wang and Strong 1996).

6.4. Concept Evaluation

A concept evaluation is conducted in the form of a workshop during a class in a master's program of IT Management at an Irish university. This course consists of eight participants that have a mixed background in the field of business and IT, both in industry and academia. Five of our participants have over ten years of professional experience in the field of IT. This evaluation takes place at the start of the DSR ABC evaluation phase.

6.4.1. Evaluation Outline

The aim of this evaluation is to explain the EABV AM concept on a high level to a group of potential stakeholders and find out their opinion in terms of certain criteria. Each of the participants has to take on the role of each of the stakeholder types, i.e. EA manager, EA practitioner, and EA customer, and evaluate the following criteria:

- *Expected stakeholder satisfaction:* This should indicate if stakeholders expect to be satisfied with the EABV AM if it is adopted.
- *Utility:* Utility, as most prominent DSR evaluation criterion, informs us about how useful our solution is in regard to the business needs.
- *Adoption:* This criterion is an indicator that informs us about the acceptance and willingness to employ our approach.
- *Improvement:* With this criterion, we want to capture potential improvements that could be addressed throughout the evolution of the artefacts.

As this is a concept evaluation on a high level, we are interested in different criteria (apart from utility) then we described before. For expected stakeholder satisfaction, utility, and adoption, we ask workshop participants to assign a rating from 1 to 5. The meaning of this rating is outlined in Table 6-3.

Rating	Expected Stakeholder Satisfaction	Utility	Adoption
1	Dissatisfied	Useless	No adoption
2	Slightly dissatisfied	Slightly useless	Unlikely adoption
3	Moderately satisfied	Moderately useful	Likely adoption
4	Satisfied	Useful	Very likely adoption
5	Very satisfied	Very useful	Complete adoption

Table 6-3: Concept evaluation criteria ratings

Moreover, we asked participants to write down three keywords that they would associate with those criteria in a brain storming manner. The aim here is to get an unbiased and spontaneous opinion in terms of how each of the participants understood the context, the EABV AM, every criterion, and the stakeholder type each of them had to assume. For expected stakeholder satisfaction, this means keywords that either increase or decrease it. For utility, keywords that either make it more useful or render it more useless. Finally, for adoption, keywords that either increase the chance or willingness of adoption, or decrease it. Accordingly, this puts more substance and clarification on how that rating was assigned.

In addition, we allow considerable time for questions and answers after the concept presentation and before the actual exercise in order to receive higher quality feedback. We choose to conduct this concept evaluation in such a way because assessment approaches like this are not very well known and are generally perceived as something new by the majority of stakeholders as we found out during numerous meetings and interviews with managers, practitioners, and customers. Consequently, we need to introduce the concept in a short period of time and receive immediate feedback so we can conclude if the concept is valuable and if, for whom.

6.4.2. Results

The results of this concept evaluation workshop reveals the not surprisingly the high approval rate for EA managers in terms of expected stakeholder satisfaction, utility, and adoption. Thereby, expected stakeholder satisfaction accounts on average for 80 percent, for utility and adoption 77.5 percent. This reflects our intent to target the EA managers as prime focus group that benefit from our approach. Consequently, the concept is perceived as satisfying, useful, and very likely to be adopted. The by far most common keyword regarding expected stakeholder satisfaction is “valuable”. Moreover, participants consider our approach as “detailed”. Other keywords stated are “flexible”, “improved decision making”, “focused”, and “improved observability”. For utility, the most common keyword is “useful”. Again, we can find “detailed” on this list. Further keywords are “simplicity”, “applicable”, “improved strategies”, “improved visibility”, “relevance”, and “improved BITA”. Finally, adoption

receives “better strategic support” as most common keyword. Others are “desirable”, “governance support”, “practicable”, and “better resource management”. Regarding improvements, participants express the need to be more specific, better exception handling, and minimize overhead. The more specific improvement in this context was attenuated once we explained more on how we apply our approach on specific projects. Improved exception handling means that participants would like to see more measures on how to deal with errors during assessment. We incorporate such measures in our evaluation phases although there is no specific error routine defined. The actual overhead minimization is considered as an ongoing effort and is a continuous objective for improvement.

From an EA practitioner’s perspective we still receive positive feedback with 65 percent expected stakeholder satisfaction, and 62.5 percent for both, utility and adoption. Accordingly, they find it moderately satisfying, useful, and likely to be adopted. For expected stakeholder satisfaction, the keyword most significant is once again “valuable” followed by “reduced complexity”. Other keywords included “detailed”, “effective”, and “reduced risks”. The following keywords decreased the rating in the opinion of some participants, namely “complex”, “unclear benefits for practitioners”, and “overhead”. Utility is most commonly associated with “practicability”. Again, our approach is considered “detailed”. Other keywords include “improved automation”, “improved planning”, and “applicable on many levels”. One participant deems the approach too difficult to use. For adoption, the EA practitioner’s perspective yields positively influencing keywords such as “clear instruction set”, “practical”, “success”, “governance”, and “reduced risk”. On the downside, it is considered as “difficult to implement”. Improvements expressed by EA practitioners are to provide clear implementation guidelines and more clarification on how practitioners benefit from the approach.

Finally, we have the group of EA customers which score 62.5 percent on expected stakeholder satisfaction, 57.5 percent on utility, and 55 percent on adoption. This translates into customer stakeholders being moderately satisfied, finding it moderately useful, and willing likely to adopt it. This result comes as expected as customers mostly benefit indirectly from such approach for it improves time and quality of service delivery. Directly, EA customers benefit in terms of their project planning, since they have an extended information base to make decisions regarding budget, staffing, and delivery time. When it comes to keywords that positively influence expected stakeholder satisfaction, customers name “useful” and “improved planning” most often. Additionally, “improved ROI” is perceived as being positively affected by our approach. A significant number achieves the keyword “irrelevant” as EA customers are not

clear about how they would be satisfied by this approach. Besides that, "overhead" is named as a factor that negatively influences the assigned rating. Utility yields positive keywords such as "relevance", "flexibility", and "simplicity". Negative keywords are "complex" and "unclear improvement". Enablers for adoption are "increased information", "better feedback", and most prominently "useful data" and "improved planning". The main inhibitors for adoption are considered to be "overhead" and "time consumption". When it comes to improvements, EA customers are mostly concerned about improving simplicity and clarifying EABV. In addition, it is suggested to better argue on how customers can benefit from this solution.

Influencing factors are perceived in some cases contradictory by participants within a particular stakeholder group. Hereby, the exception are EA managers which remark positive influencing factors consistently. The rating results are summarized in Table 6-4. It has to be noted, that scores for customers were slightly lower on all three criteria than the ones from practitioners.

	Expected Stakeholder Satisfaction	Utility	Adoption
EA Managers	Satisfied	Useful	Very likely adoption
EA Practitioner	Moderately satisfied	Moderately useful	Likely adoption
EA Customer	Moderately satisfied	Moderately useful	Likely adoption

Table 6-4: Concept evaluation: rating results

In the next Section, we outline the detailed evaluation with our chosen evaluation method within the organizational environment.

6.5. Evaluation with MAID

For our case study evaluation (Meyer and Helfert 2013a, 2013b), we are employing the Measurement and Analysis Infrastructure Diagnostics (MAID) (Kasunic 2010a) method published by the Software Engineering Institute (SEI) at the Carnegie Mellon University. For developing MAID criteria, SEI drew upon various sources of input, such as (Carnegie Mellon University Software Engineering Institute 2010; ISO/IEC 2007; Kaplan and Norton 1996; Mandic et al. 2010) as well as best practices in quantitative analysis, graphical display, and information packaging. Its purpose is to evaluate an organization's data and the information generated from that data. The two main objectives of MAID are thereby to evaluate data quality and the current measurement and analysis practice as well as giving recommendations for improvement based on such evaluation.

MAID is organized into four main phases (cf. Figure 6-2), namely *Collaborative Planning*, *Artefact Evaluation*, *On-site Evaluation*, and *Report Results* which will be described in the following subsections.

Figure 6-2: MAID overview (cf. (Kasunic 2010a))

This criterion-based method promises to be the best choice in that respect since it is was developed to measure and analyse exactly what we designed with our approach. The focus hereby is on the quality of a firm's measurement and analysis practice and the resulting reports. We tailor MAID and its criteria to fit our purposes and explain this measure in the appropriate sections. Thereby, we focus on a lightweight and effective evaluation in order to cope with time constraints for our project. This evaluation is most relevant for the Construction phase of our EABV AM as it validates our instantiated IT artefacts. In the following subsections, we will explain each of the phases and how we tailored the sub-steps and the corresponding criteria. A summary of the MAID method tailoring can be found in Appendix C..C.

6.5.1. MAID Objectives

When conducting a MAID evaluation we firstly aim to evaluate current Measurement and Analysis (M & A) practices, in our case the EABV AM. We therefore aim to get insights not only about the utility of our approach. The set of criteria chosen for evaluation is further explained in Section 6.5.5. The second MAID objective is to make recommendations for improvement. This means we target to evolve our EABV AM based on evaluation results. To achieve these objectives, we need to follow certain steps which we will describe in the next sections.

6.5.2. Classification of Evaluation Criteria

Criteria in MAID are classified into five different categories which reflect all stages of the actual method application. In total, MAID offers 325 criteria. We will describe these MAID criteria categories in the following subsections.

6.5.2.1. Measurement and Analysis Planning

This category is mainly concerned with identifying resource needs, skill training, information needs, and indicators that address these needs. Furthermore, planning and scheduling form a large part of activities that needs to be done. Moreover, we need criteria for a process to perform M & A activities. These criteria are mostly relevant on an organizational level but also include

various on project level. The latter are originally focused on software projects and are tailored for our needs. For our purpose, the EABV AP and the EABV M are the most relevant artefacts for these criteria.

6.5.2.2. Data Collection and Storage

In this category, we are concerned about collection of data addressing information needs which are identified in the EABV AP. For example, we are interested which stakeholders are accountable for a particular metric and the data collection activity. Further interest is evinced in detailed information about the metric itself, e.g. scale and unit of measurement. This information is present in our metrics template of the EABV M. Moreover, we must ensure data accuracy and completeness. Additionally, data must be stored securely which means stored data cannot be changed by unauthorized stakeholders.

6.5.2.3. Data Analysis

In this category, we are interested in criteria for data analysis for each information need. Various criteria exist to specify the data analysis process or procedure such as roles, frequency of analysis, base measures, and storage location. In addition, we have criteria that are concerned with the values and format of data sets. Furthermore, we must select appropriate statistical analysis approaches for which we have criteria that depend on this chosen approach. Thereby, data analysis is very flexible in terms of appropriate approaches.

6.5.2.4. Measurement and Analysis Reporting

We need to be aware of the expertise level of stakeholders that will use M & A information to support decision making. This is necessary in order to best transform and present data analysis results best suited for these stakeholders. Thus, we possess criteria that identify stakeholders to whom M & A information is reported along with the format of reporting. We additionally have a criterion that ensures we execute a feedback loop in order to validate information need satisfaction. Moreover, we find various criteria that are concerned with the actual representation of report information, such as how to present quantitative information in a table or a graph respectively.

6.5.2.5. Measurement and Analysis Documentation

Finally, we find several criteria for M & A documentation. For example, criteria indicating that M & A process/procedure descriptions contain easily accessible information and are split into small manageable units. Documenting a MAID evaluation serves as future reference as the

EABV AM evolves and criteria are henceforth changed. This documentation is also stored in the EABV FW repository.

6.5.3. MAID Roles and Responsibilities

In accordance to (Kasunic 2010a), we denote a group of people involved in the MAID evaluation as the MAID team. The roles and responsibilities along with the mapping to our defined DSR roles are outlined in Table 6-5. The team lead role is best suited for industry stakeholders (most likely an industry practitioner due to the level of M & A expertise) since they have the necessary contacts and system access to facilitate communication and administrative tasks. A client in MAID is the equivalent to a customer in our understanding. The customer point of contact (POC) in our case is represented as an industry practitioner since the EA organization acts as a customer in terms of the DSR evaluation. In other words, we evaluate our approach intra-organizational. Nevertheless, an industry customer, for example a project manager from a different organization may be assigned to fulfil this role if the need to evaluate the EA assessment arises from the industry customer side for a specific project with EA contribution. Basically everyone involved in the DSR project as well as additional industry customers can respond to questions and questionnaires. Stakeholders in MAID are customers interested in the MAID evaluation results. For our purpose, stakeholders include customer and practitioners since possibly everyone might be interested in the results of the MAID evaluation at some point. Moreover, a stakeholder here can actually be a whole team or organization and not just individuals. To summarise, our particular evaluation is for an EA intra-organizational project and hence, we are own customers.

Role	Responsibilities	DSR Role
Team Lead	• Leader of the evaluation team • M & A expert • Point of contact (POC) for communication • Administrative and organization activities	• Varies; usually an industry practitioner with the appropriate level of expertise and system access
Team Member	• M & A experts participating as MAID evaluators • participates in MAID activities as team lead sees fit	• Industry practitioner • Academic researcher
Sponsor	• Manager who has authorized the MAID evaluation	• Industry manager
Customer POC	• POC for communication between customer and MAID team lead • coordinates of planning and scheduling of MAID activities for customers • facilitates delivery of M & A artefacts to the team lead	• Industry customer • Industry practitioner

	• manages all activities to facilitate the MAID evaluation on-site	
Customer SME	• Customer M & A subject matter experts • answers questions about the M & A documentation • participates in MAID interviews	• Industry customer • Industry practitioner
Questionnaire Respondents	• responds to questions or questionnaires	• All (varies)
Stakeholders	• Stakeholders interested in the results of the MAID evaluation	• All (varies)

Table 6-5: MAID roles and responsibilities and the mapping to DSR roles

6.5.4. Collaborative Planning

The initial phase *Collaborative Planning* is concerned about planning and preparing employing for MAID. For that purpose, the evaluation team leader needs to arrange with the organization's sponsor and align the MAID objectives in such a way that they support the project goals included in our EA BSC. Consequently, we want to measure and analyse how successful they have been fulfilled operating the EABV AM and how useful this assessment was by employing MAID.

Collaborative Planning comprises of three different stages with several activities for each which is summarized in Table 6-6 based on the method definition document (Kasunic 2010a). For each of the activities we have an input and an output. The latter is termed as product in this context. The detailed procedural steps for each activity can be taken from (Kasunic 2010a). All of the stages and activities including input information and products are described more detailed in the following subsections.

Stage/Activity	Information Needed	Products
Establish Scope		
Determine MAID Objectives	• Description of the project goals	• List of MAID objectives
Determine Constraints	• List of MAID objectives • Estimates of stakeholder availability	• List of constraints to be met • List of stakeholder availability • List of revised MAID objectives
Determine MAID scope	• List of revised MAID objectives • List of constraints to be met	• MAID scope statement
Establish Roles and Expectations	• MAID scope statement	• List of MAID team members • List of customer SMEs
Develop Plan and Schedule		
Determine MAID Outputs	• List of revised MAID objectives	• List of outputs with descriptions

	• Input from sponsor to customer POC	
Determine MAID Inputs	• List of customer SMEs	• M & A artefact inventory
Tailor Method	• List of revised MAID objectives • List of constraints to be met • MAID scope statement	• Approved tailoring decisions
Determine Cost and Schedule	• List of revised MAID objectives • MAID scope statement • Approved tailoring decisions	• Approved cost and schedule estimates
Obtain Commitment to the Plan	• All previous products	• Approved MAID plan

Table 6-6: MAID Collaborative Planning overview

6.5.4.1. Establish Scope

Scoping is crucial at the beginning of each evaluation endeavour. We need to know precisely what we want to evaluate. Therefore, the sponsor and the MAID team leader determine the actual focus of the evaluation. In our case, operational level assessment (cf. Sec. 4.3.2) demands choosing a suitable project, and hence we evaluate our DSR artefacts as they assess the chosen project in terms of EABV.

For this purpose, we need to determine MAID objectives. Basically, we want to be clear about what we want to evaluate and what can be done with the evaluation results. As input, we need project goals and generate a list of MAID objectives. Our list of MAID objectives contains the following items:

- Evaluate the EABV AM, the EABV FW, the EABV M, the EABV AP, and the EA BSC in terms of chosen criteria
- Give recommendations on how to improve/evolve the EABV AM

Thereafter, we need to determine eventual constraints. These impact the MAID evaluation and comprise factors such as time, cost, and stakeholder availability. They may limit the scope of the evaluation. One of the requirements for our EABV AM is feasibility, and thus we need to consider this as a constraint for the evaluation. Feasibility has an impact on cost, time, and stakeholder contribution and availability.

Finally, we need to determine the actual scope of MAID. Here, we distinguish between two types of scope: (1) the scope based on categories of the MAID evaluation that will be used and (2) the organizational scope. Since selecting MAID criteria is predicated on knowledge from literature and industry while being aligned to the requirements and DSR evaluation criteria, our scope is devised by a subset of criteria in each of the MAID categories. We outline the selection

of criteria more detailed in Section 6.5.5. Regarding the organizational level, we limit ourselves to one project and hence to the scope of our chosen focus project described in Section 7.2. As a result, we produce a MAID scope statement that includes involved organizational entities, categories of criteria, and the rationale for decisions made. Notably, the scope at this stage is rather at a high level and can get more detailed during subsequent planning.

6.5.4.2. Establish Roles and Expectations

After we determined our scope, we need to know which stakeholders will participate in the evaluation. This is done by the team lead and the customer POC. Consequently, we are able to produce a list of MAID team members including contact and availability information. Furthermore, we have a list of customer SMEs which also contains information about their M & A role and skills. More on MAID roles was already explained in the previous Section 6.5.3.

6.5.4.3. Develop Plan and Schedule

The team lead and the customer POC collaboratively work on creating a plan and schedule for conducting the MAID evaluation in this stage. The first activity is to determine the MAID outputs. The information needed is the list of revised MAID objectives and input from sponsor to customer POC. We have several options on how to report MAID evaluation results, such as presentations including M & A strengths and weaknesses, MAID survey results, a list of MAID criteria with ratings and rationale, recommendations for addressing M & A weakness, or a detailed report with all the findings. These outputs can be combined as the team lead and the customer POC sees fit, resulting in a list of outputs with descriptions. For the purpose of our work, we present the preliminary results in the form of a presentation.

The next activity is to determine MAID inputs. Here, we specify all M & A relevant documents, tools, and data repositories. For this purpose, we need a list of customer SMEs for they are together with the team lead and customer POC responsible for all tasks of this activity. The resulting product is an M & A artefact inventory. The information contained for each M & A artefact is the description for each of our DSR artefacts.

Thereafter, we proceed with the tailor method activity by adapting the method in a way best suited to fulfil organizational and project objectives. The team lead and customer POC need the list of revised MAID objectives, the list of constraints, and the MAID scope statement to tailor the method. In Appendix C.12, we summarize this tailoring for our purposes. We choose to tailor on the stage level as this gives us the most flexibility without generating too much overhead. As output, we generate a document containing the approved tailoring decisions.

After clarifying how to tailor the method, we must determine the cost and schedule. This is an estimate based on the list of revised MAID objectives, the MAID scope statement, and the approved tailoring decisions. The resulting cost and schedule estimate must be approved. For our purposes, we seek additional guidance from a financial analyst in order to conduct our MAID effort as cost efficient as possible. For example, we deploy stakeholders that were involved in the EABV AM design and development to reduce the time for additional meetings and explanations necessary for new stakeholders.

Thereafter, we need to obtain a commitment to the plan. Commitment comes from the sponsor in a formal way. For that purpose, we need all previous MAID outputs. Resulting is an approved MAID plan which is documented by the team lead. The plan is distributed to all relevant stakeholders.

6.5.5. Evaluation Criteria Selection

We now present the relevant criteria we choose to evaluate our approach. As already mentioned, a complete evaluation could have 325 different criteria. Apparently, this would be out of scope in the context of our work. Since we are not able to get a full evaluation report in a manageable timeframe, we have to select criteria that are suitable for preliminary results, i.e. criteria that show that our approach is applicable to be implemented in the future for upcoming EABV assessments. The selection of criteria is impacted by literature and experts within the company and is part of tailoring MAID for our purposes. In addition, we link these MAID criteria to the requirements identified for each of the artefacts. As a result, we illustrate this mapping of criteria in Figure 6-3. For each of our artefacts, we select appropriate DSR evaluation criteria. Those DSR criteria can occur multiple times, i.e. a criterion can be used to evaluate more than one artefact. Thereafter, we choose an adequate number of suitable MAID criteria.

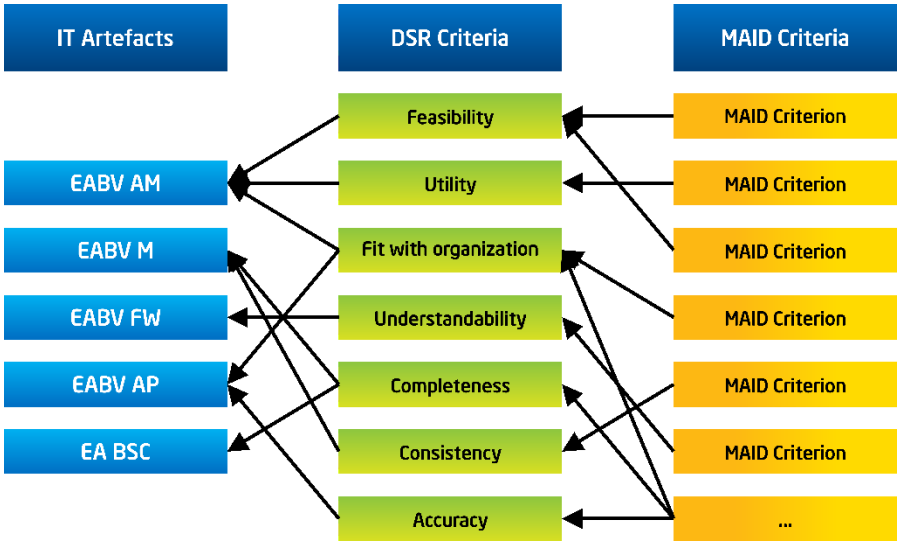

Figure 6-3: Evaluation Criteria Mapping

We end up using 23 criteria. Notably, we keep the criterion number as identifier as outlined in (Kasunic 2010b). We concentrate on top-level criteria and pool sub-criteria wherever we saw fit. The compete criteria selection is shown in Table 6-7. It has to be mentioned, that categories Data Collection and Storage and Data Analysis are already implemented at our corporate partner aligned to the EA principles issued in large parts. These are mostly general and prescriptive criteria for data usage and management, i.e. a best practice catalogue. As a consequence, we can afford to skip the majority of these criteria.

Since this M & A initiative in the form of the EABV AM and its artefacts is an approach from scratch, we need to tackle many topics from the beginning which is why the completeness DSR criterion is perceived as most crucial. This explains the choice for many of the MAID criteria. E.g. regarding the EABV M, we are interested in completeness and consistency for model evaluation. For completeness, we want to know if organizational goals are defined that can be aligned with project goals that are documented and expressed in measureable terms in order to track progress. We accomplish this by including critical success factors that indicate at which stage of achieving a goal we currently stand. Another important criterion for completeness in our model is the documentation of an assessment plan which is part of the EABV AP.

Artefact	DSR Evaluation Criteria	MAID Evaluation Criteria
EABV AM	Feasibility	**1.36** A project estimation process is developed.
	Utility	**4.3** A validation procedure (feedback loop) is defined to ensure that information needs are satisfied by the suite of M & A indicators.
	Fit with organization	**1.1** Organizational policies exist that mandate the establishment of an organization-wide measurement program.

