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Analysis of the current State of Enterprise Architecture Evaluation Methods and Practices

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Abstract: Today, more and more organizations adopt enterprise architecture (EA) processes to cope with the changing environment and to improve their performance and competitiveness. However, the evaluation of EA regarding its quality and benefits is rather difficult. The studies of previous research resulted in the recognition that there is no methodology for enabling the EA evaluation by considering the whole EA. Therefore, this paper presents and analyses the current state of methods and practices to evaluate EA from different viewpoints. The introduced approaches focus especially on performing an assessment mainly based on architectural descriptions. All methods, standards, and measures address EA related concerns and evaluation needs regarding business, information, systems, and technology. All of the presented techniques have been developed or tested and validated in a practical environment.

Keywords: Enterprise Architecture evaluation, evaluation methods, analysis

1. Introduction

Enterprise Architecture (EA) is an approach for supporting the management and development of an organization through a set of architectural models, usually including the viewpoints of business, information, information systems and technology. These views should transfer knowledge about the organization towards involved stakeholder roles. Furthermore, they give a guideline for the necessary architectural descriptions of the current architecture and also a future one.

The enterprise architecture is focusing on the realisation of the organization's goals and vision though fulfilling so called *needs*. A need captures those stakeholder's concerns that will drive key decisions by the architect, such as decisions pertaining to performance, technology or cost drivers (Hilliard, Kurland et al. 1997). The architecture must be assessed regarding the fulfilment of these needs which are also called *evaluation needs*.

The evaluation results are a useful basis for the system's improvement concerning the achievement of the organization's goals and vision. Furthermore, the evaluation supports the definition of the target EA.

This paper aims at presenting the current possibilities to evaluate EA and focusing especially on performing an assessment mainly based on the descriptions of architectural decisions and solutions. The essential research questions investigated in this paper are:

- What kind of methods for EA evaluation exists?
- What are the strengths of these methods?
- What evaluation needs are addressed by these methods?

The research for this study was conducted in four steps:

1. Review of Literature to identify the current state of EA evaluation methods and practices
2. Identification of evaluation needs based on the study of (Niina Hämäläinen 2007)
3. Investigation and analysis of modelling standards and quality evaluation methods from business process, data modelling and software architecture research areas
4. Selection of techniques which could be applied on the identified evaluation needs

The studies of previous research resulted in the recognition that currently used evaluation approaches mainly assess the EA management and development processes but there is no methodology for enabling the EA evaluation by considering the architectural decisions and solutions.
Therefore, methods, standards and measures for the assessment of certain architectural concerns of enterprise architecture are presented. The presented techniques address the concerns of business, information, systems and technology separately. All of the introduced techniques have been developed or tested and validated in a practical environment.

The paper is structured as follows. The second section describes the currently wide-spread EA evaluation approaches *enterprise maturity models* and *IT-Business-alignment*. In the third section, methods which can be applied to evaluate the architectural decisions and solutions are presented and their strengths and application areas are introduced. Finally, the fourth section concludes the paper.

3. Current State of EA Evaluation

In this section, the current state of EA evaluation and especially methods which can be applied to carry out an EA evaluation are discussed.

Existing EA assessment techniques basically focus on the improvement of enterprise architecture management and the management process which means that new EA development targets are identified and development priorities are set. Therefore, enterprise maturity models and IT-Business-alignment evaluation are utilized.

One of the first capability maturity models, Capability Maturity Model for Software (CMM), was developed by the Software Engineering Institute, Carnegie Mellon. It enables the assessment and the control of IT-related processes as well as the assessment of organization's development competence. According to (Paulk 1993), architecture maturity involves an organization's ability to organization-wide manage the development, implementation and maintenance of architectures on various levels – e.g. business, information, applications and infrastructure.

Most of the assessment models have been developed by consulting firms such as Gartner (Gartner 2002) and METAGroup (META Group Inc. 2000), and federal agencies or organizations, such as the US Office of Management and Budget (OMB) (OMB 2004), the US department of commerce (DoC) (DoC 2003), and the National Association of State Chief Information Officers (NASCIO) (NASCIO 2003). These models generally work the same way as the early CMM. Basically, they use a number of criteria to assess architecture maturity. Typical criteria are, for example, process, governance, communication, technology, and business alignment. For each criterion five maturity levels exist and they are provided with a description of aspects. The maturity models differ in the amount of criteria which are investigated. However, no matter which model is applied, they all support the identification of insufficiencies and areas of improvement in the enterprise architecture development process.

Another approach to assess the EA management and development processes is IT-Business alignment. There is a general agreement what alignment entails: the fit between business strategy, IT strategy, organizational structures and processes, and IT structures and processes (Luftman 2000). The aim of alignment is for IT activities to support those of the entire business (Chan 2002).

One well-known model is Luftman's strategic alignment assessment model which presents an approach for determining a company's business-IT alignment based on six criteria: communications, competency/value measurements, governance, partnership, skills, as well as scope and architecture (Luftman 2000). This last criterion is used to evaluate IT maturity. According to (Luftman 2000), each of these six variables is assigned five levels of alignment. The model provides a short description of the aspects of each level.

3 The Evaluation of Architectural Decisions in EA Context

The evaluation of the architecture is rather challenging because there seems to be no coherent view on enterprise architecture. Many different concepts, modelling techniques, tools, and visualisation techniques are utilized (Jonkers 2003). Sometimes the architectural decisions are not even documented at all. Moreover, predicting the fulfilment of goals through certain architectural decision in a changing and highly-dynamic environment is difficult. The literature review in the area of architecture evaluation methods resulted in the recognition that obviously there seems to be a lack of evaluation methodologies. While there are many approaches for the assessment of software architecture (Clements, Kazman et al. 2001), (A. V. Corry 2005), (H. Grahn 2003) (Bosch 2005), (Bosch and Molin 1999)) there is nothing equivalent for the EA domain. According to (Hilliard, Kurland et al. 1997), an architecture evaluation methodology must include the following tasks:

- Analysis of Needs, Goals and Vision
- Gather relevant documents and other artefacts related to the architecture
- Evaluate documentation against measures and score results
- Interpret results and identify architecture-related risks

- Documentation of results.

So far there is no method which fulfils these tasks for the entire EA. That is why we decided to follow the structure given by most of the enterprise architecture frameworks (Zachman 1987), (The Open Group 2006), (CIO Council 1999), (Defense 2003) and analysed techniques that could be applied to evaluate the different views of EA: business architecture, information architecture, systems architecture, technology architecture. All presented assessment techniques are either based on standards or are developed or validated in a practical environment.

Many of the introduced techniques rely on conceptual modelling to improve the architectural knowledge among different stakeholders from different domains such as managers, business analysts, and developers. These conceptual modelling standards enhance the architectural understanding, knowledge sharing and the analysis of the structure and behaviour of the organization, are also considered as evaluation approaches. Furthermore, review methods, simulation approaches, and measures for assessing quality attributes are presented. In the following, the suggested approaches are briefly introduced.

3.1 Business Architecture Evaluation

According to TOGAF (The Open Group 2006), the Business Architecture embodies the descriptions of business goals and objectives, business functions, business processes, business roles, and business data model. They all have to be documented in an appropriate manner which enables the analysis and evaluation. Since the business architecture transfers this essential knowledge about the organization to all kinds of stakeholders like business users, business analysts, and technical developers it is strongly relying on conceptual modelling to be understandable for people from different domains. In the following approaches for the Business Architecture evaluation are presented. These approaches are also described regarding their strengths and the evaluation needs which they address in Table 1.

3.1.1 Business Motivation Modelling

Vision, goals, objectives are the motivation behind an organization's strategies which result into actions to transform the enterprise's as-is status into the desired to-be status. Since this motivation is the foundation for the organizational structures, processes and behaviour it should be documented within the models describing EA. Usually, enterprises only capture the means to achieve goals in models (E. Yu 2006). That makes the traceability, analysis and evaluation of goals rather difficult.

Modelling the corporate governance would bring several benefits to the organization:

- Vision, goals, objectives are made explicit
- Transparency of transformation drivers (E. Yu 2006)
- Tracing of decisions and responsibilities
- Conflicts, points of improvement, and level of fulfilment become clearer though visualization
- Basis for planning and changing strategies and processes (linking *why*-knowledge to *how* (E. Yu 2006))

One of the few notations that can be used for modelling the business governance is the Business Motivation Model (BMM). It is a meta-model of concepts for modelling the business governance. It has been standardized by the Object Management Group (OMG) in August 2006.

3.1.2 Business Process Modelling and Simulation

A quite common means to gain a competitive advantage, regarding costs or innovation, is the optimization of an organization's business processes. The optimization embodies the assessment of necessary infrastructure and applications, and comparison of expected benefits (D. I. Vidovic 2003). Business process modelling and simulation are the approaches to achieve the optimization of processes (Ali Bahrami 1998).
Business process modelling is the visualization of processes regarding relationships, dependencies, and effects between processes and their activities and resources. This visualization increases the understanding about the processes and supports the validation and improvement for many stakeholders (Ali Bahrami 1998). Business process modelling aims at clarifying the organization's

processes to its employees. Usually, even the documentation of processes discloses redundancies and points of improvement. According to (D. I. Vidovic 2003), 80% of process advancements are achieved by modelling the current status. There is several business process modelling approaches available. Three wide-spread approaches are:

1. Event-Driven Process Chain (EPC)
2. Business Process Modeling Notation (BPMN)
3. Unified Modeling Language (UML)

While modelling is the visualization of business processes, simulation brings them alive. On the one hand, it is possible to evaluate the current processes (*as-is* state) regarding costs, performance and to analyse the simulation data referring optimization. On the other hand, dynamic simulation is a way to analyze *what-if* scenarios, obtain cost and performance predictions, and validate processes (Ali Bahrami 1998). The predictions, gained from the simulation, support the decision making regarding organizational change and future investments. Naturally, simulation requires high effort on architectural documentation which is rather cost and time consuming.

3.2 Information Architecture Evaluation

The Information Architecture is a high-level model of information which an organization needs in order to make decision referring the future and required changes and also to perform its operative processes (Halttunen 2002). The organization's data is organized in a *corporate data model* (D. L. Goodhue 1992) which is a conceptual and structured data model.

The quality of the Information Architecture depends on the conceptual data models' quality. However, there is a lack of quantitative methods to assess the quality of data models. Several frameworks for evaluating a data model's quality have been suggested in (O. Lindland 1994), (D. L. Moody 1994), (Kesh 1995), (R. Schuette 1998). However, most of these frameworks suggest criteria that may be used to evaluate the quality of data models but an evaluation that is based only on criteria is quite difficult because criteria may be interpreted differently (D.L. Moody 1998). While studying the previous research, only the *Moody's Framework* for the evaluation of the quality of data models (Entity-Relationship diagrams) was found.

The Moody's Framework was developed in practice and has been applied on a wide range of organizations (D.L. Moody 1998). The evaluation framework defines necessary quality factors which are illustrated in Figure 1. Furthermore, the assigned stakeholder roles are shown for each of the quality factors. To assess these quality factors the framework embodies a number of evaluation methods, which in some cases are measures (e.g. data model complexity) and in other cases are processes for carrying out the evaluation (e.g. user reviews). The strength and addressed evaluation needs of the Moody's Framework are presented in Table 1.

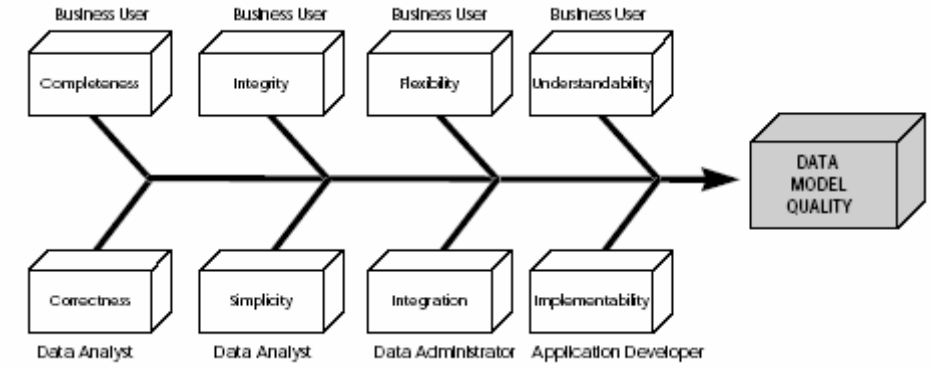

Figure 1: Data Model Quality Factors (D.L. Moody 1998)

3.3 Evaluation of utilized ICT

The ICT infrastructure includes the used systems and technology which are described through the system/application architecture and the technology architecture. The systems/application Architecture defines the software systems which is necessary to process the data and support the business. The software system is described by the *software architecture*. The software architecture basically must describe the software system's components. That means their structure as well as their behaviour and

interaction with each other because the whole software system's behaviour results from its components' behaviour and interaction (Bass, Clements et al. 2003).

Since the technology which allows the deployment of software applications is also part of the software system, it can be evaluated within the software architecture evaluation. The methods concerning the software system evaluation enable predictions regarding the whole system life cycle. Especially, characteristics, such as performance, cost, reliability and maintenance are essential characteristics in the enterprise architecture context. Methods for evaluating the software architecture are:

- Questionnaires and checklists
- Scenario-based methods
- Architectural metrics
- Mathematical modelling
- Simulation and prototyping

These methods are only applied if within the EA software systems are used which have to be developed inside the organization. A selection of scenario-based methods for the evaluation of software architecture and the benchmarking approach are presented concerning their strengths and addressed evaluation needs in Table 1. The presented scenario-based methods have been chosen because they seem to be the most effective in the early evaluation of the software architecture.

Components used within ICT infrastructure are quite often commercial-of-the-shelf (COTS) components and their quality characteristics are described by the supplier. However, it is necessary to integrate different components with each other and different implementations have different behaviour concerning runtime characteristics. Therefore the infrastructure can be evaluated by using benchmarking.

Benchmarking primary evaluates performance, scalability and reliability of the used infrastructure. The evaluation results gained from benchmarking can be compared to the expected costs which are connected to different COTS components. That cost/benefit consideration supports decision making regarding the questions which COTS components suit best the organization’s software systems. Benchmarking is also described in Table 1.

3.4 Financial methods for assessing the business value of IT investments

The financial measures costs and benefits of ICT related investment decisions should be evaluated to make and justify those decisions.
Organizations use several measures to assess business value, such as return on invest (ROI), net present value (NPV), internal rate of return (IRR), payback period, and economic value added (EVA). According to (Symons 2006), these measures have five main disadvantages regarding their utilization to measure the business value of IT.

- There are too many measures available and within a single organization different groups use different measures; furthermore, some measures have multiple interpretations which lead to inconsistency.
- These measures generate a value which leads to a wrong credibility because the value is actually based on assumptions and the value itself is only a prediction for the estimated benefit.
- These measures do not take intangible benefits, such as customer satisfaction, into account. Since it is difficult to measure intangible benefits they are completely ignored.
- The financial measures only estimate the direct benefit of an investment but they are not able to calculate further future benefits or opportunities.
- Perhaps the biggest flaw in most financial measurements is the underestimation of risks or even the failure to incorporate any risk at all.

Since, measuring the value of IT-enabled business change will be critical to almost every organization as technology becomes embedded in virtually every business process (Symons 2006), more efficient measurement tools are needed. Four methodologies which have been developed to overcome the problems of the standard financial measures are:

1. Business Value Index (BVI)

2. Total Economic Impact (TEI)
3. Val IT
4. Applied Information Economics (AIE)

The techniques are described regarding their strengths and addressed evaluation needs in Table 1.

