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EVALUATION NEEDS FOR ENTERPRISE ARCHITECTURE

AISA Project Report

Version: 1.0

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Date: 18.10.2006

Status: Final

Summary

This report describes the first results of the second phase of the AISA project's second year. The first step of this phase aimed at 1) determining which aspects (components) need to be addressed while planning Enterprise Architecture (EA) evaluation and 2) identifying the evaluation needs for EA.

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.

To determine the components needed when planning an evaluation program, a literature review was carried out. In order to define the evaluation needs for EA, the following components need to be addressed: 1) evaluation purposes, 2) audiences (stakeholders that require evaluation results), and 3) evaluation targets. Additionally, because the EA objectives provide input for defining these components, they are also considered in this study. To determine the evaluation needs for EA in terms of these components, another literature review was carried out. Moreover, the potential Critical Success Factors (CSF) for EA, which were defined during the first year of the research project, provided us as a feasible starting point for defining, in particular, the EA evaluation targets. The above components depicting the EA evaluation needs were discussed and validated in the focus group interview of seven practitioners from the participating organizations in August 8, 2006.

A general conclusion is that various evaluation purposes and various audiences may exist in an organization. The evaluation components are also dependent upon each other. For instance, the EA evaluation targets depend, at least, on the EA objectives, the evaluation purposes, and the audiences. Samples of what the evaluation components may include are provided in the report to stimulate the discussion in the organizations planning their EA evaluation.

The most important targets to be evaluated – especially in organizations that are in the early phases of their EA development – seem to be 1) scoping and purpose of EA, 2) communication and common language, 3) commitment and 4) EA models and artifacts. Additionally, because some of the evaluation questions cannot be incorporated into any specific CSF, the entire EA program is considered as a separate evaluation target. Perhaps the most pivotal, and the most difficult, question related to the entire EA program, is the question of evaluating and demonstrating the business value of EA.

It should also be remembered that EA evaluation should not be conducted in isolation; it must be compatible with, or integrated into, the other evaluation or measurement systems used in the organization.

The next steps of the project will proceed with selecting some of the evaluation targets for further scrutiny. Quality attributes will be refined and simple and usable metrics will be defined for each of these evaluation targets.



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1 Introduction

This report describes the first results of the AISA Project's second phase in the second year. The first step of this phase aimed at 1) determining which aspects need to be considered while planning Enterprise Architecture evaluation and 2) identifying possible evaluation needs for Enterprise Architecture. The step consisted of the following tasks (Figure 1):

1. Literature review and analysis: Determining the evaluation components was carried out by a literature review. The initial evaluation needs for EA (in terms of evaluation components) were determined based on a previous study done in the research project, updated and complemented by a literature review.
2. Workshop/focus group interview (Krueger and Casey 2000): Review, discussion and validation of the evaluation needs for EA was carried out in a workshop participated by seven practitioners from the co-operating companies. The workshop took place in Helsinki, August 8th 2006. Three researchers participated to the workshop; one acted as a leader of the workshop discussion and two took notes. The workshop discussion was also recorded for reviewing and completing the notes.
3. Analysis and consolidation of the results: The discussion in the workshop (focus group interview) was analyzed with the help of the tape-recordings and notes. Evaluation needs were derived from the issues brought out during the workshop discussion. These results were combined with the literature review results to be represented in this report.

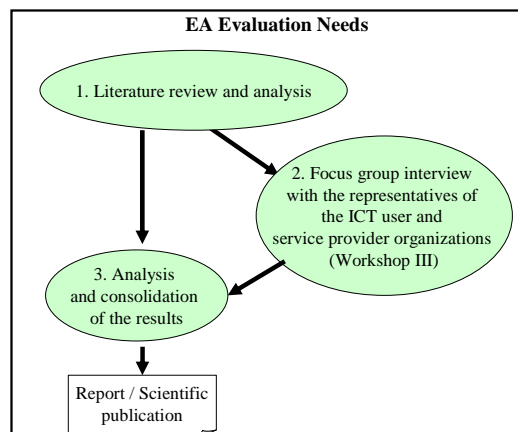


Figure 1. The steps of defining the evaluation needs for EA.

The remainder of this report is organized as follows. In the next section, we shortly describe the main concepts of Enterprise Architecture, quality, and evaluation. In the proceeding section, the evaluation needs for EA are described in terms of appropriate evaluation components. Following this, the implications for the practitioners are discussed and the last section summarizes the report.



2 Enterprise Architecture and Quality

Architecture is generally defined as “the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution” (IEEE 2000). Besides this rather static definition of architecture, it can be understood more functionally to gain an understanding of what activities are associated with architecture:

- Architectures are described with different models for different viewpoints, layers or dimensions of the architecture to lay out different aspects of the system or enterprise for analysis and planning of designs, evaluation of them, and documentation of the implemented constructs (Zachman 1987; Spewak and Hill 2000; The Open Group 2002).
- Architecture descriptions are used for further specification, design and development work on systems that are within the architecture or adjoin it over an interface. Architecture descriptions are in the case of EA very probably created by different roles and different people than those who use them for this further work.

Enterprise Architecture (EA) can be seen as a collection of all those models necessary for managing and developing an organization (Halttunen 2002). It is vital that Enterprise Architecture is derived from the visions and business strategies of an organization. Only then the enterprise architecture enables the organization to achieve its business goals (Armour, Kaisler et al. 1999a). Lately the concept of Enterprise Architecture has been defined as follows (Kaisler, Armour et al. 2005):

Enterprise Architecture “identifies the main components of the organization, its information systems, the ways in which these components work together in order to achieve defined business objectives, and the way in which the information systems support the business processes of the organization. The components include staff, business processes, technology, information, financial and other resources, etc. Enterprise architecting is the set of processes, tools, and structures necessary to implement an enterprise-wide coherent and consistent IT architecture for supporting the enterprise's business operations. It takes a holistic view of the enterprise's IT resources rather than an application-by-application view.”

2.1 High-Quality Enterprise Architecture

An Enterprise Architecture, to be successful, needs to be understood, accepted and used in everyday business functions, including also the various activities conducted by the top-management. The success needs also to be measured in order to ensure that desired results are achieved. The success, and also the quality, of EA could be measured, for example, by the extent it supports 1) the information system development projects, 2) the top management's business decisions, and 3) ICT enhancement in the organization from the CIO's point of view.

While there is no widely accepted definition of a high-quality EA, we have suggested (Ylimäki 2005; Ylimäki 2006) that *EA has high quality* if it



- conforms to the agreed and fully understood business requirements,
- fits for the purpose, which is to gain business value through EA, and
- satisfies the different stakeholders' (e.g. the top management, IT management, architects, developers) expectations in a cost-effective way and understands their current needs as well as the future requirements.

The different views of EA quality presented above implicitly imply that the quality of EA is more than merely the quality of the implemented EA, indicating that it is successfully used. The quality of EA may also refer to the quality of EA documentation, the quality of the EA development process, the quality of EA governance (process), and so forth.

2.2 Critical Success Factors for Enterprise Architecture

Critical success factor (CSF) is a common concept used e.g. in the context of total quality management (Badri, Davis et al. 1995), software architectures (Bredemeyer Consulting 2000) or project management (Clarke 1999). We have suggested (Ylimäki 2005; Ylimäki 2006) that *critical success factors for Enterprise Architecture* are the things 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. However, EA is not the silver bullet, and the EA success does not happen over night. The EA effort “provides an opportunity to get more value from the architecture, but realizing that value takes time and a long-term strategic process” (Boster, Liu et al. 2000).

During the first year of the AISA project potential CSFs for EA (Figure 2) were defined (Ylimäki 2005; Ylimäki 2006). A brief description of each potential CSF is given in Table 1.