		1.25 Common M & A standards and terminology are used within the organization.
EABV FW	Understandability	**5.2** M & A process and procedure descriptions are appropriate to user's needs. **5.3** M & A process/procedure descriptions contain easily accessible information.
	Completeness	**4.5** M & A information that is communicated to support decision making is accompanied by recommendations.
EA BSC	Completeness	**4.4** M & A information that is communicated to support decision making also contain explanations.
EABV M	Completeness	**1.2** Organizational goals are defined and documented. **1.4** Organizational goals are expressed in measureable terms so progress toward achieving a goal can be assessed. **1.6** A measurement plan is documented. **1.24** M & A terminology is defined **2.1** For each metric that is collected, a data collection process/procedure is included containing specific information.
	Consistency	**1.5** Project goals are kept current. **1.25** M & A terminology is defined. **2.3** The data form is consistent with the associated data-collection procedure.
EABV AP	Accuracy	**1.42** The plan specifies that peer review activities are conducted to identify, characterize, and record defects throughout the project life cycle.
	Completeness	**1.28** Data collection and storage procedures are documented. **1.29** The data analysis approach procedure is documented. **1.40** The plan specifies that actuals (i.e. effort, cost, schedule, and quality) be compared with estimates and the outcomes documented. **3.7** When developing measurement instruments, the analyst assesses the reliability of the measures and indicators. **4.2** For each information need identified, a report defines the following: responsible stakeholder, target audience, metrics, frequency, mechanism. **4.9** Text answering "What? When? Who? Where?" should be included in the M & A report.
	Fit with organization	**1.8** The measurement plan specifies resources to be allocated.

Table 6-7: Selection of MAID criteria aligned with DSR evaluation criteria

6.5.6. Artefact Evaluation

Phase two of MAID, *Artefact Evaluation*, is concerned about the evaluation of M & A artefacts that were identified during Collaborative Planning. This evaluation is conducted with the predefined set of MAID criteria as outlined in Section 6.5.5. Thereby, we want to assign a rating to each MAID criterion including a rationale for this rating. Additionally, we need to prepare a

questionnaire which will be used later in in phase three On-site evaluation (cf. Sec. 6.5.7.). The overview of the Artefact Evaluation phase is outlined in Table 6-8.

Stage/Activity	Information Needed	Products
Prepare for Artefact Evaluation	• List of MAID team members • List of customer SMEs • M & A artefact inventory • Approved MAID plan	• M & A artefacts received from customer organization
Conduct M & A Evaluation	• M & A artefact inventory • M & A artefacts received from customer stakeholder • MAID criteria form	• MAID criteria form – Phase 2 results
Perform Quality Audit of Results	• MAID criteria form – Phase 2 results	• Quality-audited MAID criteria form – Phase 2 results
Prepare for On-Site Evaluation		• MAID scope statement
Prepare On-site Evaluation Agenda	• M & A artefact inventory • Approved MAID plan • Quality-audited MAID criteria form – Phase 2 results	• Approved agenda for on-site evaluation
Prepare Materials	• M & A artefact inventory • Approved MAID plan • Approved agenda for on-site evaluation • Quality-audited MAID criteria form – Phase 2 results	• Interview questions organized by interviewee • Contact list for questionnaire target audience • Orientation presentation from Phase 3
Administer MAID Questionnaire	• Contact list for questionnaire target audience • Self-administered questionnaire • Interview questions organized by interviewee	• Questionnaire results • Questionnaire results organized for reporting purposes
Manage Logistics	• Approved MAID plan • Approved agenda for on-site evaluation	• Action item list to support Phase 3

Table 6-8: MAID Artefact Evaluation overview

6.5.6.1. Prepare for Artefact Evaluation

The first activity is concerned with the preparation of MAID artefacts. For this purpose, we first need the list of MAID team members which also includes contact information and availability information. Furthermore, we require the list of customer SMEs. Most importantly, we necessitate the M & A inventory which must be organized and assigned for evaluation to team members. Further required is the approved MAID plan. All MAID artefacts use the versioning employed for our DSR artefacts. The product in this phase are actual copies of the M & A

artefacts from the customer organization. Since all our M & A artefacts are available intra-organizational, we do not specifically arrange for obtaining copies and documentation from other organizations. We still consider customers in this M & A context since some artefacts, e.g. the EA BSC, is likely to be used by managers from different organizations and they could express their interest to evaluate it in terms of their M & A capabilities.

6.5.6.2. Conduct M & A Artefact Evaluation

This activity deals with conducting the actual analysis of M & A artefacts. Consequently, we require the M & A artefact inventory and all relevant M & A artefact information. An important input for the actual evaluation is the MAID criteria form. The template we employ is illustrated in Table 6-9 based on the recommendation of (Kasunic 2010a).

Item	Description
Criterion number	The criterion number according to (Kasunic 2010b).
Criterion	The evaluation criterion description.
Rating	Value of rating according to evaluator depending on how well criterion is satisfied.
Evidence of Rating	A reference to the relevant location of the artefact that supports the rating.
Rationale	The evaluator's reasoning for assigning that particular rating. This field is optional and used if it is not clear why a rating was given.
Interview questions	Captures interview questions used in Phase 3 – On-site Evaluation. The intention is to clarify criterion issues.
DSR Artefact	Describes which DSR artefact is evaluated with this criterion.
DSR Criteria	Describes to which DSR criterion this MAID criterion is mapped to.
Notes	Captures any kind of information which the evaluator sees fit for this particular criterion.

Table 6-9: MAID criteria form (based on (Kasunic 2010a))

Regarding the rating scale, we adopt the recommended scale described in (Kasunic 2010b). We summarize it in the following Table 6-10.

Rating	Description
Very adequate	Exceeds the standard for this criterion or is viewed as a superior implementation.
Adequate	Satisfies the criterion sufficiently.
Slightly inadequate	Criterion is almost satisfied. By making a slight change to the condition or practice addressed by the criterion, a rating of adequate could be achieved.

Very inadequate	The condition or practice is addressed by the organization but in an inadequate way.
Completely missing	The condition or practice does not exist based on examination of the M & A artefact.
Doesn't apply	The particular criterion does not apply to the organizational context.

Table 6-10: MAID criterion rating scale (c.f. (Kasunic 2010b))

MAID team members now can rate relevant MAID criteria of the artefacts while the MAID team lead monitors progress and enables communication between team members wherever needed. A single view of results is prepared by the team lead after the assessment in the form of the *MAID criteria form – Phase 2 results*. For this part of the evaluation, we employ a Microsoft Excel® spreadsheet.

6.5.6.3. Perform Quality Audit of Results

The objective of this activity is for the team lead to review the compiled results in terms of completeness and overall quality. As product, we have the *Quality-audited MAID criteria form – Phase 2 results*. Notably, we tailor this activity into the actual evaluation since the team lead in our case also acts as SME for criteria ratings. In other words, quality reviews happen right after rating before they are accepted for the next stage. This marks an important step in order to deliver trustworthy evaluation results (cf. Sec. 6.6).

6.5.6.4. Prepare for On-site Evaluation

As the name suggests, this activity consists of preparations for the upcoming on-site evaluation. Firstly, we must prepare the on-site evaluation agenda for which we necessitate the M & A artefact inventory, the approved MAID plan, and the quality-audited MAID criteria form – phase 2 results. Thereby, we set the agenda in the form of a series of workshops. The resulting product is the *approved agenda for on-site evaluation*.

Secondly, we prepare the materials, namely the M & A artefact inventory, the approved MAID plan, the approved agenda for on-site evaluation, and the quality-audited MAID criteria form – phase 2 results. With regard to intent, this preparation mostly consists of how to get qualitative information from stakeholders. Consequently, the MAID team lead formulates interview questions organized by interviewee, a contact list for the questionnaire target audience, a self-administered questionnaire, and an orientation presentation from phase 3 – On-site evaluation. Notably, due to the close working relationship between MAID team members, we omit the self-administered questionnaire. Nevertheless, we plan to include it after passing the EABV AM construction phase and completing an EABV operation cycle for inter-organizational projects.

Thirdly, we administer the MAID questionnaire for which we require all products from the previous activity. Basically, this is an additional way of collecting M & A practices information from all impacted stakeholders. As products, we receive questionnaire results, revised interview questions organized by interviewee and questionnaire results organized for reporting purposes.

Finally, we manage logistics where we negotiate and document all logistical details for the on-site evaluation. Here, we require the approved MAID plan and the approved agenda for on-site evaluation. As product, we create an action item list containing task information such as the description, responsibility, due date, and a completion date. All stakeholders responsible should receive this list. This activity has in practice a very organizational character and is not relevant for our research since it comprises tasks as organizing meeting rooms, drinks and food, and accommodation. Nevertheless, we have executed this activity in a simplified form.

6.5.7. On-site Evaluation

The *On-site Evaluation* phase comprises a series of interviews with customer SMEs and EA stakeholders. In addition, the M & A data repository is examined. Any M & A artefact that could not be evaluated off-site is further enquired in this phase. For organizing the interviews and workshops, we dispose of a flexible availability schedule starting with on orientation meeting in which we agree on how to conduct the On-site Evaluation. Then, we scrutinise the M & A data repositories and conducted the interviews. The on-site evaluation phase along with its information needs and products is summarized in Table 6-11.

Stage/Activity	Information Needed	Products
Conduct Orientation Meeting	• Approved agenda for on-site evaluation • Orientation presentation from Phase 3	• Orientation meeting record
Conduct Examinations of M & A Data Repositories	• Quality-audited MAID criteria form – Phase 2 results	• Intermediate Phase 2-3 artefact evaluation results
Conduct Interviews	• Interview questions organized by interviewee • Intermediate Phase 2-3 artefact evaluation results	• Interview transcripts

Table 6-11: MAID On-site Evaluation overview

6.5.7.1. Conduct Orientation Meeting

This meeting aims to provide an overview of MAID including objectives and benefits as well as the outline of the On-site Evaluation. Moreover, we answer any questions participants might have to set the record straight. Since on a high level, all team members savvy what MAID is

about, we can delve deeper into detail to clarify activities and outcomes based on the approved agenda and the orientation presentation which was produced in MAID phase 2: Artefact Evaluation. In our case, it is not necessary to keep a formal orientation meeting record.

6.5.7.2. Conduct Examinations of M & A Data Repositories

In this activity we inspect relevant M & A data repositories included in the MAID scope. This is in our case represented by the AIB as part of the EABV AP. Given that our EA performance data constitutes a manageable amount, storage performance is not relevant. More important is data quality achieved with this implementation. Notably, at the end of the prototype stage, the final choice of technology and implementation specifics is not carved in stone and will likely change according to the level of integration. Generally, this activity serves as control mechanism verifying that defined plans and procedures of the M & A practice are implemented accordingly. For these examinations, we necessitate the previous Quality-audited Phase 2 artefact evaluation results and the M & A repository. The resulting product is the Intermediate Phase 2-3 artefact evaluation results. This activity contains mostly criteria from the Data collection & storage category.

6.5.7.3. Conduct Interviews

This activity is concerned about conducting interviews with the customer stakeholders to find out whether our prototype is performing as intended. For this purpose, we require the previously defined interview questions organized by interviewee and the intermediate Phase 2-3 artefact evaluation results. The output comes in the form of interview transcripts. In our case, conducting interviews is done very quickly due to the fact that the initial evaluation did not bring up many interview questions.

6.5.8. Report Results

The final phase of the evaluation aims to compile all results from the previous two phases to generate a report. This report is usually forwarded to the customer SMEs, but since these are our EA stakeholders, we report the results internally so to speak. An overview of this activity is given in Table 6-12.

Stage/Activity	Information Needed	Products
Analyse On-site Evaluation Results	• Intermediate Phase 2-3 artefact evaluation results • Interview transcripts	• Final MAID criteria evaluation results
Derive Key Findings	• List of customer SMEs • Approved MAID plan	• Final MAID criteria evaluation findings

	• Final MAID criteria evaluation results	
Deliver Key Findings	• Final MAID criteria evaluation findings	• Delivered MAID results
Plan Next Steps	• Delivered MAID results	• Action plan

Table 6-12: MAID Report Results overview

6.5.8.1. Analyse On-site Evaluation Results

The objective of this activity is to compile and analyse all results from the On-site Evaluation. Therefore, we require the intermediate Phase 2-3 artefact evaluation results and the interview transcripts. All information is ultimately consolidated into the final MAID criteria evaluation results. For us, this activity is executed in a very short time due to the fact that we did not conduct many more interviews as the previous artefact evaluation mostly brought us final results. The reason for this is the close collaboration effort and excellent communication producing the quality-audited artefact criteria rating results (cf. Sec. 6.5.6.3).

6.5.8.2. Derive Key Findings

At this stage, MAID team members prepare the results for reporting. We review the results in regard to the MAID objectives and the MAID plan. Thereafter, we construe these results into key findings. These contain information about M & A strength and weaknesses. We further include recommendations at this point as they are the input for the Plan Next Steps activity. For this purpose, we require the list of customer SMEs, the approved MAID plan, and the final MAID criteria evaluation results. As a result, we produce the final MAID criteria evaluation findings. We will summarize our key findings in Section 7.4.1.

6.5.8.3. Deliver Key Findings

This activity diffuses the final MAID criteria evaluation findings including strength and weaknesses. These findings should support decision making for future M & A planning, or in other words clarify what we need to do in order to improve our EABV AM and the rest of the artefacts. This part of reporting constitutes the preliminary results for our DSR evaluation and we choose to present them to the different stakeholder groups in slide format which we agreed on during Collaborative Planning (6.5.4.3). A textual description of findings is summarized in this Thesis and is available for stakeholders in a separate report document containing all information about this MAID evaluation. The product here is the delivered MAID results. Notably, a full evaluation report as the output of our DSR ABC (cf. Sec. 2.2) should be the result of at least two assessment cycles in order to compare different periods and infer how successful the enterprise transformation has been.

6.5.8.4. Plan Next Steps

Actually, this activity is optional according to the method definition document (Kasunic 2010a) but nevertheless recommended. In our context, this activity can either lead back to the DSR Design phase to accommodate some of the identified weaknesses, or lead to another DSR Analysis phase if we perceive that the business need or problem respectively changed significantly to trigger another research evolution cycle. Since we need to instantiate the method, i.e. put it into operation phase, we include this activity into the EABV AM: Operation Evolve phase (7.3.8). The product here is the so called action plan which contains information on how to deal with eventual changes of the EABV AM.

6.6. Threats to Validity and Trustworthiness

In research design, threats to validity constitute a set of aspects such as criteria, events, or stakeholders that could compromise a well-grounded, justifiable, and logical correct research output as a result of the evaluation. The number of threats to validity is thought to be at least as high as the sources of validity evidence (Downing and Haladyna 2004). Validity in this regard is viewed as the adequate reflection of the truth or reality respectively by employing a particular research method including the observations during research evaluation (Roe and Just 2009). It therefore refers to the best available approximation to the truth or falsify propositions (Cook and Campbell 1979). While perceived as multidimensional concept, the overarching form of validity is considered to be the construct validity according to validity theory (Kane 2001). Further types of validity include internal, external, content, and statistical conclusion validity (Brewer 2000; Campbell 1957; Cook and Campbell 1979; Roe and Just 2009). Validity theory historically evolved in the social sciences and is traditionally part of a realistic or positivistic view in terms of ontology and epistemology (Kane 2001). This means that ontologically, the position on the nature of reality is external, objective, and independent of social actors while epistemologically, the view on what constitutes acceptable knowledge can only be described by observable phenomena (Wahyuni 2012). The major debate on validity, especially construct validity, revolves around a epistemological difference between positivists and postpositivists (Kane 2001). Validity is a concept for research evaluation predominantly found in quantitative research approaches (Graneheim and Lundman 2004).

But what does validity mean in context of DSR where we are mainly concerned about the utility and not the truth while employing mostly qualitative methods for data inquiry rather than quantitative ones? For this purpose, literature suggests the concept of trustworthiness, which includes the credibility, dependability, and transferability (Graneheim and Lundman 2004;

Guba 1981; Krefting 1991). Credibility is concerned with the research focus and the degree in confidence in how well data and process support this focus. Dependability deals with data gathering over several periods and therefore deals with data change over time. Transferability is concerned with the extent research can be transferred to different stakeholder groups and organizational environments. Philosophically, we follow *pragmatism* regarding our research paradigm (cf. Sec. 2.1) and therefore are able to choose the most adequate view to examine trustworthiness for our research approach. We discussed already several challenges and issues in context of EABV assessments in Section 4.2.2 which serves as basis to examine the threats to trustworthiness along its three in terms of DSR. This is illustrated in Table 6-13.

	Credibility	**Dependability**	**Transferability**
Technical	System errors	System errors	Compatibility
Managerial	Poor management decisions	Poor management decisions	Different management style/strategy
Cultural/Social	Trust issues, communication errors	Poor common understanding	Different culture
Alignment	Poor choice of aligning goals and metrics	Change in goals	Different goals
Evaluation	Limited to one case study, Limited number of stakeholders	Limited timeframe	Large differences in organizational context

Table 6-13: Threats to trustworthiness of research output

We now focus our discussion on the evaluation. Regarding evaluation, the credibility is limited due to the fact that we have one case study. More utility might be achieved by expanding this research with more case studies. Furthermore, it could be limited due to the number of participating stakeholders. A greater number of stakeholders might generate more trustworthy input to shape our research output. Finally, transferability is restricted due to the nature of organizational contexts. This means that different contexts might require completely different design of artefacts. As for the dependability, evaluation over a longer period of time was not possible. This means we were not able to validate it as a longitudinal case study as described in (Street and Ward 2007). Such case studies involve an extra step to include a timeline of events or changes in research variables or criteria based given the datasets. This timeline henceforth serves as basis for the case study narrative. Nevertheless, we will continue to monitor the progress of our instantiation.

6.7. Chapter Summary

This Chapter described our efforts to evaluate our approach. Therefore, we first outlined different perspectives on evaluation determined by the types of stakeholders. Thereafter, we

elaborated on suitable evaluation methods before taking a closer look at relevant DSR evaluation criteria. As first part of our evaluation, we conducted a concept evaluation workshop that yielded results about expected stakeholder satisfaction, adoption, and utility for each of the stakeholder types. Thereby, our concept was best received by EA managers. The main part of this Chapter dealt with the main evaluation method called MAID. We outlined all relevant evaluation process phases and activities as well as the resulting products. An important part here was the actual MAID criteria selection since 325 criteria for evaluation would be well out of scope, time, and budget. We agreed on 23 criteria for our evaluation. The MAID evaluation results will be presented as part of our case study in the next Chapter. Furthermore, we discussed the threats to validity or trustworthiness of our research by focusing on qualitative research in terms of DSR in alignment to a pragmatic philosophical research stance.

7. Case Study

"In theory, there is no difference between theory and practice. In practice, there is."

Chuck Reid

Throughout this Thesis, we mentioned our corporate partner several times. Now, when we describe our case study, it is time to examine our focus company and the organizational environment. Employing case study research as evaluation method roots in the defining feature of case studies: gain an in-depth and up-close examination of a case within its organizational context (Yin 2013). In contrast to other evaluation methods such as surveys, experiments, and quasi-experiments, case studies accommodate given complexities prevalent in organizational environments including changes over time while fully considering this environment and possibly interact with it (Yin 2013).

As we know from practitioners and literature, the majority of global companies employ different means to practice EA with major EA frameworks being commonly in use. Regardless of that, a goal-driven approach like ours works with every kind of EA practice as long as goals can be defined. And this is actually a requirement for a successful enterprise transformation as strategies and their execution are broken down to goals on various hierarchical levels. In this Chapter, we will firstly describe the organizational context in Section 7.1. Thereafter, we will outline the focus project for which we apply our EABV AM in Section 7.2. Then, we explain the actual instantiation of artefacts and the operation of the EABV AM in Section 7.3, the main part of the case study. Finally, in Section 7.4 we deliver our preliminary results of the evaluation and we describe the theoretical contribution to the knowledge base as well as the practical contributions in Section 7.5.

7.1. Organizational Context

Our corporate partner is the world leader in semi-conductor industry. As a global high tech company, it employs well over 107,600 people worldwide (at end of 2013) and achieving a net revenue of $52.7 billion in 2013. Thereby, 6334 people are working in the IT department. Part of that is the EA organization, which consists of about 70 enterprise architects. It comes as no surprise that a multinational company employs some kind of EA framework in order to cope with the architectural challenges it faces every day. The framework employed is an adapted

version of The Open Group Architectural Framework (TOGAF) (The Open Group 2011a). Therefore, our efforts require an alignment with this framework and the terminology already in use. In general, the terms goals and objectives are used synonymously. However in TOGAF an objective is defined as a time-bounded milestone for an organization used to demonstrate the progress towards a goal. A goal itself is a high-level statement of intent of direction for an organization which is typically used to measure an organization's success. Looking at the TOGAF content metamodel (The Open Group 2011a), we can see that a *Driver* creates a *Goal* which in turn is realised through *Objectives*. Driver, Goal and Objective are part of the Motivation Extension whereby the *Organization Unit* is the motivation initiator, i.e. drivers are motivated by the organizational unit. When we want to measure Objectives, we need the Governance Extension. Thereby, the *Measure* sets the performance criteria for the Objective which in turn is tracked against the Measure. Analogous, the Measure sets the performance criteria for the Business Service which is also tracked against the Measure. We will take a more detailed look at all of these concepts in Section 7.3.1 and explain how we define and adapt them for our purposes. Notably, the Motivation and Governance Extensions are part of the Business Architecture. Since the scope of our EABV assessment further allows for evaluating components in the data-, application-, and technology architecture, we extend the measurement concept of TOGAF with our EABV Framework. The definitions and terminology are outlined in detail in the data dictionary in Appendix A.

7.2. Focus Project: Private Cloud Infrastructure

To evaluate our approach, we choose a focus project to apply the EABV AM in order to proof the concept is viable for further employment and evolvement. The chosen project is part of the enterprise private cloud strategy. The majority of the company's business groups run production applications in this private cloud. With the chosen project, a business intelligence (BI) system for infrastructure management has been developed in order to improve infrastructure provisioning. It fosters the efforts of establishing an efficient infrastructure as a service (IaaS) and provides the basis for the ongoing efforts of shifting the focus to platform as a service (PaaS). Specifically, the focus of this project is to provide an infrastructure management operational data store (IMODS) that unifies data from all function managers within the company's cloud solution stack so it is available to end users and management tools to facilitate improved decision making based on improved data quality, data visibility, and data analytics. Notably, this project is entirely an EA project, and thus the difficulties of filtering out the actual EA contribution could be omitted. We will explore the actual instantiation within the company in the next Section.

7.3. Instantiation

Part of the design phase comprises the instantiation, which means we apply our artefacts as actionable entities within the organizational environment prior to evaluation. For this purpose, we must provide means that artefacts are usable by stakeholders. We choose to describe the instantiation of artefacts in this Chapter, as it is the very foundation of our case. Instantiated artefacts are then evaluated using MAID. Notably, MAID employs various techniques and sources commonly found in case study research, such as interviews, documents, field observations, and stakeholder feedback (Yin 2013). The remainder of this Section is organized as follows: firstly, we outline the instantiation effort for each of our artefacts. Secondly, in order to conduct an appropriate EABV assessment, we measure performance, analyse performance data, communicate business value and finally evolve the EA function based on the current assessment information (cf. Figure 5-6). In short, the MACE scheme of the EABV AM operation phase for which we will explain all comprehended activities. Finally, we concentrate our attention on the alignment with the employed EA maturity framework.