Table 1: Overview of EA Evaluation Methods

Method Name	Technique	Strengths	Addressed Evaluation Needs
Business Architecture			
Governance Modelling	conceptual modelling and review	- vision, goals, objectives are made explicit - transparency of transformation drivers - tracing of decisions and responsibilities - basis for analysis and evaluation (conflicts, improvement, level of fulfilment) - basis for planning and changing strategies and processes	- observation that ICT-architecture do not correspond to company's business's requirements - enhances the understanding of company's business/ICT - enhances the understanding of responsibilities in the company - make sure that organisational choices are suitable - An effort towards long-term technical solutions and need to argue for the long-term technical solutions
Business Process Modelling	conceptual modelling and review	- visualization of processes regarding relationships, dependencies, and effects between processes and their activities and resources - visualization increases the understanding about the processes and supports the validation and improvement for many stakeholders - 80% of process advancements are achieved by modelling the current status	- change need in the business or ICT (e.g. a need to move from one solution to another) - observation that ICT-architecture do not correspond to company's business's requirements - enhances the understanding of company's business/ICT - enhances the understanding of responsibilities in the company - make sure that organisational choices are suitable - distribution of work - Business process planning - need to find the best possible system solution and a need to understand the aspects relating the solution - An effort towards long-term technical solutions and need to argue for the long-term technical solutions
Business Process Simulation	simulation	- the current processes (*as-is* state) regarding costs, performance - analyze *what-if* scenarios, obtain cost and performance predictions, and validate processes - support the decision making regarding organizational change and future investments	- change need in the business or ICT (e.g. a need to move from one solution to another) - observation that ICT-architecture do not correspond to company's business's requirements - make sure that organisational choices are suitable - Business process planning - need to find the best possible system solution and a need to understand the aspects relating the solution - An effort towards long-term

Method Name	Technique	Strengths	Addressed Evaluation Needs
			technical solutions and need to argue for the long-term technical solutions
Information Architecture			
Moody's Framework	reviews and metrics	- evaluates data model's quality - provides quantitative measures - coverage of many data model quality aspects	- information / data models of good quality - understanding information managed in company
Software Systems Architecture			
SAAM	scenario-based review aims on scenario validation	- knowledge transfer about architectural decisions - identification of areas of high potential complexity	- understanding the state of the company's application portfolio - understand the current state of technical infrastructure - need to find the best possible system solution and a need to understand the aspects relating the solution
ATAM	- scenario-based review - regarding system's quality attributes - including scenario validation, trade-off and risk identification	- identifies risks and points of trade-off - enables evaluation of structural and behavioural system characteristics - improves architectural knowledge sharing	- change need in the business or ICT (e.g. a need to move from one solution to another) - need to enhance the understanding of company's business/ICT - understanding the state of the company's application portfolio - understanding quality aspects relating to the company's application portfolio - understanding the current state of technical infrastructure - need to find the best possible system solution and a need to understand the aspects relating the solution - An effort towards long-term technical solutions and need to argue for the long-term technical solutions
CBAM	scenario-based review with focus on cost and benefits	- measurement of design decisions with cost and benefit metric - makes uncertainty explicit associated with the estimates	- change need in the business or ICT (e.g. a need to move from one solution to another) - understanding quality aspects relating to the company's application portfolio - effort to drive investments to follow up architectural principles - An effort towards long-term technical solutions and need to argue for the long-term technical solutions
Technology/Infrastructure Architecture			
Benchmarking	Measures performance, reliability, and cost	- enables the collection of metrics regarding the system's performance, reliability	- understanding the current state of technical infrastructure

Method Name	Technique	Strengths	Addressed Evaluation Needs
		and cost - supports decision making	
Financial methods for assessing the business value of IT investments			
Business Value Index (BVI)	priority-based assessment of future investments	- supports the prioritization of investment options - tangible and intangible value can be measured	- change need in the business or ICT (e.g. a need to move from one solution to another) - effort to drive investments to follow up architectural principles - change need in the business or ICT (e.g. a need to move from one solution to another) - understanding quality aspects relating to the company's application portfolio
Total Economic Impact (TEI)	Risk-adjusted Return on Invest calculation	- measures cost, benefits, flexibility, and risk impact on business - risk-adjusted ROI	
ValIT	Value governance, Portfolio management, and investment management	- Value governance - Portfolio management - Investment management	
Applied Information Economics (AIE)	IT investment assessment through mathematical and scientific methods	- mathematical models - Developing financially-based quality assurance measures - Developing a strategic plan for information systems	

4. In conclusion

The evaluation of the EA is rather challenging because predicting the fulfilment of goals through certain architectural decision in a changing and highly-dynamic environment is difficult. Most of the evaluation needs in (Niina Hämäläinen 2007) are related to the enhancement of knowledge and understanding of the business and ICT concerns and to the recognition of necessary changes in the current EA.

The result of the conducted literature review was that there seems to be a lack of methodologies evaluating EA. Currently; the most wide-spread approaches are maturity models and IT-Business-Alignment assessment methods. However, they address primarily the enterprise architecture management and development process and not the evaluation of architectural decisions and solutions concerning the achievement of the organization's goals. Since there is no method for the evaluation of the entire EA we analyzed techniques from the areas of business processes, data modelling, software architecture evaluation, and benchmark testing. Furthermore, also methods to measure cost and benefits of ICT investment have been investigated. These measures are always a relevant basis for managerial decision making.

Most of the introduced evaluation techniques are based on reviews of the architectural descriptions. Therefore, EA evaluation depends strongly on conceptual models as input and the basis for analysis and discussion because they support sharing and communicating the architectural knowledge among different stakeholders from different domains. Furthermore, also more quantitative techniques like simulation and measuring can be applied but they require more detailed architectural descriptions.

One of the major advantages of all of the presented techniques is that they have been developed or tested and validated in a practical environment. All methods are summarized with their strengths and the evaluation needs which they address in Table 1. However, it is difficult to predict the extent of satisfaction for certain needs because the needs definitions in (Niina Hämäläinen 2007) are rather general. Only the application of the methods to the specific EA can answer the question how well the

suggested methods satisfy the evaluation needs of a specific organization. Furthermore, a combination of methods might be necessary to improve the fulfilment of certain needs.

Still, the complexity of enterprise architecture and the related variety of concerns complicates reaching an established overall evaluation approach. The problem of developing methodologies enabling the enterprise architecture evaluation in a coherent, efficient, and practical way should be overcome in future research and work.
So far it is only possible to apply different techniques on only single architectural views of EA. Integrating these introduced techniques into the EA evaluation process of a company might be difficult. These techniques are independent of each other and they refer to different standards, description models, and tools which are not compatible to those already used within in the organization.

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A Framework to Support Business-IT Alignment in Enterprise Architecture Decision Making

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Abstract

Business-IT alignment is one of the key concerns of general management and chief information officers. It is commonly recognized as an important instrument for realizing organizational effectiveness. Achieving business-IT alignment requires often change in the way managers regard IT and it demands co-operation between general and IT management. The challenge of aligning business- and IT-related concerns and requirements in architecture decision making situations is the focus of this study. As one possible solution, we present a framework of architecture decisions. This framework defines decision making aspects and business and architecture plans. Decisions are suggested to be compared against these plans at each aspect. In addition, long-term and short-term decisions at each decision making aspect are defined. This framework is meant to support creation of shared domain knowledge (especially long-term alignment) through the use of enterprise architecture plans in decision making situations. Furthermore, it can be used to support the alignment of business and IT through decision making and to assist in the evaluation of decisions. The framework was evaluated in a focus group interview by practitioners.

Keywords

Enterprise architecture, Decision making, Business-IT alignment, Framework

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Introduction

Features of the current business environment are quarterly economy, organizational changes (e.g. mergers, acquisitions, structural changes, outsourcing), pressures for aligning the business and information technology (IT), cost-effectiveness**,** changes and improvements in technologies and practices (e.g. service-oriented architecture). The rapidly changing environment all organisations must operate creates a situation where an architecture approach such as an enterprise architecture (EA) is seen as an imperative to success (Ashmore et al., 2004). Architecture helps in achieving essential business objectives. Furthermore, a good architecture shows the relation of the architectural decisions to the business objectives of the enterprise (Lankhorst et al. 2005). EA is a hierarchical approach to aligning business and ICT (Langenberg & Wegmann, 2004). Business-IT alignment is commonly recognized as an important instrument for realizing organizational effectiveness (Lankhorst et al. 2005).

The need to make good decisions is a perpetual issue for all organizations. Management decision makers are especially concerned at profitability, growth, and increasing the market share. They participate in the strategy process and in defining the values of the company. Taking the management viewpoint affects the decisions and choices that the managers make. On the other hand, IT governance and development personnel are concerned about quality (e.g. security, performance), agility, cost-effectiveness and avoiding or reducing complexity in IT environments. Currently, company and business managers make also decisions relating IT governance and development. This means that the value of IT decisions or decision proposals must be demonstrated from the business perspective. However, especially far-sighted, long-term architectural decisions maybe difficult to justify in the quarterly minded business environment. This has led into decisions that are good from the management point of view but at the same time they, for example, might increase the complexity and costs of IT environment in the long-term. Because of that, fragmentation and silo-based solutions in IT environment may be increased. It is not explicit how to align business- and IT-related concerns and aims in decision making situations. Our paper studies this question from the viewpoint of architecture decision making.

This paper considers the problem of aligning business- and IT-related concerns and requirements in architecture decision making. As one possible solution, we present a framework of architecture decisions. This framework defines decision making aspects. Decisions are suggested to be compared against business and architecture plans at each aspect. In addition, long-term and short-term decisions at each decision making aspect are defined. This framework is meant to support creation of shared domain knowledge (especially long-term alignment) through the use of enterprise architecture plans in decision making situations. Furthermore, it can be used to support the alignment of business and IT through decision making and to assist in the evaluation of decisions. The framework was evaluated in a focus group interview by practitioners.

This article is organized as follows. In the second chapter, concepts related to business-IT alignment, enterprise architecture and decision making are described. The third chapter explains the research method. The fourth chapter presents the framework for architecture decisions and reports the empirical evaluation of the framework. The last chapter summarises and discusses the results.

Previous Research

There are several areas of research that are related to our work. We do a short overview of the key literature in the areas of business-IT alignment, enterprise architecture and decision making. We also describe the use of architecture plans in decision making situations.

Business-IT alignment

Business-IT alignment has consistently been reported as one of the key concerns of general management and chief information officers (see for example Reich & Benbasat, 2000). There is also some evidence that Business-IT alignment has beneficial effects (Henderson & Venkatraman, 1993, Reich & Benbasat, 1996, Chan et al., 1997, Avison et al., 2004, Gregor et al., 2007) and it is commonly recognized as an important instrument for realizing organizational effectiveness (Lankhorst et al. 2005). Although, business-IT alignment is a desired and beneficial state it is not always achieved, since it often entails a radical change in the way general managers regard IT (Henderson & Venkatraman, 1993). Alignment requires an intense communication process whereby organizations strategic goals and IT goals are shared with organizational members (Reich & Benbasat, 2000). This requires co-operation between the business and the IT department and it is uppermost important to consider the business and IT objectives together (Avison et al., 2004).

Alignment allows organizations to apply information systems and information technology to the business delivery tasks and operational activities (Gregor, Hart & Martin, 2007). Reich and Benbasat (1996) define alignment as: *“the degree to which the IT mission, objectives, and plans support and are supported by the business mission, objectives, and plans”.* Aligning the relationships between the business and IT infrastructure makes it possible to take advantage of IT opportunities and capabilities. Alignment can be beneficial at least in three ways: maximises return on IT investment, helps to achieve competitive advantage through IS, and provides direction and flexibility in reaction to new opportunities (Avison et al., 2004).

We use the alignment model of Reich and Benbasat (1996, 2000) as a basis for our study. They distinguish intellectual and social dimension of alignment. We focus on the latter. According to Reich and Benbasat (1996) social dimension of business-IT alignment is: *”The state in which business and IT executives within an organizational unit understand and are committed to the business and IT mission, objectives, and plans”*. They identify two aspects of social alignment: short-term and long-term. Short-term alignment refers to shared understanding of short-term goals and long-term alignment is having a shared understanding of IT vision. Reich and Benbasat (2000) state that the shared domain knowledge between business and IT management influences long-term alignment. They define shared domain knowledge as*: ”The ability of IT and business executives, at a deep level, to understand and be able to participate in the others’ key processes and to respect each other’s unique contribution and challenges”* We suggest that using enterprise architecture plans in decision making situations is one method that can support the development of shared domain knowledge within an organization.

Organization’s enterprise architecture can enable the alignment of business strategy and information technology (Gregor, Hart & Martin, 2007). For example, EA can help alignment by drawing viewpoints of general and IT management together under a common

organizational framework. This integrates the two managerial viewpoints and makes them more visible. EA can also be used to define and describe the current and future state of the organization’s business and IT. (Gregor et al., 2007) Next we examine the concept enterprise architecture in a more detailed manner.

Enterprise architecture

Enterprise architecture capabilities are typically developed to be used as an instrument in managing an organization’s daily operations and future development (Lankhorst et al., 2005). Enterprise architecting is seen as “*a planning, governance, and innovation function that enables an organization to progress toward its vision of its future state*” (Leganza, 2007). Usually enterprise architecture deliverables are closely aligned to the strategic enterprise plan of the organization (Subramanian et al., 2006). Enterprise architecture is an adopted means for coping with companies’ ever-increasing complexity and for ensuring that companies appropriately use and optimize their technical resources (Shah & Kourdi, 2007).

Definition for EA is presented by Lankhorst et al. (2005, 3): “*enterprise architecture 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.”* An enterprise architecture explains how all the information technology elements in an organization – systems, processes, organizations’, and people – work together as a whole (Morganwalp & Sage, 2004). EA commonly has four viewpoints: business architecture, information architecture, application architecture and technology architecture. These viewpoints are promoted in many widely used frameworks such as E2AF (2005) FEA (2002), and TOGAF (2003). Implementation of an enterprise architecture offers, for example, a way forward in integrating independent ICT silos across inter-organizational units.

Enterprise architecture management is a continuous and iterative process identifying company’s business strategy needs and controlling and improving the existing and planned IT support for an organization (Ernst et al., 2006). The enterprise architecture work not only thus considers the information technology (IT) of the enterprise, but also business processes, business goals, strategies, etc. are considered in order to build a holistic and integrated view on the enterprise (Ernst et al., 2006). Thus EA management is the discipline of managing the whole enterprise architecture and the artifacts building the enterprise architecture.

Organisations’ drivers for and expectations of benefits of an enterprise architecture vary. Both business- and IT-related benefits are expected to be achieved. In addition, the expected benefits are different depending on viewpoint. For example, the benefits expected by general management and IT governance management (e.g. CIO) vary. IFEAD (2005) has investigated why enterprise architecture is important for companies. Expected benefits of EA approach are that EA delivers insight and overview of business and IT, it is helpful in mergers and acquisitions. EA supports out-/insourcing and systems development as well as manages IT portfolio and delivers roadmaps for change. In addition, EA is expected to assist in decision making, managing complexity, and in business, as well as, IT budget prioritization. More precisely, business-related benefits are, among others (Shah & Kourdi, 2007):

- reduction in impact of staff turnover: capture knowledge from employees and consultants and provide business solutions from third party organizations consistently so they can conform to the current models,

- faster adaptability: facilitate knowledge acquisition necessary for changing systems and adopting new components,
- operating procedures improvement: understand and model business processes, review and reengineer processes,
- decision making: represent enterprise layers and components modularly to let the organization make business decisions in the context of a whole instead of a stand-alone part.

IT-related benefits are among others (Shah & Kourdi, 2007):

- complexity management: facilitate the scoping and coordination of programs and information systems projects, manage complexity and describe the interdependencies in a usable manner,
- technical resource oversight: identify and remove redundancy,
- knowledge management: manage and share knowledge modularly so it can be visualized across different levels
- IT visibility: IT resources and systems are more aligned to business strategies and are better placed for responsiveness.

Decision making

A large amount of literature and studies exist on decision making practices and processes (e.g. Drucker et al, 2001, Welch, 2001, Gray, 2006, Bhushan & Rai, 2004, Cook et al., 2007, Qudrat-Ullah et al., 2007, and Shapira, 2002). In addition, there are some scientific journals in the field of decision making such as ‘Journal of behavioral decision making’, ‘Judgement and decision making’ and ‘Information Sciences for Decision Making’.

Commonly, decision making seems to be understood as a cognitive process leading to the selection of a course of action among variations. Every decision making process produces a final choice, which can be action or an opinion. Decision making consists of a group of phases. A general model of basic phases of decision making is presented in the next figure.

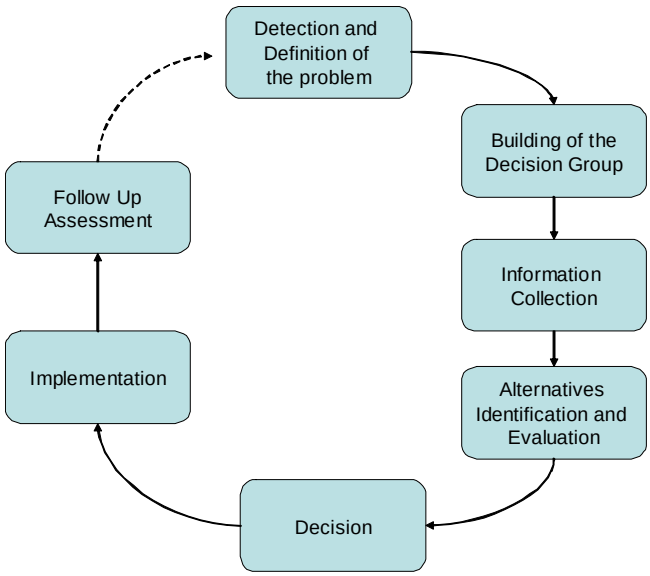

Figure 1. A general decision process model (Power, 2002).

Decision making processes and practices in companies relate among others to the strategic management, portfolio management (e.g. IT project portfolio and application portfolio management), and project management.

Decision making challenges relate especially to information based on which decisions are made and process of decision making. The essential challenges are (Ullman, 2006):

- The information may be uncertain.
- There exist different interpretations of the information that exist and different things are important.
- There exist no a good decision making strategy and it is not clear what to do next reach a decision.
- In addition, the risks associated with each alternative are not understood.
- In addition, it must manage alternative and criteria evolution and it musts get buy-in on any decision it is made.

Decision making is especially a reasoning process which can be rational or irrational, can be based on explicit assumptions or tacit assumptions. Architecture descriptions and plans and information included in them can be used in reasoning. The focus of this study is the use of architecture plans in the following decision making phases: detection and definition of the problem, information collection and alternatives identification and evaluation (see Figure 1).

Architectures plans and decision making in organisations

Literature and guidelines have been published relating architecture decisions (e.g. Clements, 1995, Jansen & Bosch, 2005) and decision making (e.g. Asundi et al. 2001, Cullen & Hoppermann, 2006, Johnson et al., 2004, Linstone, 1999, Meszaros, 1995, Pulkkinen, 2006, and Jansen & Bosch, 2005). Some studies have also tackled how to relate architecture planning to companies’ other decision making processes (Ekstedt, 2004 and Johnson et al., 2004).

Plans can be used to support decision making. Decisions can be made about these and/or these can be source information for the decision making. Decision making can be about the selection of a plan. Executing a plan usually requires many actions, but may not require any new decisions (Krantz & Kunreuther, 2007). Sometimes, a plan leaves open a choice of subplans at some critical juncture, and in that case, there is an additional decision that has to be made (Krantz & Kunreuther, 2007).