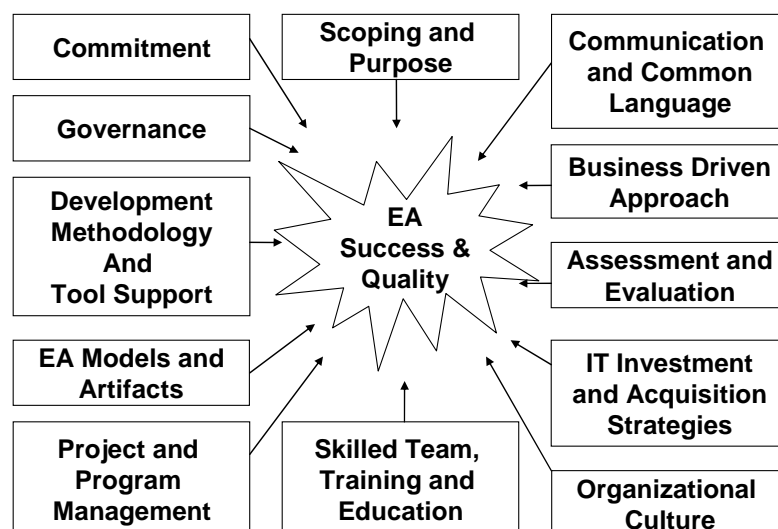


Figure 2. Potential Critical Success Factors for EA.



Table 1. Brief descriptions of the potential Critical Success Factors for EA.

CSF	Description/Content
Scoping and Purpose	Includes the definition of architecture (EA/SA) in the organization, the key stakeholder groups, the mission, goals and direction of EA, the purpose of EA and how wide organizationally, how deep and detailed, and how fast should the EA be developed in the organization.
Business Driven Approach	Includes the business linkage of architecture (EA) development, business-IT alignment, the business requirements, as well as the requirements set by the various stakeholders, and the equivalency between the requirements and architecture.
Communication and Common Language	Deals with the definition of architectural concepts (the common vocabulary), the definition of communications plan and strategy, and the success of architecture related communication.
Commitment	Refers to the commitment and involvement of the top-management in the architectural work, as well as the organizational buy-in.
Governance	Relates to issues such as governance (and guidance) structures, roles, responsibilities, processes and activities, change management processes (both the organizational and the architectural changes), and risk management processes.
IT Investment and Acquisition Strategies	Deals with the relationship (and dependency) between architectures or architectural work as well as with the IT investment and acquisition strategies of the organization.
Development Methodology and Tool Support	Deals with issues such as the definition and usage of the architecture frameworks, development methods and tools in architecture development and management.
EA Models and Artifacts	Deals with issues such as developing a documentation plan, collecting and analyzing the business requirements, ensuring that all necessary views are modeled providing a coherent and concise picture of the enterprise (current and future models), and developing a transition plan.
Assessment and Evaluation	Deals with the definition of issues, such as, architecture evaluation targets, architecture evaluation purposes and audience, architecture evaluation process and criteria (metrics), data gathering and analysis techniques.
Skilled Team, Training and Education	Refers to issues such as the capabilities and skills of the architecture team, the architecture/business training of architects, as well as other stakeholders.
Organizational Culture	Deals with issues such as the organization's readiness to develop and utilize EA, attitudes towards architecture approach, attitudes towards changes in general, and the organizational changes the architecture development may lead to.
Project Management	Deals with issues such as the coordination between various (architecture) projects, utilization of project milestones and checkpoints for architectural evaluation or guidance, taking advantage of lessons learned and best practices as well as being on budget and schedule.



3 Evaluation Components

Evaluation can be described as “a process of determining merit, worth, or significance” (Lopez 2000). **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” (Taylor-Powell, Steele et al. 1996). However, the evaluation discipline lacks a general theory, and in the different areas of knowledge different approaches are applied (Lopez 2000). An example of the categorization of these various approaches is briefly depicted in Table 2. The categories seem not to be exclusively distinguishable, especially, if the Consumer- and Participant-Oriented approaches are combined, the resulting approach can be regarded as the Stakeholder-oriented approach, because Consumer (or Customer) is one of the stakeholders to be kept on mind.

Table 2. An example of categorization of evaluation approaches (Fitzpatrick, Sanders et al. 2004).

Approach	Description
Objective-oriented	Focuses on making clear the goals and objectives and measuring how the project has done in reaching them. This approach is suitable if measuring outcomes is a major purpose of the evaluation.
Management-oriented	The aim is to identify and provide information needed by e.g. the project managers. This approach is suitable if a major purpose of the evaluation is program development.
Consumer-oriented	The aim is to provide information for users of products or services. This approach is suitable when either improving products or services or helping users to select among different products or services.
Expertise-oriented	The arguments for and against an action or proposal are laid out, as in a trial. This approach is suitable if the purpose of the evaluation is to determine whether or not to continue a project/program.
Adversary-oriented	Provides a balanced examination of all sides of controversial issues, highlighting both strengths and weaknesses.
Participant-oriented	Program participants and stakeholders are the key sources of both questions and the information to answer the questions. This approach is suitable for program improvement purposes.

Many other classifications exist, too (see e.g. Lopez 2000). 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 (Juran and Godfrey 2000; Dale 2003). We share the similar viewpoint in this study: EA evaluation can roughly be divided into the evaluation of 1) EA models and artifacts (product view) and 2) the rest of the CSFs described in Figure 2 and Table 1 (process view). This report focuses on the evaluation needs for EA including also the EA models and artifacts on a general level. A more detailed analysis of the



evaluation needs for the architecture models and artifacts is described in (Hämäläinen 2006).

A lot of literature exists on evaluation (Shadish, Cook et al. 1991; Taylor-Powell, Steele et al. 1996; Lopez 2000; Stufflebeam 2001; Fitzpatrick, Sanders et al. 2004; Chen 2005). In Table 3 the building blocks, the components, for evaluation are briefly described. All the components need to be addressed while planning the EA evaluation.

Table 3. The components of evaluation planning.

Component	Description	References
Purpose	The purpose of the evaluation: <ul style="list-style-type: none"> - Why are we doing the program? - Why are we doing the evaluation? - What's the point? What do we want to accomplish? 	(Taylor-Powell, Steele et al. 1996), (Titcomb 2000)
Target	The object under evaluation (to delimit the factors to be considered): <ul style="list-style-type: none"> - What are we going to evaluate (the whole program, just a particular component, or some components)? 	(Lopez 2000), (Taylor-Powell, Steele et al. 1996)
Audience	Potential users of the evaluation information/results: <ul style="list-style-type: none"> - Who will use the evaluation (results)? - How will they use it? - What they want to know? What questions will the evaluation seek to answer? 	(Taylor-Powell, Steele et al. 1996; Grasso 2003)
Quality Attributes and Metrics	The characteristics of the target that are to be evaluated <ul style="list-style-type: none"> - What information will help answer the questions? - What information do you need to answer the questions? 	(Taylor-Powell, Steele et al. 1996; Lopez 2000), (Titcomb 2000)
Yardstick or Standard	The ideal target against which the real target is to be compared.	(Lopez 2000; Titcomb 2000)
Data Gathering Techniques	The techniques needed to obtain data to analyze each criterion/indicator: <ul style="list-style-type: none"> - What sources of information will be used? - What data collection method(s) will be used? - What 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? - What is the schedule for data collection? 	(Taylor-Powell, Steele et al. 1996; Lopez 2000), (Titcomb 2000)
Synthesis Techniques (Data	Techniques used to judge each criterion and, in general, to judge the target, obtaining the results of evaluation: <ul style="list-style-type: none"> - How will the data be organized or tabulated? 	(Taylor-Powell, Steele et al. 1996; Lopez 2000), see also (Grasso 2003)



Component	Description	References
Analysis Techniques)	<ul style="list-style-type: none"> - What, if any, statistical techniques will be used? - How will narrative data be analyzed? - Who will organize and analyze the data? - How will the information be interpreted and by whom? - How will the evaluation be communicated and shared? To whom? 	
Evaluation Process	<p>Series of activities and tasks by means of which an evaluation is performed:</p> <ul style="list-style-type: none"> - What steps are needed? E.g. planning or preparation (evaluation design), examination (data gathering), decision making (synthesis, analysis, documentation) - When will the steps be conducted? - How long will it take to conduct each step, to collect the data needed? - Who conducts the steps? Who collects the data? - How will the results be documented, reported, communicated? - Who will receive the report? Will it answer their questions? 	<p>(Lopez 2000) (Taylor-Powell, Steele et al. 1996), (Titcomb 2000)</p>
Manage the evaluation	<p>Responsibilities, budget and timeline. Risks.</p> <ul style="list-style-type: none"> - What resources do you need? - Whose time and how much of it is available to work on evaluation? - How much may the evaluation work cost? - What kind of expertise is needed to conduct the evaluation? - When is the evaluation (information) needed? (the flexibility is needed; evaluation should be adjusted so that it is completed when it will have the maximum impact) - What threats will damage the integrity of the data and the conclusions we want to draw? - Do you foresee any barriers or obstacles? 	<p>(Taylor-Powell, Steele et al. 1996) (Titcomb 2000) (Grasso 2003)</p>

In the workshop discussion, it was brought up that also the objectivity of evaluation and evaluation information need to be addressed. 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 on an acceptable level.