7.3.1. EABV M

We already discussed our conceptual UML class diagram model (cf. Sec. 5.3). This serves as basis for the data-driven development of our approach. Thereby, we develop a conceptual data model which we already described in Section 5.3.1. Thereafter, we continue with a logical data model. The logical data model (and therefore its components) conveys the concept in compact and expressive form in order to serve as a vehicle for communication. The aim here is to achieve a common understanding between business and IT. We model our logical data model with two different tools. First, we model it in Microsoft Visio 2013 Professional®. The reason for this is it is widely available within the company and hence the instantiated model can easily be viewed and edited by various stakeholders. Nevertheless, once the model is finished in Visio, we develop the logical data model with ER/Studio® as this is the current standard tool for database development employed by our corporate partner. The logical data model is described in detail in the Appendix A.2.

The final stage of our data modelling endeavour marks the development of a physical data model. Basically, this means we translate the logical data model into an actual database instance. Thereby, we enter a level of technological dependence where we need to consider implementation specific topics such as performance. In other words, the purpose of the physical data model is to account for technical capabilities and constraints of the employed database management system. As we deliver in a prototype, issues such as performance and scalability

will not affect our actual database. Hence, we conclude that an actual physical data model is not required at this stage. Instead, we instantiate our data model using Microsoft Access 2013 Professional®, i.e. we provide a physical database instantiation.

7.3.2. EABV FW

The EABV FW is basically reflected in the database instantiation of the EABV M that stores all references to relevant documentation. It is therefore manifested by making the framework repository persistent. This encompasses the storage to models, methods, assessments, reports, and recommendations. Future plans are to include all this information into the EA portal which also encompasses a collaboration platform. Additionally, we plan to provide a list of suitable methods for data analysis to assist data architects and analysts. Moreover, The EABV FW is currently diffused in document form for adoption and training purposes.

7.3.3. EABV AP

The EABV AP is documented and supported by a Microsoft Excel 2013® tool linked to our database. Each of the process steps includes required activities, responsible stakeholders, as well as inputs and outputs. The EABV AP is fundamental to operate the EABV AM and hence is aligned to the MACE scheme (cf. Sec. 5.4). Therefore, we refer to the relevant subsections in this Chapter for a more detailed description of the instantiation of the EABV AP.

Future plans include to implement the process based on the BPMN model outlined in Section 5.4. The actual data points for the EABV AP have been defined and communicated although the detailed documentation of these is omitted in this Thesis as this is part of the non-disclosure agreement. The reason for this is, that our EABV AP is linked to internal IT processes that are not to be published. However, we can list them on a high level leaving out integration details. Despite that, our research endeavour spent considerable efforts on integrating this process into current business processes regarding our requirements.

7.3.4. EA BSC

The perspectives are linked by goals in the form of a cause-effect diagram termed as Strategy Map (Kaplan et al. 2000). The EA strategy map is depicted Figure 7-1. We produce this map with Provision®[3] and as part of the EA BSC instantiation. Thereby, actual goals are derived from our survey results (cf. Sec. 4.2.1) which we construe to make EA less time consuming and less complicated. Since goals stem from the practitioner's side and not from academia we avoid the gap outlined in (Lange et al. 2011). Achieving goals increases stakeholder satisfaction

[3] http://bps.opentext.com/products/product/provision-enterprise-architecture-it-planning

which is then be communicated as EABV, e.g. higher revenue because satisfied customers are more likely to consume EA services repeatedly.

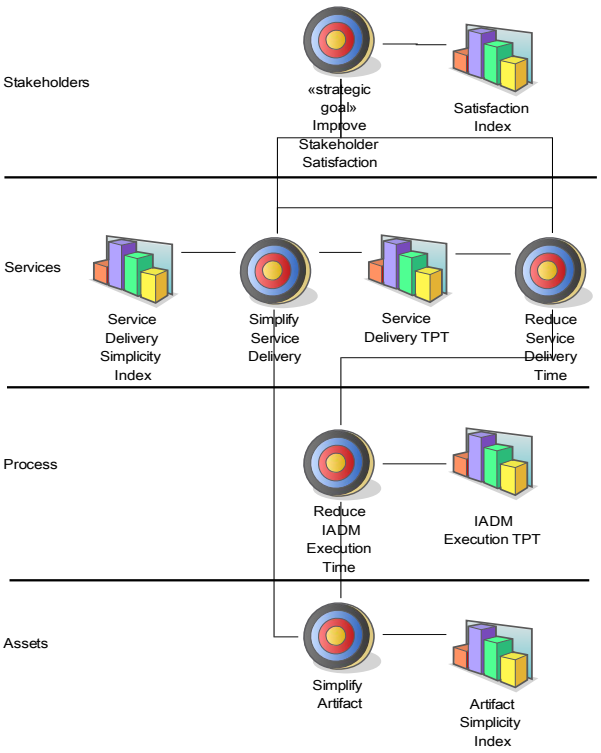

Figure 7-1: Strategy map for overall EA goals

7.3.5. EABV AM: Operation – Measure

After receiving the assessment commitment and financial support, we start the execution of the EABV AP as part of the EABV AM: Operation – Measure sub phase. Firstly, we align resources constituted by assigning roles and responsibilities to stakeholders. In total, six stakeholders participate in the EABV AP execution: two EA managers, three EA practitioners, and myself. In the following subsections, we outline the selection of goals and metrics, collection of performance data, and our assessment plan.

7.3.5.1. Selection Goals and Metrics

We start with extracting and documenting relevant goals for our focus project aligned to EA strategy. The level of detail for these goals varies greatly in practice so we need to find a conformant way to capture them. For this purpose, we employ the goal template derived from the EABV M (cf. Sec. 5.3.3). Since we measure the success of these goals, we have to obtain relevant information to identify critical success factors (Bullen and Rockart 1981). We therefore employ the GQM approach (Mandic et al. 2010) to identify goals and according metrics aligned with the project. This method allows us to ask specific questions for our goals and henceforth

find appropriate metrics for them. Details about the workshops applying this method can be found in the Appendix B.1.1. All goals and metrics are captured and stored in the AIB.

For our focus project, we develop a specific strategy map which is illustrated in Figure 7-2. The list of goals and associated metrics will be outlined more detailed in Appendix B.1. As we can see, all goals in the asset perspective impact goals in the process perspective which in turn impact goals in the service perspective. Finally, service perspective goals impact goals in the stakeholder perspective. Notably, in this cause-effect relation one goal can impact several goals and be impacted by several goals. Furthermore, this impact can happen in the same perspective.

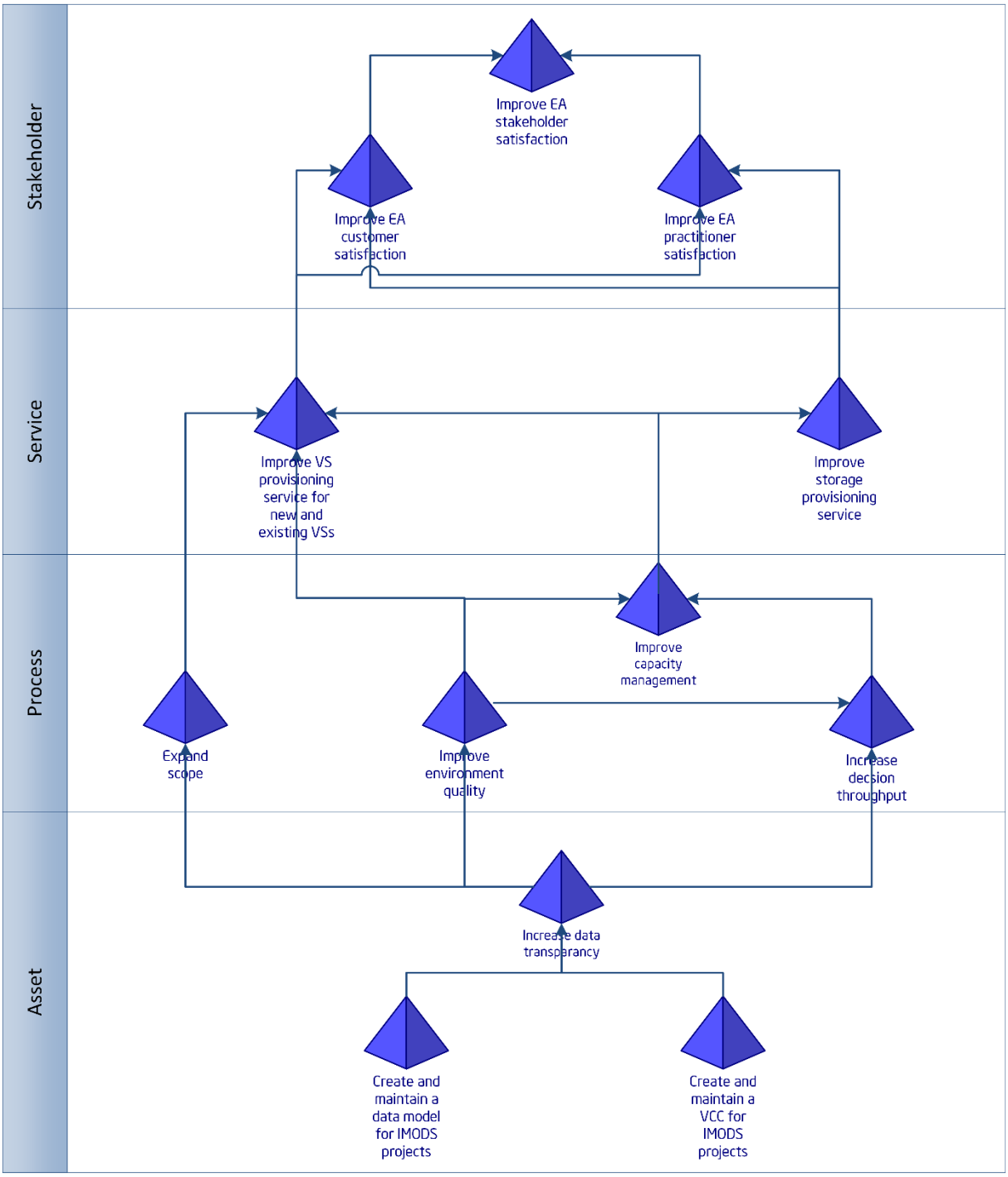

Figure 7-2: Strategy map for focus project

7.3.5.2. Assessment Plan

Our revised assessment plan (cf. Sec. 5.4.2) is depicted in Table 7-1. Basically, our assessment plan is a detailed list of tasks. We retain the roles defined earlier (cf. 5.4.5) when asking about who is responsible for a particular task and the corresponding outputs. Notably, roles can change once such an assessment approach is no longer within the boundaries of ES which means that academic stakeholders do not need to contribute anymore since the EABV AM is past the Construction phase. The level of detail for each of the fields can be expanded as

stakeholders see fit. Currently, the assessment plan is not made persistent in a normalised manner although this option is considered in the course of method evolution. We do not provide the full detail with this instance as is not crucial in terms of conveying the usage of the assessment plan. For example, we omit the actual stakeholders including their roles and responsibilities that participated in the assessment. Also, a complete list of all goals and metrics is not included in this simplified assessment plan due to reasons of readability. After specifying this assessment plan and approving it, we can start to measure performance. Hereby, we start to perform the measurement by integrating procedures and collecting data.

Task	What?	Why?	How?	Who?	Where?	When?
Identify Information Need	EABV	Rationale given in the introduction	Expert interviews	EA stakeholders	Inter-organizational	On-demand
Select Goals	(Project) goals	Goal-driven approach	Expert interviews, GQM	EA stakeholders, Academic researcher	Project scope	On-demand
Select Metrics	Various metrics defined for the focus project.	Obligatory	Expert interviews, GQM	EA stakeholders, Academic researcher	Project scope	After goals
Collect Data	Stakeholder input, EA project data	Obligatory	Project performance data, various methods, including peer reviews for data quality	EA practitioners, Academic researcher	Project scope, various data points	Continuous, project life-cycle
Analyse Data	Project performance data	Obligatory	Manually	EA practitioners, Academic researcher	Project scope	After data collection
Communicate Results	EABV reports	Obligatory	Presentation, EA BSC	EA practitioners, Academic researcher	Project team, EA team, various data points	After data analysis
Evaluate Information Product	EABV reports	Required for data quality and evolution	Qualitative, Expert reviews	EA stakeholders, Academic researcher	Project team, EA team	After reporting

Acquire and deploy supporting technologies	List of tools	Tool-support is crucial	Tool-dependent solution	EA stakeholders	EA organization	Throughout EABV AM evolution

Table 7-1: Revised assessment plan (simplified)

7.3.5.3. Collection of Performance Data

We define data points as virtual gateways for collecting and providing data at certain points in time during the execution of the EABV AP in conjunction with other corporate processes. The most important process the EABV AP interacts with is the project/program life cycle (PLC) consisting of various phases from project start to termination or end-of-life (EOL) respectively. Data points within the EABV AP are documented in the assessment plan and are most relevant in regard to integration. They can be viewed as process interfaces where the information flow to the EABV AP is performance data, and the information flow going outward is consolidated and analysed performance data. Data collection and provisioning is done usually on-demand since all goals, CSFs, and metrics are kept current and can be monitored with the EA BSC. The more mature our implementation gets, the higher the degree of automation we can achieve.

The list of data points is illustrated in Table 7-2. Besides the PLC, we receive significant input from strategic planning as it purports the goal breakdown in terms of strategic execution. Moreover, the EA governance process is responsible to ensure whether a project adheres to corporate standards and principles. Furthermore, we include data points for alignment with the IT-CMF for the sake of completeness. We will describe this alignment of periodic EA maturity assessments and our continuous approach more thoroughly in Section 7.3.9. Once all prerequisites for data collection are fulfilled, we commence to retrieving data and storing it in the AIB.

Data Point	EABV AP input from	EABV AP output to
PLC	• Applicable project goals and metrics (plan assessment) • Stakeholder feedback (evaluate assessment)	• Performance feedback (perform the assessment) • Applicable information products (perform the assessment)
Strategic Planning	• Information need (plan the assessment) • Strategic goals (plan the assessment)	• Applicable information products in the form of EABV reports (perform the assessment) • Recommendations (perform the assessment)
EA Governance	• Stakeholder feedback such as satisfaction (perform the measurement)	• Applicable information products (perform the assessment)

IT-CMF	• Recommendations for alignment purposes (perform assessment) • Applicable goals and metrics (plan the assessment)	• Revised outcomes • Revised metrics • Revised practices

Table 7-2: Data points for the EABV AP

7.3.6. EABV AM: Operation – Analyse

Currently, data analytics at our corporate partner in context of EABV assessments is an emergent practice, and means to consolidate it into an analytics inventory is an ongoing effort. Deriving insight from data is the main objective in this regard and hence, with the AIB and the EABV FW repository, we aim to contribute to this endeavour. Data analytics and storage for measurement was lacking for a majority of companies (Offen and Jeffery 1997) but it was largely adopted in the early 2000s by our corporate partner. Since our data analysis is currently not applied on large data sets, we do not require to employ a comprehensive data mining methodology. In case this becomes relevant in future, we plan to employ CRISP-DM (Cross Industry Standard Process for Data Mining) (Shearer 2000) for data analysis and data mining.

Performance data collected includes the time it took to provision a new virtual server in the private cloud. This allows for an analysis of the actual provision service delivery time. Further contributing to service delivery time is the decision report generation time. Data quality is analysed qualitatively by questioning stakeholders. For financial data analysis, the Net Present Value (NPV) (Brealey 2012) was employed. NPV is still one the most common employed methods to determine whether a project or program receives funding (Graham and Harvey 2001) by summing up the present values of a time series of cash flows. In addition, the Total Cost of Ownership (TCO) (Grossman and Hart 1986) approach is employed to accommodate cost reduction and feasibility requirements by estimating all direct and indirect costs.

A statistical model, including IMODS data, utility costs, operating costs, and stakeholder data, results in a linear optimization problem. Since the complexity and details of this model is out of scope for this Thesis, we omit specifics about it. Nevertheless, solving this optimization problem satisfies various information needs and enriches reports or information products respectively. Consequently, towards the end of this phase, we ultimately create information products satisfying information needs. We need to be aware that the analysis aims to answer a wide variety of business questions that are not necessarily aligned to the goals. This makes sense because in some cases data contains insights that could not be anticipated beforehand and thus are not reflected in goals.

7.3.7. EABV AM: Operation – Communicate

In this phase, we communicate the EABV based on the performance data analysis done in the previous phase. For this purpose, we need to define a basic reporting template. This template is based on the EABV M and is represented as outlined in Section 5.3.5. Thereby, we communicate EABV associated with a specific goals and according metrics. Even if goals are not successfully achieved, we report a negative EABV. Such is the case when the disbenefit exceeds the benefit, although this did not occur during our assessment.

One of the problems identified during the Analysis phase is that EA contribution from architects often happens just at the beginning of a project, and further information about impact and benefits of their input is not visible throughout the PLC. With introducing a detailed communication phase, we address this gap and close the feedback loop in order to provide decision makers with an improved information base aside from identifying EABV. But what constitutes an adequate reporting process and infrastructure? A guideline with a set of general criteria is outlined in (ISO/IEC 2007) and summarized in the following list:

- Awareness of the limitations of the results
- Inclusion of date and time of data collection
- Names and versions of employed tools for measurement and analysis
- Number of observations that yield a particular result
- Sampling procedures used
- Assumptions used for underlying analysis techniques
- Clarify how aggregates are performed (e.g. average or weighted average)
- Unit of observation about which conclusions are drawn
- How was incomplete data and anomalies treated, if applicable
- How was data combined across different data sets, if applicable
- For any statistical tests,
    - Whether they are one or two sided
    - The alpha levels used (amount of acceptable error)
    - How p values are calculated (the probability of getting the observed result or a more extreme one by chance)
- How confidence intervals are calculated, if applicable
- Statistical methods used (including limits)

This list is extended in (Kasunic 2010b) predominantly in the data reporting MAID criteria category. We already described our EABV template resulting from the EABV M in Section 5.3.5. With EABV attributes, we are able to follow these guidelines in a flexible way. This means the level of detail depends on the target audience of information products. Since our as well as the IMODS project are internal EA project (i.e. projects within the EA organization), EA managers and EA practitioners are actually EA customers. Our consolidated EABV reports can be found in Appendix B.2.5.

7.3.8. EABV AM: Operation — Evolve

Based on the reports generated for EABV communication, we are able to make more educated decisions on how to improve the current assessment approach and the EA function itself. We now are be able to determine the value of the EA contribution and derive key learnings that serve as input for making appropriate adaptations. The first part of the evolution phase is to give recommendation based on the results of the assessment. For example, we might learn that we need an additional data point for data collection within the PLC to collect additional data. Another example is that we might need to store more comprehensive assessment data in the AIB which incurs an extension of our data model. These are considered as minor changes and will be handled in the Evolve phase of the MACE scheme. When it comes to major changes such as a complete redesign of an artefact, we need to trigger a new design and evaluate cycle as part of the improvement phase of the EABV AM (cf. Sec. 4.3.1.3). Our evaluation results and recommendations regarding the EABV AM are described more detailed in the following Section 7.4. Here, we summarize our recommendations together with the rationale for the IMODS project in Table 7-3. The next step based on these recommendations is an action plan that specifies the evolution of IMODS. However, this is out of scope of this Thesis.

Recommendations: IMODS Project	Rationale
Improve human resource management	Using appropriate skill-based employees, such as software developers, instead of relying on a single type of human resource (architects) to assume all project roles.
Improve cloud resource management	Share capacity management capabilities between multiple data centres and also support the hybrid use of secure internal and external clouds.
Extend automation	Extend automation for business logic to decide which service is appropriate. Also the location of services should be automatic, depending on the cloud environment, i.e. public, private, or hybrid. Furthermore, all components and nodes should be dynamically added and removed as necessary.
Increase adoption	Virtualization of approximately 60 percent of our computing environment across Office, Enterprise, and Services, with a goal of 75 percent.

Improve tool support	In order to improve application development in terms of business agility, we recommend to add rapid, elastic scaling web-based applications. This is mostly in terms of reporting functionality, e.g. a dashboard.

Table 7-3: Recommendations for Enterprise Private Cloud

7.3.9. Alignment with EA Maturity Framework

At this point, we are further interested in the alignment to the periodic EA maturity assessments. Periodic assessments for EA at our corporate partner were conducted using the IT Capability Maturity Framework (IT-CMF) (Curley 2009). This framework consists of 36 critical capabilities organized into four macro capabilities. Enterprise Architecture Management (EAM) is thereby a critical capability (in the macro capability *Managing the IT Capability*) which provides the necessary models and practices for defining, planning, and managing the business and IT capabilities. EAM organizes its *Capability Building Blocks* (CBBs) into the categories *Practices*, *Planning*, and *People*. Of main concern for our approach is the CBB *Architecture Value* which revolves around defining, measuring and communicating the value/impact of architectures and architecture practices. Each CBB has a set of practices, outcomes, and metrics that determine what to do to achieve a certain level of maturity and how to measure it. During our project, we closely work together with the Innovation Value Institute (IVI) that issues the IT-CMF. In case of our corporate partner, several EA maturity assessments were conducted throughout the years and it is therefore possible to make year-on-year comparisons. Our research project was partly motivated due to shortcomings in EA maturity, especially in the Architecture Value CBB.

7.4. Preliminary Results

During Construction of the EABV AM, evaluation constitutes a crucial part to determine whether our solution fulfilled its objectives and what measures can be taken to ameliorate eventual shortcomings. Preliminary results represent the output of a first evaluation, a prototype evaluation in our case. Thus, we present our MAID evaluation results based on the chosen MAID criteria that are aligned with DSR criteria.

7.4.1. MAID Results

We now present the results for our MAID evaluation based on 23 criteria. Our evaluation is observational and descriptive in a sense that a case study was conducted to investigate the artefacts in the organizational environment while backing up arguments with informed usage of the knowledge base (Hevner et al. 2004). All quality-audited criteria ratings can be found in the Appendix D which marks an important step to achieve trustworthiness of our evaluation As already pointed out in 6.5.5, we focused on criteria that address completeness due to the fact

that no prior assessment measure was employed and therefore our approach had to fill a huge gap in that respect based on the requirements and stakeholder needs. Regarding ratings, we achieved on overall score of *Adequate*. The summary of scores is illustrated in Table 7-4.

DSR Criteria	Avg. Score
Feasibility	Adequate
Utility	Very adequate
Fit with organization	Slightly inadequate
Understandability	Adequate
Usability	Slightly inadequate
Completeness	Adequate
Consistency	Adequate
Accuracy	Adequate
Total Score	Adequate

Table 7-4: DSR criteria MAID rating score summary

These ratings and several interviews resulted in our key findings which we summarize in Table 7-5. We include strengths and weaknesses, but also include recommendations. Based on key findings and recommendations, we can evolve our approach. MAID results have been diffused to relevant stakeholders to decide the next steps to EABV AM evolution.

Key Finding	Strengths	Weaknesses	Recommendation
Improve integration	The strength of our approach is that from a conceptual standpoint there is no inhibitor regarding integration. It is well suited to be employed with virtually any technology.	Since our implementation is limited to tools that are not well integrated into the application landscape, yet widely used, we experience shortcomings on a technical level of integration.	Switch to web-based applications supported by current technologies employed. A detailed recommendation will be made available for our corporate partner in the form of an implementation guideline suited to the system and application landscape.
Improve reporting	Our reporting so far is concise and straight to the point. It leaves a lot of flexibility on how to communicate EABV based on basic set of attributes.	A weakness is that not the entire concept of EABV is normalized from a data modelling perspective. At this stage of development, this was not considered as requirement although it would put more detail and clarification into reporting.	Reporting must be done frequently to gain more insights in how to best satisfy the information needs. Information products need to be more accurately adapted to satisfy different stakeholder needs.