Architecture descriptions and plans that are produced and used to support the decision making are e.g. baseline architecture descriptions, target architecture plans, architectural roadmaps, transition plans, architecture vision and system architecture plans. The baseline architecture encompasses the different layers and existing enterprise components (Shah & Kourdi, 2007). This description servers as a starting point for identifying relationships between different components as well as gaps that should be filled to improve organizational performance (Shah & Kourdi, 2007). The target architecture plan specifies the new enterprise architecture components and strategic initiatives that should perform to bridge the existing gaps and ensure the competitive advantage (Shah & Kourdi, 2007). Architectural roadmaps represents the baseline architecture’s intermediary alternatives while mitigating the risks and analyzing existing gaps during the shift to the target architecture (Shah & Kourdi, 2007). Roadmaps

highlight the architectural milestones performed prior to reaching the target architecture (Shah & Kourdi, 2007). Transition plans document the activities undertaken during the shift from the baseline to the target architecture (Shah & Kourdi, 2007). These are specifications of the baseline (as-is) and target (to-be) architecture views in terms of managing the architectural transition's feasibility. Such plans could include risk assessment, gap analysis, and resources supporting transition. Architecture principles are goals, constraints and guidelines for any information system developed in an organization (Subramanian et al., 2006). Architecture vision describes the ideal or the desired state of the organization. Information system/software architecture plans describe structures of an information system.

Next we apply the literature in construction of a framework to support business-IT alignment in enterprise architecture decision making. Avison et al. (2004) have done a somewhat similar study. They applied their strategic alignment model to an EA framework. In comparison to our study, their framework is aimed at investigating and interrelating different strategies of general and information management. Our framework concentrates more on the decision making situations where enterprise architecture plans are used.

Research Method

Aim of this research was to develop a framework 1) to support creation of shared domain knowledge (especially long-term alignment) through the use of enterprise architecture plans in decision making situations, 2) to help the alignment of business and IT related concerns and requirements in decision making, and 3) to support the evaluation of decisions suitability for the plans and requirements of business and IT.

In the development of the framework, the following research phases were carried out:

1) Gathering information about decision making, business-IT alignment and enterprise architecture planning.
2) Construction of the framework based on the literature.
3) Evaluation of the framework in a focus group interview.
4) Development of the framework based on results of the focus group interview.

The companies and interviewees are described in the table 1.

Companies	*Number of personnel (year 2005)*	*Number of interviewees*	*Viewpoints of interviewees*
Banking, finance and insurance company	11 974	2	enterprise architecture
Telecommunication company	4989	1	enterprise architecture
Business & IT consulting and development organization	a part of a large international company with 329 373 employees in total	2	enterprise architecture, software architecture

Table 1. Interviewees in the focus group interview.

Interviewees in the focus group were practitioners from three different companies. They were managers and specialists of the management of enterprise and software architectures in their organizations. The participants were interviewed as one group in order for group members to influence each other by responding to ideas and comments of others (Krueger & Casey, 2000). The use of group interview did have an impact, bringing out new aspects. However, it is possible that the interviewees did not discuss some aspects due to confidentiality reasons. The interview was tape-recorded and notes were written during the interview session. Based on the data, the framework was improved. This framework is presented in the next chapter.

A Framework for Architecture Decisions

In this chapter, we present a framework of architecture decisions. This framework consists of decision making aspects and plans/information. Decisions are suggested to be compared and evaluated against business- and IT-related information and plans. These are introduced in Table 2. The chosen decision making aspects are identified to be relevant from enterprise architecture planning point of view.

Decision Making Aspects	**Plans / information against to which decisions to be made on this aspect are suggested to be compared**
EA Planning: • Target architecture and transition plan development • Architecture visioning • Road mapping • Development of architecture principles	- Company strategy - Business environment changes - Business trends and forecasts - …
Portfolio planning: • Project portfolio • Application portfolio	- Business plans, drivers and needs - Long-term enterprise architecture plans: target architecture plans, road maps, transition plans, architecture vision - …
Project / solution design	- Business requirements for the project - Architecture principles and guidelines defined for any information system developed in the organization (e.g. Goals, constraints, and guidelines) - (Long-term architecture plans) - …

Table 2. Decision making aspects relevant from architecture planning point of view.

Table 3 presents the framework developed for architecture decisions. In addition this framework describes the difference between long- and short- term architecture decisions.

Traditionally, long- and short-term architecture decisions have been frequently used concepts by practitioners in architecture planning (especially by IT governance and system developers).

Decision Making Aspects	**Short-term architecture decision**	**Long-term architecture decision**
EA planning	Suitable for near-term strategy, near-term business environment change and near-term business trends and forecasts	Suitable for long-term strategy, business environment change and business trends and forecasts
Portfolio planning	Suitable for current business plans, drivers and needs BUT Does not support long-term enterprise architecture plans	Suitable for current business plans, drivers and needs AND Supports long-term enterprise architecture plans
Project – solution design	Suitable for the defined business requirements for project BUT - Non-compliant with architecture principles and - Does not support and realize the long-term enterprise architecture plans.	Suitable for defined business requirements for project AND - Compliant with architecture principles and - Supports and realize long-term enterprise architecture plans.

Table 3. A framework for architecture decisions.

The framework was evaluated by practitioners from a group of companies in a focus group interview. The framework was developed based on comments. Examples of comments and observations are presented in the following.

The decision making aspects were accepted by practitioners. These aspects were thus seen as a suitable approach from practice point of view. In addition, it was seen that short- and long-term architecture decision may be a good decision. For example, a comment was presented in the focus group interview: "*Sometimes a short-term decision may be needed to be done when there is no time to define and plan a long-term decision*." In addition, in some cases, it may not be clearly known which of decisions are long-term and which short-term. For example, information related to business environment change may be uncertain. Uncertainty of information, against to which decisions are evaluated, affects to the reliability of evaluation results. Therefore, the decision that is expected to be long-term may turn out short-term decision and vice versa. As an interviewee stated: "*Future shows if the decision is long- or*

short-term.” Sometimes it may be needed to make an exception to the accepted architecture plans and principles. These exceptions should be recognized and explained. Several needs for making exceptions, for example to architecture principles, may be a sign of a need to change architecture principles.

Practitioners were also asked to mention examples of short- and long-term decisions. An example of short-term decision is the choice of other technology than it is regarded as a long-term technology choice. Reasons for this may be a lack of resources or skills for the long-term technology and immaturity of long-term technology. Another example is the use of point-to-point solution in integration solutions when longer-term integration technology solution is not wanted or is not able to be introduced yet. In addition, as a short-term decision from the architecture point of view is seen the focusing projects only serving business needs heedless of what kind architecture these projects build. Projects developed thus new services and products without looking after whole architecture they build. Long-term decisions are for example technology infrastructure projects that focus on the building the basis infrastructure according to the enterprise architecture plans and consolidation projects.

Conclusions

This study focuses on how to carry out and improve business-IT alignment using enterprise architecture plans in decision making situations. In addition, this study aims to increase the understanding of short- and long- term decisions as well as the difference between them. Our framework for architecture decisions supports the creation of shared domain knowledge. This comes through the use of enterprise architecture plans in decision making situations. Communication between general and IT management in decision making situations increases the level of understanding about others’ viewpoint and work processes. Enterprise architecture advances the creation of shared domain knowledge by giving general and IT managers a common language and tools for co-operation. Use of the framework for architecture decisions increases particularly long-term alignment between business and IT.

This study contributes both to the practice and research. The results of this study help to understand and align the requirements and objectives of the business and IT in decision making. In addition, this study increases the understanding of long- and short-term architecture decisions as well as the difference between them. From practitioners’ point of view, the developed framework is suggested to be applied in the enterprise architecture decision making and especially to support the communication between general and IT management. This study contributes to the research on enterprise architecture decision making. Especially, results of this study focus on how to carry out and improve business-IT alignment in the enterprise architecture –related decision making. Research on this area is lacking.

There are some limitations in our study. The focus group interview was done from the viewpoint of enterprise and software architects. It would be beneficial to have another focus group where the participants would be business and IT decision makers. This would give more knowledge about decision making from the architecture plans’ users viewpoint. After this the framework should be evaluated and developed further if necessary. There is a need for empirical studies on how organizations use enterprise architecture plans in decision making.

Based on the results, we suggest that both business- and IT-related concerns should be taken better into account in decision making, although, these concerns may be conflicting. Architecture plans are suggested to be used to support communication between general and IT management in decision making situations.

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Article

POTENTIAL CRITICAL SUCCESS FACTORS FOR ENTERPRISE ARCHITECTURE

Tanja Ylimäki

ABSTRACT

During the past few years, enterprise architectures (EAs) have garnered considerable attention from both practitioners and academics in the fields of information systems and business management. It is suggested that EA is an approach for controlling the complexity and constant changes in the business environment of an organization. Research has mainly focused on the development and modeling of EA, while quality aspects of EA have gained less attention. The aim of this study is to provide insight into the critical success factors for EA representing issues that have to be done exceedingly well in order to achieve a high-quality EA, which in turn, enables the business to gain more success.

KEYWORDS

Enterprise Architecture, Critical Success Factors, Quality, Maturity, Evaluation, Assessment

INTRODUCTION

During the past few years, enterprise architectures (EAs) have garnered considerable attention from both the practitioners and the academics in the fields of information systems (IS) and business management. It has been suggested that EA is an approach for controlling the complexity and constant changes in the business environment of an organization, enabling a real alignment between the business vision, business requirements and information systems (Armour et al., 1999a; 1999b; Kaisler et al., 2005). EAs are generally seen as blueprints which identify the focal parts of the organization (such as people, business processes, technology, information, and information systems), as well as the means that identify how these different parts collaborate to achieve the desired business objectives (Hoogervorst 2004; Kaisler et al., 2005). An ideal EA provides a holistic, enterprise-wide and consistent view of the organization instead of looking at it from the point of view of a single application or system (Kaisler et al., 2005; Lankhorst, 2005).

It seems that EA studies have mainly focused on the development and modeling of EA (Zachman, 1987; Armour et al., 1999a; The Open Group, 2002; Lankhorst, 2005; Halttunen et al., 2005; Pulkkinen & Hirvonen, 2005), while the quality and assessment aspects have only recently gained attention, especially in the form of maturity models and assessments (U.S. Department of Commerce, 2003; U.S. Government Accountability Office, 2003; Industry Advisory Council, 2005; National Association of State Chief Information Officers, 2003; Office of Management and Budget, 2003). The maturity models do have their roots in the field of quality management (Fraser et al., 2002; Chrissis et al., 2003), but it seems that they are considered as simpler tools than the "traditional" quality management systems to assess the stage of the organization's EA and to enhance its maturity.

The maturity of the EA refers to the organization's capability to manage the development, implementation and maintenance of architecture that consists of various viewpoints (van der Raadt et al., 2004). Usually, these viewpoints include business, information, systems, and technical architecture (e.g., The Open Group, 2002). Furthermore, the idea of these maturity models is that the maturity evolves over time from one level to the more advanced level – without skipping any level in between – towards an

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idealistic ultimate state (Klimko, 2001). Therefore, we consider these maturity models as one means of advancing the quality of EA by providing at least an initial EA quality management system.

What does high quality mean in the context of EA, then? There seems to be a lack of scientific studies in which the quality of EA has been discussed. In our research project we have suggested that a high-quality EA conforms to the agreed and fully understood business requirements, fits for its purpose (e.g. a more efficient IT decision making), and satisfies the key stakeholder groups' (the top management, IT management, architects, IT developers, and so forth) expectations in a cost-effective way understanding both their current needs and future requirements (based on Lecklin, 2002 and Dale, 2003). In addition, the quality of EA may also refer to the quality of EA specifications or the quality of the EA development or governance processes.

Additionally, the concept of critical success factor (CSF) has been utilized in Total Quality Management (TQM) (Badri et al., 1995, Claver et al., 2003; Lecklin, 2002; Tarí, 2005) to indicate those issues that must be done exceedingly well in order to succeed. Originally, the CSFs were used to determine precisely what information is most needed by the top management representing the "key areas where things must go right in order to successfully achieve objectives and goals" (Bullen and Rockart, 1981; Rockart, 1982). In order to ensure that favorable results have been gained in these key areas, it is important that the current status of performance in each of the areas should be measured on a continual basis (Bullen and Rockart, 1981). While the idea of CSF has later on found its way to many other areas as well (such as project management), it awakened our interest for studying the CSFs in the context of EA: what are the factors that have to be carried out exceedingly well in order to attain a successful EA – a high-quality EA – which in turn enables the business to reach its objectives and gain more value.

In this article, we present a study which aims at determining the potential CSFs for EA – a set of potential key areas from which the organization should choose the most critical factors of its own based on its business objectives, the role of EA in the organization, and so forth. These factors, when carefully addressed, should enable the achievement of a high-quality EA. In the next section, we describe the research process. Following this, the set of potential CSFs for EA are presented. Finally, the last section summarizes the paper.

RESEARCH PROCESS

In order to identify the potential CSFs for EA the following steps were conducted:

1. Literature Review: There seems to be a lack of scientific research on CSFs for EA. Fortunately, CSFs have been studied in some other domains, closely related to EA, such as TQM (Badri et al., 1995; Claver et al., 2003; Tarí, 2005), business-process re-engineering (Al-Mashari and Zairi 1999), business-IT alignment (Luftman et al., 1999), project management (Clarke, 1999), enterprise resource planning systems (Nah et al. 2001) and software architectures (Bredemeyer Consulting, 2000; Hämäläinen et al., 2006). Based on reviewing these domains in addition to numerous EA literature including, for instance, the existing EA maturity models (U.S. Department of Commerce, 2003; U.S. Government Accountability Office, 2003; Industry Advisory Council, 2005; National Association of State Chief Information Officers, 2003; Office of Management and Budget, 2003), the initial list of CSFs for EA was defined. The list of factors was analyzed in order to organize similar factors into groups (see Figure 1).

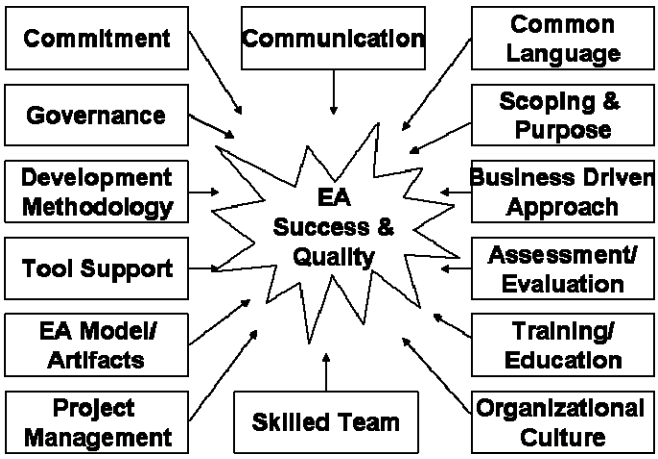

Figure 1. Initial Set of Potential Critical Success Factors for EA.

2. Empirical Research: A focus group interview (Krueger & Casey, 2000) of five architecture practitioners from three IT user and service provider organizations was organized. The objective of the interview was 1) to assess the literature review results, and 2) to collect additional CSFs from the practitioners, based on their personal experience. A group interview was considered as a means to stimulate the discussion by allowing the participants to respond to and comment each others' ideas and

opinions. The downside of this approach would be that the group influence would likely leave confidential information undisclosed. In the interview conducted by two researchers, the results of the literature review were presented, and the interview was structured according to them. In addition to the notes taken, the interview was also tape-recorded and videotaped.

3. Consolidation of the Results: The results from both the empirical study and the literature review were combined and a set of twelve potential CSFs was accomplished (Figure 2). In this step, some factors were also combined. Because 'Communication' is supported by a 'Common Language', these two factors were combined. In a similar basis, also the 'Development Methodology' and 'Tool Support' were combined, as well as 'Skilled Team' and 'Training and Education'. Additionally, even though 'IT Investment and Acquisition Strategies' (U.S. Department of Commerce, 2003; U.S. Government Accountability Office, 2003; State of North Carolina Office of Enterprise Technology Strategies, 2003) can be seen as a part of 'Governance', we positioned it as a separate CSF to highlight the primary objective of EA: the need to develop IT systems that enable and support the organization to achieve its business goals and objectives successfully. Furthermore, the characteristics of each CSF were formulated as questions.

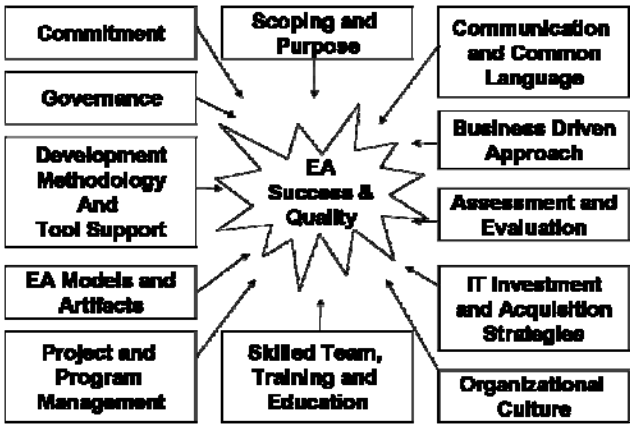

Figure 2. Updated Set of Potential Critical Success Factors for EA

POTENTIAL CRITICAL SUCCESS FACTORS FOR EA

In the following section of this article, the characteristics of the potential CSFs for EA are described in the form of key questions assigned to each factor. With the help of this set organizations can select the limited set of CSFs suitable for their purposes, and to assess the extent the CSFs have been taken into consideration in the EA development. While the focus group interviewees agreed on all the CSFs for EA resulting from the literature review, only the interview results that add some information or characteristics to the CSFs for EA are referred to as (Interview, 2005).