Relationships between the components are, to some extent, depicted in Figure 3. EA objectives are included in the figure because they affect both the purposes and the targets of EA evaluation by providing input for them.



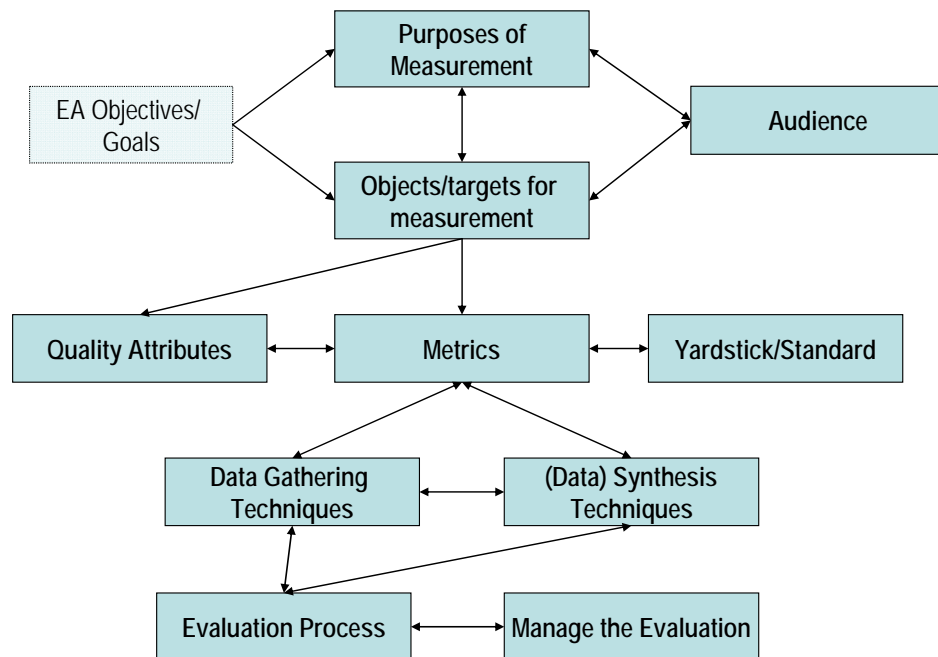


Figure 3. EA Evaluation components.

Since the aim of this step of the AISA project is to determine the EA evaluation needs, the rest of the report focuses on the following evaluation components: 1) EA objectives, 2) evaluation purposes, 3) audiences, and 4) evaluation targets.

After addressing these components, we are able to go on defining suitable evaluation criteria (quality attributes), and usable and simple metrics to evaluate each target.



4 EA Objectives

EA objectives define the goals for 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 seen. Based on the literature review, several possible objectives were found to drive the EA work. The objectives are roughly categorized into 1) technology related, 2) strategic, 3) business, 4) financial and 5) miscellaneous objectives. Samples of EA objectives in each category are listed in Table 4, where, especially, the issues brought up in the workshop are referred to as (FGI 2006). More objectives are listed in the Appendix 1

In the workshop, one important trigger for EA work was brought up, namely 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 system environment (legacy systems). It has become ever more challenging to control this multifaceted environment – no one, nowhere, understands the “big picture”, and difficulties arise especially in the decision making process. As a conclusion, there may be no way of seeing how a decision affects the different parts of the organization (processes, information systems, people, technology, and so forth). 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.

Table 4. Some examples of EA objectives.

Category	Objective	Literature References
Technology	<p>Increased interoperability and integration of e.g.</p> <ul style="list-style-type: none"> - Information systems supporting the business - Data, business processes - Legacy, migration and new systems (FGI 2006) <p>→ aiming at simpler systems and lower costs (FGI 2006)</p> <p>Also the conformance of new technologies to EA and the effects of obsolete technologies should be taken into consideration (FGI 2006)</p>	<p>(Hjort-Madsen 2006) (The Open Group 2002) (OMB FEA Program Management Office 2004) (CIO Council 2001) (IAC 2005) (GAO 2003) (Anaya and Ortiz 2005)</p>
Strategic	<p>More strategic agility, e.g.</p> <ul style="list-style-type: none"> - Business adaptability - Strategic adaptability - Increased organizational flexibility/agility 	<p>(Bhathena 2006) (Morganwalp and Sage 2004) (Kamokawa and Okada 2005) (Saha 2004) (Aziz, Obitz et al. 2005) (Guevara and Workman 2006)</p>
	Better economies of scale	(Syntel 2005)



Category	Objective	Literature References
	Volume thinking (FGI 2006)	(CIO Council 2001)
Business	Business Process Excellence; Low cost provider, emphasizing efficient, reliable and predictable operations	(Ross and Weill 2005) (Van Grembergen and Saull 2001) (Kamokawa and Okada 2005)
	Improved Business-IT alignment	(Morganwalp and Sage 2004) (CIO Council 2001) (Aziz, Obitz et al. 2005; Malan and Bredemeyer 2005)
	Better management of IT investments, e.g. - To inform, guide, and constrain the decisions for the enterprise - Faster, simpler, and cheaper procurement - Reduced risks	(Van Grembergen and Saull 2001) (The Open Group 2002; Saha 2004) (CIO Council 2001)
	Reduced product/service time to market / time of delivery, leading to e.g. - More product leadership	(CIO Council 2001; Aziz, Obitz et al. 2005; Ross and Weill 2005) (Morganwalp and Sage 2004; IAC 2005),(GAO 2003), (Guevara and Workman 2006)
	More sophisticated asset management, e.g. - Predicting and controlling complex technical systems	(Morganwalp and Sage 2004), (Hjort-Madsen 2006)
Financial	Lower IT Costs - Lower IT operations costs - Improved IT operations efficiency - Lower support and maintenance costs - Reduced application development, implementation and maintenance cost - Lower acquisition costs - More efficient use of software licenses	(Ross and Weill 2005), (Morganwalp and Sage 2004; Aziz, Obitz et al. 2005) (The Open Group 2002) (Syntel 2005) (Van Grembergen and Saull 2001) (FGI 2006)
Miscellaneous	Improved Innovation, e.g. - Emerging technologies research - Supporting knowledge development and management	(The Open Group 2002) (Kamokawa and Okada 2005), (Van Grembergen and Saull 2001) (Morganwalp and Sage 2004)
	Improved change management, e.g. - EA “is the means to describe your business in terms of people, processes and IT in order to facilitate rapid and valuable impact analysis, thereby enabling performance-oriented change management” (MEGA 2006) - to support cultural and organizational changes, assist in implementing change - Life cycle thinking and change management (FGI 2006)	(CIO Council 2001) (OMB FEA Program Management Office 2004) (Schekkerman 2004b) (de Boer, Bosanque et al. 2005) (IAC 2005) (GAO 2003) (MEGA 2006) (Kluge, Dietzsch et al. 2006b) (Guevara and Workman 2006)



5 EA Evaluation Purposes

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

The EA evaluation purposes were planned to be organized according to the categories described in Table 2. However, this proved to be a non-trivial task because some evaluation purposes seemed to fit into several categories. Hence, we decided to define more informative categories to depict high-level purposes for EA evaluation. The categories used in organizing the EA evaluation purposes are the following: 1) Aiding decision making, 2) Describing results, 3) Assessing/Assuring results, 4) Analyzing results, 5) Describing process/product, and 6) Analyzing process/product. It should be noticed that this categorization is only a suggestion and other categorizations can be created. Samples of EA evaluation purposes in each category are listed in Table 5. The table also includes potential alternatives of the categorization described in Table 2. More EA evaluation purposes are listed in the Appendix 2.

Table 5. Some examples of EA evaluation purposes.