Increase adoption	The strength of adoption so far is that our approach was well received from all stakeholder groups and that support is extended.	The major weakness regarding adoption is still that it is not implemented on a large scale for all projects.	Steadily increase the application of the approach to different projects and therefore increase adoption. In the future, it should be employed for tactical and strategic level assessments.
Improve tool support	The strength of tool support currently is that employed tools are available to every stakeholder and all relevant concepts have been implemented.	Although tools are widely available, the actual support for implementing our approach is limited due to the fact that is not networked in addition to the shortcomings from an integration perspective.	Evaluate current BI solutions for suitable EABV AM implementation. Regarding the database, switching to a different technology is recommended.

Table 7-5: MAID key findings and recommendations

7.5. Contribution

In this Section, we highlight and summarise our contribution to both the academia and the industry in accordance to our research context outline in Section2.6. Thereby, we examine the theoretical contributions of our approach. This forms a part of the evaluation which we think is necessary in order to give our artefacts the necessary academic foundation, context, and justification. Thereafter, we elaborate on the practical contributions describing the impact on decision making and the impact on EA maturity. We outline all relevant theoretical and practical contributions in the following Sections.

7.5.1. Theoretical Contribution

With arguing that EA is a dynamic capability, we provide a strong underlying theoretical base for further investigation and the design of artefacts. Putting assets as a perspective in the EA BSC as fundamental points of interest for performance contribution and assessments thereof, we provide a transparent model (EABV M) to integrate, configure, gain, and release those assets or resources respectively. Moreover, we outline our findings regarding challenges during the alignment of periodic and continuous EA assessments according to our research context (cf. Sec.2.6) which therefore supports future the practice of conducting such assessments. Being aware of a problem is the first step to avoid or solve it. Thereafter, we are able to derive principles that form a good practice to design a method to assess EABV (cf. Sec. 5.1.3 and Appendix E). Furthermore, we contribute to DSR by presenting a research process centred on artefacts which is therefore coined as artefact build cycle (ABC) (cf. Sec.2.2). We further

elucidate involved roles and responsibilities for this research endeavour (cf. Sec.2.4). Another interesting contribution amounts to shaping research and the corresponding output depending on various research criteria. For this purpose, we introduce a DSR profile to indicate in which general direction research is carried out (cf. Sec.2.5).

7.5.2. Practical Contribution

Having described what our approach contributed to the theoretical knowledge base, we now take a closer look what we administer to practice.

7.5.2.1. Impact on Decision Making

Data-driven decision making is improving productivity by 5-6% according to a study of 179 companies employing this approach (Brynjolfsson et al. 2011). With our approach, we facilitate decision making improvements which impact not only productivity, but in addition time-to-market, and business agility. Productivity improvements thereby manifest themselves in faster availability of infrastructure for office and enterprise applications due to better resource management. According to our EA stakeholders, decision making is alleviated and decision makers display more confidence in making decisions. The main benefit for decision makers is represented by the timeliness of decisions resulting in greatly reduced service delivery time which in turn increases productivity. Productivity increase is estimated on average 6-7% as we learned from SMEs at our corporate partner. We do not want to underestimate the impact of investing time to understand goals and their indented purpose, an inherent benefit of goal-driven approaches as common understanding reduces risks and greatly reduces communication time by avoiding redundant information flows. A more thorough analysis on decision making impact involving more projects is a projected objective in the future.

7.5.2.2. Impact on EA Maturity

At the time of finishing our research project, no new EA maturity assessment was conducted. Nevertheless, the unanimous opinion of various SMEs was that this approach, once fully adopted, increases the Architecture Value CBB to level 4 from 2.1. At the current prototype stage, a rating of at least 3 is expected. Thereby, the SMEs consist of stakeholders from our corporate partner as well as experts from IVI, publishers of the IT-CMF. We aim to find out the actual maturity level of this CBB during the next maturity assessment as well as the impact on the overall EAM critical capability.

7.6. Chapter Summary

This Chapter shed light on how we performed our instantiation. Firstly, we described instantiation details for each of the IT artefacts. Then, we went through the phases of the MACE scheme which encompasses the steps of the EABV AP. Furthermore, we elaborated on the alignment with the maturity framework IT-CMF. We argued that insights from both approaches are valuable to each other and result in an overall increase of framework quality. Another important part of this Chapter are the preliminary results of our MAID evaluation. We found out, that we need to concentrate mostly on integration and adoption in order to improve the EABV AM. We concluded the Chapter with elaborating on the achieved theoretical and practical contributions. Theoretical contributions comprise identified challenges for EABV assessments and a set of principles for constructing, operating, and improving an EABV assessment approach, and setting them into an adequate theoretical context by exploiting dynamic capabilities. Moreover, we contributed to DSR by introducing the ABC and DSR profiles. Regarding practical contributions, we elaborated on the impact on decision making and EA maturity. Both impacts yield positive results.

8. Diffusion and Critical Discussion

"The future is here. It's just not widely distributed yet."

William Gibson (1948 -)

This Chapter is dedicated to last phase of the ABC, namely *Diffusion* in Section 8.1. Thereafter in Section 8.2, we elaborate on critical aspects of our work where we identify shortcomings and limitations, as well as frame the room for improvement.

8.1. Diffusion

Diffusion marks the step of emitting outcomes of the research process to different kinds of audiences through various channels by means of various media, usually in the form of a publication (cf. Figure 2-2). Hereby, diffusion is conceived as concurrent step throughout the ABC as diffusing results can basically occur at any stage in the course of a DSR project. The reason for this is that communication of results, sharing of opinions, discussing of concepts is fundamental for effective and quality collaboration. Especially in terms of ES, where two worlds, academic and industry, collide and aim for exploitable synergies during the whole project life cycle. Thus, we facilitate a feedback loop within the ABC. Therein, usual types of audiences are either management-oriented or technology-oriented which consequently calls for different forms of representation, i.e. the focus of the DSR contribution must be adapted to the intended audiences (Hevner et al. 2004). For example, Diffusion is incorporated within the Evolve phase of the MACE scheme.

We can distinguish between the following output types for diffusion:

- *Academic publication:* This could be journal papers, conference papers, or conference poster presentations.
- *Industry publication:* This involves white papers, industry conference papers, industry conference poster presentations.
- *Presentation:* This form of output includes presentations for academic audiences, such as a research group, and for our industry partner.
- *Text document:* A more detailed description of concepts and IT artefacts. This actually includes this Thesis. At the start of the project, we employ a versioned list of questions

document to ensure common understanding of the environment, framing the scope, and identifying the business need.

- *Communication output:* This includes all emails, discussions, workshops, and teleconferences. Such output marks a crucial part for a research project since it ensures quality collaboration and regular information transfer is invaluable for understanding and henceforth designing a solution. For example, summaries of teleconferences diffused to all participants is very helpful in that matter.

8.2. Critical Discussion

From a critical perspective, we are aware that we cannot design and deliver a one-size-fits-all solution even though on a higher level the DSR abstraction principle is fulfilled. The question whether our approach is applicable to other disciplines than EA has to be answered with a clear yes. Not only adhering to this DSR abstraction principle to allow artefacts to solve different problem classes largely determined by the application domain, performance measurement and management itself is a discipline that comprises methods and techniques that can be applied to virtually any domain. Nevertheless, the requirements from another organization and domain might change the design of IT artefacts or exchange one IT artefact with another serving the same purpose. In other words, our approach needs to be adapted for different organizations.

We are aware that this solution is very broad from a conceptual standpoint, but in order to accommodate our research requirements, we need to provide a flexible and comprehensive method while preserving as much simplicity as possible. Moreover, we are aware, that our proof of concept is not nearly as evolved as to deliver a complete mature industry solution. Nevertheless, we set out to proceed on the roadmap to follow our recommendations and improve our artefacts and their instantiation within the company. Even though adoption for a process-based innovation like our approach is less likely than a product- or service-based innovation at firm level (Damanpour and Gopalakrishnan 2001), we aim for a complete adoption for large EA projects in the near future.

Another critical aspect is the actual differentiation between the EA and IT function. We have to deal with considerable overlapping in practice as EA historically evolved as a discipline out of the IT function but meanwhile, EA is perceived as strategic management function (Ahlemann et al. 2012b). Consequently, we extended the synthesized ITBV model to include strategy and goals, which through performing EA processes and services generate a particular outcome that yields benefits or disbenefits. This is what we view as EABV. This differentiation, and the perception of what EA represents varies from company to company. In this regard, not only

employed EA frameworks play a major role, but in addition the employed EA service model which essentially frames the scope of EA contributions. Regarding EA frameworks, we could have brought more content but we considered it not a necessity to convey the basic concepts of EA and how it can be employed. Part of the reason is owed to the myriad of available EA frameworks (Schekkerman 2006) and hence, we just focused on and aligned our efforts towards TOGAF as this framework is employed as an adapted version at our corporate partner.

We employed a rather comprehensive evaluation method with MAID. While all stakeholders agreed on having a detailed method poses a good way to start from, it was generally perceived as being too time consuming. This led to the current form of method tailoring and criteria selection. While certain criteria result in good discussions and provide common understanding, we do not think that all criteria are relevant for a rating effort since the criteria categories data collection and storage and data analysis contain prescriptive statements that are part of general guidelines for good data management practice which are already adopted in large parts by our corporate partner. During MAID criteria selection, we found that not enough relevant criteria for feasibility were available. This is a shortcoming that needs to be addressed in future evaluations by introducing criteria that are in line with the feasibility requirement. With continuing evolvements of the EABV AM, we build up the AIB that allows for improved decision making on how to reduce overhead and improve feasibility. For future evaluations, we consider trimming down (tailoring) MAID even more in order to avoid generating too much overhead. In addition, we plan to incorporate some of the criteria for measurement success described in (Jeffery and Berry 1993).

Critically contemplating the positive feedback from an EA manager's perspective, we need to be aware that the actual implementation is crucial for stakeholder satisfaction, utility, and further adoption. As already mentioned at several stages of this document, a mature industry solution is well out of scope and requires further efforts to develop and adopt. Even doing so is not a guarantee for success which we found out when identifying challenges for EABV assessments (Meyer and Helfert 2012) and discussing the threats to trustworthiness (cf. Sec. 6.6). Evaluation results clearly revealed potential improvements in terms of integration and adoption. Therefore, an improved implementation is necessitated and employees require skill and training to better apply the EABV AM. This, and the benefit of employing the method will lead to the anticipated adoption.

9. Conclusion and Outlook

"If all economists were laid end to end, they would not reach a conclusion."

George Bernard Shaw (1856 – 1950)

Enterprise Architecture is an extensive and comprehensive discipline that serves as means to better cope with the complexity found in today's corporate world. Due to many possible ways to employ EA methods and techniques, assessing resulting benefits represents a non-trivial task. In this regard, we identified various challenges and problems in the course of our research (Meyer and Helfert 2012). Many industry practitioners and managers struggle to put meaningful figures behind EA practices and clarify its benefits in terms of business value. This is what makes EA as application domain for performance measurement and management interesting and relevant from a research point of view. This is underlined by several publications in that area (cf. Sec.2.7). Despite those contributions, we found a gap in literature. There is whether a comprehensive description of a method facilitating assessments of EABV nor a guideline how to design and instantiate it within an organizational context. Moreover, we put EA on a theoretical foundation by arguing it is in fact a dynamic capability. As such, EA is employed to integrate, release, reconfigure, and gain assets, mostly in the form of IT intellectual capital. Furthermore, with our research, we not only shed light on the definition of EABV, but also how to measure EA performance, analyse EA performance data, and communicate EABV. Activities that are all part of an evolutionary cycle to accommodate changes in business and stakeholder needs. By doing that, we deliver the EABV Assessment Method (EABV AM) that increases EA maturity. The EABV AM constructs, operates, and improves several IT artefacts, namely the EABV Framework (EABV FW), the EABV Model (EABV M), the EABV Assessment Process (EABV AP), and the EA Balanced Scorecard (EA BSC). Thereby, we answered all of our research questions outlined in the introduction (cf. Sec. 1.2). The *main RQ*, how to design a method to assess EABV marks the main part of this Thesis. We thereby elaborated on design choices throughout the text and argued why and how decisions were made in accordance to constraints, principles, and requirements. The resulting EABV AM is characterized by three stages: (1) *Construction* involves the design of IT artefacts that address the business needs and is executed by an adapted DSR process, namely the DSR ABC. (2) *Operation* introduces an assessment process to measure, analyse, communicate, and evolve relevant EA data to conclude

about EABV. (3) *Improvement* is the last stage that allows the EABV AM to mature and evolve. Thereby, the EABV AM spawns further IT artefacts that answer additional research questions. Firstly, *RQ1* is concerned about what EABV is and how can we model it. For that purpose, we conducted a thorough literature review and gained many insights form ITBV research. We synthesized the EABV M that forms the basis for definitions, common understanding, and instantiations solving problems of the perception/definition problem class. Secondly, *RQ2* is all about how to measure EA performance which we answered by presenting an adapted industry standard measurement process, the EABV AP. It is an assessment process that comprises activities to measure, analyse, communicate, and evolve EA and EABV assessments respectively. The EABV AP is goal-driven and is closely tied to the EA BSC including its strategy map to clarify and link strategy, goals, and metrics. The EA BSC is the performance measurement instrument of choice as we are able to clearly assign goals to different perspectives seen fit for our purposes. In addition, the EABV AP and the EA BSC answer *RQ3* as they are able to communicate results of EABV in a predefined manner. Those reporting templates are stored within the repository of the EABV FW. We thereby solve problems of the visibility/transparency problem class as well as from the improvement/optimisation problem class. Since no new maturity assessment is conducted at present time, only estimates are available that confirm a significant increase in EA maturity, which is the answer to *RQ4*.

Designing and evaluating an IT artefact marks an important contribution, while introducing it into the organizational environment bolsters this contribution even more (Niederman et al. 2012). We thereby focused on a flexible approach to accommodate a dynamic organizational environment. Our approach is modular as it comprises five IT artefacts which have defined points of integration. After collaboratively designing our IT artefacts, we spend considerable time and efforts to evaluate our instantiated IT artefacts by employing MAID, a method to diagnose a particular measurement and analysis infrastructure. As it is criterion-based, we linked our DSR evaluation criteria to MAID criteria and rated a chosen set of those in small workshop groups. As a result, we were able to identify various points of improvement for our approach. Therefore, we outlined our approach on how to evaluate it in an organizational context. With employing our DSR approach, we leveraged several benefits, especially for research project management. All participants were clear on what to do and accomplish underlining the simplicity of our ABC and its sub-steps.

To summarize, the contribution to the knowledge base besides the evaluation of each of our artefacts is outlined in Table 9-1.

Artefact	Contribution to Knowledge Base
EABV AM	• Providing detailed method for EABV assessment • Provide insights on construction, i.e. contribute to design science research methodology • Provide details on how to operate the EABV AM • Accommodate improvement and evolution
EABV FW	• Providing guidelines and recommendations on how to assess EABV • Provide alignment to EA maturity assessments • Provide templates on how to communicate EABV (e.g. reports)
EABV AP	• Adapted standard process to measure EA performance • Analyse EA performance data • Communicate EABV
EABV M	• Provide model for EABV • Provide context for EABV • Provide definitions for EABV and EABV assessment • Provide common terminology for EABV assessment
EA BSC	• Adapt well known performance measurement framework for EA • Define new goals • Define new metrics

Table 9-1: Summary of contributions to knowledge base for each artefact

Projected next steps are a full adoption and integration of our approach within the organizational context. This encompasses an improvement implementation using different technologies. Furthermore, we aim to extend our EABV M to even better reflect the context of EABV assessments and allow for advanced data analytics. Moreover, we aim to instantiate the EABV AP BPMN model with an available BPM solution and foster the integration with other processes. In addition, learnings from this endeavour shall yield synergies with the IT-CMF and contribute to the EA maturity knowledge base. Further future work will include adoption studies in other organizations. It has to be noted that due to the complex nature of this topic we can only demonstrate the viability of our solution as long term evaluations would be out of scope for this project. From a wider perspective, this research opened up a number of additional research opportunities. For example, studies that elaborate on the dynamic capability EA and how it is impacted by strategic management and execution. Furthermore, employing the ABC for different research efforts could provide valuable insights.

Concluding, the efforts and insights of this project tap an interesting topic within an interesting domain where we answered the question how to design a method to assess the Enterprise Architecture Business Value. Although comprehensive in nature, we managed to focus on the necessary parts to convey the concept and employment of this method. As a contingent approach, we want to further explore other possibilities to improve this method as many paths

lead to desired outcomes. In other words, the evolution of this method encompasses additional research forming a task we are looking forward to undertake.

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10. Appendix

A. Data Dictionary

For our purposes, the data dictionary is a document describing the data in a centralized way containing information about meaning, relationships, origin, usage and format of data. It can thereby be viewed as a metadata repository (IBM 1993).

A.1. Conceptual Data Model

Although we already described the entities and relationships of the conceptual data model in Section 5.3.1, we replicate this information for the sake of completeness. The model is illustrated in Figure A-1. On a conceptual level, we have five relevant entities.

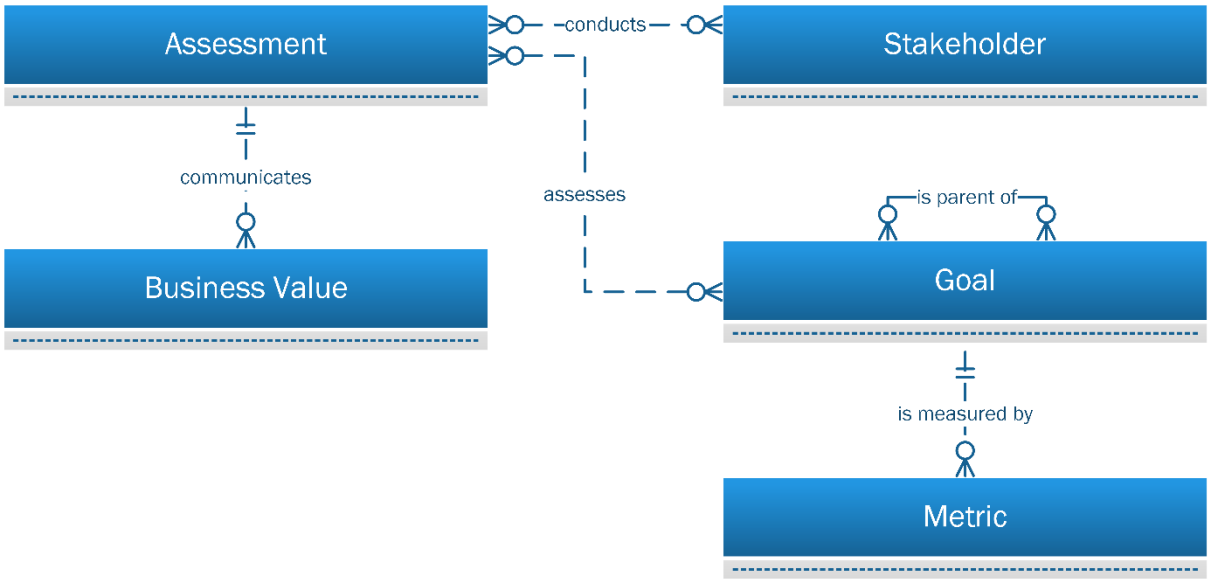

Figure A-1: Conceptual data model

A.2. Logical Data Model

The logical data model and therefore its components conveys in compact and expressive form in order to serve as a vehicle for communicating. The aim here is to achieve a common understanding between business and IT. In the following subsections, we will first describe all relevant data types and then all entities or tables respectively along with their attributes, keys, (PK, FK), if they are required I, and the type. Furthermore, for every entity we list all the relations for the sake of completeness. Relations are described by type, cardinalities, and a description. For many-to-many *(n-m)* relations, we have so called mapping tables. In our description of the relations, we ignore those tables to provide a better understanding of the purpose of a relation. The logical data model is illustrated in Figure A-2.

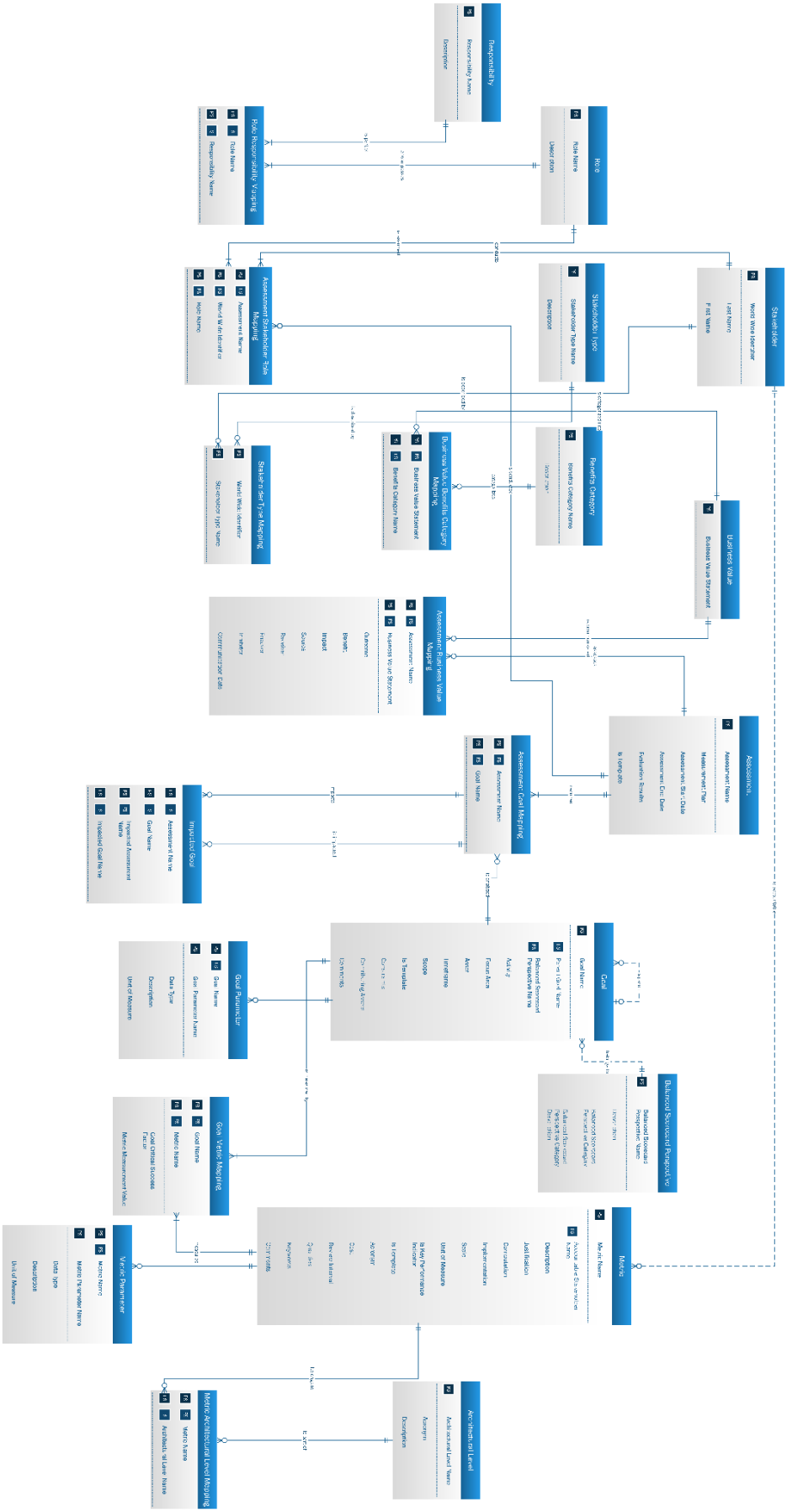

Figure A-2: EABV M – Logical data model

A.2.1. Data Types

Data types determine the syntactically valid entries for each field in a table. Data types vary for each database vendor. Since our approach is instantiated with Microsoft Access, we will use those basic data types. We have to mention that at a logical level, technology is in general irrelevant nevertheless, we want to keep data types consistent from logical to physical level. The following Table A-1 summarizes all relevant data types we used. Nevertheless, we provide typical synonyms for other SQL dialects or database vendors respectively.