Scoping and Purpose

Scoping and Purpose relate to the extent the organization has addressed the following issues right from the beginning of the EA development:

- Holistic EA (Lankhorst, 2005), specific to the enterprise (Ashmore et al., 2004): What is the definition of EA in the organization? Are all the key EA stakeholder groups defined and documented?
- A clear mission, goals and direction (Belout & Gauvreau, 2004; Pinto & Mantel, 1990; Reel, 1999; Turner & Müller, 2005) and the declaration of will (Interview, 2005): Why the organization wants to apply the EA approach (definition of the business case)? What are the organization's objectives (Somers & Nelson, 2001)? What are its EA objectives? What are the existing problems (Bredemeyer Consulting 2000) or future problems (Interview 2005) it wants to solve through EA? To what extent are the objectives and importance of EA understood and approved by the organization members (also other than IT organization)?
- Value and benefits of EA (Ambler, 2005; Boster et al., 2000; Buchanan & Soley, 2003): What benefits (financial or other) are to be reached via the EA approach? Do different stakeholder groups have contradictory or competing opinions about the possible benefits? To what extent are the benefits of EA understood and approved in the organization?
- A clearly defined EA scope (Clarke, 1999; Lam, 2005): How wide organizationally, how deep and detailed, and how fast an EA should be developed (Industry Advisory Council, 2005)?

Communication and Common Language

Effective communication is essential in sharing knowledge, achieving a common understanding, agreement and a shared view of the EA scope, vision, and objectives, as well as of the developed models and other artifacts. Furthermore, communication is an important means of gaining

commitment to the EA effort. Focal issues to be considered about Communication and Common Language are as follows:

- A common, well-defined vocabulary of terms and concepts (Lankhorst, 2005; Motwani et al., 2005; Ylimäki & Halttunen, 2005): Are the key architectural concepts defined, documented and used? On what sources are they based? Which viewpoints do they cover? Are other concepts, such as the (system) development methodology concepts, or concepts related to the development and investment processes of the enterprise defined, documented and used (Interview, 2005)?
- Communications plan and strategy (META Group Inc. 2000; Coronado & Antony 2002; Rehkopf & Wybolt, 2003; Industry Advisory Council, 2005): Is the communication plan or strategy for architectural communication defined and documented? What issues are defined in it?
- Various communication channels (Rudawitz, 2003): What means and possibilities of communication are used? Has the architectural communication been successful? Have any problems been detected?
- Timing: In which phases or situations does architecture-related communication exist? How is the communication timed? Is the communication regular, frequent and proactive (Al-Mashari & Zairi, 1999, Nah et al., 2001; Porter & Parker, 1993)?

Business Driven Approach

Business linkage is elementary in EA development (Baker and Janiszewski, 2005; Carbone, 2004; U.S. Department of Commerce, 2003; META Group Inc., 2000; The MITRE Corporation, 2004; Ramsay, 2004). Business Driven Approach is about ensuring that EA initiatives are traceable to the business strategy indicating clear alignment between business and IT (Schekkerman, 2004; Van Eck et al., 2004).

Key questions, thus, relate to the definition of the business requirements and ensuring that they are also met:

- How are the business strategy and the business requirements taken into account in architectural planning?
- How are the business requirements for the architecture recognized? Are they documented?
- How and when is the equivalency between the requirements and architecture assured?
- Are also the requirements set by external stakeholders (such as legislation, standards, even business owners and partners) taken into consideration in addition to the business requirements (Interview, 2005)?

Commitment

Without long-term top management commitment (also referred to as leadership, sponsorship or involvement) an EA effort will not succeed (Al-Mashari & Zairi, 1999; Badri et al., 2005; Basu, 2004; Bolton, 2004; Perkins, 2003; Quazi et al., 1998). Quarter-based-economy impedes the long-term thinking that EA requires; it is sometimes difficult to justify the top management that the investment that seems expensive at the moment will save money in the future (Interview, 2005). The key questions related to the Commitment are as follows:

- Top management commitment (U.S. Government Accountability Office, 2003; National Association of State Chief Information Officers, 2003; Industry Advisory Council, 2005; Interview, 2005): To what extent is the top management committed to the EA approach? How is the top management commitment expressed? To what extent is the top management involved in the EA development?
- Organizational buy-in (Bredemeyer Consulting, 2000; Industry Advisory Council, 2005; Office of Management and Budget, 2005; Interview, 2005): To what extent are the other stakeholder groups of the organization (such as the CIO, software developers, maintenance, and project managers) committed to the EA approach? How is their commitment expressed? To what extent are they involved in the EA development?

Development Methodology and Tool Support

A lot of requirements for methods to develop and maintain an EA in the ever changing business environment are suggested. Methods should be structured, well-defined and documented including, for instance, processes, guidelines, best practices, drawing standards and other means to promote the quality of architectures, as well as support for tracking architectural decisions and changes (Lankhorst, 2005). Moreover, the architecture process should be, among other things, business-strategic-driven, practice-oriented, situational, model-based, disciplined, rigorous, repeatable, and widely usable with reasonable costs (Perkins, 2003; Morganwalp & Sage, 2004; van der Raadt et al., 2004), as well as iterative and incremental (Ambler, 2005; Armour et al., 1999a; Ramsay, 2004). The key questions are as follows:

- Established architecture framework (Office of Management and Budget, 2005; National Association of State Chief Information Officers, 2003; Carbone, 2004; Interview, 2005): Is the framework defined and documented? What views or levels it includes? Is it based on some existing frameworks, such as TOGAF (The Open Group, 2002), Federal EA Framework (FEAF) (Chief Information Officers Council, 1999) or the Zachman Framework (Sowa & Zachman, 1992)? Has it been communicated to the key stakeholders? Is it understood, accepted and complied by them?
- Established architecture process or methodology (U.S. Government Accountability Office, 2003; Lankhorst, 2005): Is the development methodology defined, documented and used? What characteristics does the methodology have (see examples mentioned above)? Does the method include guidance for architectural decision making and documentation? Does the method provide support for the reuse of the processes, instructions, models or other artifacts (Kaisler et al., 2005)?
- Architecture principles (Armour et al., 1999a): Have the architecture principles been defined to guide the architecture development? Are they communicated, approved and used?
- Visualization techniques (Lankhorst, 2005): Which modeling languages are used in the EA development? Are they dependent on the tools used?
- Effective tool support (Chief Information Officers Council, 2001; U.S. Government Accountability Office, 2003; Industry Advisory Council, 2005; Perkins, 2003; Kaisler et al., 2005; Lam, 2005; Lankhorst, 2005): To what extent are tools used in the EA development; are they used in modeling, documenting, communicating or managing the architectures? What kinds of tools are used (data stores, modeling tools, documentation tools, communication tools, and so forth)? How well do these tools fit the needs the organization has? Are the tools compatible with each other or with other tools, such as BPR tools and system development tools (Interview, 2005)?

Several existing methods (processes), frameworks and tools for EA are described, for instance, by Ylimäki et al. (2005).

EA Models and Artifacts

The development method guides the creation of EA models and other artifacts. As the models are a valuable help in communicating the architecture to the various stakeholders, it is important that the following issues are addressed:

- Documentation plan (Kartha, 2004): Does a documentation plan exist? Is it communicated to the key stakeholder groups, approved and followed?
- Business and architectural requirements (van der Raadt et al., 2004; Armour et al. 1999b; Erder & Pureur, 2003): Are both the business and architectural requirements defined, documented, communicated and approved? Are the requirements extensive enough?
- Models provide a coherent and concise picture of the enterprise (National Association of State Chief Information Officers, 2003; van der Raadt et al., 2004; Kaisler et al., 2005; Lankhorst, 2005): Are all the necessary levels or views of the architecture (such as business, information, application and technology) modeled? Are these models communicated to relevant stakeholder groups (Interview, 2005)? Is the ownership of the models defined indicating who to contact if more information is needed (Interview, 2005)? Are they up to date? Are they extensive and finished enough? Are they clear, readable, comprehensible and including dependencies (Bredemeyer Consulting, 2000; The MITRE Corporation, 2004; van der Raadt et al., 2004)? Do the models address both the current situation (as-is descriptions) and the future situation (to-be descriptions) (Armour et al., 1999a; Industry Advisory Council, 2005; Office of Management and Budget, 2005)? Do models conform to the architecture principles and standards (Armour et al., 1999b; van der Raadt et al., 2004)?
- Traceability: Does the traceability between the business requirements and EA models exist (Armour et al., 1999b), as well as between the business requirements and architectural decisions (Erder & Pureur, 2003)?
- Transition plan (Armour et al., 1999a; Industry Advisory Council, 2005; Office of Management and Budget, 2005): Is there a transition plan telling how and when to get to the target architecture? Is it communicated and approved?
- Architectural decisions: Are the architectural decisions documented?

Even though the list of requirements for successful models and artifacts seem to be exhausting, in practice they do not need to be 100 % perfect, they just need to be good enough (Ambler, 2005), and

simplification, clarification and minimization are key to long-term architecture success (Dikel et al., 1995).

EA Governance

Governance and management have various definitions in the literature. In general, governance deals with the management and organizational aspects of architecture (van der Raadt et al., 2005), but it can also refer to "how an organization makes decisions, sets priorities, allocates resources, designates accountability, and manages its architectural processes" (Baker & Janiszewski, 2005). Key questions related to EA Governance are as follows:

- Established governance structure (META Group Inc., 2000; Carbone, 2004; Industry Advisory Council, 2005): Is the architecture governance structure defined, documented and complied? Are the roles, responsibilities and authorizations defined, documented and complied?
- Effective governance processes and activities (Rehkopf & Wybolt, 2003; Control Objectives for Information and related Technology, 2000; van der Raadt et al., 2005): Are the processes, activities or tasks (such as definition of the architecture policy, principles or architecture compliance strategy) defined and documented? Does an 'EA Statute Book' exist guiding the EA work (Interview, 2005)? What communication and coordination means are used (e.g. feedback channels, discussion, reports of progress) (The Open Group, 2002; Industry Advisory Council, 2005)?
- Effective change management environment (Bolton, 2004; Kaisler et al., 2005; Office of Management and Budget, 2005): Are the practices for managing both architectural (The Open Group, 2002) and organizational (Dale, 2003; Hermanssen & Caron, 2003) changes defined, documented and complied? Has a consensus been reached on those possible future changes in the business environment (e.g. a future merger) or in the business requirements that need to be taken into account in the ongoing architecture design (Interview, 2005)?
- Effective risk management (Al-Mashari & Zairi, 1999; Belout & Gauvreau, 2004; Pinto & Mantel, 1990): Are the architectural risks defined, documented and complied? Are the risk management practices defined, documented and complied?
- Integration into the organization's business management processes (Ashmore et al., 2004; Control Objectives for Information and Related Technology, 2000): To what extent is the EA governance processes integrated to the organization's business management processes, such as investment process or strategy refinement process?

Project and Program Management

EA development is usually conducted through projects and project management skills play a crucial role in project success (Pinto & Kharbanda, 1996). Other issues regarded important are as follows:

- Program management (Interview, 2005): How is the coordination between various EA development projects organized and conducted? How is it assured that the projects are compliant with the EA? How is the inter-project communication conducted?
- Milestones and check points (Interview, 2005): Are the project milestones defined? How are they utilized? Is any kind of architectural evaluation done on the milestones?
- Lessons learned (Interview, 2005): Are the lessons learned (best practices), related either to the project work and project management, or to the architectural work and architectures, systematically collected by the end of the project?
- Realistic budgets and schedules (Belassi & Tukel, 1996; Coronado & Antony, 2002; Nah et al., 2001; Turner & Müller, 2005): Is the project budgeting successful? Is the project scheduling successful?

Assessment and Evaluation

Assessment and Evaluation of EA is undertaken as a part of the EA governance. What makes the EA evaluation challenging, is the fact that it may take years before the effects and consequences of, for instance, an architectural decision, can be measured (Interview, 2005). Essential issues in evaluation planning and implementation are, especially, as follows:

- Evaluation targets (Lopez, 2000; Taylor-Powell et al., 1996): What is evaluated? In the following some examples are suggested (Curran, 2005; Hilliard et al., 1996; Industry Advisory Council, 2005; Morganwalp & Sage, 2004; National Association of State Chief Information Officers, 2003): EA models and artifacts, EA processes, EA maturity, value of EA, business value added by EA (business-IT alignment), effectiveness of EA, completeness and correctness of EA, EA adoption (utilization or usage of architectures),

people (competency and skills), or work environment (culture, leadership, structure).

- Purpose and audience of evaluation (Taylor-Powell et al., 1996): Why are these objects evaluated? By whom and how are the evaluation results used?
- Evaluation process and criteria (Lopez, 2000; Taylor-Powell et al., 1996): How and when is the evaluation done? Is the evaluation conducted in each step of the development process (Bredemeyer Consulting, 2000)? Is it a continuous process (Claver et al., 2003, Tarí, 2005)? Which evaluation methods are used? Which metrics or criteria are used? Which tools are used – benchmarking, reviews, quality function deployment (Erder & Pureur, 2003), scenarios (Interview, 2005), maturity models or other tools?

IT Investment and Acquisition Strategies

IT Investment and Acquisition Strategies refer to the extent to which the EA influences the IT investment and acquisition strategy of the organization; whether EA guides IT investments or not (U.S. Department of Commerce, 2003; U.S. Government Accountability Office, 2003). Key issues that need to be addressed are as follows:

- Investment process in the organization: What sort of investment process model is used? How are IT investments executed?
- Architecture decisions vs. IT investment decisions (U.S. Government Accountability Office, 2003): What is the relationship between architectural and investment decisions? Is an investment decision unavoidably also an architectural decision? Do architectural plans have an effect on investments? Are investments done on the basis of architectural planning? How and when are architectural plans used in the investment planning and execution?

Skilled Team, Training and Education

EA development requires teamwork between the key stakeholder groups; architects, business domains, top management, and even business partners (Schekkerman 2004). The following issues to be addressed are as follows:

- Architecture team (Chief Information Officers Council, 2001; U.S. Government Accountability Office, 2003): Is the architecture team established? How many persons are working in the team? Are the roles and responsibilities of the team members defined, documented and used? Has a chief architect been named (Akella & Barlow, 2004; Passori & Schafer, 2004)? Is the team working full-time? Does the team have necessary facilities and equipment (Reel, 1999)?
- Sufficient training (Chrissis et al., 2003): To what extent are both the team members and other key stakeholder groups trained in architectural work? Has a training plan been done for these groups? Do the architecture team members have the necessary skills; both business and technical skills (Boster et al., 2000; D'Souza & Mukherjee, 2004)? Is the competence of the team members evaluated? To what extent do the architects train other stakeholders (Interview, 2005)? Is the training considered as a continuous process allowing people to receive appropriate information and training courses at appropriate level of detail for their need (Al-Mashari & Zairi, 1999; Porter & Parker, 1993; Tarí, 2005)?

Training and education are needed at least in the following levels: 1) General EA information, including the strategies of the organization, the common EA framework, the EA vision and objectives, and the target architecture, should be provided to all stakeholders (Interview, 2005), 2) training in new technologies, best-practices, methods, tool usage, and so forth should be provided for architects (Basu, 2004; Coronado & Antony, 2002; Curran, 2005; Interview 2005), 3) IT information should be provided to business managers, and 4) business information should be provided to the IT managers (Morganwalp & Sage 2004).

Organizational Culture

While developing an EA, the organizational culture should also be taken into consideration aiming at good organizational and cultural fit (Lam, 2005; Sumner, 2000) because in many cases cultural changes are inevitable (Coronado & Antony, 2002). Especially, the organization's readiness to develop and utilize the EA is an essential issue (META Group Inc., 2000). It includes aspects like attitudes towards changes both by the management and the employees, communication environment, risk management and so forth (Mann & Kehoe, 1995; Motwani et al. 2005; Rudawitz, 2003). Moreover, the organization culture, particularly the organizational structure, has an impact on the success of an EA; if the EA issues are discussed only within a department or other profit center the perspective is too narrow to accomplish good and sustainable architecture solutions (Interview, 2005). Key questions related to cultural issues are as follows:

- Attitudes towards architecture approach: What is the role of the architecture within the organization; is the EA seen as a mentor and a guide helping business and IT decision making, or merely as an auditing or controlling mechanism (Interview, 2005)? How are the attitudes towards architectures and architects?
- Attitude towards changes (Luftman, 2000; Rudawitz, 2003; van der Raadt et al., 2004; 2005): How is the organization's capability to accept and adapt to changes in general? How are the attitudes towards architecture-driven changes?
- Trusting environment (both socially and politically) and open communication (Rudawitz, 2003; van der Raadt et al., 2004; 2005): Are different opinions or criticism allowed to be expressed within the organization? Are the architects encouraged to challenge each others' views and opinions and to debate the possible architectural solutions with each other (Interview, 2005)? Do the architects have the courage to question things without being branded as troublemakers (Interview, 2005)?
- Organizational constraints: Have any organizational constraints for architectural work been detected? How are they handled and resolved? Particularly, silo thinking and strict profit responsibilities may be barriers to EA success, if each department in an organization acts on a stand-alone basis, not interacting or co-operating with other departments, focusing only to the departmental bottom line (Interview, 2005).