Category	Purpose	Literature References
Aiding decision making (Management-oriented/Expertise-oriented)	To inform management decisions and actions to e.g. <ul style="list-style-type: none"> - Direct EA or EA program improvement - Inform EA policymaking - Support decision making about the EA program/project itself → to steer the program 	(Basili, Caldiera et al. 1994) (ETS Office 2003) (Stufflebeam 2001) (GAO 2003)
Describing results (Objective-oriented)	To provide stakeholders with accurate accounting of EA program results, by e.g. <ul style="list-style-type: none"> - Demonstrating alignment with business strategy - Demonstrating the (business) value of EA, - Demonstrating the benefits of EA - Demonstrating the value of IT/IT investments - Evaluating the effectiveness of EA - Evaluating the quality of the (EA) processes and products 	(Van Grembergen and Saull 2001; Aziz, Obitz et al. 2006) (Basili, Caldiera et al. 1994) (GAO 2003) (Department of Veterans Affairs 2001)



Category	Purpose	Literature References
Assessing / assuring results (Objective- oriented)	<p>To determine if the objectives of EA or EA program are achieved, by e.g.</p> <ul style="list-style-type: none"> - Demonstrating alignment with business strategy - Demonstrating the (business) value of EA, - Demonstrating the benefits of EA - Demonstrating the value of IT/IT investments - Evaluating the effectiveness of EA - Evaluating the quality of the (EA) processes and products - Performing cost-benefit analysis <p>An important aspect of assuring results is also to evaluate different architecture solutions in order to choose the most suitable solution for the organization</p>	<p>(Aziz, Obitz et al. 2006) (Van Grembergen and Saull 2001); (Stufflebeam 2001) (Morganwalp and Sage 2004) (Basili, Caldiera et al. 1994; GAO 2003) (Department of Veterans Affairs 2001); (IEEE 1998)</p>
Analyzing results (Objective- oriented)	<p>To examine EA or EA program objective and benefit achievement trends (e.g. short or long term), by e.g.</p> <ul style="list-style-type: none"> - Assessing the progress towards goals of the EA development/deployment - Assessing the progress towards target architecture 	<p>(Basili, Caldiera et al. 1994) (GAO 2003); (ETS Office 2003); (Stufflebeam 2001) (Department of Veterans Affairs 2001)</p>
Describing process /product (Participan t-oriented/ Consumer- oriented)	<p>To determine cause and effect relationships in EA program or EA, e.g.</p> <ul style="list-style-type: none"> - Assessing the impacts of changes - Evaluating the impact of corrective action - Evaluating the impact of decisions made (e.g. how they have affected the target architecture) 	<p>(The MITRE Corporation 2004; de Boer, Bosanque et al. 2005); (Basili, Caldiera et al. 1994; Stufflebeam 2001)</p>
Analyzing process/ product (Managem ent- oriented)	<p>To explicate and illuminate EA or EA program, for e.g.</p> <ul style="list-style-type: none"> - Identifying and assessing risks (operational, related to EA, related to business, related to different views of architecture (business, information, application, technology), to e.g. avoid over engineering (over engineering is a risk and may result in wasted resources) - Clarifying and prioritizing requirements - Understanding and documenting architecture - Organizational learning 	<p>(The MITRE Corporation 2004) (Rajput 2004) (Stufflebeam 2001; Jayashetty, Manjunatha et al. 2004) (Abowd, Bass et al. 1997)</p>



6 EA Evaluation Audiences

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

In the beginning of the workshop, potential stakeholder groups of Enterprise Architecture were discussed and these are described in (Niemi 2006). In Figure 4, some potential stakeholders – audiences – of EA evaluation results are described. Audiences that were added based on the workshop discussion are: Business Process Management/ Process Developers, Business Users, Product Management, Projects/ Project Managers, and Research and Development (R&D).

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 needs for evaluation because they are interested in different points of view (financial, strategic, efficiency, and so forth). A balance, or priority, between these various needs have to be addressed. In practice, one or two of the audiences are usually dominating, and therefore, their needs may be given first priority.

An important stakeholder group, that is not actually an evaluation information audience, but assists the EA evaluation team (either internal or external evaluators) to format the evaluation information using a language that is comprehensible for each audience, is Internal Communications.

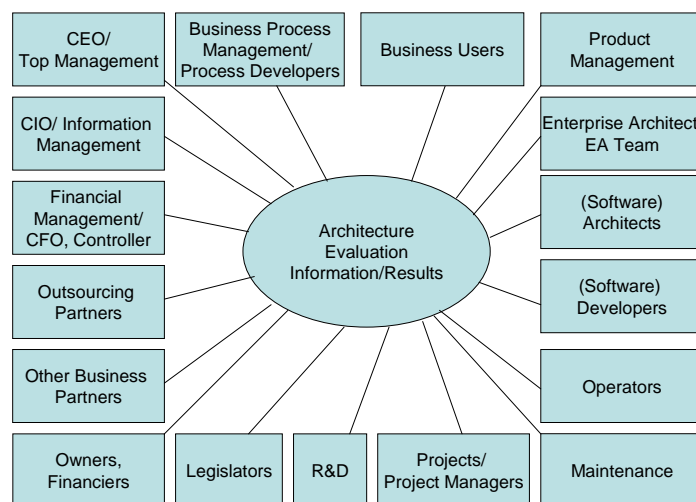


Figure 4. Some possible audiences for EA Evaluation results.



7 EA Evaluation Targets

CSFs for EA, which were briefly described in Table 1, 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, the compatibility between these evaluation components should be assured.

The characteristics of the evaluation targets indicating the aspects or qualities of the targets that will be evaluated, are usually described with the help of quality attributes. Unfortunately, there is no consensus on what the quality attributes for EA are or should be. Some preliminary studies, suggesting quality attributes especially for EA, have been conducted (van den Bent 2006; Veltman-van Reekum 2006). At this point of the research project, an alphabetical list of possible attributes is provided (see Appendix 3) to stimulate the determination of the characteristics that are to be evaluated about each target.

EA evaluation targets are represented in Table 6. Some sample evaluation questions are related to each target. Especially, the issues addressed in the workshop discussion are referred to as (FGI 2006). Additionally, a more detailed analysis of the evaluation needs for architecture models and artifacts is represented in (Hämäläinen 2006).

While some of the evaluation needs (evaluation questions) cannot be incorporated into any specific CSF, also the entire EA program is considered as a separate evaluation target. Evaluation questions related to the entire EA program are, particularly, how is the program progressing, what is the business value of the EA (program), how mature is the EA (program), or how well does EA ensure, for instance, business process excellence, customer orientation, innovation or strategic adaptability.

Table 6. EA Evaluation targets and sample evaluation questions.

Evaluation Target and Sample Evaluation Questions	Literature References
Scoping and Purpose	
- To what extent are the objectives and benefits of the architecture approach identified, documented and approved in the organization? How clear or understandable are the objectives and benefits?	(Jayashetty, Manjunatha et al. 2004) (Ylimäki 2006)
- Are the objectives derived from the business or IT strategies of the organization (FGI 2006)?	(Hilliard, Kurland et al. 1996; Hilliard, Kurland et al. 1997)
- To what extent are the stakeholders of EA and their concerns identified?	(Morganwalp and Sage 2004)
- To what extent does the architectural work cover the organization?	(IAC 2003)
- What is the scope of the EA? How has it changed/expanded during the last quarter/year etc.? How controllable is the EA scope? (FGI 2006)	(NASCIO 2004) (Motola 2006)
- To what extent are the objectives and benefits of the architecture approach evaluated in order to ensure that they are met?	