Data Type Name	Description
Text	Short, alphanumeric values, such as a last name or a street address.
Number	Numeric values, such as distances. Note that there is a separate data type for currency.
Date/Time	Date and Time values for the years 100 through 9999.
Rich Text	Text or combinations of text and numbers that can be formatted using colour and font controls.
Calculated Field	Results of a calculation. The calculation must refer to other fields in the same table. You would use the Expression Builder to create the calculation.
Attachments	Attached images, spreadsheet files, documents, charts, and other types of supported files to the records in your database, similar to attaching files to e-mail messages.
Hyperlink	Text or combinations of text and numbers stored as text and used as a hyperlink address.
Memo	Long blocks of text. A typical use of a Memo field would be a detailed product description.
Yes/No	Yes and No values and fields that contain only one of two values.

Table A-1: Basic data types (as available in Microsoft Access ™)

A.2.2. Stakeholder

A stakeholder is basically "an individual, team, or organization (or class thereof) with interests in, or concerns relative to, a system" (IEEE 2007). A system in this respect is any kind of hardware and/or software aiming to fulfil a certain function for the enterprise, i.e. "a collection of components organized to accomplish a specific function or set of functions" (IEEE 2007). In the context of our data models, stakeholders are solely treated as individuals. Additional information about the stakeholder may be linked at any time using the worldwide identifier, e.g. contact details such as email and telephone number. The stakeholder table has three relations.

Attribute	PK	FK	R	Type	Description
World Wide Identifier	Y		Y	Number	The worldwide identifier (WWID) is unique for every employee working for our corporate partner. It is specific to our organizational context.
Last Name				Text	Last name of the stakeholder.
First Name				Text	First name of the stakeholder.

Table A-2: Entity Stakeholder

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Stakeholder	1	conducts (identifying)	1-n	Assessment Stakeholder Role Mapping	States that a stakeholder conducts one or more assessments.
Stakeholder	1	is described by (identifying)	0-n	Stakeholder Type Mapping	States that a stakeholder is more detailed described by its type.
Stakeholder	1	is accountable for (non-identifying)	0-n	Metric	States that a stakeholder can be accountable for zero or more metrics.

Table A-3: Entity Stakeholder: Relations

A.2.3. Assessment

An assessment is a method or process that informs us about current performance of an enterprise function or components thereof. Performance can be described as purposeful actions taken today to produce meaningful results tomorrow (Neely 2004). Optionally, we might want to store methods used for a particular assessment with this entity. An assessment has three relations.

Attribute	PK	FK	R	Type	Description
Assessment Name	Y		Y	Text	The name of the assessment. For example, these can be linked to the EA project that is assessed.
Measurement Plan			Y	Attachment	A measurement plan determines direction and course of action as well as scope and involved stakeholders that participate in the assessment or measurement respectively. Here, we just link to an external document.
Assessment Start Date			Y	Date/Time	Date and time when the assessment starts.
Assessment End Date			Y	Date/Time	Date and time when the assessment ends.
List of Used Methods			Y	Attachment	This list contains all employed methods for this assessment. For example, it contains which methods and techniques for data analysis or financial analysis were used. This information is available in a separate document. This is part of the EABV FW repository.
Assessment Result			Y	Attachment	The result of the assessment is available in a separate document that contains all information products, recommendations, and evaluation results. This information is basis for the actual EABV report.
Is Template			Y	Yes/No	Flag, that indicates whether an entry can be used as a template. This is usually the case when a tool or application is used for capturing assessments and users want to create a new one based on an old one due to the similarities of projects and goals.

Table A-4: Entity Assessment

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Assessment	1	is conducted by (identifying)	0-n	Assessment Stakeholder Role Mapping	States that an assessment is conducted by 0 or more stakeholders assuming zero more roles.
Assessment	1	requires (identifying)	1-n	Assessment Goal Mapping	States that an assessment requires at least one goal.
Assessment	1	assesses, (identifying)	0-n	Assessment Business Value Mapping	States that an assessment assesses zero or more business values.

Table A-5: Entity Assessment: Relations

A.2.4. Role

A role is the part a stakeholder plays in the assessment. A role thereby encompasses a collection of tasks and responsibilities. A role determines what a particular stakeholder has to do during an assessment.

Attribute	PK	FK	R	Type	Description
Role Name	Y		Y	Text	This name serves as identifier of the role. An example would be Project Manager.
Description				Text	Describes what that role is and summarizes what is has to do.

Table A-6: Entity Role

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Role	1	is assumed by (identifying)	1-n	Assessment Stakeholder Role Mapping	States that at least one role must be assumed by a stakeholder during an assessment.
Role	1	encompasses (identifying)	1-n	Role Responsibility Mapping	States that a role encompasses one or more responsibilities.

Table A-7: Entity Role: Relations

A.2.5. Assessment Stakeholder Role Mapping

This entity serves as mapping table and brings together the assessment, the stakeholder, and the role. Basically, it states that a stakeholder participates or conducts an assessment respectively by assuming particular roles. Notably, all primary keys are foreign keys. Regarding data modelling, this table fulfils the fourth normal form for database normalization. This is because role and stakeholder both have multivalued dependencies to assessment: $Assessment \rightarrow Stakeholder$ and $Assessment \rightarrow Role$. An assessment must be conducted by at least one stakeholder which must assume at least one role. The fourth normal form is more relevant in practice than originally perceived (Wu 1992).

Attribute	PK	FK	R	Type	Description

Assessment Name	Y	Y	Y	Text	The name of the assessment. For example, these can be linked to the EA project that is assessed.
World Wide Identifier	Y	Y	Y	Number	The worldwide identifier (WWID) is unique for every employee working for our corporate partner. It is specific to our organizational context.
Role Name	Y	Y	Y	Text	This name serves as identifier of the role. An example would be Project Manager.

Table A-8: Entity Assessment Stakeholder Role Mapping

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Assessment Stakeholder Role Mapping	0-n	is conducted by (identifying)	1	Assessment	States that an assessment is conducted by one or more roles assumed by one or more stakeholders.
Assessment Stakeholder Role Mapping	1-n	conducts (identifying)	1	Stakeholder	States that a stakeholder conducts an assessment assuming at least one role.
Assessment Stakeholder Role Mapping	1-n	is assumed (identifying)	1	Role	States that a role is assumed by a stakeholder for an assessment.

Table A-9: Entity Assessment Stakeholder Role Mapping: Relations

A.2.6. Responsibility

A responsibility determines for which activities a stakeholder in a certain role is responsible during an assessment. A role thereby determines the set of responsibilities. In our case, these are in line with the activities in the EABV AP. The reason to include this information is that we enrich stakeholder information, increase potential tool support capabilities, and provide a better understanding of what a stakeholder in a role has to do during an assessment.

Attribute	PK	FK	R	Type	Description
Responsibility Name	Y		Y	Text	The name of the responsibility. Usually, it states the activity to be done in short.
Description			Y	Text	A more detailed description of the activity for which a stakeholder with a certain role is responsible.

Table A-10: Entity Responsibility

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Responsibility	1	is part of (identifying)	1-n	Role Responsibility Mapping	States that at least one responsibility is part of a role.

Table A-11: Entity Responsibility: Relations

A.2.7. Role Responsibility Mapping

This entity serves as mapping table and brings together roles and responsibilities.

Attribute	PK	FK	R	Type	Description

Role Name	Y	Y	Y	Text	This name serves as identifier of the role. An example would be Project Manager.
Responsibility Name	Y	Y	Y	Text	The name of the responsibility. Usually, it states the activity to be done in short.

Table A-12: Entity Role Responsibility Mapping

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Role Responsibility Mapping	1-n	encompasses (identifying)	1	Role	States that a role encompasses one or more responsibilities.
Role Responsibility Mapping	1-n	is part of (identifying)	1	Responsibility	States that at least one responsibility is part of a role.

Table A-13: Entity Role Responsibility Mapping: Relations

A.2.8. Stakeholder Type

In order to provide a more detailed description, we distinguish between three types of stakeholders. EA Managers are concerned about the strategy and high-level impact of EA. They are responsible for justifying the investments made and the overall quality of the EA outcome. EA Practitioners are Enterprise Architects at various levels of experience and are concerned about delivering quality output that is used by the EA Customers for their projects and programs. Thereby, every stakeholder can contribute to the strategy, be it business or EA strategy. The stakeholder type becomes relevant for reporting since the information product can vary from type to type. Notably, we focus on reporting to EA Managers in the course of this project.

Attribute	PK	FK	R	Type	Description
Stakeholder Type Name	Y		Y	Text	The name of the stakeholder type. Valid entries include EA manager, EA practitioner, and EA customer.
Description			Y	Text	Detailed description of what the particular stakeholder type is.

Table A-14: Entity Stakeholder Type

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Stakeholder Type	1	is described by (identifying)	0-n	Stakeholder Type Mapping	States that zero or more stakeholders are described by one or more stakeholder types.

Table A-15: Entity Stakeholder Type: Relations

A.2.9. Stakeholder Type Mapping

This entity serves as mapping table by linking a stakeholder to a stakeholder type.

Attribute	PK	FK	R	Type	Description

World Wide Identifier	Y	Y	Y	Number	The worldwide identifier (WWID) is unique for every employee working for our corporate partner. It is specific to our organizational context.
Stakeholder Type Name	Y	Y	Y	Text	The name of the stakeholder type. Valid entries include EA manager, EA practitioner, and EA customer.

Table A-16: Entity Stakeholder Type Mapping

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Stakeholder Type Mapping	0-n	is described by (identifying)	1	Stakeholder	States that zero or more stakeholders are described by one or more stakeholder types.
Stakeholder Type Mapping	0-n	is described by (identifying)	1	Stakeholder Type	States that zero or more stakeholders are described by one or more stakeholder types.

Table A-17: Entity Stakeholder Type Mapping: Relations

A.2.10. Business Value

Business value or EABV is defined as *"the contribution from EA services and processes to firm performance aligned to strategic goals that benefit the health of organizations, the satisfaction of stakeholders, and the capabilities of the enterprise by integrating, reconfiguring, gaining, and releasing assets or resources respectively in order to ensure adequate leveraging of these benefits to achieve sustainable competitive advantage."* (cf. Sec. 3.7). Basically EABV is a kind of performance that has an outcome, impact, and benefit. This table stores the high-level value statement as well as the benefits category.

Attribute	PK	FK	R	Type	Description
Business Value Statement	Y		Y	Text	The statement of BV is a short concise sentence that indicates what the benefit of the outcome was.

Table A-18: Entity Business Value

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Stakeholder Type Mapping	0-n	is described by (identifying)	1	Stakeholder	States that zero or more stakeholders are described by one or more stakeholder types.
Stakeholder Type Mapping	0-n	is described by (identifying)	1	Stakeholder Type	States that zero or more stakeholders are described by one or more stakeholder types.

Table A-19: Entity Business Value: Relations

A.2.11. Assessment Business Value Mapping

This entity serves as mapping table between assessment and business value. Notably, this is where we find a lot of the attributes typical for EABV. It means that EABV can just be communicated when an assessment is conducted. Nevertheless, business value can exist without an assessment because a business value statement itself can be reused on a high level.

Attribute	PK	FK	R	Type	Description
Assessment Name	Y	Y	Y	Text	The name of the assessment. For example, these can be linked to the EA project that is assessed.
Business Value Statement	Y	Y	Y	Text	The statement of BV is a short concise sentence that indicates what the benefit of the outcome was.
Outcome			Y	Text	The outcome is the result of the EA contribution to performance.
Benefit			Y	Text	The benefit is the positive result that was achieved with the performance contribution. In case of a negative result, we speak of disbenefit.
Impact			Y	Text	The effect of the outcome is the resulting change within the enterprise.
Source				Text	The source of the benefit, which can be a stakeholder, an event, or some other kind of measure.
Receiver				Text	The receiver of the benefit, which can be a stakeholder, an event, or some other kind of measure.
Enabler				Text	The enabler of the benefit, which can be a stakeholder, an event, or some other kind of measure.
Inhibitor				Text	The inhibitor of the benefit, which can be a stakeholder, an event, or some other kind of measure.
Recommendation				Text	A recommendation is a set of possible actions that could be taken to improve the EABV.
Communication Date				Date/Time	The date when this BV was actually communicated or reported respectively.

Table A-20: Entity Assessment Business Value Mapping

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Assessment Business Value Mapping	0-n	assesses (identifying)	1	Assessment	States that an assessment assesses zero or more business values. This means we could have more outcomes, impacts, benefits, and therefore reports that are communicated as business value.
Assessment Business Value Mapping	0-n	is communicated (identifying)	1	Business Value	States that zero or more business values are communicated during an assessment. Zero means, that we have no business value assessed yet. Every assessment should yield a business value in the end nevertheless.

Table A-21: Entity Assessment Business Value Mapping: Relations

A.2.12. Benefits Category

The benefits category is based on the framework developed by (Shang and Seddon 2002). It is more thoroughly described in Section 3.7. It simply categorizes various business value statements. This information mostly comes into play during analysis and reporting since we want to know in which category we achieved the most value or where we didn't perform too well.

Attribute	PK	FK	R	Type	Description
Benefits Category Name	Y		Y	Text	The name of the benefits category. Valid entries include: operational, managerial, IT infrastructure, organizational, strategic.
Description				Text	Description of the benefit category.

Table A-22: Entity Benefits Category

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Benefits Category	1	categorizes (identifying)	0-n	Business Value Benefits Category Mapping	States that benefits category categorizes zero or more business values.

Table A-23: Entity Benefits Category: Relations

A.2.13. Business Value Benefits Category Mapping

This table serves as mapping business value to benefit categories.

Attribute	PK	FK	R	Type	Description
Business Value Statement	Y	Y	Y	Text	The statement of BV is a short concise sentence that indicates what the benefit of the outcome was.
Benefits Category Name	Y		Y	Text	The name of the benefits category. Valid entries include: operational, managerial, IT infrastructure, organizational, strategic.

Table A-24: Entity Business Value Benefits Category Mapping

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Business Value Benefits Category Mapping	0-n	is categorized into (identifying)	1	Business Value	States that a business value is categorized into zero or more benefit categories.
Business Value Benefits Category Mapping	0-n	categorizes (identifying)	1	Benefits Category	States that benefits category categorizes zero or more business values.

Table A-25: Entity Business Value Benefits Category Mapping: Relations

A.2.14. Balanced Scorecard Perspective

This entity describes all four perspectives of the EA Balanced Scorecard (BSC). For more information on those refer to Section 5.5.

Attribute	PK	FK	R	Type	Description
Balanced Scorecard Perspective Name	Y		Y	Text	The name of the BSC perspective. Valid values include: Stakeholder, Service, Process, and Asset.
Description				Text	The description of the BSC perspective.
Balanced Scorecard Perspective Category				Text	Further categorizes a particular BSC perspective. For example, the stakeholder perspective is categorized into EA managers, EA practitioners, and EA customers.

Balanced Scorecard Perspective Category Description				Text	Describes the BSC perspective category.

Table A-26: Entity Balanced Scorecard Perspective

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Balanced Scorecard Perspective	1	belongs to (non-identifying)	0-n	Goal	States that zero or more goals belong to a balanced scorecard perspective.

Table A-27: Entity Balanced Scorecard Perspective: Relations

A.2.15. Goal

A goal is a statement of intent to direct an organization which is typically used to measure an organization's (stakeholder's) success, and serves as time-bounded milestone for an organization (stakeholder) to demonstrate the progress. This definition is based on the definitions of goals and objectives in (The Open Group 2011a). For our purposes, objectives are sub-goals that are measured.

Attribute	PK	FK	R	Type	Description
Goal Name	Y		Y	Text	The name of the goal.
Parent Goal Name		Y		Text	The name of the parent goal. If a goal has a parent goal, it is considered as a sub-goal.
Balanced Scorecard Perspective Name		Y	Y	Text	The name of the BSC perspective. Valid values include: Stakeholder, Service, Process, and Asset.
Activity			Y	Text	Names the activity that needs to be done to achieve that goal, for example reduce costs, or increase stakeholder satisfaction.
Focus Area			Y	Text	Describes the business concept and context of the activity associated to.
Asset			Y	Text	The asset (or resource) that is targeted, e.g. for improvement, reduction, or increase. For examples refer to Section 3.6.
Contributing Assets				Text	Describes what other assets can contribute to this goal.
Timeframe			Y	Date/Time	Indicates the period of time in which the goal must be achieved.
Scope			Y	Text	Defines the scope for a goal. That means that organizational and architectural boundaries are described. For example, it could contain information about which application landscape in which architecture is relevant for this goal. Notably, this field is planned to be normalized in the future.
Risk			Y	Text	Risk is defined as knowing future event probability of something to happen in contrast to uncertainty which is unknown probability of future events. Measured uncertainty is a risk (Dimitrić and Škalamera-Alilović 2005).

Constraints				Text	Briefly describes the limiting factors for a goal, for example financial support, tool functionality, or stakeholder skills.
Is Template			Y	Yes/No	Flag, that indicates whether an entry can be used as a template. This is usually the case when a tool or application is used for capturing goals and users want to create a new one based on an old one.
Comments				Text	Free text for any comments not covered by previous fields.

Table A-28: Entity Goal

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Goal	0-1	is parent of (non-identifying)	0-n	Goal	States that zero or one goal can be the parent of zero or more goals. We use this relation to facilitate a hierarchy to support sub-goals.
Goal	0-n	belongs to (non-identifying)	1	Balanced Scorecard Perspective	States that zero or more goals belong to a balanced scorecard perspective.
Goal	1	is assessed (identifying)	0-n	Assessment Goal Mapping	States that one goal is assessed by zero or more assessments.
Goal	1	has (identifying)	0-n	Goal Parameter	States that a goal can have zero or more goal parameters. Parameters are defined for computation purposes.
Goal	1	is measured by (identifying)	1-n	Goal Metric Mapping	States that a goal is measured by one or more metrics.

Table A-29: Entity Goal: Relations

A.2.16. Assessment Goal Mapping

This entity serves as mapping table between assessment and goal.

Attribute	PK	FK	R	Type	Description
Assessment Name	Y	Y	Y	Text	The name of the assessment. For example, these can be linked to the EA project that is assessed.
Goal Name	Y	Y	Y	Text	The name of the goal.

Table A-30: Entity Assessment Goal Mapping

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Assessment Goal Mapping	0-n	is analysed (identifying)	1	Goal	States that one goal is analysed by zero or more assessments.
Assessment Goal Mapping	1	impacts (identifying)	0-n	Impacted Goal	States that one goal impacts zero or more other goals.
Assessment Goal Mapping	1	is impacted by (identifying)	0-n	Impacted Goal	States that zero or more goals are impacted by one other goal.
Assessment Goal Mapping	1-n	requires (identifying)	1	Assessment	States that one assessment requires at least one goal.

Table A-31: Entity Assessment Goal Mapping: Relations

A.2.17. Impacted Goal

An impacted goal is a goal that is effected in some way by other goals. We need this table in order to store the strategy map (cf. Sec. 5.5.5), which is a cause-and-effect relationship between goals. The strategy map is relevant during an assessment.

Attribute	PK	FK	R	Type	Description
Assessment Name	Y	Y	Y	Text	The name of the assessment. For example, these can be linked to the EA project that is assessed.
Goal Name	Y	Y	Y	Text	The name of the goal.
Impacted Assessment Name	Y	Y	Y	Text	The name of the impacted assessment.
Impacted Goal Name	Y	Y	Y	Text	The name of the impacted goal.

Table A-32: Entity Impacted Goal

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Impacted Goal	0-n	impacts (identifying)	1	Assessment Goal Mapping	States that one goal impacts zero or more other goals.
Impacted Goal	0—n	is impacted (identifying)	1	Assessment Goal Mapping	States that zero or more goals are impacted by one other goal.

Table A-33: Entity Impacted Goal: Relations

A.2.18. Goal Parameter

This table adds a parameter to a goal. That means that we can support parameterization on implementation level, or in other words, we can more easily compute certain values if necessary.

Attribute	PK	FK	R	Type	Description
Goal Name	Y	Y	Y	Text	The name of the goal.
Goal Parameter Name	Y		Y	Text	The name of the goal parameter.
Type			Y	Text	The type of the parameter. Valid values include:
Description			Y	Text	The description of the parameter.
Unit of Measure			Y	Text	The unit of measure of the parameter. Valid values include: currency, percent, positive numbers, etc.

Table A-34: Entity Goal Parameter

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Goal Parameter	0-n	has (identifying)	1	Goal	States that one goal has zero or more goal parameters.

Table A-35: Entity Goal Parameter: Relations

A.2.19. Metric

Metrics serve as common denominator for comparisons between two or more observed measures. They are usually calculated and therefore are considered as relative metrics. The aim of metrics is to deliver decision support, i.e. they should incorporate the capability to let

decision makers infer future performance as well as assist in various planning processes. Metrics can be critical success factors which inform the stakeholders what conditions and requirements must be met in order to achieve a certain goal. Moreover, they can indicate how effective that particular goal was achieved. In practice, we do not distinguish between measures and metrics. For more information about metrics, refer to Section 5.3.4.

Attribute	PK	FK	R	Type	Description
Metric Name	Y		Y	Text	The name of the metric.
Accountable Stakeholder Name		Y		Text	Indicates which stakeholder is accountable for a metric. For certain smaller metrics, we do not employ accountability.
Acronym				Text	The acronym of the metric. This is to shorten certain metric names for efficiency purposes.
Description			Y	Text	The description of the metric.
Justification			Y	Text	Justifies the use of a metric. This is necessary for reviewing purposes and decisions whether to keep the metric or not.
Computation			Y	Text	Lists formulas, methods, or techniques on how to compute the metric.
Implementation			Y	Text	Describes how the metric is implemented, e.g. what kind of software was used to develop and compute it. Or which software including hardware is required to collect data.
Cost			Y	Text	Indicates how much effort in terms of financial expenditures are necessary to employ a metric. Valid values include: High, Medium, and Low.
Scale			Y	Text	Determines the scale of the values of a metric. E.g. 0-100, 0-1, 1-n, etc.
Unit			Y	Text	Determines the unit for a metric, e.g. percent.
Review Interval				Date/Time	Indicates how often this metric needs to be reviewed. Usually, this is only relevant for longer projects.
Qualities				Text	Lists the qualities that are relevant for a metric such as efficiency, data quality, reliability etc.
Is Key Performance Indicator			Y	Yes/No	Indicates whether a metric serves as key performance indicator. If yes, it means it is compared against a critical success factor defined in the goal.
Keywords				Text	A list of keywords for search purposes.
Comments				Text	Free text allowing users to leave additional comments not covered by other fields of this table.
Is Template			Y	Yes/No	Flag, that indicates whether an entry can be used as a template. This is usually the case when a tool or application is used for capturing goals and users want to create a new one based on an old one.

Table A-36: Entity Metric

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Metric	1	measures (identifying)	1-n	Goal Metric Mapping	States that one metric measures one or more goals.
Metric	1	has (identifying)	0-n	Metric Parameter	States that a metric can have zero or more metric parameters. Parameters are defined for computation purposes.
Metric	0-n	is accountable for (non-identifying)	1	Stakeholder	States that a stakeholder is accountable for zero or more metrics.
Metric	1	belongs to (identifying)	0-n	Metric Architectural Level Mapping	States that a metric belongs to zero ore more architectural levels.