CONCLUSIONS

In this study, we described the potential CSFs for EA derived from the literature review and the focus group interview. When evaluating our study, it should be remembered that the empirical data was collected during a single group interview session participated by five practitioners from three companies and, as such, strong generalizations cannot be made. Additionally, the literature review results presented to the interviewees may have influenced their response. We believe, however, that our study has exposed some important aspects of reaching a high-quality EA.

First, the quality of EA is a concept that does not yet have an established definition. We suggested a preliminary definition for the quality of EA. To put it simply, an EA has high quality if it is understood, accepted and used, and the EA is measured in order to ensure that the quality requirements are met. Furthermore, we consider the maturity models as one means of advancing the quality of EA.

Second, the success and quality of EA are influenced by several – and to some extent interrelated – factors. For instance, communication can be regarded as a focal issue, because it enables carrying out many of the other factors successfully. Especially, commitment seems to be dependent on communication (and the common language): if the communication practices are just about shaping up, it is unlikely that a strong top-management commitment, or organizational buy-in, has yet been reached. It also seems that if the EA objectives are defined and they support the business objectives, it will be easier to gain both the top management commitment and the organizational buy-in. The detailed dependencies between the potential CSFs, however, were not analyzed in this study.

Third, the potential CSFs for EA provide a selection of important issues to be taken into consideration in EA efforts. From this set, as suggested by Bullen and Rockart (1981) a limited set of the most critical factors for a particular organization at a particular point of time can be determined depending on the needs of the organization: in different organizations different factors may be regarded as the most critical ones.

Fourth, the potential CSFs can also be used as a checklist by which practitioners both in the IT user and service provider organizations undertaking, or planning to undertake, EA efforts can ensure that the efforts are comprehensive, well-implemented, and have the minimum chance of failure. Additionally, CSFs can be regarded as possible targets for which EA evaluation criteria, metrics and methods can be developed.

Consequently, this study raises some additional research questions, such as:

- What kind of dependencies there are between the CSFs? How interrelated the factors are? Furthermore, an interesting question is, whether there are any contradictory factors.
- How can an organization prioritize or weigh the CSFs to select the most critical factors of its own? How the phase of the organization's EA development, or the maturity of its EA, affects the prioritization needs and possibilities?
- How can the CSFs for EA be utilized in evaluating the maturity, and thus, the quality of

EA, in the organization? Which simple and usable evaluation criteria and metrics are suitable to measure the extent each CSF has been taken into account? Are there any other possible targets for which the criteria and metrics should be defined? How many criteria and metrics should be used in evaluating the organization's EA? How can an organization choose the most suitable ones for its purposes among these different criteria and metrics? Which metrics suit to a particular EA maturity level?

The next steps of the research project will focus on studying 1) how well the set of 12 CSFs for EA can be utilized in the initial EA assessment – how holistic and extensive view of the state of the organization's EA do they provide?, 2) whether these factors are the essential targets for evaluating an EA?, and 3) which metrics are suitable for each factor? Answering these questions will result in a more detailed EA evaluation model.

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Enterprise Architecture Benefits: Perceptions from Literature and Practice

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Abstract

Enterprise Architecture (EA) is considered a means for acquiring a multitude of benefits in organizations by most academic literature and practitioners alike. However, academic research has almost omitted the domain of EA benefits and value realization, and thus more research on the subject is needed. This paper describes a study which aims to chart the benefits of EA by a comprehensive literature review and a focus group interview of practitioners. As a result, a categorization of the EA benefits is composed and analyzed.

1. Introduction

Enterprise Architecture (EA) includes all the models needed in managing and developing an organization, and takes a holistic view of its business processes, information systems and technological infrastructure [see e.g. 1-3]. It has become one of the major interests of both business and academia. It is claimed to provide a vehicle for aligning and integrating strategy, people, business and technology, and enabling an agile enterprise – continually evolving within the ever-changing environment [see e.g. 4, 5].

However, investments need to be made in organizational, cultural and technical infrastructure to support the EA program [see e.g. 2] and be justified by demonstrating the positive effects of EA to key stakeholders [see e.g. 5]. Still, presenting the benefits of EA is difficult since measuring its effects comprehensively is demanding and the architecture itself is constantly changing [5]. Academic research has almost omitted the subject of EA benefit and value realization, focusing instead mostly on EA frameworks [see e.g. 6-8], and EA development methods and tools [see e.g. 9-11]. Recently, a few contributions have been made in the domain of EA evaluation [see e.g. 5, 12-16]. However, the evaluation and measurement – and even the definition of – the benefits and value of EA seem so far to have escaped the attention of academic research.

Nevertheless, the need for defining the potential benefits of EA is evident – it might even be the prerequisite for the selection of objectives for an EA program, measuring the realized benefits and value of EA, and thus providing a rationale for key stakeholder support and investments in EA [see e.g. 17]. Therefore, this study aims to chart the benefits of EA and EA work (EA planning, development and management) by an extensive literature review and a focus group interview of practitioners.

This paper is organized as follows. In the next section, the research method is described. In Section 3, the literature on EA benefits is discussed. In Section 4, the benefits of EA are categorized and in Section 5, the categorization is analyzed. Section 6 includes a discussion of the study's contribution and agenda for further research. Finally, Section 7 concludes the paper.

2. Research Method

To identify the benefits of EA, the following steps were conducted.

1. *Literature review*. Literature on EA and architectures in general was charted for references of benefits using both academic and general search engines on the Internet, using keywords such as benefit, objective, value and evaluation with terms enterprise architecture and architecture. Moreover, additional literature was found by studying the references sections of the found papers. Literature by both academia and practitioners was included in the review for a more diverse view of benefits. Academic journal articles and conference papers, magazine articles, books, research reports by institutions, industry white papers, published government documents and electronic sources were reviewed, and the found EA benefits listed. Subsequently, closely related benefits were combined for a more compact list of benefits by the discretion of the author. Based on reviewing the literature, a preliminary list of 27 EA benefits was composed.

2. *Focus group interview on the literature review results*. A focus group interview [see e.g. 18] of seven practitioners from five Finnish or international organizations, either information and communication technology (ICT) users or service providers, was organized in August 2006. The organizations were either independent companies, or divisions, subsidiaries or other parts of domestic or global enterprises. Furthermore, they represented different industries and employed from 14 to several thousand people. All of the organizations were conducting EA work and thus employed specialists who could contribute to the study. Each organization provided one or two persons to the interview. In four of the organizations, the interviewees had an EA-level viewpoint of the enterprise, and in one, they were more focused on the system architecture level. The objectives of the interview were 1) to review the literature review results, and 2) to collect additional, experience-based information. The interview was carried out in a group, because group influence was thought to stimulate the discussion. However, confidential information may thus have remained undisclosed. The interview was moderated by one researcher, while the other two took notes. In

addition to the notes taken, the interview was also audio-recorded.

3. *Composing a categorization of the EA benefits*. The results from the literature review and the focus group interview were analyzed and combined into a categorization of the EA benefits.

3. Literature on EA Benefits

Even though the number of academic research papers exclusive on the benefits of EA is very low, a greater number of studies mention several EA benefits or objectives. Generally, the benefits are not the main topic of the papers. On the contrary, they are typically briefly disclosed in the introduction section. Journal articles (7) and industry white papers (8) seem to dominate the area, added with a number of conference papers (5) and government documents (4), such as EA evaluation frameworks and reports. Moreover, a few research reports (3) by various institutions, books (2), magazine articles (2) and electronic sources (1) exist.

While the literature focuses on listing a multitude of benefits, it does not clearly define and describe them. Furthermore, there does not seem to be an established model for classifying the benefits in the EA context, despite some categorizations have been proposed [see e.g. 5, 19, 20]. Moreover, the literature does not generally differentiate between benefits at different levels of abstraction; particularly, between abstract, high-level benefits such as integration or agility of an enterprise [see e.g. 4, 21], and more concrete, lower-level benefits such as shortened cycle times or cost savings [see e.g. 5, 19]. Additionally, it does not commonly distinguish between the benefits, the characteristics of EA, and the areas of EA work from which the benefits could be gained. For example, standardization and integration activities may lead to cost savings [see e.g. 22], and all of these are mentioned as EA benefits [see e.g. 14, 23]. Furthermore, the causes, effects and other relationships between various EA benefits, EA characteristics and EA work activities are not clearly defined in the literature.

In addition to the deficiencies mentioned above, the literature does not normally provide academic research results of any kind to quantify the argued benefits or value of EA, with the exceptions of a few case studies [see e.g. 17, 24] and survey-based studies [see e.g. 19, 25, 26]. Even these provide mainly qualitative information of the gained benefits. While this kind of EA research is arguably carried out in the industry, the majority of the results do not become published.

4. Categorization of the EA Benefits

This section presents a categorization of the EA benefits identified in the literature review and the focus group interview. First, the benefits and their representative sources are listed on Table 1. Second, the benefits are categorized according to a Information Systems (IS) benefit classification model [27]. The seven most cited benefits and the benefit categorization are analyzed in the next section.

The focus group generally agreed with the preliminary list of EA benefits, and considered several of them especially important in their work. These benefits are listed on Table 1 as a reference number 45. Considering the challenges mentioned in the previous section, a sufficient magnitude of benefits was preserved to represent as much of the whole range of identified benefits as possible. However, a number of closely related benefits were combined to maintain clarity.

As can be seen from Table 1, the range of benefits is extensive and without proper categorization, it is difficult to comprehend. For this reason, a IS benefit classification model [27] was selected and applied to the domain of EA. The basis for selecting this model was its clarity, applicability and suitability: it is reasonable to categorize the EA benefits on the basis of their measurability and the potential to attribute them to EA or EA work.

The horizontal axis of the model distinguishes between quantifiable and non-quantifiable benefits, and the vertical axis between benefits that can be accounted to EA or EA work, and those that significantly depend on other organizational or environmental factors as well. In the model, the benefits are categorized into the following categories:

Hard benefits can be objectively quantified (e.g. in monetary terms, time or other numeric values) and attributed to EA or EA work. They could be related to possible cost and cycle time reduction and economies of scale. Moreover, they could include increased standardization attained by utilizing the standards defined in EA, increased reuse of architectural models, descriptions and documentation, and increased interoperability between systems constructed according to EA. Hence, they can potentially be attributed to EA.

Intangible benefits cannot be easily quantified, but they can be attributed to EA or EA work. These benefits can be realized, particularly, from the development and usage of architectural models and descriptions, leading to better insight of the enterprise and thus supporting e.g. decision making.

Indirect benefits can be measured in quantifiable terms, but cannot be attributed to EA or EA work. They are related, especially, to an enterprise's better position in the market, improved management and customer orientation, and more efficient business processes – factors that can be quantified by various metrics but only partially attributed to EA.

Table 1: the identified benefits of EA

Benefit	[1]	[3]	[4]	[5]	[8]	[12]	[13]	[14]	[17]	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[28]	[29]	[30]	[31]	[32]	[33]	[34]	[35]	[36]	[37]	[38]	[39]	[40]	[41]	[42]	[45]
Evolutionary EA development & governance				X																						X				X			
Provides a holistic view of the enterprise	X	X	X	X				X			X	X		X		X			X		X				X	X		X	X		X	X	X
Improved alignment to business strategy				X			X	X		X			X	X						X	X					X	X			X	X		
Improved alignment with partners	X			X				X			X		X			X										X		X	X				
Improved asset management				X				X							X	X									X	X							
Improved business processes									X	X							X			X										X			
Improved business-IT alignment			X	X				X	X	X	X		X	X			X		X		X				X	X				X		X	X
Improved change management	X	X					X	X				X				X	X	X	X	X	X	X	X		X							X	X
Improved communication		X		X				X		X	X		X	X				X	X	X						X						X	X
Improved customer orientation	X					X		X	X	X				X								X								X			
Improved decision making	X	X		X									X			X			X	X						X							
Improved innovation	X			X	X			X	X	X							X				X					X				X			
Improved management of IT investments	X				X			X					X	X	X	X		X	X			X							X	X		X	
Improved risk management				X	X			X		X	X		X	X	X				X	X	X			X		X					X	X		
Improved staff management									X		X		X	X															X	X	X		X	
Improved strategic agility	X		X	X				X	X	X	X	X								X						X							
Increased economies of scale																			X										X	X				
Increased efficiency				X		X							X	X	X		X					X	X											
Increased interoperability and integration			X		X	X	X	X		X		X	X	X	X				X	X	X	X	X											
Increased market value								X						X										X										
Increased quality						X								X					X	X		X							X	X		X		
Increased reusability				X	X	X		X			X		X	X							X					X	X				X	X		
Increased stability	X																															X	X
Increased standardization						X	X	X					X	X	X				X	X	X						X						X
Reduced complexity					X			X					X		X	X	X		X		X				X								X
Reduced costs				X	X	X		X		X	X		X	X	X		X				X	X	X			X		X	X	X	X		X
Shortened cycle times				X	X	X		X	X	X	X			X			X		X			X				X		X	X	X			

Strategic benefits are positive effects that are realized in the long run and are typically affected by a multitude of factors. Therefore, they generally cannot be objectively quantified or completely attributed to EA or EA work. These benefits may include, for example, increased stability of an enterprise in an environment of constant change, better strategic agility, and improved alignment with business strategy.

The benefits of EA were categorized into the model by using the author's discretion (see Figure 1). For this reason, the categorization is merely meant to be suggestive of the potential types of the EA benefits. Because of this rather subjective nature of the categorization, the relative positions of the benefits inside the categories were not specified. Therefore, the order of benefits inside the categories is horizontally alphabetical.

5. Analysis of the Categorization

In this section, the seven most cited EA benefits are selected for discussion and analysis. Subsequently, the categorization of the benefits is analyzed.

The most cited benefits from the literature and the focus group interview include 1) *reduced costs*, 2) *providing a holistic view of the enterprise*, 3) *improved business-IT alignment*, 4) *improved change management*, 5) *improved risk management*, 6) *improved interoperability and integration*, and 7)

shortened cycle times. From these, *reduced costs* seem to be related to a great number of other benefits: the costs could be lowered by reducing duplication and overlapping in technologies and processes, reusing components, integrating systems, increasing standardization, and rationalizing procurement [see e.g. 5, 14, 22, 23]. *Shortened cycle times* also seem to be related, at least, to reuse and standardization [see e.g. 14, 22]. Realizing these benefits, on the other hand, can lead to increased efficiency [see e.g. 22].

Improved alignment between business and IT seem to be a vaguer concept, but is stated to be contributed at least by defining a common business vision by EA [see e.g. 14, 42] and performing governance over projects for EA compliance [see e.g. 31]. *Integration and interoperability* seem also to be related to alignment, and thus could be improved by increasing collaboration between organizational functions with the aid of integrated IT systems [see e.g. 4]. *Change management*, on the other hand, could be improved by documenting the current state, the target state, and transition plans to EA [see e.g. 31, 42]. Moreover, EA documents could also be used for the improvement of *risk management*, by e.g. providing a description of the current state for preparing an enterprise for unplanned changes [see e.g. 14], defining common standards, guidelines and principles that the IT organization can use for decision making, and providing information to projects for assuring EA compliance [see e.g. 31]. Finally, most of the benefits seem to be contributed by a *holistic view of the enterprise* that a high-quality EA can provide.

Recent EA surveys [25, 26] from the industry, as well as the focus group interview results, also indicate that *change management*, *reduced IT costs* and *alignment between business and IT* are among the most important EA-related concerns for practitioners. Moreover, providing a *holistic view of the enterprise* seems to be a self-evident benefit of EA in literature. However, *managing the complexity of IT assets* is considered equally important in the surveys and was also one of the concerns of the focus group, but was not among the top-10 most cited EA benefits in this study.