Evaluation Target and Sample Evaluation Questions	Literature References
<p>Business Driven Approach</p> <ul style="list-style-type: none"> - To what extent are the business requirements taken into account in architectural planning? - To what extent are the business requirements identified and documented? - To what extent are the business requirements prioritized and how they are prioritized? To what extent are they conflicting or competing? To what extent is the architecture team aware of the changes in business requirements? Has the architecture team all necessary information related to the business? (FGI 2006) - To what extent do the requirements cover the concerns of stakeholders? To what extent are the requirements of different stakeholders in balance (FGI 2006)? - To what extent are the requirements relevant to e.g. business strategy? - To what extent is the equivalency between the requirements and architecture assured? 	<p>(Luftman 2000; ETS Office 2003) (Ylimäki 2006) (OMB FEA Program Management Office 2004; OMB 2005) (Curran 2005) (Hilliard, Kurland et al. 1996; Hilliard, Kurland et al. 1997; Burk 2005) (CIO Council 2000)</p>
<p>Communication and Common Language</p> <ul style="list-style-type: none"> - To what extent are the architectural concepts defined, documented, approved and used in communication? - To what extent is the communication on architectures and architectural work established between different stakeholders? - To what extent are the architects/the architecture team capable of communicating with different stakeholders using the language these stakeholders can comprehend (FGI 2006)? - To what extent are the relevant stakeholders and their concerns identified? - To what extent is communication evaluated? How effective and successful is the communication? Has the architecture communication reached the key stakeholders? Has the communication been understandable? - Has the communication been on such a level (granularity) that it satisfies the needs of the stakeholders (FGI 2006)? - To what extent has the architects/architecture team been capable of communicating the top management whether the business requirements can be implemented in the schedule set by the business (FGI 2006)? - To what extent are the communication challenges identified and responded to? 	<p>(ETS Office 2003; Ylimäki 2006) (IAC 2003; OMB 2005) (NASCIO 2004; Tash 2006)</p>
<p>Commitment</p> <ul style="list-style-type: none"> - To what extent is the (top) management aware of the architecture approach of the organization (FGI 2006)? - To what extent is the (top) management aware of the objects and benefits of EA? - To what extent is the (top) management committed to and involved in the architecture approach? Does the management sponsor the EA approach (FGI 2006)? - To what extent are the other stakeholders aware of the architecture approach of the organization (FGI 2006)? - To what extent are the other stakeholders committed to and involved in the architecture approach? 	<p>(ETS Office 2003) (Jayashetty, Manjunatha et al. 2004; Ylimäki 2006) (Kamokawa and Okada 2005) (GAO 2003; IAC 2003)</p>



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Evaluation Target and Sample Evaluation Questions	Literature References
<ul style="list-style-type: none"> - To what extent do the various stakeholder groups participate in the architecture development? 	
<p>Governance</p> <ul style="list-style-type: none"> - To what extent is the governance structure defined, documented, approved and established? Are the roles, responsibilities and authorizations defined, documented and complied? Are the authorizations adequate enough (FGI 2006)? - To what extent are the governance processes and tasks defined, documented and implemented? - Does the governance have the necessary resources (time, money, etc.) (FGI 2006)? - How is the architecture work/governance positioned in the organization (e.g. in the information system management/CIO or elsewhere in the organization chart)? How successful has this solution been? Is there any need to reposition the architecture work/governance? (FGI 2006) - To what extent are architecture policies/ guiding principles defined, documented and approved? - To what extent does the governance assure e.g. the effectiveness of participation, presence of right processes, or the alignment with organization's strategic goals? - To what extent are both the architectural and organizational changes and risk management issues taken into account? - How effective are the EA governance processes, structures and practices? How helpful are they considered e.g. by the projects (FGI 2006)? Has there been a need to change these processes? How many changes have been needed? (FGI 2006) - To what extent do the governance processes provide feedback to the strategic or business planning processes (FGI 2006)? - To what extent is the EA governance process integrated into other business management processes (FGI 2006)? - Is there a formalized EA compliance process? How effective is it? - How effective is the planning, tracking and utilization of resources? 	<p>(Jayashetty, Manjunatha et al. 2004) (ETS Office 2003; Curran 2005; Ylimäki 2006) (GAO 2003) (Kamokawa and Okada 2005) (Ross 2004a) (Hilliard, Kurland et al. 1996; Hilliard, Kurland et al. 1997; Weill and Woodham 2002; Burk 2005) (OMB 2005) (CIO Council 2000; IAC 2003) {NASCIO, 2004 #729}</p>
<p>IT investment and Acquisition Strategies</p> <ul style="list-style-type: none"> - To what extent does architectural work influence the IT investments and acquisition strategies of the organization? - How many investments comply with EA? How many do not comply with EA and why not? - How effective are the investment and acquisition strategies? - How effective/viable/practical is the investment decision making (process) (FGI 2006) 	<p>(DoC 2003); (ETS Office 2003); (GAO 2003); (Ylimäki 2006); (Burk 2005); (Hilliard, Kurland et al. 1996; Hilliard, Kurland et al. 1997); (Tash 2006); (CIO Council 2000)</p>



Evaluation Target and Sample Evaluation Questions	Literature References
<p>EA Development Methodology and Tool Support</p> <ul style="list-style-type: none"> - To what extent is the architecture framework defined, documented, approved and used? - To what extent is architecture development controlled by an established process or methodology? - To what extent is the architecture development supported by (automated) tools? - To what extent are methodologies and methodology use evaluated? How effective are the methodologies (FGI 2006)? Do they provide sufficient guidance? Do they support reuse of models, patterns etc.? - To what extent are tools and tool use evaluated? How helpful are the tools, can the work be done faster with them (FGI 2006)? How well do they support the architecture development and management? How effectively are the tools used? - 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 (FGI 2006)? - To what extent is architecture process evaluated? How effective is the architecture process? To what extent does the architecture process meet its quality criteria? - What are the costs of methodology use? To what extent are verifiable benefits received from methodology use? - To what extent are verifiable benefits received from framework use? 	<p>(ETS Office 2003) (Ylimäki 2006) (GAO 2003; Burk 2005) (Hilliard, Kurland et al. 1996; Hilliard, Kurland et al. 1997) (Morganwalp and Sage 2004) (IAC 2003) {NASCIO, 2004 #729} (Motola 2006)</p>
<p>EA Models and Artifacts</p> <p>Notice that a more detailed analysis of the evaluation needs for architecture models and artifacts is represented in (Hämäläinen 2006)</p> <ul style="list-style-type: none"> - To what extent are the document templates designed and how useful have those templates been (FGI 2006)? - To what extent are 1) the current and 2) objective states of EA and 3) the transition plan described, documented and approved? - How many decisions were made to develop e.g. the target architecture? How long did it take make these decisions? (FGI 2006) - How many components there are in the system (FGI 2006)? - To what extent are the models and documentation evaluated? To what extent do models and documentation meet the evaluation criteria (e.g. quality attributes)? - Are the models understandable and clear? Are they up-to-date? Are they complete enough? Are the concepts used in the models consistent? Are the models consistent enough providing a holistic view of the organization? (FGI 2006) - To what extent are the models and documentation used? How many stakeholders use models and documentation? (FGI 2006) - To what extent is model and documentation use measured? Are they useful to particular stakeholders? Do they provide the information needed by a particular stakeholder? (FGI 2006) - To what extent are the different views of EA aligned? Do they provide a coherent view of the organization? (FGI 2006) - How flexible is the architecture? To what extent does it consider the future (business) requirements that can be seen at present (FGI 2006)? - To what extent is the compliance of models and (the implemented) architecture evaluated? How compliant are they? 	<p>(Carbone 2004a; Ylimäki 2006) (GAO 2003) (Vasconcelos, Pereira et al. 2004) (Department of Veterans Affairs 2001; Burk 2005) (Hilliard, Kurland et al. 1996; Hilliard, Kurland et al. 1997) (Morganwalp and Sage 2004) (OMB 2005) {NASCIO, 2004 #729} (Guevara and Workman 2006)</p>