Table A-37: Entity Metric: Relations

A.2.20. Goal Metric Mapping

This entity serves as mapping table between goal and metric. It contains the actual value of the metric during measurement. For tracking purposes, we introduce additional tables on the physical level that includes timestamps. Furthermore, we want to be able to add or remove certain metrics for a particular goal during the project run time.

Attribute	PK	FK	R	Type	Description
Goal Name	Y	Y	Y	Text	The name of the goal.
Metric Name	Y	Y	Y	Text	The name of the metric.
Goal Critical Success Factor			Y	Text	A critical success factor constitutes the target or magnitude for stating whether the goal was successfully achieved or not.
Metric Measurement Value			Y	Number	The actual measurement value of the metric for a particular goal.

Table A-38: Entity Goal Metric Mapping

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Goal Metric Mapping	1-n	is measured by (identifying)	1	Goal	States that a goal is measured by one or more metrics.
Goal Metric Mapping	1-n	measures (identifying)	1	Metric	States that one metric measures one or more goals.

Table A-39: Entity Goal Metric Mapping: Relations

A.2.21. Metric Parameter

This table adds a parameter to a metric. That means that we can support parameterization on implementation level, or in other words, we can more easily compute certain values if necessary.

Attribute	PK	FK	R	Type	Description

Metric Name	Y	Y	Y	Text	The name of the metric.
Metric Parameter Name	Y		Y	Text	The name of the metric parameter.
Type			Y	Text	The type of the parameter. Valid values include:
Description			Y	Text	The description of the parameter.
Unit of Measure			Y	Text	The unit of measure of the parameter. Valid values include: currency, percent, positive numbers, etc.

Table A-40: Entity Metric Parameter

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Metric Parameter	0-n	has (identifying)	1	Metric	States that one metric has zero or more goal parameters.

Table A-41: Entity Metric Parameter: Relations

A.2.22. Architectural Level

This table stores all relevant architectural levels, namely the business architecture, the data architecture, the application architecture, and the technology architecture. For more information on these levels, refer to Section 3.1.

Attribute	PK	FK	R	Type	Description
Architectural Level Name	Y		Y	Text	The name of the architectural level.
Acronym			Y	Text	The acronym of the architectural level.
Description			Y	Text	The description of the architectural level.

Table A-42: Entity Architectural Level

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Architectural Level	1-n	is part of (identifying)	1	Metric Architectural Level Mapping	States that a metric is part of one or more architectural levels.

Table A-43: Entity Architectural Level: Relations

A.2.23. Metric Architectural Level Mapping

This entity serves as mapping table between metric and architectural level.

Attribute	PK	FK	R	Type	Description
Metric Name	Y	Y	Y	Text	The name of the metric.
Architectural Level Name	Y	Y	Y	Text	The name of the architectural level.

Table A-44: Entity Metric Architectural Level Mapping

Entity Name	Cd.	Rel.	Cd.	Entity Name	Description
Metric Architectural Level Mapping	0-n	is part of (identifying)	1	Architectural Level	States that one metric is part of zero or more architectural levels.

Metric Architectural Level Mapping	0-n	belongs to (identifying)	1	Metric	States that one metric belongs to zero or more architectural levels.

Table A-45: Entity Metric Architectural Level Mapping: Relations

A.3. Physical Data Model

The physical data model is available digitally instantiated with Microsoft Access® 2013.

B. EABV AP: Additional Information

B.1. EABV AP: Plan the Assessment

B.1.1. GQM Method Workshops

During one of the on-site visits at our corporate partner, we employed a tailored GQM method (Basili et al. 1994) consisting of seven steps. These are outlined in Figure B-1. For all steps, we estimated necessary time.

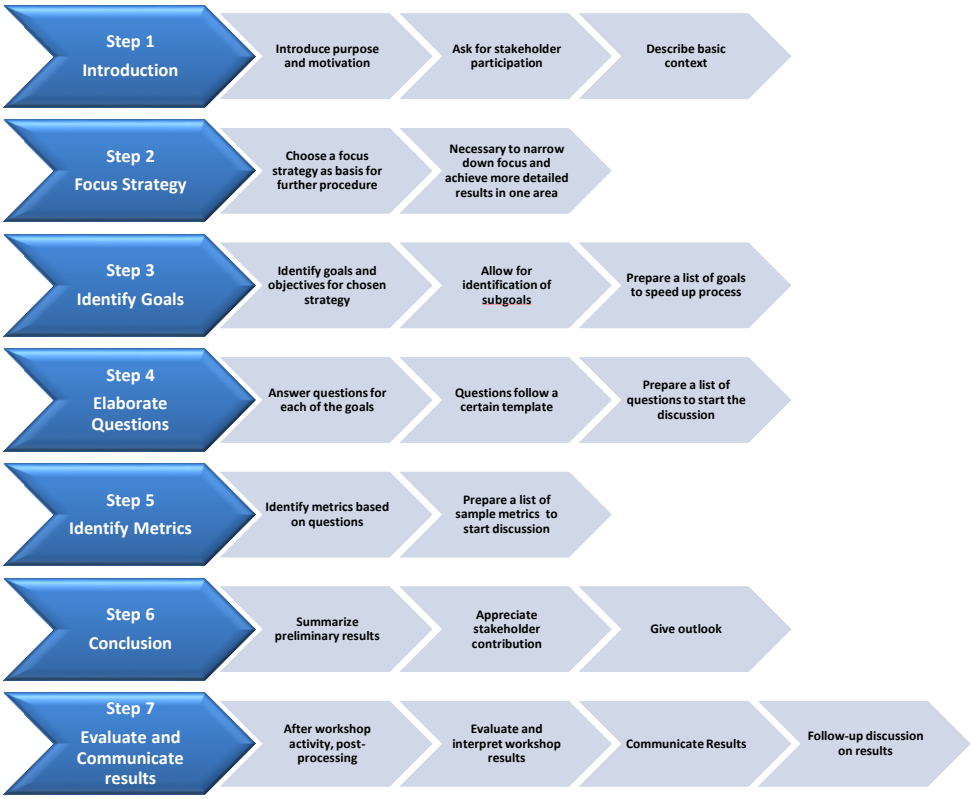

Figure B-1: Adapted structure of the GQM method

B.1.2. List of Goals

We expressed a total of 12 goals the focus project. These were all aligned to overall EA strategic goals. Following is a list of each of these goals based on the template we defined earlier in Section 5.3.3. Notably, goals with number one to three (#1-#3) are all about stakeholder satisfaction, overall and one for each, EA practitioners and EA managers. We opted to just list the overall EA stakeholder satisfaction goal here.

#1 Goal Name	**Improve EA stakeholder satisfaction**
Activity	Improve EA stakeholder satisfaction
Focus Area	EA customers, EA practitioners, EA managers
Asset	EA stakeholder satisfaction (people asset)
Critical Success Factor	10% increase in stakeholder satisfaction to current value

Timeframe	12 months
Scope	EA services and process including outcomes
Constraints	EA principles
Relations	*Impacted by*: Improve EA stakeholder satisfaction (customers, practitioners), Improve storage provisioning service, Improve virtual server provisioning service for new and existing virtual servers
Perspective	Stakeholder
Strategy	Improve overall EA quality

Table B-1: Goal #1: Improve EA stakeholder satisfaction

#4 Goal Name	**Improve storage provisioning service**
Activity	Reduce total execution time, improving quality of decisions
Focus Area	Storage provisioning time and quality
Asset	Storage provisioning service (IT intellectual capital asset)
Critical Success Factor	Reduce execution time under 8 hours
Timeframe	12 months
Scope	SAN[4] storage for office and enterprise applications
Constraints	EA principles, vendor specific virtual servers, production database only on virtual server
Relations	*Impacted by*: Improve virtual server provisioning service *Impacts*: Improve EA practitioner satisfaction, Improve virtual server provisioning service for new and existing virtual servers
Perspective	Service
Strategy	Improve EA service delivery time (make EA faster)

Table B-2: Goal #4: Improve storage provisioning service

#5 Goal Name	**Improve virtual server provisioning service for new and existing virtual servers**
Activity	Reduce total execution time
Focus Area	Virtual server provisioning time
Asset	Virtual server provisioning service (IT intellectual capital asset)
Critical Success Factor	Virtual server provisioning under 3 hours
Timeframe	12 months
Scope	Virtual servers for office and enterprise applications
Constraints	EA principles, vendor specific virtual servers, production database only on virtual server
Relations	*Impacted by*: Improve storage provisioning service, Expand scope, Improve capacity management *Impacts*: : Improve EA customer satisfaction, Improve storage provisioning service, Improve capacity management
Perspective	Service
Strategy	Improve EA service delivery time (make EA faster)

Table B-3: Goal #5: Improve virtual server provisioning time

#6 Goal Name	**Improve capacity management**
Activity	Increase data quality in terms of storage utilization and allocation
Focus Area	Memory, network and disk IO, storage, CPU allocation
Asset	Capacity management and storage practice (IT intellectual capital asset)

[4] Storage Area Network

Critical Success Factor	Provide reliable view of current storage utilization and allocation
Timeframe	12 months
Scope	SAN storage for office and enterprise applications
Constraints	EA principles
Relations	*Impacted by*: Improve storage provisioning service, Improve virtual server provisioning service for new and existing virtual servers *Impacts*: :Improve storage provisioning service
Perspective	Process
Strategy	Improve EA reliability

Table B-4: Goal #6: Improve capacity management

#7 Goal Name	**Create and maintain a data model for IMODS projects**
Activity	Create and maintain data model (logical and physical)
Focus Area	Building the integrated view for infrastructure data
Asset	Data models (IT intellectual capital asset)
Critical Success Factor	Logical and physical models exist and are maintained
Timeframe	3 months
Scope	Solution architecture, IMODS
Constraints	IT building codes
Relations	*Impacted by*: *Impacts*: :Increase data transparency
Perspective	Asset
Strategy	Enforce enterprise data modelling standard for IMODS projects

Table B-5: Goal #7: Create and maintain data model for IMODS projects

#8 Goal Name	**Create and maintain a value cost chain for IMODS projects**
Activity	Create and maintain value cost chain
Focus Area	Visualize the movement and reuse of IMODS data
Asset	Value cost chain (IT intellectual capital asset)
Critical Success Factor	Value cost chain exists and is maintained
Timeframe	3 months
Scope	Solution architecture, IMODS
Constraints	IT building codes
Relations	*Impacted by*: *Impacts*: Increase data transparency
Perspective	Asset
Strategy	Enforce enterprise data modelling standard for IMODS projects

Table B-6: Goal#8: Create and maintain a value cost chain for IMODS projects

#9 Goal Name	**Improve environment quality**
Activity	Increase data quality through data quality management practices in IMODS
Focus Area	Enforcing data quality management standards and practices
Asset	Environment data quality (IT intellectual capital asset)
Critical Success Factor	Decreasing environment error rate from 22% to under 5%
Timeframe	6 months
Scope	Cloud landscape (physical, virtual, and storage solutions)
Constraints	Logical data model definitions

Relations	*Impacted by*: Increase data transparency *Impacts*: Improve capacity management, Increase decision throughput, Improve virtual server provisioning service for new and existing virtual servers
Perspective	Process
Strategy	Improve data quality through EA practices

Table B-7: Goal #9: Improve environment quality

#10 Goal Name	**Improve data transparency**
Activity	Provide access and BI capabilities to data beyond vendor constraints
Focus Area	Enabling data access
Asset	Specific data records (IT intellectual capital asset)
Critical Success Factor	Data attributes visible from 50 to 2500
Timeframe	3 months
Scope	Cloud landscape (physical, virtual, and storage solutions)
Constraints	Logical data model definitions
Relations	*Impacted by*: Create and maintain a data model for IMODS projects, Create and maintain a value cost chain for IMODS projects *Impacts*: Expand scope, Improve environment quality, Increase decision throughput
Perspective	Asset
Strategy	Improve data quality through EA practices

Table B-8: Goal #10: Improve data transparency

#11 Goal Name	**Expand scope**
Activity	Expand (and reprioritize) stakeholder access rights, visibility, and data usage
Focus Area	Enabling integrated data usage and facilitate new data usage
Asset	IMODS (IT intellectual capital asset)
Critical Success Factor	Expand visibility from 5 to 80 people
Timeframe	12 months
Scope	Cloud landscape (physical, virtual, and storage solutions)
Constraints	Security policies in terms of authorizations
Relations	*Impacted by*: Increase data transparency *Impacts*: Improve virtual server provisioning service for new and existing virtual servers
Perspective	Process
Strategy	Improve data quality through EA practices

Table B-9: Goal #11: Expand scope

#12 Goal Name	**Increase decision throughput**
Activity	Reduce capacity report generation time
Focus Area	Report generation for capacity management
Asset	Capacity management, storage
Critical Success Factor	Reduce capacity report generation from 6 months, to 3 months, to daily
Timeframe	12 months
Scope	SAN storage for office and enterprise
Constraints	EA principles
Relations	*Impacted by*: Increase data transparency, Improve environment quality *Impacts*: Improve capacity management
Perspective	Process

Strategy	Improve service delivery time through EA practices

Table B-10: Goal #12: Increase decision throughput

B.1.3. List of Metrics

In this Section of the Appendix, we list the metrics we employed to measure EA performance. It has to be noted that not all of them needed to be identified with the GQM method as they were partly available. This is a good example of metric reusability, a practice which we accommodate in our method design.

Notably, the field implementation usually contains source code or a link to it. Furthermore, we do not list concrete examples. Regarding stakeholder satisfaction, we just list the overall metric and not each metric for each individual stakeholder type (cf. metric #14).

#1 Metric Name	**Slot Utilization**
Acronym	SU
Description	The ratio of storage frame slots that are populated with drives compared to the total available storage frame slots.
Justification	This metric is an operational metric crucial to determine the capital efficiency of storage.
Computation	$SU = \frac{Populated\ slots}{Total\ slots}$
Implementation	Embedded into a DB view
Accountability	Storage infrastructure owner
Cost	Low
Scale	0-1; 0-100
Unit	none; percent
Review interval	On demand
Architectural level	DA, TA
Dependencies	
Qualities	Efficiency
Example	
is KPI	
Keywords	Infrastructure, storage
Comments	Used at frame level

Table B-11: Metric #1: Slot utilization

#2 Metric Name	**Overall storage efficiency**
Acronym	OSE
Description	The ratio of customer stored data compared to the raw storage capacity.
Justification	This metric is one of the core metrics crucial to determine the storage efficiency.
Computation	$OSE = \frac{Customer\ stored\ data\ (file\ system)}{Raw\ storage\ capacity\ (hard\ drive)}$
Implementation	ETL and DB view
Accountability	Storage infrastructure owner
Cost	High
Scale	0-1; 0-100

Unit	none; percent
Review interval	On demand
Architectural level	DA, TA
Dependencies	
Qualities	Efficiency
Example	
is KPI	Yes
Keywords	Infrastructure, storage
Comments	OSE usually per frame, can be scaled at data centre or enterprise level

Table B-12: Metric #2: Overall storage efficiency

#3 Metric Name	**Low-cost storage performance**
Acronym	LCSP
Description	The ratio of customer data stored on our low-cost storage compared to the total customer data stored.
Justification	This metric is one of the core metrics crucial to determine the storage efficiency.
Computation	$LCSP = \frac{Customer\ stored\ data\ (on\ low\ cost)}{Total\ customer\ stored\ data}$
Implementation	ETL and DB view
Accountability	Storage infrastructure owner
Cost	High
Scale	0-1; 0-100
Unit	none; percent
Review interval	On demand
Architectural level	DA, TA
Dependencies	
Qualities	Efficiency
Example	
is KPI	
Keywords	Infrastructure, storage
Comments	

Table B-13: Metric #3: Low-cost storage performance

#4 Metric Name	**Used percentage**
Acronym	UP
Description	This is the percentage of Usable Capacity that is used to store customer data.
Justification	Core metric for capacity monitoring.
Computation	$UP = \frac{Used\ capacity}{Usable\ capacity}$
Implementation	ETL and DB view
Accountability	Storage infrastructure owner
Cost	High
Scale	0-1; 0-100
Unit	none; percent
Review interval	On demand
Architectural level	DA, TA
Dependencies	

Qualities	Capacity and risk management
Example	
is KPI	
Keywords	Infrastructure, capacity, risk
Comments	Can be aggregated over frames and data centres.

Table B-14: Metric #4: Used percentage

#5 Metric Name	**Allocation percentage**
Acronym	AP
Description	This is the percentage of Usable Capacity that has been allocated to customers.
Justification	Core metric for capacity monitoring.
Computation	$AP = \frac{Allocated\ capacity}{Usable\ capacity}$
Implementation	ETL and DB view
Accountability	Storage infrastructure owner
Cost	High
Scale	0-1; 0-100
Unit	none; percent
Review interval	On demand
Architectural level	DA, TA
Dependencies	
Qualities	Capacity and risk management
Example	
is KPI	Yes
Keywords	Infrastructure, capacity, risk
Comments	Can exceed 100%, limit is 150%. Can be aggregated over frames and data centres.

Table B-15: Metric #5: Allocation percentage

#6 Metric Name	**Customer utilization of allocated capacity**
Acronym	CUAC
Description	This represents how much specific customers have used the storage capacity that has been allocated to them.
Justification	Core metric for capacity monitoring.
Computation	$CUAC = \frac{Customer\ stored\ data\ (file\ system)}{Allocated\ capacity}$
Implementation	ETL and DB view
Accountability	Storage infrastructure owner
Cost	High
Scale	0-1; 0-100
Unit	none; percent
Review interval	On demand
Architectural level	DA, TA
Dependencies	
Qualities	Capacity and risk management
Example	
is KPI	Yes
Keywords	Infrastructure, capacity, risk

Comments	Can exceed 100%, limit is 150%. Can be aggregated over frames and data centres.

Table B-16: Metric #6: Customer utilization of allocated capacity

#7 Metric Name	**Allocation headroom**
Acronym	AH
Description	This is a metric to enable IT storage operations engineers to quickly adapt to customer demands.
Justification	Core metric for ad-hoc storage allocation in response to customer demands.
Computation	Special algorithm
Implementation	ETL and DB view
Accountability	Storage infrastructure owner
Cost	Very high
Scale	0-X
Unit	GB (Gigabyte)
Review interval	On demand
Architectural level	DA, TA
Dependencies	
Qualities	Capacity and risk management
Example	
is KPI	Yes
Keywords	Infrastructure, capacity, risk
Comments	

Table B-17: Metric #7: Allocation headroom

#8 Metric Name	**Virtual server provisioning time**
Acronym	VSPT
Description	This metric measures the total throughput time from request to delivery of the virtual server (VS).
Justification	Basis for determining how fast the service can be delivered. Relates to other time-to-market metrics.
Computation	Total throughput time
Implementation	DB
Accountability	Virtual server service delivery owner
Cost	Low
Scale	0-X
Unit	Minutes
Review interval	On demand
Architectural level	DA, TA
Dependencies	
Qualities	Responsiveness, time-to-market, agility
Example	
is KPI	
Keywords	Virtual server provisioning, time
Comments	

Table B-18: Metric #8: Virtual server provisioning time

#9 Metric Name	**Virtual server capacity management refresh interval**

Acronym	VSCMRI
Description	Measures the time capacity management storage data is refreshed.
Justification	In terms of data quality, it determines the timeliness of storage data.
Computation	Refresh interval
Implementation	DB
Accountability	Virtual server service delivery owner
Cost	Low
Scale	0-X
Unit	Hours
Review interval	On demand
Architectural level	DA, TA
Dependencies	
Qualities	Timeliness
Example	
is KPI	
Keywords	Virtual server provisioning, time
Comments	Answers the question when the storage data will be updated.

Table B-19: Metric #9: Virtual server capacity management refresh interval

#10 Metric Name	**Virtual server capacity management data collection quality**
Acronym	VSCMDCQ
Description	Measures the data collection quality of virtual server capacity management. It is a qualitative metric including reliability, completeness, validity and utility.
Justification	Important to gain insights about (perceived) data quality.
Computation	Small survey (3-5 items) with a Likert scale. Score is average points. This index can optionally be shown as percent value.
Implementation	Post service delivery survey
Accountability	Virtual server service delivery owner
Cost	Low
Scale	from 1 to 5
Unit	none; percent
Review interval	Depends on delivery
Architectural level	DA, TA
Dependencies	
Qualities	Data quality
Example	
is KPI	
Keywords	Virtual server capacity management, storage, data quality
Comments	

Table B-20: Metric #10: Virtual server capacity management refresh interval

#11 Metric Name	**Exists**
Acronym	
Description	Binary measure to determine if corresponding measured object exists.
Justification	Needed to determine the existence of a particular object, e.g. a data model.
Computation	Boolean

Implementation	DB
Accountability	Enterprise architect
Cost	Low
Scale	true; false
Unit	none
Review interval	On demand
Architectural level	DA, TA
Dependencies	
Qualities	
Example	
is KPI	
Keywords	Object exists
Comments	Metric commonly reused.

Table B-21: Metric #11: Exists

#12 Metric Name	**Is Maintained**
Acronym	
Description	Binary measure to determine if corresponding measured object is maintained.
Justification	Needed to determine if a particular object is maintained, e.g. a data model.
Computation	Boolean
Implementation	DB
Accountability	Enterprise architect
Cost	Low
Scale	true; false
Unit	none
Review interval	On demand
Architectural level	DA, TA
Dependencies	
Qualities	
Example	
is KPI	
Keywords	Object maintained
Comments	Metric commonly reused.

Table B-22: Metric #12: Is Maintained

#13 Metric Name	**Cloud infrastructure environment quality**
Acronym	CIEQ
Description	Measures the data quality of the cloud infrastructure environment. It is a qualitative metric including reliability, completeness, validity and utility.
Justification	Important to gain insights about (perceived) data quality.
Computation	Small survey (3-5 items) with a Likert scale. Score is average points. This index can optionally be shown as percent value.
Implementation	Periodic manually
Accountability	Virtual server service delivery owner
Cost	Low
Scale	from 1 to 5

Unit	none; percent
Review interval	Depends on delivery
Architectural level	DA, TA
Dependencies	
Qualities	Data quality
Example	
is KPI	
Keywords	Cloud infrastructure, data quality
Comments	

Table B-23: Metric #13: Cloud infrastructure environment quality

#14 Metric Name	**Stakeholder satisfaction index**
Acronym	SSI
Description	This metric determines the satisfaction of EA stakeholders with the overall EA contribution.
Justification	One of the most important metrics in order to determine the overall EA quality as perceived by EA stakeholders.
Computation	Small survey (3-5 items) with a Likert scale. Score is average points. This index can optionally be shown as percent value.
Implementation	This metric is implemented as part of the project life cycle and is therefore on project scope, i.e. we do not have a time dimension but rather a per project dimension.
Accountability	Virtual server service delivery owner
Cost	Low
Scale	from 1 to 5
Unit	none; percent
Review interval	biannual (1st half, 2nd half)
Architectural level	All
Dependencies	
Qualities	Data quality
Example	
is KPI	
Keywords	Cloud infrastructure, data quality
Comments	

Table B-24: Metric #14: Stakeholder satisfaction index

#17 Metric Name	**Service delivery simplicity index for EA customers**
Acronym	$SDSI_{cust}$
Description	The SDSI is a metric that indicates the degree of simplicity of the EA service delivery as perceived by the EA customers.
Justification	When delivering an EA service, we want to have feedback if the delivery was simple enough. If too complicated, we need to simplify it.
Computation	Small survey (3-5 items) with a Likert scale. Score is average points. This index can optionally be shown as percent value.
Implementation	This metric is implemented as part of the project life cycle and is therefore on project scope, i.e. we do not have a time dimension but rather a per project dimension.
Accountability	Contributing EA practitioner, PM

Cost	Low
Scale	from 1 to 5
Unit	none; percent
Review interval	biannual (1st half, 2nd half)
Architectural level	BA, AA
Dependencies	
Qualities	Usability, simplicity, time-to-market
Example	
is KPI	Yes
Keywords	Service, time
Comments	Adaptable for particular services

Table B-25: Metric #17: Service delivery simplicity index for EA customers

#18 Metric Name	**Service delivery throughput time**
Acronym	SDTPT
Description	The SPTPT is a metric that indicates how long the EA service delivery takes.
Justification	We need to keep track about the time it takes for the EA team to deliver their services. If they deliver to slow, we must speed up.
Computation	$SDTPT = SD_{Start} - SD_{End}$
Implementation	This metric is implemented at DB level starting with a received request for service delivery and ending with the final delivery.
Accountability	Contributing EA practitioner, PM
Cost	Low
Scale	0-X
Unit	Hours
Review interval	biannual (1st half, 2nd half)
Architectural level	BA, AA
Dependencies	
Qualities	Usability, simplicity, time-to-market
Example	
is KPI	Yes
Keywords	Service, time
Comments	Adaptable for particular services.