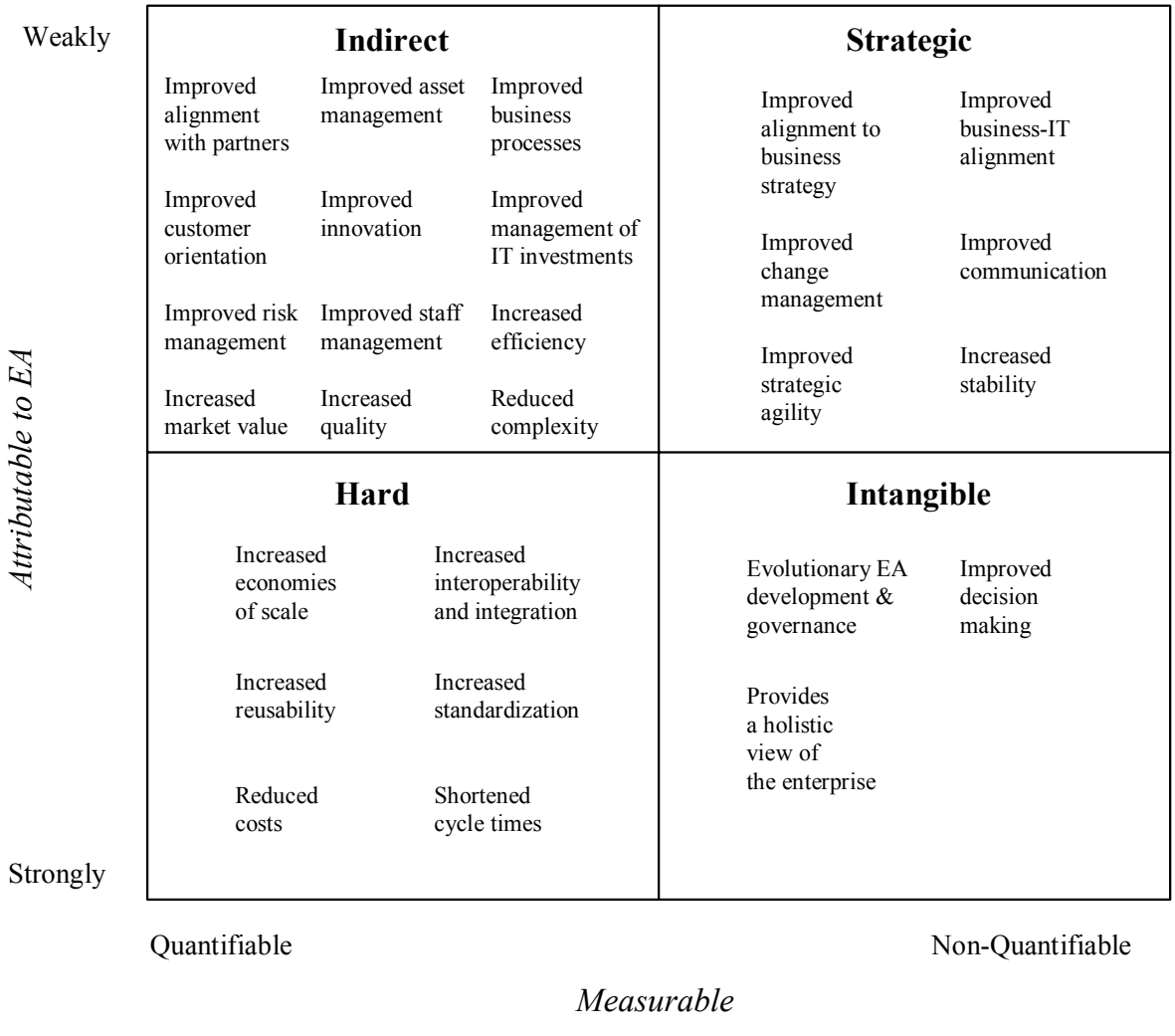

Fig 1. The EA benefits categorized according to the Giaglis et al. model

According to the categorization, the challenge of evaluating and measuring the benefits seems to be that most of the benefits are indirect or strategic – even if they can be clearly quantified, they are difficult to address to EA or EA work. Moreover, the relatively large amount of strategic benefits impedes the evaluation as well. Consequently, in the initial stages of EA maturity, applicable evaluation criteria and metrics for hard benefits could be developed for showing "quick wins". In higher maturity levels however, metrics for other types of benefits should be developed as well to quantify the value of EA more comprehensively. Even the indirect and strategic benefits might include elements which could be evaluated and addressed to EA.

6. Discussion

This section includes a discussion of this study's contribution to research and practitioners, limitations of the study, and agenda for further research.

Contributions to Research

This study contributes to research in several ways. Firstly, it provides researchers with a perception of what benefits can be received from EA and EA work. Secondly, it provides one potential categorization for the benefits. Thirdly, the categorization can be used as a basis in determining what kind of evaluation criteria and metrics could be used in measuring the realization of the benefits.

Contributions to Practice

Practitioners may use the results of this study to select a certain set of benefits to act as objectives of their EA programs. Moreover, the research provides practitioners with a variety of potential EA benefits for rationalizing EA work initiation. Practitioners may also find the categorization useful in developing metrics for quantifying the benefits in later stages of EA work.

Although the benefits of EA could be used by practitioners to define a set of EA objectives to be pursued, the focus group advised that conducting EA work by merely aiming at the selected objectives could result in a failure, because factors external to the objectives (e.g. business environment changes and undisclosed business goals) may also have a considerable effect on EA work. Moreover, the interview showed that in enterprises initiating EA work, the risk of failure is greater and the benefits acquired cannot be clearly addressed to EA because of the less established position and influence of the EA program in the enterprise.

Limitations of the Research

There are a few limitations in this study, which could impede generalizing the results. Firstly, EA benefits are organization-specific at least to some extent. There could be differences between enterprises depending on e.g. the geographical area, the enterprise type, the industry, the EA maturity, the size of enterprise and the EA program, and the market situation and position. Naturally, the selection of EA objectives and thus the direction of the EA program also have an effect on the benefits received. Secondly, the categorization of the EA benefits is based only on the author's discretion. Thirdly, the study is primarily based on the extensive literature review, supplemented only by a small amount of empirical data (the focus group interview). However, the literature review already provides a valuable contribution, which is strengthened by the validation and practical viewpoint of the focus group, and clarified by the categorization of the benefits.

Agenda for Further Research

This study provides a number of important themes for further research. Firstly, the benefits itself should be unambiguously and consistently defined, and their categorization empirically validated. Secondly, a valid and consistent model should be constructed to illuminate the relationships between EA benefits, EA characteristics and EA work activities on different levels of abstraction. Thirdly, metrics and evaluation criteria should be charted and developed for measuring the realization of the benefits. Fourthly, the benefits should be empirically quantified by applying these metrics and criteria to provide a rationale for adopting an EA approach or making further investments in EA. In the near future, we aim at identifying metrics and evaluation criteria for assessing EA value and the realization of the benefits.

7. Conclusion

In this paper, the benefits of EA were charted by an extensive literature review, supplemented by a focus group interview of practitioners. Subsequently, the benefits were categorized according to a IS benefit classification model [27]. Furthermore, seven of the most cited benefits and the categorization were analyzed.

It is worth noting that EA should be communicated effectively to realize the benefits [see e.g. 22]. Even then, EA does not guarantee long-term value because a multitude of factors affects the realization of benefits [see e.g. 43, 44]. Moreover, distinguishing the contribution of EA from all the potential factors affecting the realization of the benefits is a significant challenge. Naturally, the benefits identified in this study are only suggestive of what kind of value an EA could provide to an enterprise. Nevertheless, the results can be used by practitioners to build a business case for EA. On the other hand, enterprise decision-makers should note an opposite argument: EA should be seen as an asset, not an expense, and that the expenses are actually realized by not investing in EA [see e.g. 22, 42].

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Enterprise Architecture Compliance: the Viewpoint of Evaluation

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Abstract: Enterprise Architecture (EA) provides a holistic view of entire organization, including various viewpoints such as business, information, systems and technology. It is of interest for academics and practitioners alike. It has been suggested that EA is an approach for controlling the complexity and constant changes in the organization and its business environment, assisting organizations in realizing a multitude of positive business impacts. As the organization transforms from the current EA state towards the improved target state through a set of projects, at least the compliance between the projects and EA should be examined to assure that the organization is moving towards the desired direction. The concept of EA compliance has not been a target of academic research, but practitioners have addressed the concept more extensively in the form of compliance evaluation method descriptions, checklists, white papers and standards. The concept has especially been addressed in the US Government. Nonetheless, the area of research is fragmented, lacking a comprehensive perception of EA compliance and its evaluation, stressing only the regulatory and corporate governance connotation of the term, and focusing mainly on the EA compliance of projects. However, we consider this perception to be too narrow, and want to study if there are any other aspects that should be addressed. Therefore, in this paper, we address the concept more extensively, aiming to develop a broader, unbiased understanding of the concept of EA compliance. Particularly, based on a literature review and a focus group interview of EA practitioners from both information technology (IT) user and service provider organizations, we describe the various possible perspectives of EA compliance, and discuss various areas of its evaluation. Especially, EA compliance evaluation goals, evaluation targets and evaluators are addressed. This extensive view to EA compliance enables organizations to assure that the transition towards the target state is controlled more systematically, for example by guiding investments and development projects to comply with EA.

Keywords: Enterprise Architecture (EA), Enterprise Architecture work, compliance, evaluation

1. Introduction

Enterprise Architecture (EA) is an approach for supporting the management and development of an organization through a set of architectural models, usually including the viewpoints of business, information, information systems and technology (see e.g. de Boer et al. 2005, Kaisler et al. 2005, Jonkers et al. 2006). As well as the current architecture, EA also includes a description of the target architecture and a transition plan (Armour et al. 1999, Lankhorst 2005). A multitude of organizations are in the process of implementing the approach, seeking to realize several important business and information technology (IT) related benefits. Hence, EA is considered highly interesting by both academics and practitioners.

Typically, the transformation from the current EA towards the target EA is carried out through a set of projects (see e.g. The Open Group 2006). Therefore, these projects should be guided and controlled by EA to ensure that the projects and their output actually move the organization towards the target EA (see e.g. The Open Group 2006). In other words, the projects have to be compliant with EA.

Despite its importance, the concept of EA compliance has not received the attention in academia thus far – academic literature on the subject is extremely rare. Literature on the subject mostly consists of practical sources, such as US Government and other public administration method descriptions, industry white papers, and standards. Mainly, these sources deal with tools and procedures for supporting or conducting EA compliance evaluation, such as evaluation process descriptions (Eurocontrol 2006, The Open Group 2006, CIO Council 2001, NIH 2006, GAO 2003) or checklists (NIMA 1998, The Open Group 2006) developed by practitioners. Also, definitions exist for the levels or “amount” of compliance (The Open Group 2006, BTA 2006).

Currently, many organizations are actively developing their EA processes, and EA compliance related activities as a part of these processes. This indicates the importance of the concept of EA compliance in practice. The downside of the existing literature is that the concept of compliance seems to be

vague, especially in the context of EA. In addition, it does not seem to be completely clear how to evaluate EA compliance. Hence, we consider EA compliance as an important area of further scrutiny: does EA compliance encompass only the compliance between projects and EA, or are there other aspects that should be addressed? Therefore, this paper aims to develop an extensive perception of EA compliance. Particularly, we want to describe the various possible perspectives of EA compliance, and clarify its evaluation by addressing the following issues: 1) what are the goals of EA compliance evaluation, 2) what are the specific targets of EA compliance evaluation, and 3) who should evaluate EA compliance.

The study consisted of the following steps:

- *Literature review* was carried out systematically. First, a keyword search in four high-quality academic databases (Academic Search Elite, Electronic Journals Service, Science Direct and Web of Science), Google Scholar and Google was carried out by keywords such as "compliance" and "conformance" to investigate the concept on a general level. Second, keywords such as "architecture and "enterprise architecture" were added to the search to scrutinize it in the EA context. On the basis of the review, the concept of EA compliance was described, and the selected aspects of EA compliance evaluation addressed.
- *Focus group interview* (see e.g. Krueger and Casey 2000) of seven EA practitioners representing five Finnish or international IT user and service provider organizations, employing from 14 to several thousand people, was arranged to validate the literature review results and to supplement additional, experience-based information. Two researchers conducted the interview; one moderated the discussion and the other took notes. The interview was also audio-recorded for reviewing and completing the notes.
- *Analysis and consolidation of the results* of both the focus group interview (later referred as interview) and the literature review was carried out with the help of the recordings and notes. Specially, the description of EA compliance was revised, and practical views on EA compliance evaluation targets and evaluators constructed on the basis of the interview results.

The paper is organized as follows. Next, we discuss the concept of EA compliance. Following this, EA compliance evaluation is discussed from the practical viewpoint in terms of evaluation goals, targets, and evaluators. Finally, the last section concludes the paper.

2. Concept of EA Compliance

In literature, compliance mainly refers to the conformance with rules – standards, regulations, laws, contracts and so forth (Quality Assurance Project 2006, PEER Center 2006, Internal Auditing Standards Board 1995, Allman 2006), but no single well-defined definition seem to exist. The same applies in the EA context as well. Instead, the literature review gave us the following perspectives.

First, it is suggested that EA compliance aims to ensure the compliance of individual projects with EA, which can be assessed with the help of two processes as described in TOGAF (The Open Group 2006):

- *Architecture Compliance Review Process* evaluates a single project against the agreed "architectural criteria, spirit, and business objectives" and
- *Project Impact Assessment* evaluates the "project-specific views of the enterprise architecture that illustrate how the enterprise architecture impacts on the major projects within the organization".

Second, EA compliance may refer to the compliance between EA and standards, reference models, or principles, which can be evaluated via a compliance assessment process (The Open Group 2006). Third, EA compliance may also aim to the use and enforcement of EA in the every day decision making by the organization (Spurway and Patterson 2005). In order to ensure that real value is gained through EA, both *proactive and reactive compliance processes* are needed. The former is concerned with how and when EA artifacts are used in IT projects, and the latter is related to EA reviews and assessments carried out in IT projects. (Spurway and Patterson 2005) Fourth, it has been suggested that compliance between EA and organization's procurement policies should also be considered (Aziz et al. 2006, GAO 2003, CIO Council 2001). Therefore, it seems that EA compliance is related to projects and investment processes alike.

Deriving from the various perspectives above, EA compliance encompasses at least three aspects:

- Compliance between organization's projects or investments and agreed boundaries set by EA,

- Guidelines and constraints induced to projects or investments by EA, and
- Compliance between EA descriptions and standards, reference models, or principles.

Finally, although literature generally considers it to be self-evident, we want to stress that EA should reflect the business strategies and objectives of the organization as closely as possible (see e.g. GAO 2003). Therefore, EA compliance should also take the aspect of business-drivenness into account.

The above perspectives of EA compliance were discussed by the interviewees, who brought out that they provide a too limited view of the concept. Instead, it was suggested that there could be two types of EA compliance:

- *Internal compliance* refers to the compliance between investments – as well as the projects that implement the investments – and EA with its policies and guidelines.
- *External compliance* is about the compliance between EA and business – are the EA guidelines and target state descriptions in line with the business vision, mission, objectives, strategies, and action plans. External compliance may also refer to EA's ability to react to the changing environment of the organization, as well as to the compliance of EA with the laws and regulations the organization needs to obey.

Next, these types of EA compliance are addressed from the evaluation viewpoint.

3. Evaluating EA Compliance

In this section, the evaluation of EA compliance is discussed in terms of main goals of compliance evaluation (why to evaluate EA compliance), more precise evaluation targets (what is compared to what), and evaluators (who conducts the evaluation). These first two issues are discussed because they are the first aspects to begin any evaluation planning with (see e.g. Niemi and Ylimäki 2007). Evaluators are addressed because they have been disregarded in literature, and the diversified nature of compliance suggests that multiple evaluators may be required.

3.1. Key Goals of Evaluation

In literature, three major goals for EA compliance evaluation are suggested:

- *Directing a project or an investment to comply with EA – the proactive approach* (adapted from Spurway and Patterson 2005), see also (The Open Group 2006, NIH 2006, Aziz et al. 2006, CIO Council 2001, Paras 2005): this includes particularly direction and guidance of projects and the investment process to ensure that the organization is moving towards the target EA, supporting projects and the investment process by defining how and when EA artifacts are utilized, and encouraging the organization, especially IT projects, to utilize EA descriptions and guidelines.
- *Assuring the compliance between the output of a project or an investment process and EA – the reactive approach* (adapted from Spurway and Patterson 2005), see also (GAO 2003, NIH 2006): this includes EA reviews and assessments within projects and the investment process, and project and investment follow-up with regard to EA descriptions.
- *Assuring the compliance between EA and internal or external standards, reference models and principles* (adapted from The Open Group 2006): this includes evaluation of EA descriptions to be constructed according to defined standards, reference models and principles, by both the organization and external authorities.

Furthermore, based on our experiences in the ongoing research project, we suggest the following additional goal.

- *Ensuring the usability and appropriateness of EA policies, EA frameworks, EA descriptions, business objectives and so forth:* this provides basis for improvement, for example, by evaluating EA through experience-based feedback from projects and the investment process, or by identifying whether the EA descriptions, standards, policies and principles, or even the business requirements themselves require modification.

This notion has also been disclosed in the context of non-compliance, which may be a positive situation: it could provide feedback on the areas of EA to be potentially modified, or areas of project architecture that may be incorporated into EA (The Open Group 2006).

All these goals were considered essential by the interviewees as well. In addition to these high-level goals, a number of various benefits of EA compliance evaluation are defined in literature. Particularly, TOGAF (The Open Group 2006) provides an extensive list of project compliance review benefits, including benefits related to architecture quality management, project management, business, and EA visibility in the organization.

3.2. Evaluation Targets

According to literature, EA compliance evaluation usually deals with the following three high-level objects: 1) the EA itself, 2) a project or an investment process, and 3) the output of a project or an investment process (The Open Group 2006, Spurway and Patterson 2005, GAO 2003, Aziz et al. 2006, CIO Council 2001, NIH 2006). The EA compliance evaluation target can therefore be defined as the relationship between these objects. The high-level objects are displayed in Table 1 together with the potential low-level items to be utilized in evaluating the relationship between the objects in EA compliance evaluation.

Table 1: EA compliance evaluation objects

Evaluation Object	*Items to be evaluated*	*References*
Enterprise Architecture	- Architectural descriptions (target architecture) - Transition plan - Principles and guidelines	(Spurway and Patterson 2005, The Open Group 2006, CIO Council 2001, Aziz et al. 2006, GAO 2003, NIH 2006)
Project / investment process	- Architectural descriptions (project or system architecture) - Business case - Acquisition plan - Project plan	(CIO Council 2001, Aziz et al. 2006, GAO 2003, NIH 2006)
Project / investment process output	- Architectural descriptions (project or system architecture)	(NIH 2006, Spurway and Patterson 2005, GAO 2003)

However, the interviewees considered the above view of three evaluation objects, and therefore also the evaluation targets, to be insufficient in practice. Particularly, they stated that compliance between EA and business (vision, mission, objectives, strategies, and action plans) should not be taken for granted; instead, it should be regarded as a separate evaluation target. Moreover, the group expressed that projects and investments should not be paralleled as one evaluation object; in reality, project is a tool to implement an investment. Finally, they considered external partners, vendors and customers to be important evaluation objects as well in certain situations.