Evaluation Target and Sample Evaluation Questions	Literature References
<p>Assessment and Evaluation</p> <ul style="list-style-type: none"> - To what extent are the needs for architecture evaluation identified and approved? To what extent do these needs correspond to the maturity of the organization's EA as well as to the organization's policies (ways of working)? (FGI 2006) - To what extent are the users of evaluation information identified (= stakeholders and their concerns)? - To what extent are the targets of evaluation identified? - To what extent are the evaluation criteria and metrics identified? - To what extent are the evaluation criteria and metrics aligned with the other evaluation metrics used in the organization (FGI 2006)? - To what extent are the evaluation points identified? What is the time-frame of evaluation (FGI 2006)? - To what extent are the evaluation practices identified? - To what extent are the costs and benefits of evaluation measured? - What are the costs of evaluation? To what extent are verifiable benefits received from evaluation? (Cost-benefit analysis) - Are evaluation techniques aligned with architecture maturity? - To what extent is the evaluation program assessed? Are we evaluating the right things? Does the evaluation provide right information for the right stakeholders at a right time? Is the evaluation process or techniques effective (e.g. in the sense of time and money)? 	<p>(Ylimäki 2006) (GAO 2003) (Burk 2005) (Hilliard, Kurland et al. 1996; Hilliard, Kurland et al. 1997) (CIO Council 2000; IAC 2003; Aziz, Obitz et al. 2006) (IEEE 1998)</p>
<p>Skilled Team, Training and Education</p> <ul style="list-style-type: none"> - To what extent are the roles and responsibilities of the architecture team (architects) defined? - Does the team have the necessary resources (time, money, etc.) (FGI 2006)? - To what extent does the team has the necessary skills and knowledge needed in architectural work? How skillful and knowledgeable is the team? To what extent does the team has various skills and experience (in business, technology, system development, architecture, etc.) (FGI 2006)? - How have the necessary skills been acquired; through training, hiring, partners, consultants etc. (FGI 2006)? - To what extent is training and education available for the architects, for the other stakeholders? Is the training provided internally/externally? - To what extent are the training and education needs of other stakeholders taken into account? How skillful and knowledgeable are they? - To what extent has a training plan been developed and followed? - To what extent is training and education evaluated? How effective is training and education? How many persons have gained training/education? What kind of training/education? How much has it cost? 	<p>(Jayashetty, Manjunatha et al. 2004), (IT Governance Institute 2005) (ETS Office 2003) (Ylimäki 2006) (Kamokawa and Okada 2005) (GAO 2003) (OMB 2005) (IAC 2003)</p>



Evaluation Target and Sample Evaluation Questions	Literature References
<p>Organizational Culture</p> <ul style="list-style-type: none"> - To what extent is the architecture approach approved by the organization? How aware are the organization members of the architecture approach and its objectives (FGI 2006)? How is the EA perceived by the organization (members)? - To what extent are the cultural challenges or constraints for architectural work been identified? - To what extent are the challenges or constraints responded to? - To what extent is the organization willing to change in general? To what extent are the employees resistant or willing to change in general? - How do the organization members response to architecture driven changes? - How has EA affected the organization, its structure and culture, after integrating or consolidating e.g. some of the financial and personnel management functions (FGI 2006)? - How long time has is taken to make the required changes in the organization? Has it taken longer or shorter time than earlier? (FGI 2006) 	<p>(Ylimäki 2006) (META Group Inc. 2000; Rudawitz 2003)</p>
<p>Project and Program Management</p> <ul style="list-style-type: none"> - To what extent is the coordination between architecture development or implementation projects organized? - To what extent does the project methodology emphasize the importance of architecture? To what extent does the project methodology include architecture guidance (FGI 2006)? - To what extent has a project gained architecture guidance? How useful has the guidance been? (FGI 2006) - To what extent are the project milestones defined? To what extent is architectural evaluation done on the milestones (= architectural compliance review)? - To what extent are the lessons learned collected and transferred during or in the end of the project? - How successful have the project budgeting and scheduling been? How many projects have been successful in the sense of time and money? How many projects have had to refine budget, schedule or the project scope (FGI 2006)? Why? - Does the project deliver what was needed (what was planned) on schedule? If not, why not? - To what extent are the business objectives met? - To what extent are the architectural objectives met? - To what extent are the project objectives met? - To what extent are the EA-guiding principles followed in the project? - How is the architecture compliance of a project assured? To what extent do the projects fit to the EA? - How many projects have had difficulties in following the guiding principles or architectural constraints? How many projects have indicated a need to change or refine the architecture (plans, objectives etc.)? (FGI 2006) - What is the business value of (IT) projects? 	<p>(Carbone 2004a) (Ylimäki 2006) (Ross 2004a) (Van Grembergen and Saull 2001) (GAO 2003) (Hilliard, Kurland et al. 1996; Hilliard, Kurland et al. 1997; Department of Veterans Affairs 2001; Burk 2005) (ETS Office 2003) (Motola 2006)</p>



Evaluation Target and Sample Evaluation Questions	Literature References
<p>Entire EA Program</p> <ul style="list-style-type: none"> - To what extent does EA meet the key stakeholders' concerns (i.e. captures the right information)? - What are the benefits of the EA approach to each stakeholder group (FGI 2006)? - To what extent does EA offer content to stakeholders in a satisfactory way in terms of <ol style="list-style-type: none"> 1) architecture effectiveness (doing the right things = product quality) and 2) architecture efficiency (doing the things right = process quality)? - How well EA ensures organizational alignment with business strategy? (Business Alignment) - To what extent is the progress towards the target architecture evaluated? How is the program progressing? - To what extent are the EA and business objectives and benefits met? If objectives are not met, why not, and how to assure that the same mistakes are not done again (FGI 2006)? - What kind of business impacts does EA provide? How have these impacts evolved/changed over time (quarter, year, 2-3 years, etc.)? (FGI 2006) - To what extent does EA provide the 'big picture' of the organization and assist business operations effectively in a situation where e.g. the market share is increasing, and the profitability is high (i.e. in a situation, where no radical changes are not necessary) (FGI 2006)? - How effective/viable/practical is the decision making (process) (FGI 2006) - How has EA affected the IT costs? Have they been decreasing or increasing? (FGI 2006) - What is the business value of EA? - What is the ROI/ROA of EA? - How well EA facilitates the management of change? - What business process/service improvements does EA provide? - What kind of support does EA provide for the business processes development and management (FGI 2006)? - How well EA ensures that interfaces, information, interoperation and connectivity are standardized (integration)? - How well EA integrates IT? (Convergence)? - How well EA ensures reuse of services and technologies? - How well EA ensures business process excellence? - How well EA ensures customer orientation? - How well EA ensures innovation? - How well EA ensures strategic adaptability? - How mature is the organization's EA (program)? How has the maturity evolved over time (quarter, year, 2-3 years etc.)? (FGI 2006) 	<p>(OMB FEA Program Management Office 2004; IT Governance Institute 2005; OMB 2005) (Kamokawa and Okada 2005) (Rico 2005) (Van Grembergen and Saul 2001) (Kluge, Dietzsch et al. 2006a) (Curran 2005) Gartner 2002; (Department of Veterans Affairs 2001) (NASCIO 2004; Burk 2005) (Guevara and Workman 2006)</p>



8 Discussion

In this section, we discuss the implications of this research for the practitioners.

Usually, each organization has its own specific objectives for the architecture approach. The purposes for evaluating the organization's EA program can be defined based on these objectives, but 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 the decision-making in a situation where the organization's role and position in its line of business is changing, while the architecture team likes to know how useful the projects have considered architecture guidance, or how many projects have effected the architecture. Once these aspects are clarified, the primary evaluation targets, that are 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 objectives for the architecture approach, its EA program – or the objectives need to be revisited to ensure and maintain the unanimity about them – it can stimulate the discussion and definition of the EA objectives with the help of the sample objectives represented in this report (section 4). Similarly, discussion on the evaluation purposes, audiences and evaluation targets can be assisted and supported by the examples represented in sections 5, 6 and 7, respectively. Cross-tabulations can be used to depict the dependencies between the different evaluation components, such as, between

- the EA objectives and EA evaluation purposes,
- the audiences and EA evaluation purposes,
- the EA evaluation purposes and EA evaluation targets, and
- the audiences and EA 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. In the workshop discussion, it was 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 the architecture. While the organization matures, more detailed business impacts can likely be measured. However, in this study, evaluation targets and evaluation questions were not mapped to the maturity levels.

Finally, in the workshop discussion, it was emphasized that no matter what the evaluation targets and metrics are, they must be compatible with, or integrated into, 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 demonstrate lower costs at the same time.



9 Conclusions

In this report, we have presented the evaluation components that need to be addressed during EA evaluation planning. Since this step of the research project aimed at determining the evaluation needs for EA, the following evaluation components were addressed (see also Table 3): 1) evaluation purposes, 2) audiences and 3) evaluation targets. Additionally, because the EA objectives provide input for defining these components, they were also addressed in this study.