Table B-26: Metric #18: Service delivery throughput time

#19 Metric Name	**Virtual server delivery decision time**
Acronym	VSDDT
Description	The VSDDT measures the time it takes to instantiate a virtual server which directly affects the decision time.
Justification	The decisions how and where a virtual server is provisioned need to be improved and therefore measured. The data must be timely and trustworthy.
Computation	$VSDDT = VSPT - VSIT$
Implementation	This metric is implemented as automated data collection based on the VSPT and the VSIT (actual VS implementation time).
Accountability	EA practitioner
Cost	Low

Scale	0-X
Unit	Hours
Review interval	annual
Architectural level	All
Dependencies	
Qualities	Timeliness, trustworthiness
Example	
is KPI	Yes
Keywords	Timeliness, trustworthiness
Comments	

Table B-27: Metric #19: Virtual server delivery decision time

#20 Metric Name	**Number of integrated data sources**
Acronym	NOIDS
Description	The NOIDS is a metric that informs us about the VCs which are integrated as data sources into one specific data base.
Justification	No data source silos should be in existence and therefore we need this metric.
Computation	$NOIDS = X$
Implementation	The number of DS entries inserted into the reporting environment data base.
Accountability	EA practitioner
Cost	Low
Scale	0-X
Unit	none
Review interval	On demand
Architectural level	DA
Dependencies	
Qualities	Data quality (utility)
Example	
is KPI	Yes
Keywords	Data quality, utility
Comments	

Table B-28: Metric #20: Number of integrated data sources

#21 Metric Name	**Number of useful data attributes**
Acronym	NOUDA
Description	The NOUDA is a metric that provides an increased variety on an enterprise level view.
Justification	To satisfy a minimum level of visibility.
Computation	$NOUDA = X$
Implementation	The number of useful attributes in the integrated DB (parameterized tables).
Accountability	EA practitioner
Cost	Low
Scale	0-X
Unit	none
Review interval	On demand
Architectural level	DA
Dependencies	

Qualities	Data quality (utility)
Example	
is KPI	Yes
Keywords	Data quality, utility
Comments	

Table B-29: Metric #21: Number of useful data attributes

#22 Metric Name	**Number of stakeholders with data access**
Acronym	NOSDA
Description	The NOSDA is a high level metric to inform us about the visibility scope of the data in terms of stakeholder numbers.
Justification	More visibility or data access respectively facilitates and encourages a greater variety of data usage with additional benefits.
Computation	$NOSDA = X$
Implementation	The number of stakeholders is stored in a particular DB.
Accountability	EA practitioner
Cost	Low
Scale	0-X
Unit	none
Review interval	On demand
Architectural level	BA, DA
Dependencies	
Qualities	Data quality (serendipity)
Example	
is KPI	
Keywords	Data quality, serendipity
Comments	

Table B-30: Metric #22: Number of stakeholders with data access

#23 Metric Name	**Number of different types of reports generated**
Acronym	NODRG
Description	The NODRG is a high level metric that informs us about the number of different kinds of data usages.
Justification	Since we have expanded scope we also want to know how many different usages of data are facilitated.
Computation	$NODRG = X$
Implementation	The number of stakeholders is stored in a particular DB.
Accountability	EA practitioner
Cost	Low
Scale	0-X
Unit	none
Review interval	On demand
Architectural level	BA, DA
Dependencies	
Qualities	Data quality (serendipity)
Example	

is KPI	
Keywords	Data quality, serendipity
Comments	

Table B-31: Metric #23: Number of different types of reports generated

B.1.4. Goal-Metric Alignment

Having listed all goals and metrics, it is time to align them for the assessment of the IMODS project. Both of them are reusable and can conceptually exist on their own as mentioned during the description of our data dictionary in Appendix A. The goal-metric alignment is listed in Table B-32.

Goals	Metrics	Notes
#1 Improve stakeholder satisfaction	• #14 Stakeholder satisfaction index	This is the overall satisfaction index as composite of the satisfaction indices of all three stakeholder groups.
#4 Improve storage provisioning service	• #1 Slot utilization • #2 Overall storage efficiency • #3 Low-cost storage performance	These metrics provided the best performance indicators to improve the storage provisioning service by improving decisions based on collected and analysed performance data.
#5 Improve virtual server provisioning service for new and existing virtual servers	• #8 Virtual server provisioning time	The main goal for improvement virtual server provisioning was envisioned in terms of reduced time. Hence, the choice for this metric.
#6 Improve capacity management	• #7 Allocation headroom • #9 Virtual server capacity management interval • #10 Virtual server capacity management data collection quality	To improve capacity management, these metrics are best suited to make better decisions.
#7 Create and maintain a data model for IMODS projects	• #11 Exists • #12 is Maintained	Simple indicator to ensure that a data model is in existence and maintained.
#8 Create and maintain a value cost chain for IMODS projects	• #11 Exists • #12 is Maintained	Simple indicator to ensure that a value cost chain is in existence and maintained.
#9 Improve environment quality	• #13 Cloud infrastructure environment quality	Quality as perceived by stakeholders.
#10 Improve data transparency	• #20 Number of integrated data sources • #21 Number of useful data attributes	Provides information about visibility of data.
#11 Expand scope	• #22 Number of stakeholders with data access • #23 Number of different types of reports generated	Most adequate way of assessing the expansion of scope.

#12 Increase decision throughput	• #19 Virtual server delivery decision time	Time to make decisions greatly affects throughput.

Table B-32: Goal-Metric alignment for IMODS

B.2. EABV AP: Perform the Assessment

This part of the Appendix lists the consolidated EABV reports.

B.2.5. Consolidated EABV Reports

As part of the perform assessment step of the EABV AP, we communicate results. This means we generated information products in the form of EABV reports that satisfy the information need of deriving EABV from performance data. For our focus project, we reported EABV as follows:

EABV #1	**Increased stakeholder satisfaction**
Benefit	*Organizational Benefit:* Increased satisfaction resulted in better collaboration between the stakeholders. It therefore becomes more efficient and effective. Moreover, stakeholders are more motivated to consume the service. This also increases the overall reputation of the EA organization. *Operational Benefit*: Satisfied stakeholders mean less risk of project failure.
Outcome	Through the reduction of server provisioning time, the stakeholders, especially EA customers are much more satisfied with the VS provisioning service. It helps their services and products to achieve a faster time-to-market. We could observe in increase in service consumption, EA visibility and reputation, and stakeholder motivation affecting productivity (estimate of 6-7% increase).
Source	The source of this EABV is the EA organization and the EA practitioners realizing this project as well as the EA managers investing into it.
Receiver	The receivers are mostly EA customers. In addition, EA practitioners and EA managers experience alleviations in making decisions which increased their overall satisfaction. Hence, the value of this project is distributed accordingly between the three stakeholder groups.
Enabler	The enablers for this EABV were on the one hand the EA managers that supported this project financially and also the EA practitioners that triggered it since they were pointing out the need for action in this regard. More specifically, the enabler was to employ suitable data modelling to provide IMODS.
Inhibitor/Limitations	So far, no significant inhibitors or limitations could be identified that would decrease stakeholder satisfaction.
Date of performance data collection	The date of performance data collection started 6 months into the project. Data collection is done twice a week. For the purpose of this Thesis, exact dates are not relevant.
Used tools	• Microsoft Excel 2013® for analysing • Microsoft Access 2013® for storing • Microsoft PowerPoint 2013® for reporting
Data analysis method details	Stakeholder satisfaction index based on a short survey.

Table B-33: EABV #1: Increased stakeholder satisfaction

EABV #2	Improved decision making
Benefit	*Strategic Benefit:* Increased decision making better supports executing strategies that rely on this service through transparency and agility. It also allows for faster time-to-market for services and products relying on IMODS. *Managerial Benefit*: Improved decision making a classic example of a managerial benefit. It encompasses risk and cost reduction among others. *Operational Benefit*: Improved decision making reduces the time and increases agility and efficiency for provisioning the service.
Outcome	Increased decision making allows for improved allocation of storage, network, and CPU resources. This makes the service not only faster, but also more efficient. Decision makers expressed more confidence in infrastructure data. Accuracy and timeliness were named as major contributors. Moreover, this improvement affects productivity (estimate of 6-7% increase).
Source	The source of this EABV is the EA organization and the EA practitioners realizing this project as well as the EA managers investing into it.
Receiver	EA practitioners and EA managers experience alleviations in resource management which also benefit EA customers. Hence, the value of this project is distributed accordingly between the three stakeholder groups.
Enabler	The enablers for this EABV were on the one hand the EA managers that supported this project financially and also the EA practitioners that triggered it since they were pointing out the need for action in this regard. More specifically, the enabler was to employ suitable data modelling to provide IMODS and the increase of data visibility.
Inhibitor/Limitations	So far, no significant inhibitors or limitations could be identified besides human misjudgements.
Date of performance data collection	The date of performance data collection started 3 months into the project. Data collection is done twice a week. For the purpose of this Thesis, exact dates are not relevant.
Used tools	• Microsoft Excel 2013® for analysing • Microsoft Access 2013® for storing • Microsoft PowerPoint 2013® for reporting
Data analysis method details	Data quality survey for decision makers.

Table B-34: EABV #2: Improved decision making

EABV #3	Reduced virtual server provisioning time
Benefit	*Strategic Benefit:* Reduced virtual server provisioning time increases business agility and strategic execution. *Managerial Benefit:* Less provisioning time translates into reduced costs. *Operational Benefit*: Stakeholders in need of this service have less downtime due to increased delivery speed.
Outcome	Time to provision a new virtual server was reduced from two weeks to 45 minutes. This marks a major contribution to savings with this project and the cloud strategy which are 9.2 million USD.
Source	The source of this EABV is the EA organization and the EA practitioners realizing this project as well as the EA managers investing into it.

Receiver	EA practitioners and EA managers experience alleviations in resource management which also benefit EA customers. Hence, the value of this project is distributed accordingly between the three stakeholder groups.
Enabler	The enablers for this EABV were on the one hand the EA managers that supported this project financially and also the EA practitioners that triggered it since they were pointing out the need for action in this regard. More specifically, the enabler was to employ suitable data modelling to provide IMODS and the increase of data visibility.
Inhibitor/Limitations	So far, no significant inhibitors or limitations could be identified.
Date of performance data collection	The date of performance data collection started 3 months into the project. Data collection is done twice a week. For the purpose of this Thesis, exact dates are not relevant.
Used tools	• Microsoft Excel 2013® for analysing • Microsoft Access 2013® for storing • Microsoft PowerPoint 2013® for reporting
Data analysis method details	Data quality survey for decision makers.

Table B-35: EABV #3: Reduced virtual server provisioning time

EABV #4	**Reduced costs**
Benefit	*Managerial Benefit:* Achieved storage savings of USD 9.2 million in an accounting year.
Outcome	Time to provision a new virtual server was reduced from two weeks to 45 minutes. This marks a major contribution to savings with this project and the cloud strategy which are 9.2 million USD.
Source	The source of this EABV is the EA organization and the EA practitioners realizing this project as well as the EA managers investing into it.
Receiver	EA practitioners and EA managers experience alleviations in resource management. EA customers receive reduced project costs due to reduced cycle time. Hence, the value of this project is distributed accordingly between the three stakeholder groups.
Enabler	The enablers for this EABV were on the one hand the EA managers that supported this project financially and also the EA practitioners that triggered it since they were pointing out the need for action in this regard. More specifically, the enabler was to employ suitable data modelling to provide IMODS and the increase of data visibility.
Inhibitor/Limitations	So far, no significant inhibitors or limitations could be identified that would increase costs.
Date of performance data collection	The date of performance data collection started 6 months into the project. Data collection is done on demand. For the purpose of this Thesis, exact dates are not relevant.
Used tools	• Microsoft Excel 2013® for analysing • Microsoft Access 2013® for storing • Microsoft PowerPoint 2013® for reporting • Various other tools at our corporate partner
Data analysis method details	Part of a TCO analysis at our corporate partner.

Table B-36: EABV#4: Reduced costs

C. MAID Evaluation: Products

In this part of the Appendix, we list the actual products or deliverables respectively that were generated by our application of the MAID evaluation. Every relevant product is explained in the following subsections.

C.3. List of MAID Objectives

MAID objectives define and clarify the targeted intention of the evaluation. They answer the question why we want to evaluate. The following table lists these objectives.

MAID Objective	Description
Evaluate the EABV AM	Evaluate the EABV AM based on certain criteria. Since this is the overarching artefact, we need to find adequate criteria that regard. We evaluate this artefact against its objectives, requirements, and outputs.
Evaluate the EABV FW	Evaluate the EABV FW based on certain criteria. Since this artefact is mainly instantiated in document form and partly within the database, we need to gather qualitative stakeholder feedback. We evaluate this artefact against its objectives, requirements, and outputs.
Evaluate the EABV M	Evaluate the EABV M based on certain criteria. We evaluate this artefact against its objectives, requirements, and outputs.
Evaluate the EABV AP	Evaluate the EABV AP based on certain criteria. We evaluate this artefact against its objectives, requirements, and outputs.
Evaluate the EA BSC	Evaluate the EA BSC based on certain criteria. We evaluate this artefact against its objectives, requirements, and outputs.
Give recommendations on how to improve/evolve the EABV AM (and containing artefacts)	As result of this evaluation, we need to be able to give recommendations on how to improve/evolve the EABV AM and its artefacts. Notably, this could start the DSR ABC anew. Minor changes don't start a new research cycle and are handled in the regular scope of the EABV AM operation phase. Major evolvements could be the redesign of an entire artefact, e.g. the EABV AP needs to be based on another measurement process. Minor changes could be the change of an EA BSC perspective. For example, we want to explicitly include a business value perspective as topmost one and move the stakeholder perspective to an asset category.

Table C-1: List of MAID objectives

C.4. List of constraints to be met

The actual constraints are typically influenced by factors such as cost, schedule, and personnel availability. The list of constraints relevant for us and an explanation for the decisions made is outlined in the following table.

MAID Constraint	Description
Cost	The evaluation is funded as part of the overall project funding. The additional cost is influenced by the commitment of additional stakeholders, so their time contributing to the evaluation needs to be regarded and eventually constrained. A full evaluation including all criteria is not possible in terms of costs.

Schedule	Overall evaluation schedule was largely depended on individual stakeholder availability as well as the actual possibility of on on-site visit to conduct the evaluation. The schedule also does not permit a full evaluation including all criteria.
Personnel Availability	Regarding personnel availability, we agreed to participate in regular meetings and organize additional meetings and on-site visits on demand depending on the schedule of involved stakeholders. This proved to work best with all participating stakeholders.

Table C-2: List of MAID constraints

C.5. List of personnel availability

Since this is a prototype small scale project, we did not explicitly employ a timesheet for our members. Meetings and on-site visits were scheduled whenever it was suitable for relevant stakeholders. Besides regular meetings, ad hoc meetings depended on the schedule of individual stakeholders.

C.6. List of revised MAID objectives

This list is actually the same as the original one already described in Section C.3. No changes were necessary for our purposes.

C.7. MAID Scope Statement

The MAID scope statement is identified relatively early in the evaluation process and therefore is on a high level and not very detailed. In our opinion, the true scope of the evaluation boils down to the actual selection of criteria. This determines not only the scope, but also reflects the focus aligned with the objectives for the particular evaluation.

MAID Scope	Description
MAID Scope Statement	The scope of our MAID evaluation is to proof the concept of the EABV AM and its artefacts (EABV FW, EABV M, EABV AP, EA BSC). It was applied to one focus project and therefore we focus on project level assessment for our assessment scope which impacts the selection of criteria and therefore the scope of the MAID evaluation.
Organizational entities	The evaluation is funded as part of the overall project funding. The additional cost is influenced by the commitment of additional stakeholders, so their time contributing to the evaluation needs to be regarded and eventually constrained. A full evaluation including all criteria is not possible in terms of costs.
Criteria categories for each organizational entity	Overall evaluation schedule was largely depended on individual stakeholder availability as well as the actual possibility of on on-site visit to conduct the evaluation. The schedule also does not permit a full evaluation including all criteria.
Rationale for decisions made	Regarding personnel availability, we agreed to participate in regular meetings and organize additional meetings and on-site visits on demand depending on the schedule of involved stakeholders. This proved to work best with all participating stakeholders.

Table C-3: MAID scope statement

C.8. List of MAID Team Members

This list contains all of our team members for the evaluation. Since this information is not relevant for this Thesis, the information is omitted. The number of MAID team members participating in this evaluation was six.

C.9. List of Customer SMEs

This list contains all of our customer SMEs for the evaluation. Since this information is not relevant for this Thesis, the information is omitted.

C.10. List of MAID Outputs

The list of our projected MAID outputs are reported in several ways. First, we diffuse a presentation in slide format with the M & A strengths and weaknesses. Here, we also include the recommendations on how to evolve our EABV AM and the other artefacts. Furthermore, we provide a list of MAID criteria with the ratings and rationale for those ratings. The list of MAID outputs is summarized as follows:

- Presentation
    - Strengths and weaknesses of the M & A artefacts
    - Recommendations on how to evolve the EABV AM
- List of MAID criteria with ratings and the rationale for the rating
- A report, that summarizes all MAID findings
    - part of this Thesis document, available separately for our corporate partner

C.11. M & A Artefact Inventory

In this inventory, we record the actual objects that are to be evaluated. In our case, these are our DSR artefacts. Notably, we omitted the information about a file name and file type since this is not applicable in our case. We chose to include a column for volume of content instead of the standard number of pages or records. The information about the customer SME is not relevant for our case and therefore was not included. The inventory is summarized in the following table:

Artefact Name	Usage	Volume of Content
EABV Assessment Method (AM)	A method that describes what needs to be done to assess EABV. It is used as a prototype proof of concept at current stage.	Main document is this Thesis, although relevant parts of it were extracted and diffused as separate documents. In addition, there are several presentations describing the method.
EABV Framework (FW)		

EABV Model (M)	The EABV model is used in the form of a conceptual UML class model to convey the basic idea of EABV assessments. The same is true for the conceptual data model, although this is further developed to a logical data model, which then is implemented as physical database.	Several modelling tool documents and a physical database implementation. In addition, we provide a data dictionary document defining all entities, attributes, and relationships.
EABV Assessment Process (MP)	The EABV AP is used to measure performance, analyse performance data, communicate EABV, and evolve the EABV AM and its artefacts based on the findings by either triggering a full research cycle, or just as part of the operational activities ("on the fly"). The EABV AP makes use of the EABV M.	The EABV AP is described in a document with several figures. In addition, we provide a BPMN 2.0 process model.
EA Balanced Scorecard (BSC)	The EA BSC is used to organize various goals and metrics in four different perspectives. A cause-effect relationship between goals is facilitated with a strategy map.	The EA BSC is described in a document and instantiated as a prototype tool.

Table C-4: M & A artefact inventory

C.12. Approved Tailoring Decisions

This product lists various changes to the standard method. We chose to tailor on the stage level as this gives us the most flexibility without generating too much overhead.

Method Stage	Change
Collaborative Planning	• Changes in terminology in order to be in line with the organizational practices • Due to project size, multiple roles per stakeholder • Client/Customer organization is the same as the M & A artefact developer organization
Artefact Evaluation	• Data collection manually and mostly with expert interviews • Perform Quality Audit of Results combined with Conduct M & A Artefact Evaluation activity • Manage Logistics executed in a simple way not following the suggested pattern, thereby omitting most of the non-research relevant products such as action item lists • Self-administered questionnaire omitted due to the close working relationship of evaluation stakeholders • In practice, artefact evaluation and on-site evaluation were conducted on-site which led to a merge or quick activity passing effect • Evaluation criteria selection: We just chose criteria of the first order and pooled sub-criteria as we saw fit
On-site Evaluation	• No specific orientation meeting record was planned

	• In practice, artefact evaluation and on-site evaluation were conducted on-site which led to a merge or quick activity passing effect
Report Results	

Table C-5: Approved tailoring decisions

C.13. Approved Cost and Schedule Estimates for MAID Effort

The approved cost was calculated as part of the funding of this project. The schedule estimates were mostly focused on a two month period for an on-site visit at our corporate partner. Since the details of this product is not of further relevance for this Thesis, we omitted the estimate information.

C.14. Approved MAID Plan

The approved MAID plan comes in the form of a presentation summarizing the contents of all previous products. We ensured that everyone participating in the evaluation is on the same page, cost and schedule is sorted out, and that the anticipated results are in line with the goals for this project.

C.15. M & A Artefacts Received From Customer Organization

Since the customer organization is the EA organization, this product is the collection of available artefact information described in the M & A inventory. In other words, all artefact information is readily available at any given time.

C.16. Quality-audited MAID criteria form – Phase 2 results

This product automatically includes the *MAID criteria form – Phase 2 results* since we conduct the quality audit right during the evaluation. The list of these criteria is available in Appendix D.

C.17. Self-Administered Questionnaire

This questionnaire is planned to be employed for the full evaluation cycle after the EABV AM construction phase to obtain additional stakeholder feedback for our evaluation besides the expert interviews and the artefact evaluation. At the time of this writing and current stage of development, we deemed it not necessary to employ such a questionnaire for evaluation purposes.

D. MAID Evaluation: Results

In this part of the Appendix, we list all Quality-audited MAID artefact criteria ratings. Notably, almost no interview questions were needed as the on-site evaluation interview part was combined with the quality audit.