Based on the literature review and the interview, we suggest the following high-level objects between which EA compliance evaluation can potentially be conducted:

- *Business:* particularly business vision, mission, objectives, strategies, and action plans.
- *Investment:* needed to fulfill certain business objectives.
- *Project:* the tool to implement an investment.
- *Enterprise Architecture*: a holistic view to the entire organization.
- *External Directions:* especially regulations, standards, or reference architectures that need to be taken into consideration in business operations or IT development.
- *Partners and Vendors:* may provide their own procedures, guidelines or constraints in out-sourcing engagements or when an organization purchases commercial off-the-shelf (COTS) products.
- *Customers:* in some cases, the organization's customer's EA, practices or guidelines need to be evaluated for compliance as well.
- *Actual Impacts of a Project or an Investment:* indicating whether and how long a step or transition has the project or investment taken towards the target EA state.

These evaluation objects, as well as the evaluation targets of both internal and external compliance, are displayed in Figure 1. Compliance between the objects – the evaluation targets – is depicted with arrows. Block arrows depict primary internal or external compliance evaluation targets and small dotted arrows other possible targets to be evaluated. Additionally, examples of lower-level items belonging to each object are included to illustrate the possible documents that can be utilized in compliance evaluation.

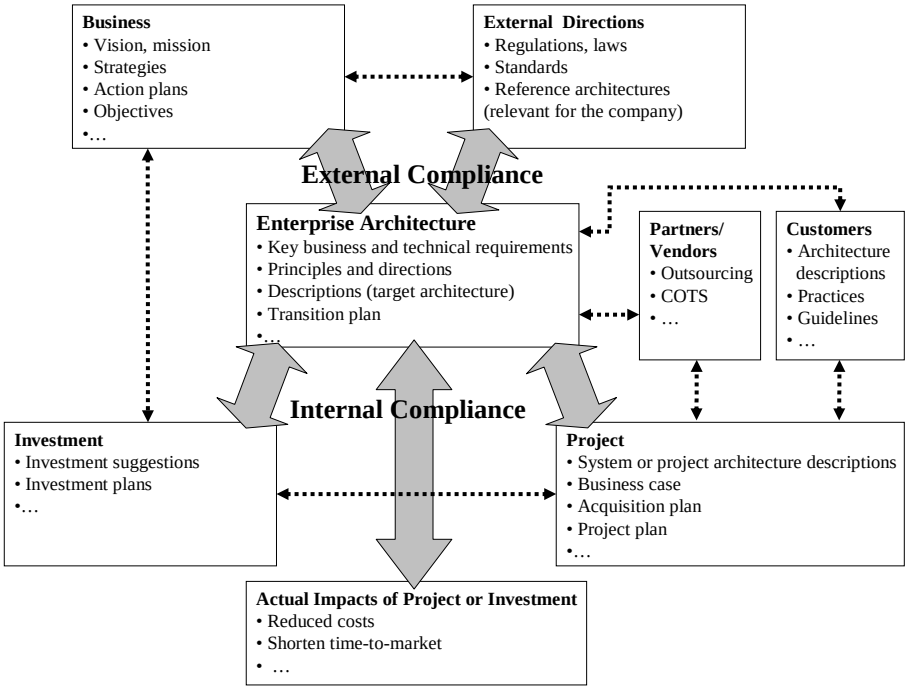

Figure 1: EA compliance objects and evaluation targets (derived from the interview results)

According to the interview, both internal and external compliance should be evaluated. In addition, there is a set of other possible evaluation targets between the evaluation objects that may require consideration in organizations. These aspects are briefly addressed in the following.

External EA compliance evaluation targets. First of all, compliance (on an acceptable level) is required between business and EA. According to the interviewees, it should be evaluated especially in the case of top management or strategy change, helping to assure that EA stays compliant with the altered business strategy, objectives, or other business requirements. Another external compliance evaluation target is the compliance between external directions and EA. Evaluation of this relationship is required especially if a reference architecture, such as TOGAF (The Open Group 2006), is applied.

Internal EA compliance evaluation targets. Similarly, compliance evaluation is required between EA and an investment, a project, and the actual impacts of both investments and projects. The interviewees stressed that it is possible for a project to succeed and fulfill its objectives, but for the investment the project implemented to fail – the impacts of the investment were not as expected. Additionally, compliance between a project and EA may include two levels (adapted from The Open Group 2006): EA design process compliance (are we doing things right) and EA compliance (are we doing the right things).

Other possible EA compliance evaluation targets. First, compliance should be assured between external directions and business to ensure that all necessary regulations, laws, standards, and so forth, are conformed to. Second, it should be assured that there is compliance between business and an investment. Third, compliance is also required between EA and partners and vendors, especially in mergers and outsourcing cases. The merger or outsourcing partner may have their own EA policies and guidelines, and the organization may need to reach compliance with them. If a project utilizes COTS products, the products' characteristics may affect the compliance between EA, the project, and its impacts. In addition, IT vendors and service providers may provide practices, methods and architectural documents to projects, affecting EA compliance. Fourth, in close customerships, compliance (at least to some extent) may be required between an organization's and its customer's EA, practices and guidelines. Finally, it should be assured that a project stays compliant with the investment it is supposed to implement.

3.3. Evaluators

Literature typically does not state precisely which stakeholders should conduct EA compliance evaluation. However, Spurway and Patterson (2005) provide examples on two classes of EA compliance evaluation roles:

- *Project roles*, which provide necessary project documentation needed in EA compliance evaluation, and
- *Architecture roles*, which carry out the actual compliance evaluation and support project roles in the identification and creation of necessary documentation.

Generally, the EA team seems to be considered a self-evident evaluator. Nevertheless, according to National Institutes of Health (NIH 2006), self-evaluation of EA compliance can also be carried out in projects. Hence, we initially proposed two types of stakeholders that carry out EA evaluation (adapted from NIH 2006, Spurway and Patterson 2005):

- *EA team*, which provides direction and guidance to projects and investment processes, and carries out formal EA compliance reviews. Compliance guidance is either 1) provided to projects or the investment process automatically or 2) asked by project or investment process representatives when needed.
- *Project or investment representative*, e.g. the project manager, who provides the EA team with documentation needed in EA compliance evaluation, but can also carry out self-evaluation of EA compliance.

However, the literature-based viewpoint of two major evaluators was considered too limited by the interviewees. Instead, they suggested that potential EA compliance evaluators are the stakeholders (or roles) that have responsibility in the area of each evaluation object. According to this perception, the possible evaluators are displayed in Table 2.

Table 2: Possible evaluators of EA compliance, based on the interview

Evaluator	*Description*	*Responsibility area*
Business Developer, Process Owner, or Business Architect	Has the responsibility of business (process) development or business architecture, and could perform or assist in evaluating the compliance between business and EA. Also, may perform or assist compliance evaluation between business and external directions or an investment.	Business
EA Team or Enterprise Architect	Provides direction and guidance for projects and performs or assists in evaluating both external and internal compliance. Also, may evaluate the compliance between EA and partners' or customers' policies and guidelines. Evaluation is possibly conducted with the help of (formal) compliance reviews.	Enterprise Architecture
Investment Representative, e.g. Controller	Participates in evaluating whether the planned investment is in line with the organization's strategies and goals.	Investment
Project Representative, e.g. Project Manager or Technical Architect	Has the responsibility of project management or project content. May carry out self-evaluation of compliance between the project and EA. In addition, may participate in conducting compliance evaluation between the project and partners, customers or the investment. However, the project manager may not be aware enough about EA to be able to do self-evaluation.	Project
Representative(s) of Out-sourcing or IT/service Provider Partner(s)	Assists in evaluating whether partner's policies and guidelines, or even its EA, are taken into account in organization's EA and projects.	Partners

In addition to the stakeholders mentioned in Table 2, there may be yet another stakeholder who could be regarded as an evaluator of EA compliance: the EA governance board, also referred to as the architecture board (see e.g. The Open Group 2006) or the EA steering committee (see e.g. CIO Council 2001). If an EA governance board exists in an organization (including representatives from various stakeholder groups), it may have – among many other things – the responsibility of evaluating

EA compliance. Thus, possible problems encountered if any single stakeholder (such as a project manager or the EA team) evaluates its own work can be avoided.

4. Conclusions

In this paper, we presented a study which aimed at discussing the various perspectives of EA compliance, and address its evaluation in terms of evaluation goals, targets and evaluators. In this section, the main conclusions of this study are highlighted and themes for further research provided. When judging our study, it should be remembered that it is based on a literature review validated and supplemented by a focus group interview of seven practitioners from five organizations initiating EA work. Our work was planned as a preliminary study: we have attempted to elucidate the vague concept of EA compliance and to start a discussion on the subject.

The concept of EA compliance seems to include more aspects than the compliance with laws and regulations alone. It was suggested that EA compliance can be divided into internal and external aspects. The former refers to ensuring that investments, projects implementing the investments, as well as their actual impacts, are conformant with EA and its policies and guidelines. The latter refers to ensuring that EA is conformant with the business objectives and strategies. It may also refer to the EA's ability to react to the changing environment of the organization, as well as to the conformance with the laws and regulations the organization needs to obey.

Subsequently, EA compliance evaluation was addressed in terms of evaluation goals, evaluation targets and evaluators. The main goal of EA compliance evaluation is to ensure that the organization is moving towards the target architecture. Basically, this can be done in two ways: 1) by directing a project or investment to comply with EA, or 2) by assuring the compliance between the actual impacts of investment or project and EA. Additionally, EA compliance evaluation helps ensure the usability and appropriateness of EA policies, descriptions and so forth and provides valuable feedback to the architecture group: is there a need to change something in the EA, or should even the business requirements be reconsidered?

A set of evaluation objects between which compliance may be evaluated were suggested. These objects include: business, investments, EA, projects, external directions, partners, customers, and the actual impacts of an investment or a project. Therefore, compliance evaluation targets are the relationships between these objects. Several targets were described, divided into external, internal and other possible evaluation targets. Moreover, stakeholders conducting or assisting the EA compliance evaluation were suggested to be those stakeholders who deal with or are in charge of the above mentioned evaluation objects. Usually, the EA compliance evaluation is conducted with the help of documents related to each evaluation object.

Furthermore, the interviewees stressed that also the following two aspects should be kept in mind when planning and conducting EA compliance evaluation:

- *EA compliance has a dynamic nature:* organizations' environment is constantly changing, and so are their EAs. Therefore, compliance can be evaluated to be on an acceptable level at the moment, but it does not guarantee that this is the case in future.
- *EA compliance seems to depend on the EA maturity level:* both the meaning and the content of EA compliance may vary according to the EA maturity level. It was suggested that in the lower levels of maturity (in the beginning of EA development work), EA compliance and its evaluation actually equals quality assurance, and especially the impacts of EA work are a focal issue. After the EA process has become a more established, more profound aspects of EA compliance will become increasingly important. However, the maturity level dependence was not studied further in this research.

The extensive view of EA compliance enables organizations to address the issue more comprehensively. It can be used to make sure that all the important aspects of EA compliance have been considered – judging from the literature reviewed, the concept has not been comprehensively addressed before, even in official compliance processes and practices. In practice, this paper may provide ideas and views on how to deploy EA guidance, descriptions and principles to projects and investment processes, which in turns enables the organization to assure that it is moving towards the desired target architecture. These perceptions, together with the various aspects of EA compliance evaluation presented, may also serve as a stimulus for organization-specific planning of EA compliance evaluation, which is eventually required if the organizations want to endorse EA

compliance. However, each organization needs to make its own decisions on the actual steps of the evaluation process, and to implement it as a continuous EA governance activity.

For researchers, the results provide a foundation for which to build further research. Especially, more generic practices, guidelines and reference models for systematic EA compliance evaluation could be developed. Furthermore, the relationship between EA compliance and EA maturity could be studied in more detail to clarify how the organization's EA maturity level affects the meaning and content of EA compliance and its evaluation.

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Enterprise Architecture Evaluation Components

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ABSTRACT

Enterprise Architecture (EA) is a holistic view of an organization, including the viewpoints of business, information, systems and technology. It is stated to provide significant benefits to organizations, and is therefore of interest for both academics and practitioners. However, evaluating EA, or its benefits, is difficult. Moreover, the studies on EA evaluation are mostly inconsistent, and almost omit the planning aspect of evaluation. This study suggests the evaluation components that need to be addressed in EA evaluation planning, charted by a literature review supplemented and validated by a focus group interview. In addition, four evaluation components are further described.

Keywords

Enterprise Architecture, evaluation, evaluation components, evaluation planning

INTRODUCTION

Enterprise Architecture (EA) provides a holistic view of an organization through a set of architectural models, including the viewpoints of business, information, systems and technology [see e.g. 6, 14, 16]. It is an approach for managing and developing an organization, and is stated to provide a multitude of positive business impacts [see e.g. 10, 20]. Therefore, EA is of growing importance for both academics and practitioners. However, a great deal of resources has to be engaged to EA work (that includes EA planning, development and governance), and thus evidence of its positive impacts has to be presented through EA evaluation to rationalize the investments on EA [see e.g. 20]. Moreover, it is widely known that information gained through successful evaluation is crucial in the management and improvement of any initiative. Nevertheless, the research on EA is currently fragmented, focusing mostly on frameworks [see e.g. 12, 28, 31], and development methods and tools [see e.g. 3, 7, 18]. Only recently have EA evaluation issues gained some attention [see e.g. 20, 21, 26]. Still, the studies on EA evaluation are mostly inconsistent, focusing particularly on defining EA metrics and evaluation criteria, especially in the form of maturity models [see e.g. 9, 13, 24], but almost omitting the aspect of elaborate evaluation planning. However, we think that EA evaluation planning requires taking into account a broader set of aspects than metrics alone. Therefore, this study pursues to suggest the evaluation components needed to be addressed already in the EA evaluation planning phase, before organizations move on to the actual evaluation.

The paper is organized as follows. First, the research process is briefly described. Second, the components of EA evaluation are presented. Third, four components – EA objectives, evaluation objectives, evaluation targets, and audience of the evaluation results – are described in more detail. Finally, the last section concludes the paper.

RESEARCH PROCESS

The study was conducted in four stages. First, a literature review was carried out to compose a perception of program evaluation, its components, as well as to chart the possible content of the components in the EA context. Second, a focus group interview [see e.g. 17] of seven practitioners from five Finnish and international ICT user and service provider organizations was organized in August 2006 to validate the literature review results and to supplement additional, experience-based information. The organizations were either 1) independent companies, or 2) divisions, subsidiaries or other parts of domestic or global enterprises. Moreover, they represented different industries and employed from 14 to several thousand people. Three researchers conducted the interview; one moderated the discussion and two took notes. The interview was also audio-recorded for reviewing and completing the notes.

Third, the information from the literature and the focus group interview was analyzed with the help of the recordings and notes, and combined to describe the components of EA evaluation. Fourth, especially four evaluation components – EA objectives, evaluation objectives, evaluation targets, and audience of the evaluation results – were discussed in more detail. These can be regarded as the starting points for EA evaluation planning. After addressing these components, it is possible to go on to defining suitable evaluation criteria (quality attributes), and usable and simple metrics to evaluate each evaluation target.

DEFINING THE EVALUATION COMPONENTS

Even though the evaluation discipline lacks a general theory [19], some definitions can be found. **Evaluation** can be described as “the identification, clarification, and application of defensible criteria to determine and evaluation object’s value, its merit or worth, in regard to those criteria [8]. Briefly, it is “a process of determining merit, worth, or significance” [19]. Basically, evaluation focuses on products or processes. This viewpoint has been adopted particularly in the discipline of quality management aiming at improving the quality of products and processes [5, 15].

Program evaluation refers to “the thoughtful process of focusing on questions and topics of concern, collecting appropriate information, and then analyzing and interpreting the information for a specific use and purpose” [30]. By program we mean a set of ongoing and planned activities aiming at a specific outcome [8, pp. 54]. Thus, EA can be regarded as a program.

A substantial amount of literature exists on evaluation [see e.g. 4, 8, 11, 19, 27, 29, 30]. A literature review gave us a list of building blocks that need to be addressed in evaluation planning. In Table 1, these building blocks or components of evaluation are briefly described. While these components, that are rather generic in nature, are regarded as essential in (program) evaluation, and especially in its planning phase, we suggest that this is also the case in the context of EA evaluation. EA deals with both products (architecture artifacts, models etc.) and processes (development process, management process etc.), which are the focus of evaluation by its definition. Hence, all the components in the table need to be addressed in EA evaluation planning as well.

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Table 1. The components of evaluation.