Literature review gave us examples of evaluation needs, which were reviewed and discussed in the workshop participated by seven representatives of the co-operating organizations.

As a conclusion, it seems that various evaluation purposes and various audiences may exist in an organization. Furthermore, EA evaluation targets depend, at least, on the EA objectives, the evaluation purposes, and the audience. Potential CSFs for EA, defined during the first year of the research project, provided a feasible starting point for determining the EA evaluation targets. Also the entire EA program was considered as a separate evaluation target.

The importance of the scope and purpose of EA was emphasized in the focus group discussion: it should be written down, why the architecture approach is applied in the first place. Usually, the objectives of EA are derived from the strategies of the organization, either from the business or IT strategies. These strategies should explicitly convey the purpose of the IT organization, or the information systems management organization, and its objectives followed by a clear purpose and objectives for the architecture work.

Other evaluation targets that arose during the workshop discussion, and that seem to be salient – especially in the organizations taking their early steps in the EA development – were communication and common language, commitment, models and artifacts, and the evaluation of the business impacts of the EA program. The last target – evaluating the business impacts of EA, was considered to be the most difficult task: How to evaluate whether the EA process and, especially, the results (models, new information systems, new processes, new ways of doing business, and so forth), have benefited the various stakeholders? How to evaluate those benefits? An additional challenge is to prove that the business impacts are actually – or at least partially – consequences of EA efforts.

One possible solution to this problem is presented by (Guevara and Workman 2006); they state that IT projects can impact business value only by five ways, namely, by 1) increasing revenue, 2) reducing costs, 3) improving process efficiency, 4) mitigating risks, and 5) preserving capabilities.



Finally, even though the discussion in the workshop mainly focused on the enterprise architecture level, the evaluation needs (evaluation purposes, audiences, and targets) presented in this report are, to some extent, applicable to software architecture level as well.

The next steps of the project will proceed with selecting some of the architecture evaluation targets described in this report for further scrutiny. Following this, quality attributes will be refined and simple and usable metrics will be defined for each of these evaluation targets.



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APPENDIX 1. Objectives for EA.

Category	Objective	References
Technology	Standardization, e.g. - Sharing common system development methods - Ensure standard IT portfolio (convergence)	(Riland and Paterson 2006) (CIO Council 2001; OMB FEA Program Management Office 2004)
Technology	Increased interoperability and integration of e.g. - Information systems supporting the business - Data, business processes - Legacy, migration and new systems (FGI 2006) → aiming at simpler systems and lower costs (FGI 2006) “realizing that the business rules are consistent across the organization, that the data and its use are immutable, interfaces and information flow are standardized, and the connectivity and interoperability are managed across the enterprise” (CIO Council 2001)	(Hjort-Madsen 2006) (The Open Group 2002) (OMB FEA Program Management Office 2004); (CIO Council 2001) (GAO 2003; IAC 2005) (Anaya and Ortiz 2005)
Strategic	More strategic agility, e.g. - Business adaptability - Strategic adaptability - Increased organizational flexibility/agility	(Bhathena 2006) (Morganwalp and Sage 2004) (Saha 2004; Kamokawa and Okada 2005); (Aziz, Obitz et al. 2005) (Guevara and Workman 2006)
Strategic	Tighter alignment to business strategy	(OMB FEA Program Management Office 2004) (Morganwalp and Sage 2004)
Strategic	Increased market value	(IT Governance Institute 2005)
Strategic	Increased quality (of processes, products and resources), by e.g. - Simplification and consistency at every level - Integrity and dependability of aggregated data	(GAO 2003; IAC 2005; Syntel 2005)
Strategic	Better economies of scale Volume thinking (FGI 2006)	(Syntel 2005) (CIO Council 2001)
Business	Improved customer orientation, e.g. - Improved customer intimacy EA is the transformation mechanism to create one company/organization focused on its clients	(Ross and Weill 2005) (Van Grembergen and Saul 2001) (Kamokawa and Okada 2005) (IAC 2005) (GAO 2003)
Business	Business Process Excellence; Low cost provider, emphasizing efficient, reliable and predictable operations	(Ross and Weill 2005) (Van Grembergen and Saul 2001) (Kamokawa and Okada 2005)
Business	Increased (asset) productivity	(Saha 2004); (GAO 2003)
Business	Increased strategic and tight alignment with partners, e.g. - Flexible sourcing of value chain components	(Morganwalp and Sage 2004) (Aziz, Obitz et al. 2005)
Business	Improved Business-IT alignment	{ Crumps, 2006 #128 } (Morganwalp and Sage 2004) (Kluge, Dietzsch et al. 2006b) (CIO Council 2001) (Aziz, Obitz et al. 2005; Malan and Bredemeyer 2005)
Business	Synergy Achievement	(Van Grenbergen & Saul 2001)



Category	Objective	References
Business	Better management of IT investments, e.g. <ul style="list-style-type: none"> - To inform, guide, and constrain the decisions for the enterprise - Faster, simpler, and cheaper procurement - Reduced risks 	(Van Grembergen and Saull 2001; The Open Group 2002; Saha 2004) (CIO Council 2001)
Business	Managerial Satisfaction <ul style="list-style-type: none"> - More senior management satisfaction with IT - More business unit leader satisfaction with IT 	(Ross and Weill 2005)
Business	Better IT Responsiveness <ul style="list-style-type: none"> - Reduced application development, implementation and maintenance time - Faster acquisition/procurement process of IT - Technical Adaptability: <ul style="list-style-type: none"> - IT effectively responds to ever-changing business needs - To design more agile and responsive enterprise systems that provide value to the business partners' demands 	(Ross and Weill 2005) (Syntel 2005) (Van Grembergen and Saull 2001) (The Open Group 2002) (Morganwalp and Sage 2004) (Aziz, Obitz et al. 2005) (Guevara and Workman 2006)
Business	Improved and consistent communication, e.g. <ul style="list-style-type: none"> - Greater data sharing - Integrated process standards - Supporting knowledge development and management 	(Ross and Weill 2005) (CIO Council 2001) (Schekkerman 2004b) (de Boer, Bosanque et al. 2005) (Aziz, Obitz et al. 2005) (Morganwalp and Sage 2004)
Business	Reduced product/service time to market / time of delivery, leading to e.g. <ul style="list-style-type: none"> - More product leadership 	(Ross and Weill 2005) (CIO Council 2001; Aziz, Obitz et al. 2005) (Morganwalp and Sage 2004) (IAC 2005) (GAO 2003) (Kluge, Dietzsch et al. 2006b) (Guevara and Workman 2006)
Business	More sophisticated asset management, e.g. <ul style="list-style-type: none"> - Predicting and controlling complex technical systems 	(Morganwalp and Sage 2004) (Hjort-Madsen 2006)
Business	Risk Management, e.g. <ul style="list-style-type: none"> - Reduced business risk - Improved legal and regulatory compliance - Increased disaster tolerance - Reduced security breaches - Reduced decision risks - Reduced risks of investments 	(Aziz, Obitz et al. 2005; Ross and Weill 2005) (The Open Group 2002; Morganwalp and Sage 2004; IT Governance Institute 2005) (CIO Council 2001)
Business	Supported decision making (strategic and operational), leading to e.g. <ul style="list-style-type: none"> - More efficient program management 	(CIO Council 2001) (Malan and Bredemeyer 2005) (IAC 2005) (Schekkerman 2004b) (Morganwalp and Sage 2004; de Boer, Bosanque et al. 2005)
Business	Evolutionary and adaptive development and governance of architecture	(Morganwalp and Sage 2004)
Financial	Cost-effectiveness, from e.g. <ul style="list-style-type: none"> - Cost savings - Increased productivity - Increased quality 	(Syntel 2005) (Rico 2005) (Kamokawa and Okada 2005) (Tash 2006)