Item	Description
Criterion number	1.1
Criterion	Organizational policies exist that mandate the establishment of an organization-wide measurement program.
Rating	Slightly inadequate
Evidence of Rating	Firstly, a policy is for a measurement program is not entirely implemented yet. Nevertheless, the funding and support for our project paves the way to creating this policy and to embed it into current operations.
Rationale	The initiative to build the EABV AM is the step into the direction for an ongoing organization-wide program. After the prototyping phase, we need to implement and integrate it into current operations backed up by a mandatory policy. Once this commitment is given and the financial support ensured, we can achieve a rating of adequate. For very adequate, we need to evolve and mature our approach over several periods in order to implement this policy in a superior way. Although our assessment is focused on project level, such a policy is necessary in order be applied to every project in the EA organization.
Interview questions	1 When is a full policy planned to be implemented? 2 What will be the scope of this measurement program?
DSR Artefact	EABV AM
DSR Criterion	Fit with organization
Notes	

Table D-1: MAID Criterion 1.1: Rating

Item	Description
Criterion number	1.2
Criterion	Organizational goals are defined and documented.
Rating	Adequate
Evidence of Rating	Strategic planning defines high level goals for the organization which are then documented. Such goals often lead to programs or projects that implement this strategy.
Rationale	Strategy is an important part and also driver for executing projects. For our purposes, we need goals as input for our EABV AP since we deliver a goal-driven approach.
Interview questions	
DSR Artefact	EABV AP
DSR Criterion	Completeness
Notes	

Table D-2: MAID criterion 1.2: Rating

Item	Description
Criterion number	1.4

Criterion	Organizational goals are expressed in measureable terms so progress toward achieving a goal can be assessed.
Rating	Adequate
Evidence of Rating	Organizational goals are mostly expressed in measureable terms. Going further to project goals, our goal template forces these measureable terms.
Rationale	Since our assessment approach's core functioning relies on a goal-metric alignment, we need to have every goal expressed in measureable terms. In case organizational goals or project goals are not expressed in such a way, we provide means to do so in order to be able to store them in our assessment information base.
Interview questions	
DSR Artefact	EABV M
DSR Criterion	Completeness
Notes	

Table D-3: MAID criterion 1.4: Rating

Item	**Description**
Criterion number	1.5
Criterion	Organizational business goals are kept current.
Rating	Adequate
Evidence of Rating	Organizational business goals are kept current on a quarterly basis.
Rationale	This criteria is important to us to not lose the overall link to strategy and the organization even though we are focusing on project level. It is crucial to keep organizational and project goals consistent. The implementation could be very adequate if the goal communication and documentation is slightly improved.
Interview questions	
DSR Artefact	EABV M
DSR Criterion	Consistency
Notes	

Table D-4: MAID criterion 1.5: Rating

Item	**Description**
Criterion number	1.6
Criterion	A measurement/assessment plan is documented.
Rating	Very adequate
Evidence of Rating	Our EABV AP mandates the documentation of an assessment plan which is also linked within our assessment information base.
Rationale	In our opinion, this criteria is necessary to achieve the best possible execution of the assessment since it contains all relevant information on how to conduct the assessment. Since our assessment plan is very detailed, we consider it as very adequate for our purposes. To underline this, we also evolved our assessment plan from the one recommended in the ISO standard measurement process to better reflect our efforts.
Interview questions	
DSR Artefact	EABV AP

DSR Criterion	Completeness
Notes	

Table D-5: MAID criterion 1.6: Rating

Item	Description
Criterion number	1.8
Criterion	The measurement plan specifies resources to be allocated.
Rating	Very adequate
Evidence of Rating	Related to criterion 1.6, we capture resource allocation for our assessment in the measurement plan.
Rationale	Our EABV AM is based on the theoretical background of dynamic capabilities and hence we are interested specifically which resources or assets respectively are integrated, configured, released, or gained. We specify those assets in the measurement plan since they are also relevant for our EA BSC asset perspective. Hence, we gave the rating very adequate.
Interview questions	
DSR Artefact	EABV AP
DSR Criterion	Fit with organization
Notes	

Table D-6: MAID criterion 1.8: Rating

Item	Description
Criterion number	1.24
Criterion	M & A terminology is defined.
Rating	Very adequate
Evidence of Rating	The EABV M defines all M & A related terminology.
Rationale	Based on the conceptual and logical data models, all relevant M & A terms are defined and documented. In addition, these are in line with existing terminologies where applicable. Consequently, we give this criterion a rating of very adequate. This is crucial to promote a common understanding.
Interview questions	
DSR Artefact	EABV M
DSR Criterion	Completeness
Notes	

Table D-7: MAID criterion 1.24: Rating

Item	Description
Criterion number	1.25
Criterion	Common M & A standards and terminology is used within the organization.
Rating	Very inadequate
Evidence of Rating	The EABV M defines all M & A related terminology. The EABV AM delivers common standards for M & A.
Rationale	The adoption of M & A terminology and standards is crucial for EA assessment commitment and understanding. Since this is a prototype project, adoption is still not throughout the organization but rather just used within a small part of the organization. Once applied to more projects, we expect increased adoption and therefore common standards and terminology used.

Interview questions	
DSR Artefact	EABV AM
DSR Criterion	Fit with organization
Notes	

Table D-8: MAID criterion 1.25: Rating

Item	Description
Criterion number	1.28
Criterion	Data collection and storage procedures are documented.
Rating	Slightly inadequate
Evidence of Rating	The EABV AP documents these procedures.
Rationale	For the Proof of Concept instantiation, we relied on non-integrated tool support and therefore the documentation does not include technical details of corporate software and related interfaces.
Interview questions	
DSR Artefact	EABV AP
DSR Criterion	Completeness
Notes	

Table D-9: MAID criterion 1.28: Rating

Item	Description
Criterion number	1.36
Criterion	A project estimation process is developed.
Rating	Adequate
Evidence of Rating	The assessed project in conjunction with the EABV AM includes an estimation process.
Rationale	An estimation process is in our case characterized by appraising the expenditures in terms of time and money based on the planning information. This planning and estimation is part of the project life cycle. With more assessment cycles and evolvements, we can refine the estimation based on past experiments. We think it is necessary to know whether we perceive a project important enough to justify the additional assessment overhead.
Interview questions	
DSR Artefact	EABV AM
DSR Criterion	Feasibility
Notes	

Table D-10: MAID criterion 1.36: Rating

Item	Description
Criterion number	1.40
Criterion	The plan specifies that actuals (i.e. effort, cost, schedule, and quality) be compared with estimates and the outcomes documented.
Rating	Adequate
Evidence of Rating	The assessment plan specifies this as a requirement at task analyse data.
Rationale	Depending on the project or process assessed, estimates differ in level of detail. Nevertheless, we integrated the EABV AP in a way that allows the assessment plan to capture this information. For a superior implementation, we need to further integrate and develop this required procedure.

Interview questions	
DSR Artefact	EABV AP
DSR Criterion	Completeness
Notes	

Table D-11: MAID criterion 1.40: Rating

Item	Description
Criterion number	1.42
Criterion	The plan specifies that peer review activities are conducted to identify, characterize, and record defects throughout the project life cycle.
Rating	Adequate
Evidence of Rating	The assessment plan as part of the EABV AP specifies review activities at each data point, whether data is collected or provided.
Rationale	The reason for this criteria is to enhance the overall accuracy of data flows. We think that it is not necessary to keep peer reviewing too often but just where it matters and that is when data is actually transferred or when we have a data flow respectively. To get a very adequate rating, the whole EABV AP implementation must receive a higher integration into current application landscape.
Interview questions	
DSR Artefact	EABV AP
DSR Criterion	Accuracy
Notes	

Table D-12: MAID criterion 1.42: Rating

Item	Description
Criterion number	2.1
Criterion	For each metric that is collected, a data collection process/procedure is included containing specific information.
Rating	Adequate
Evidence of Rating	The metric template defined in the EABV M specifies a computation and implementation field is required which stores this information.
Rationale	The combination of computation and implementation specifies all necessary information how data is collected for each metric. This information is in line with the EABV AP as it is relevant at which step the collection is done. For achieving very adequate, this information has to be more detailed, and ideally be selectable from a catalogue of processes and procedures.
Interview questions	
DSR Artefact	EABV M
DSR Criterion	Completeness
Notes	

Table D-13: MAID criterion 2.1: Rating

Item	Description
Criterion number	2.3
Criterion	The data form is consistent with the associated data-collection procedure.
Rating	Adequate

Evidence of Rating	The EABV M facilitates the consistency between data form and data-collection procedure.
Rationale	Since we have not normalized procedure information, we cannot fully assure consistency in this matter. For a higher rating, we would need to specify the data collection procedures including parameters on a data format level. This was out of scope for this prototype project but gets more relevant once a list of procedures is stored.
Interview questions	
DSR Artefact	EABV M
DSR Criterion	Consistency
Notes	

Table D-14: MAID criterion 2.3: Rating

Item	Description
Criterion number	3.7
Criterion	When developing measurement instruments, the analyst assesses the reliability of the measures and indicators.
Rating	Adequate
Evidence of Rating	During the EABV AP planning it is ensured that all measurement instruments are reliable.
Rationale	As part of the EABV AP planning the assessment phase, stakeholders responsible for conducting the assessment are also responsible to investigate measurement instruments, such as metrics and methods as reliable.
Interview questions	
DSR Artefact	EABV AP
DSR Criterion	Reliability
Notes	

Table D-15: MAID criterion 3.7: Rating

Item	Description
Criterion number	4.2
Criterion	For each information need identified, a report defines the following: responsible stakeholder, target audience, metrics, frequency, mechanism.
Rating	Adequate
Evidence of Rating	The reports contain this information as part of information product generation during the EABV MP.
Rationale	Reports are not entirely normalized but this additional information is required in the reports. Reporting needs to advance in a way that current tools will support reporting with all required details.
Interview questions	
DSR Artefact	EABV AP
DSR Criterion	Completeness
Notes	

Table D-16: MAID criterion 4.2: Rating

Item	Description
Criterion number	4.3

Criterion	A validation procedure (feedback loop) is defined to ensure that information needs are satisfied by the suite of M & A indicators.
Rating	Very adequate
Evidence of Rating	The EABV AP is designed to ensure a feedback loop.
Rationale	This feedback loop procedure is inherently part of the EABV AP as is the ISO standard measurement process it is based on. Information needs are satisfied by information products and these are evaluated and reported accordingly.
Interview questions	
DSR Artefact	EABV AP
DSR Criterion	Utility
Notes	

Table D-17: MAID criterion 4.3: Rating

Item	Description
Criterion number	4.4
Criterion	M & A information that is communicated to support decision making also contain explanations.
Rating	Slightly inadequate
Evidence of Rating	Communicated information is required to contain explanations as part of the EA BSC.
Rationale	Communicated information is available in the EA BSC and contains explanations. These could be more detailed.
Interview questions	
DSR Artefact	EA BSC
DSR Criterion	Usability
Notes	

Table D-18: MAID criterion 4.4: Rating

Item	Description
Criterion number	4.5
Criterion	M & A information that is communicated to support decision making is accompanied by recommendations.
Rating	Adequate
Evidence of Rating	The EABV FW stores recommendations for each assessment.
Rationale	Recommendations can be detailed further and also better aligned with other frameworks, such as the IT-CMF. A higher rating could involve a normalization of a recommendation.
Interview questions	
DSR Artefact	EABV FW
DSR Criterion	Completeness
Notes	

Table D-19: MAID criterion 4.5: Rating

Item	Description
Criterion number	4.9
Criterion	Text answering “What? When? Who? Where?” should be included in the M & A report.
Rating	Adequate

Evidence of Rating	The information product (EABV report) contains this level of detail.
Rationale	Since reports or their template is not yet normalized or integrated into the current reporting infrastructure, we cannot achieve the highest rating. Nevertheless, to provide this information is required for reporting purposes.
Interview questions	
DSR Artefact	EABV AP
DSR Criterion	Completeness
Notes	

Table D-20: MAID criterion 4.9: Rating

Item	Description
Criterion number	5.2
Criterion	M & A process and procedure descriptions are appropriate to user's needs.
Rating	Adequate
Evidence of Rating	The descriptions for processes and procedures are described differently for managers and practitioners in terms of level of detail in the EABV AP.
Rationale	In our opinion, this criteria gains more relevance once we have completed a certain level of integration and therefore the descriptions vary depending on employed tools. For the time being, the higher level of detail for descriptions is more relevant for EA practitioners since they are actually using the framework. The descriptions are part of the EABV FW.
Interview questions	
DSR Artefact	EABV FW
DSR Criterion	Understandability
Notes	

Table D-21: MAID criterion 5.2: Rating

Item	Description
Criterion number	5.3
Criterion	M & A process/procedure descriptions contain easily accessible information.
Rating	Adequate
Evidence of Rating	These descriptions are to be found in the EABV FW repository.
Rationale	Since these descriptions are made persistent within the data model, the repository is able to link to relevant descriptions. Further plans are to make this information available online, e.g. through a web portal.
Interview questions	
DSR Artefact	EABV FW
DSR Criterion	Understandability
Notes	

Table D-22: MAID criterion 5.3: Rating

E. EA Principles for EABV Assessment Approaches

In this Section of the Appendix, we list all of the EA principles we created for guiding and ruling EABV assessment approaches. We hereby followed the structure outlined in Section 3.1.4.

Attribute	Description
Name	***#1 An EABV assessment approach shall ultimately generate value.***
Type	All
Category	Business
Statement	An EABV assessment approach must generate value through adequately delivering information to improve the EA practice and therefore organizational and firm performance.
Rationale	The reason to employ such an approach is to generate value by improving current practices and eliminating present inefficiencies.
Implications	EABV reports about achieved benefits must be diffused to relevant stakeholders in an adequate manner as designated by the EABV assessment approach in order to facilitate EABV generation.
Quality Attributes	Business value generation

Table E-1: Principle #1: An EABV assessment approach shall ultimately generate value

Attribute	Description
Name	***#2 Constructing, operating, and improving an EABV assessment approach shall be feasible.***
Type	All
Category	Business
Statement	Constructing, operating, and improving of an EABV assessment method must be feasible in terms of financial and personnel investment.
Rationale	As with any other performance measurement approach employed, we want to ensure that the overhead in terms of time and monetary is minimized to achieve the best possible effectiveness.
Implications	A feasibility requirement encompasses that investment decisions for integrating, reconfiguring, gaining, and releasing IT assets need to be approved and within the current budgetary boundaries.
Quality Attributes	Feasibility

Table E-2: Principle #2: Feasibility of adopting an EABV assessment method

Attribute	Description
Name	***#3 Common definitions and understanding of an EABV assessment approach shall be facilitated.***
Type	Construction, description

Category	All
Statement	The design and description of an EABV assessment approach must be understood by stakeholders involved in the design, implementation, evaluation, and the eventual operation by also providing common definitions.
Rationale	A common understanding removes the risk of failure due to improper adoption of a method. Stakeholders need to be on the same level of understanding for it additionally enables a more effective adoption and usage of the method. Common definitions are crucial in this regard.
Implications	A common understanding will most likely require staff training and skill development to ensure proper employment of the method.
Quality Attributes	Understandability

Table E-3: Principle #3: Common understanding of the EABV assessment method

Attribute	**Description**
Name	***#4 The EABV assessment approach shall be flexible.***
Type	Construction
Category	All
Statement	The EABV assessment approach shall be flexible to accommodate organizational changes.
Rationale	In order to cope with the dynamics of modern day business and changing requirements, an EABV assessment approach must be able to be adapted simply and quickly.
Implications	The design must be modular and loosely coupled. This should also alleviate integration of new components.
Quality Attributes	Flexibility

Table E-4: Principle #4 The EABV assessment approach shall be flexible

Attribute	**Description**
Name	***#5 The EABV assessment approach shall be goal-driven.***
Type	Construction, process
Category	All
Statement	The EABV assessment method shall be goal-driven. Goals serve as input to determine if a strategy was successful with appropriate metrics.
Rationale	Without goals, it is hardly possible to determine success and benefits.
Implications	Goals and according metrics must be reused or defined in order to employ a goal-driven approach.
Quality Attributes	Goal-driven

Table E-5: Principle #5 The EABV assessment approach shall be goal-driven

Attribute	**Description**
Name	***#6 The EABV assessment approach shall generate quality output.***

Type	Construction, description
Category	All
Statement	The EABV assessment method must generate quality output for each target stakeholder group based on gathered and 232nalysed data. Thereby, information products and reports respectively must adhere to current data reporting guidelines and practices.
Rationale	The structure and format of reported information is a key component for a good quality reporting standard.
Implications	A predefined set of reporting guidelines and templates must be maintained for each stakeholder group.
Quality Attributes	Data quality

Table E-6: Principle #6 The EABV assessment method shall generate quality output

Attribute	**Description**
Name	***#7 Output of the EABV assessment approach shall be made persistent.***
Type	All
Category	All
Statement	The output of the EABV assessment approach shall be made persistent. This encompasses a data modelling approach and an appropriate database technology and management.
Rationale	Without storing assessments and other relevant information such as goals and metrics, benchmarking, integration, tool support, etc. is hardly possible in an adequate way.
Implications	A data modelling approach and a dedicated database to store relevant information has to be employed.
Quality Attributes	Persistency

Table E-7: Principle #7 Output of the EABV assessment approach shall be made persistent

Attribute	**Description**
Name	***#8 Output of the EABV assessment approach shall be communicated to all relevant stakeholders.***
Type	Construction, description
Category	All
Statement	The output of the EABV assessment approach shall be communicated to all relevant stakeholders. This procedure shall facilitate a feedback loop in order to gain more transparency of information for decision making.
Rationale	It is important that EABV assessment information is communicated to all relevant stakeholders, especially to assist in decision making regarding future strategies and goals.

Implications	The reporting to target groups is an activity that must be implemented in the assessment process. This principle is closely aligned to Principle #6 that states that reports must also possess a certain quality.
Quality Attributes	

Table E-8: Principle #8: Output of the EABV assessment approach shall be communicated to all relevant stakeholders

Attribute	Description
Name	***#9 An EABV assessment approach shall integrate with current practices.***
Type	All
Category	All
Statement	An EABV assessment approach shall integrate with current practices. This means that employed frameworks and methodologies need to be considered.
Rationale	Without regarding the practices of the current EA function, it is hardly possible to determine whether benefits of EA can be achieved and leveraged.
Implications	Data points or points for integration respectively need to be properly defined when employing an EABV assessment method. This requires a profound knowledge of current frameworks, services and processes, as well as methodologies within the EA function and sometimes beyond.
Quality Attributes	Integration

Table E-9: Principle #9: An EABV assessment approach shall integrate with current practices

Attribute	Description
Name	***#10 An EABV assessment approach shall integrate with current technologies.***
Type	All
Category	All
Statement	An EABV assessment approach shall integrate with current technologies. This means that employed applications, tools, and technology infrastructure need to be considered.
Rationale	Without regarding the technologies of the current EA function, it is hardly possible to determine whether benefits of EA can be achieved and leveraged.
Implications	Data points or points for integration respectively need to be properly defined when employing an EABV assessment method. This requires a profound knowledge of current technologies.
Quality Attributes	Integration

Table E-10: Principle #10: An EABV assessment approach shall integrate with current technologies

F. Survey for EA Stakeholders

Herein, we outline two different questionnaires: One for EA practitioners and EA managers, and one for EA customers. Both include a Section with general questions that identify the role and experience of the respondents and a Section about their perception of EA benefits. In the latter Section, we can find some variations of the items. The Likert scale is represented as follows: Strongly agree, agree, don't agree or disagree, disagree, strongly disagree.

F.18. Questionnaire for EA Practitioners and EA Managers

Items	Answers
1.1. What is your job title?	Selection of jobs, e.g. Enterprise Architect
1.2. What are your primary roles in your job?	Selection of roles, e.g. Project Manager, Solution Architect, Capability Manager
1.3. Which level are you in your job?	Selection of levels, e.g. Junior, Senior, Principal
1.4. To which organizational unit to you belong?	Selection of organizational units
1.5. How often do you interact with your customers?	Daily, weekly, monthly, few times a year, never

Table F-1: General questions for EA practitioners and EA managers

Items	Answering Options
1.6. I benefit from EA.	Likert-scale 1-5
1.7. If yes, in which areas do you benefit from EA?	Free Text
1.8. EA facilitates …	
1.8.1. Cost reduction	Likert-scale 1-5
1.8.2. Improved ROI[5]	Likert-scale 1-5
1.8.3. Common understanding	Likert-scale 1-5
1.8.4. Improved communication	Likert-scale 1-5
1.8.5. Improved BITA[6]	Likert-scale 1-5
1.8.6. Improved processes	Likert-scale 1-5
1.8.7. Faster Time-to-Market	Likert-scale 1-5
1.8.8. Competitive advantage	Likert-scale 1-5
1.8.9. Improved Decision Support	Likert-scale 1-5
1.8.10. Improved Reusability	Likert-scale 1-5
1.8.11. Reduced complexity	Likert-scale 1-5
1.8.12. Improved Sustainability	Likert-scale 1-5
1.8.13. Reduced risks	Likert-scale 1-5
1.8.14. Improved Standardization	Likert-scale 1-5
1.8.15. Improved Agility	Likert-scale 1-5
1.8.16. Improved Interoperability	Likert-scale 1-5

[5] Return on Investment
[6] BITA: Business IT Alignment

1.9. EA is essential in defining the overall IT strategy.	Likert-scale 1-5
1.10. The EA strategy is well defined.	Likert-scale 1-5
1.11. EA translates business goals into IT goals.	Likert-scale 1-5
1.12. EA increases organizational performance.	Likert-scale 1-5
1.13. EA customers appreciate my contribution to their work.	Likert-scale 1-5
1.14. EA alleviates the design of products, services and processes.	Likert-scale 1-5
1.15. I am aware of the EA Principles.	Likert-scale 1-5
1.16. EA principles guide my behavior.	Likert-scale 1-5
1.17. The self-governance process is clearly defined and easily executed.	Likert-scale 1-5
1.18. Which EA artifacts deliver the most value to the company?	Freely assign 100 points to the EA artifacts
1.19. With which three EA artifacts do you work the most?	List three EA artifacts
1.20. What would you suggest to improve EA?	Free Text

Table F-2: Perception of EA benefits for EA practitioners and EA managers

F.19. Questionnaire for EA Customers

Items	Answers
1.21. What is your job title?	Selection of jobs, e.g. Software engineer
1.22. What are your primary roles in your job?	Selection of roles, e.g. Project Manager
1.23. Which level are you in your job?	Selection of levels, e.g. Junior, Senior; Principal
1.24. To which organizational unit to you belong?	Selection of organizational units
1.25. How often do you interact with members from the EA organization?	Daily, weekly, monthly, few times a year, never

Table F-3: General questions for EA customers

Items	Answering Options
1.26. I benefit from EA.	Likert-scale 1-5
1.27. If yes, in which areas do you benefit from EA?	Free Text
1.28. EA facilitates …	
1.28.1. Cost reduction	Likert-scale 1-5
1.28.2. Improved ROI	Likert-scale 1-5
1.28.3. Common understanding	Likert-scale 1-5
1.28.4. Improved communication	Likert-scale 1-5
1.28.5. Improved BITA	Likert-scale 1-5
1.28.6. Improved processes	Likert-scale 1-5
1.28.7. Faster Time-to-Market	Likert-scale 1-5
1.28.8. Competitive advantage	Likert-scale 1-5
1.28.9. Improved Decision Support	Likert-scale 1-5
1.28.10. Improved Reusability	Likert-scale 1-5
1.28.11. Reduced complexity	Likert-scale 1-5
1.28.12. Improved Sustainability	Likert-scale 1-5
1.28.13. Reduced risks	Likert-scale 1-5

1.28.14. Improved Standardization	Likert-scale 1-5
1.28.15. Improved Agility	Likert-scale 1-5
1.28.16. Improved Interoperability	Likert-scale 1-5
1.29. EA is essential in defining the overall IT strategy.	Likert-scale 1-5
1.30. EA enhances the overall business capability of my organization.	Likert-scale 1-5
1.31. I benefit from the collaboration with Enterprise Architects.	Likert-scale 1-5
1.32. EA improves the execution of processes in my organization.	Likert-scale 1-5
1.33. EA principles guide my behavior.	Likert-scale 1-5
1.34. With which three EA artifacts do you work the most?	List three EA artifacts
1.35. What would you suggest to improve EA?	Free Text

Table F-4: Perception of EA benefits for EA customers