Component	Description	References
Evaluation Purpose	The purpose of evaluation: - Why is the program carried out? - Why should the evaluation be conducted? - What is desired to be accomplished by the evaluation?	[8, 30, 32]
Evaluation Target	The object under evaluation (to delimit the factors to be considered): - What are the evaluation targets (the whole program, a particular area, or a number of areas within the program)?	[8, 19, 30]
Evaluation Audience	Potential users of the evaluation information and results: - Who will use the evaluation results? - How will they use it? - What do they want to know? Which questions will the evaluation seek to answer?	[8, 11, 30]
Quality Attributes and Metrics	The characteristics of the target that are to be evaluated: - What information will help to answer the evaluation questions? - What information is needed to answer the questions?	[8, 19, 30, 32]
Yardstick or Standard	The ideal result against which the real result is to be compared.	[19, 32]
Data Gathering Techniques	The techniques needed to obtain data to analyze each characteristics of an evaluation target: - What sources of information will be used? - What data collection method(s) will be used? - Which instruments (e.g. recording sheet, questionnaire, video or audio tape) will be used? - When will the data be collected (e.g. before and after the program, at one time, at various times, continuously, over time)? - Will a sample be used? - Who will collect the data? - When will the data be gathered? What is the schedule?	[8, 19, 30, 32]

Data Synthesis Techniques	Techniques used to judge each characteristic of an evaluation target and, in general, to judge the target, obtaining the results of evaluation: - How will the data be organized or tabulated? - What, if any, statistical techniques will be used? - How will narrative data be analyzed? - Who will organize and analyze the data? - How will the data be interpreted and by whom? - How will the evaluation findings be communicated and shared? To whom?	[8, 19, 30], see also [11]
Evaluation Process	Series of activities and tasks by means of which an evaluation is actually performed: - What steps are needed? (E.g. evaluation design, examination/data gathering, and decision making including synthesis, analysis, and documentation). - When will the steps be conducted? - How long will it take to conduct each step? - Who conducts the steps? - How will the results be documented, reported, communicated so that they are understood and regarded as credible? - Who will receive the report? Will it answer their questions?	[8, 19, 30, 32]
Evaluation Management	Issues related to responsibilities, resources required (people, budget, timeliness, and so forth) and risks. - What kind of expertise is needed to conduct the evaluation? - Who are available to work on evaluation (either from the organization the evaluation takes place in, or external evaluators)? - How much may the evaluation work cost? - When are the evaluation results needed? Flexibility is important; evaluation should be able to be completed at a point where it will have the maximum impact in the organization. - Are there any threats that may harm the validity or reliability of the results? Are there any other risks to be considered?	[11, 30, 32], see also [8]

According to Table 1, the definition of evaluation purposes needs to start with answering the question “why is the program carried out”. In the context of EA, this requires an understanding of EA objectives; what are the organization’s goals of EA and EA work. EA objectives provide a valuable input to EA evaluation planning affecting both the purposes and the targets of EA evaluation, and can, thus, even be regarded as an additional component to be taken into consideration. Moreover, the evaluation purposes and targets are interrelated with each other. Evaluation audiences, on the

other hand, have various evaluation needs and concerns, and thus affect both the evaluation purposes and targets.

Additionally, the interviewees stressed that also the objectivity of evaluation and evaluation information need to be addressed. However, to some extent it must be accepted, that all evaluation information is not necessarily very objective, and different evaluators may come up with different results. To minimize the diversity of the results, both the evaluation process and the analysis techniques should be detailed enough to guide the evaluation work to ensure that the reliability of the evaluation results is acceptable. In Figure 1, a number of other relationships between the evaluation components are, to some extent, depicted as well. These will be addressed by further research in more detail.

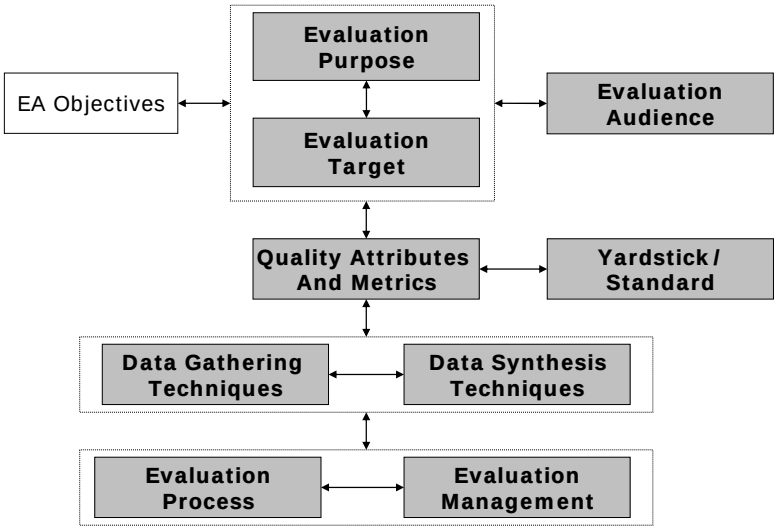

Figure 1. The components of EA evaluation.

FROM ENTERPRISE ARCHITECTURE OBJECTIVES TO EVALUATION TARGETS

This section describes the following EA evaluation components in more detail: 1) EA objectives, 2) evaluation purposes, 3) evaluation audiences, and 4) evaluation targets. These are the first components that have to be taken into account in EA evaluation planning, before any quality attribute or metrics selection and definition can be conducted.

EA Objectives

EA objectives define the goals of the EA approach in the organization; why it wants to apply the EA approach and what it wants to achieve through EA. Even though the EA objectives need to be defined in each organization based on, for instance, the business or IT strategy of the organization, some common features of these goals can be found.

Based on the literature review and the focus group interview, several possible objectives, based on the potential benefits wanted to be realized in the organization, were found to drive EA work. Some examples of these objectives are

- To improve business-IT alignment [see e.g. 6, 20]
- To improve change management [see e.g. 10, 26, 31]

- To improve communication [see e.g. 26, 31]
- To increase interoperability and integration [see e.g. 20, 26, 31]. According to the focus group, these issues could be related to e.g. legacy, migration and new information systems. Moreover, the conformance of new technologies to EA, and the effects of obsolete technologies should be taken into consideration, as stated by the focus group.
- To reduce complexity [see e.g. 20, 26, 31], also emphasized by the focus group.
- To reduce (IT) costs [see e.g. 13, 20, 26, 31], also emphasized by the focus group.
- To shorten cycle times [see e.g. 13, 20, 26, 31].

More detailed discussion on the various potential benefits of EA and EA work is provided by Niemi [22].

Evaluation Purposes

EA evaluation purposes provide justification for doing EA evaluation in the first place. They should answer questions like “why should the evaluation be conducted” and “what is desired to be accomplished by the evaluation”. EA evaluation purposes are, to a great extent, dependent on the objectives of EA. Additionally, as it was brought up by the focus group, different audiences (stakeholders) have different needs for evaluation, and thus, different evaluation purposes are required. Especially, business management is mainly interested in financial measurement, while ICT organization may be more interested in technological aspects. Also, the time frame of evaluation affects the evaluation purposes; in the long run, an organization is more likely to be able to evaluate the business value of EA (the business impacts), than in the early phases of EA development cycle.

In literature, various evaluation approaches have been proposed and categorized. For instance, the approaches could be categorized by the areas of knowledge where evaluation is applied, such as education, business, or government [33]. In the beginning, our plan was to organize the EA evaluation purposes according to the categories described in [33]. However, this proved to be a non-trivial task because the categories are overlapping to some extent. Hence, instead, we suggest that most of the EA evaluation purposes seem to fall into the following areas:

- Aiding decision-making about the EA program itself and to steer the program [adapted from 2, 9, 29], or “to ensure that expected benefits from the EA are realized and to share this information with executive decision-makers, who can then take corrective action to address deviations from expectations” [9].
- Describing results of the EA program to the stakeholders by demonstrating, for instance, alignment with business strategy, the (business) value of EA, the benefits of EA, or the value of IT and IT investments [adapted from 1, 2, 9].
- Determining whether the objectives of EA or the EA program are achieved, for instance, by evaluating the effectiveness of EA and the quality of (EA) processes and products, or by performing cost-benefit analysis [adapted from 1, 2, 9, 20, 29].
- Analyzing the status of the EA program by 1) examining the EA objective and benefit achievement trends (short or long term), such as progress towards the goals of the EA program as well as towards the target EA state [adapted from 2, 9, 29], or 2) by identifying and assessing various risks related to EA and business [adapted from 25, 29].

Evaluation Audiences

EA evaluation audience refers to potential users of EA evaluation information and results. While planning EA evaluation, the EA stakeholder groups that may need or require evaluation results need to be defined. Additionally, potential ways these stakeholder groups will use the information should be discussed and determined.

The potential stakeholders of EA are described in [23]. However, each organization has to discuss and determine the relevant stakeholders for its EA approach, as well as for its EA evaluation results. Each audience may have different evaluation needs and concerns because they are interested in different points of view (financial, strategic, efficiency, and so forth). As stated by the focus group, a balance, or priority, between these various needs has to be addressed. In practice, one or two of the audiences are usually dominating, and therefore, according to the focus group, their needs may be given first priority.

In Figure 2, some potential stakeholders – audiences – of EA evaluation results are displayed. Evaluation audiences that were added on the basis of the focus group interview are marked with an asterisk (*). Moreover, in the figure, R&D refers to research and development. An important stakeholder group, that is not actually an audience of the evaluation results, but assists the EA evaluation team (either internal or external evaluators) to format the evaluation information using a language that is comprehensible by each audience, is Internal Communications.

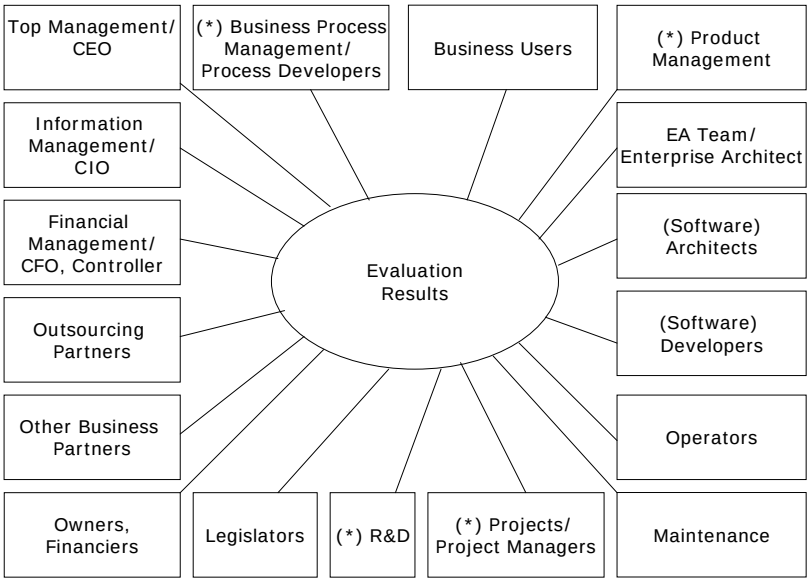

Figure 2. Possible audiences of EA evaluation results.

Evaluation Targets

Previously in our ongoing research project, we have defined a set of potential Critical Success Factors (CSFs) for EA, indicating the issues that have to be done exceedingly well in order to gain high quality EA, which in turn enables the business to reach its business objectives and gain more value [33]. The set of 12 potential CSFs for EA provided a starting point for determining the EA evaluation targets. However, it should be remembered that the evaluation targets are also dependent on the objectives of EA, the purposes of EA evaluation, and the various audiences (stakeholders) that may require the evaluation results; therefore, compatibility between these components should be assured.

In the following, examples of evaluation questions related to each potential target (or

a potential CSF for EA), particularly brought up by the focus group, are presented (see [33] for more information about the potential CSFs for EA):

- Scope and Purpose (of EA): Are the EA objectives derived from the business or IT strategies of the organization? How has the scope of EA changed or expanded during the last quarter (or year)? How controllable is the EA scope?
- Business Driven Approach: To what extent are business requirements prioritized and how they are prioritized? To what extent are they conflicting or competing? To what extent is the EA team aware of the changes in business requirements? Has the team all necessary information related to the business?
- Communication and Common Language: To what extent are the architects, the EA team, capable of communicating with different stakeholders using a language these stakeholders can comprehend?
- Commitment: To what extent is the (top) management aware of the EA approach of the organization? Does the management sponsor the EA approach?
- Governance: How is EA work and governance positioned in the organization (e.g. under the information systems management and CIO, or elsewhere in the organizational chart)? How successful has this solution been? Is there any need to relocate or reorganize EA work and governance? Does EA governance have necessary resources (time, money, etc.)? How helpful have the governance processes been considered by e.g. projects?
- IT Investment and Acquisition Strategies: How effective, viable, and practical is the investment decision making process?
- EA Development Methodology and Tool Support: To what extent are methodologies and methodology use evaluated? How effective are the methodologies? What are the costs of tool use? To what extent are verifiable benefits received from tool use? How does the tool use affect other features of system development, such as its production costs, flexibility, adaptability or expandability?
- EA Models and Artifacts: To what extent are EA document templates designed and how useful have the templates been? Are the models consistent enough to provide a holistic view of the organization?
- Assessment and Evaluation (of EA): To what extent are the purposes, targets and audiences of EA evaluation identified and approved? To what extent do these correspond with the maturity of the organization's EA? To what extent are the EA evaluation criteria and metrics aligned with the other evaluation metrics used in the organization? What is the time-frame of evaluation?
- Skilled Team, Training and Education: Does the EA team have the necessary resources (time, money, etc.)? To what extent does the team have various skills and experience (in business, technology, system development, architecture, etc.)?
- Organizational Culture: How aware are the organization members of the EA approach and its objectives? How has EA affected the organization, its structure and culture, after integrating or consolidating functions, for instance, in finance or personnel management? How long has it taken to make the required changes in the organization? Has it taken longer or shorter time than earlier?
- Project and Program Management: To what extent does the project methodology include EA guidance? To what extent has a project received EA guidance? How useful has the guidance been? How many projects have indicated a need to change or refine EA (e.g. EA plans or objectives)?

While some of the evaluation needs (or evaluation questions) cannot be incorporated into any specific CSF for EA, the entire EA program is considered a separate evaluation target as well. Evaluation questions related to the entire EA program, stressed by the

focus group, are particularly: How is the program progressing? What are the benefits of the EA approach to each stakeholder group? What kind of business impacts does EA provide? How have these impacts evolved or changed over time (in a quarter, year, etc.)? How has EA affected IT costs? Have they been decreasing or increasing? How mature is the organization's EA (program)? How has the maturity evolved over time?

CONCLUSIONS

In this study, the evaluation components of EA were defined by a literature review, supplemented and validated by a focus group interview of EA practitioners. Subsequently, four of the evaluation components were described in more detail, namely: 1) EA objectives, 2) evaluation purposes, 3) evaluation audiences, and 4) evaluation targets.

When evaluating our study, it should be remembered that it is mainly based on a literature review, only validated by a focus group interview of seven practitioners from organizations initiating EA work. Therefore, strong generalizations cannot be made. Our work was planned as a preliminary study of revealing issues – also other than metrics definition – to be addressed while planning EA evaluation.

The resulting model of components can be used by practitioners in organizations to structure the planning phase of EA evaluation, and help to assure that all evaluation components are addressed before moving on to the actual evaluation. As a result, organizations could expect better comparability between the results of different evaluations, and greater results validity compared to an ad hoc approach. In addition, we summarize the following practical implications from our study.

One of the most important EA work triggers was underlined by the focus group: the ever more complex and constantly changing environment the organizations have to deal with. There are complexities in the business environment, as well as in the existing information systems environment (legacy systems). It has become ever more challenging to control this multifaceted environment. EA has been suggested to be one possible approach for putting some structure into the chaos as well as to manage the changes needed for improving the business and the organization. To ensure that EA has actually achieved desired results, evaluation is required.

Usually, each organization has its own specific objectives for the EA approach. The purposes of evaluating the organization's EA program can be defined on the basis of these objectives. However, other sources may exist as well, such as the most important audiences and their various requirements for evaluation information – top-management may want information to support decision-making, while EA team would need to know how useful has EA guidance been considered by projects, or how many projects have effected EA. Once these aspects are clarified, the primary evaluation targets, compatible with the requirements set by different audiences, as well as with the evaluation purposes, can be defined.

If the organization has not yet clarified its EA program's objectives, it can stimulate the discussion and definition of the EA objectives with the help of the sample objectives presented in this paper. Similarly, discussion on evaluation purposes, audiences and evaluation targets can be assisted and supported by the given examples. Cross-tabulations can be used to depict dependencies between different evaluation components, such as

- EA objectives and evaluation purposes,
- audiences and evaluation purposes,
- evaluation purposes and targets, and
- audiences and evaluation targets.

In addition, it should be noticed that the maturity of the organization's EA affects the selection of evaluation targets, as well as the definition of evaluation criteria and metrics. Interviewees stressed that the EA maturity level of the organization, the evaluation targets, and the evaluation criteria and metrics need to be compatible. In particular, a 'young architecture organization' should start with defining simple metrics (such as on/off-metrics or quantitative metrics) indicating and demonstrating, for instance, the extent the stakeholders are aware of the EA approach and its objectives, or the support and guidance provided to projects implementing or changing EA. While the organization matures, more detailed business impacts can potentially be measured. However, in this study, evaluation targets and evaluation questions were not mapped to maturity levels.

The interviewees also emphasized that no matter what the EA evaluation targets and metrics are, they must be compatible with the other evaluation and measurement systems used in the organization (such as Balanced Score Cards). Especially, if the business is striving for substantial growth (in the sense of market share, sales volume, and so forth), IT cost metrics are not likely to show lower costs at the same time.

For researchers, the EA evaluation component model constructed provides a basis for further research on EA evaluation. Firstly, more research is needed to validate the evaluation component model. Secondly, the evaluation components and interrelationships not covered by our research, particularly EA quality attributes and metrics, should be further studied. Thirdly, the evaluation components could be mapped to EA maturity levels, highlighting the differences in EA evaluation on different levels of maturity.

Finally, even though the discussion in this paper has focused on EA evaluation, the evaluation components presented are generic in nature and thus applicable to many other evaluation endeavors as well.

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This study was conducted as a part of an ongoing research project called AISA focusing on the quality management of enterprise and software architectures. The project is funded by the Finnish Funding Agency for Technology and Innovation (TEKES) and the participating companies. We wish to express our gratitude to the companies for their co-operation.

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