Category	Objective	References
Financial	Reusability of e.g. <ul style="list-style-type: none"> - Models - Code - Software and hardware components - Services - Processes 	(Aziz, Obitz et al. 2005) (Morganwalp and Sage 2004) (Riland and Paterson 2006)
Financial	Lower IT Costs <ul style="list-style-type: none"> - Lower IT operations costs - Improved IT operations efficiency - Lower support and maintenance costs - Reduced application development, implementation and maintenance cost - Lower acquisition costs - More efficient use of software licenses 	(Aziz, Obitz et al. 2005; Ross and Weill 2005) (Morganwalp and Sage 2004) (The Open Group 2002) Hite 2003; (Van Grembergen and Saull 2001) (Syntel 2005) (FGI 2006)
Miscellaneous	Improved Innovation, e.g. <ul style="list-style-type: none"> - Emerging technologies research - Supporting knowledge development and management 	(The Open Group 2002) (Kamokawa and Okada 2005) (Van Grembergen and Saull 2001; Morganwalp and Sage 2004)
Miscellaneous	Improved change management <ul style="list-style-type: none"> - EA “is the means to describe your business in terms of people, processes and IT in order to facilitate rapid and valuable impact analysis, thereby enabling performance-oriented change management” (MEGA 2006) - To support cultural and organizational changes, assist in implementing change - Life cycle thinking and change management (FGI 2006) 	(CIO Council 2001) (OMB FEA Program Management Office 2004); (Schekkerman 2004b); (de Boer, Bosanque et al. 2005) (IAC 2005), (GAO 2003), (MEGA 2006) (Kluge, Dietzsch et al. 2006b) (Guevara and Workman 2006)
Miscellaneous	Staff management excellence, e.g. <ul style="list-style-type: none"> - Reduced skill set requirements (Reduce the variety of skills required by IT professionals within the enterprise) → Increased flexibility of staffing	(Van Grembergen and Saull 2001) (Syntel 2005) (Aziz, Obitz et al. 2005)



APPENDIX 2. EA Evaluation Purposes.

Category	Purpose	References
Aiding decision making (Management-oriented / Expertise-oriented)	<p>To inform management decisions and actions to e.g.</p> <ul style="list-style-type: none"> - Direct EA or EA program improvement - Inform EA policymaking - Support decision making about the EA program/project itself - About program planning and installation - About program continuation, expansion or “certification” - About program modification <p>→ to steer the program</p> <p>“helps surface additional factors that may inhibit EA development or implementation, focuses or redirects available resources, generates support for follow-on architectures, and provides a scorecard on overall processes” (ETS Office 2003)</p> <p>“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” (GAO 2003)</p>	(Basili, Caldiera et al. 1994) (ETS Office 2003) (Stufflebeam 2001) (GAO 2003)
Aiding decision making (Management-oriented)	<p>To assess investments and payoffs, for e.g. providing a rationale to adopt or refine new techniques, methods etc.</p>	(Basili, Caldiera et al. 1994); (Stufflebeam 2001)
Describing results (Adversary-oriented)	<p>To provide balanced information on strengths and weaknesses of e.g.</p> <ul style="list-style-type: none"> - EA, EA program, organization and current processes/products - Organization’s EA readiness/EA capability 	(Basili, Caldiera et al. 1994) (Stufflebeam 2001) (META Group Inc. 2000) (Syntel 2005) (ETS Office 2003)
Describing results (Objective-oriented)	<p>To provide stakeholders with accurate accounting of EA program results, by e.g.</p> <ul style="list-style-type: none"> - Demonstrating alignment with business strategy - Demonstrating the (business) value of EA, - Demonstrating the benefits of EA - Demonstrating the value of IT/IT investments - Evaluating the effectiveness of EA - Evaluating the quality of the (EA) processes and products 	(Van Grembergen and Saull 2001; Aziz, Obitz et al. 2006) (Basili, Caldiera et al. 1994) (GAO 2003) (Department of Veterans Affairs 2001)
Assessing / assuring results (Objective-oriented)	<p>To determine if the objectives of EA or EA program are achieved, by e.g.</p> <ul style="list-style-type: none"> - Demonstrating alignment with business strategy - Demonstrating the (business) value of EA, - Demonstrating the benefits of EA - Demonstrating the value of IT/IT investments - Evaluating the effectiveness of EA - Evaluating the quality of the (EA) processes and products - Performing cost-benefit analysis 	(Aziz, Obitz et al. 2006) (Van Grembergen and Saull 2001); (Stufflebeam 2001) (Morganwalp and Sage 2004) (Basili, Caldiera et al. 1994; GAO 2003) (Department of Veterans Affairs 2001); (IEEE 1998)



Category	Purpose	References
Assessing / assuring results (Objective- oriented / Expertise- oriented)	To assure that the results of EA or EA program are positive, by e.g. - Demonstrating alignment with business strategy - Demonstrating the (business) value of EA, - Demonstrating the benefits of EA - Demonstrating the value of IT/IT investments - Demonstrating the improved business-IT alignment - Evaluating the effectiveness of EA - Evaluating the quality of the (EA) processes and products - Performing cost-benefit analysis	(Aziz, Obitz et al. 2006) (Van Grembergen and Saull 2001) (Stufflebeam 2001; Morganwalp and Sage 2004) (Basili, Caldiera et al. 1994) (GAO 2003) (Department of Veterans Affairs 2001) (IEEE 1998)
Assessing / assuring results (Objective- oriented)	To assess benefits and gains of EA or EA program, by e.g. - Demonstrating the (business) value of EA, - Demonstrating the benefits of EA - Demonstrating the value of IT/IT investments - Evaluating the effectiveness of EA - Performing cost-benefit analysis	(Aziz, Obitz et al. 2006; Cumps, Viaene et al. 2006) (Van Grembergen and Saull 2001); (Stufflebeam 2001; Morganwalp and Sage 2004) (IEEE 1998)
Analyzing results (Expertise- oriented)	To pinpoint responsibility of good and bad EA or EA program outcomes, for e.g. determining incentives	(Stufflebeam 2001)
Analyzing results (Participant- oriented)	To diagnose EA or EA program shortcomings, for e.g. Detection of problems -> directs EA or EA program improvement	(Stufflebeam 2001) (Abowd, Bass et al. 1997)
Analyzing results (Objective- oriented)	To examine EA or EA program objective and benefit achievement trends (e.g. short or long term), by e.g. - Assessing the progress towards goals of the EA development/deployment - Assessing the progress towards target architecture	(Basili, Caldiera et al. 1994) (GAO 2003) (ETS Office 2003) (Stufflebeam 2001) (Department of Veterans Affairs 2001)
Analyzing Results (Participant- oriented/ Expertise- oriented)	To compare results and benefits of EA or EA program to norms and standards (if available) or to compare performance of competing EA programs, by e.g. - Evaluating EA, EA program, organization and current processes/products - Evaluating organization's EA readiness/EA capability - Demonstrating the (business) value of EA, - Demonstrating the benefits of EA - Demonstrating the value of IT/IT investments - Demonstrating the improved business-IT alignment - Evaluating the effectiveness of EA - Evaluating the quality of the (EA) processes and products	(Aziz, Obitz et al. 2006) (Van Grembergen and Saull 2001) (Stufflebeam 2001) (Morganwalp and Sage 2004) (Basili, Caldiera et al. 1994; GAO 2003)
Describing process /product (Participant- oriented / Consumer- oriented)	To determine cause and effect relationships in EA program or EA, for e.g. - Assessing the impacts of changes - Evaluating the impact of corrective action	(The MITRE Corporation 2004; de Boer, Bosanque et al. 2005) (Basili, Caldiera et al. 1994; Stufflebeam 2001)



Category	Purpose	References
Describing process/ product (Objective-oriented/ Expertise-oriented)	To describe and critically appraise EA or EA program, for e.g. - Organizational learning - Gaining stakeholder support	(Stufflebeam 2001) (Abowd, Bass et al. 1997)
Analyzing process/ product (Management-oriented)	To explicate and illuminate EA or EA program, for e.g. - Identifying and assessing risks (operational, related to EA, related to business, related to different views of architecture (business, information, application, technology), to e.g. avoid over engineering (over engineering is a risk and may result in wasted resources) - Clarifying and prioritizing requirements - Understanding and documenting architecture - Organizational learning	(The MITRE Corporation 2004) (Rajput 2004) (Stufflebeam 2001; Jayashetty, Manjunatha et al. 2004) (Abowd, Bass et al. 1997)
Analyzing process/ product (Expertise-oriented)	To assess EA's or EA program's theoretical soundness, by e.g. - analyzing EA's or EA program's compliance with theories and standards	(Stufflebeam 2001); (ISO 2001); (Satpathy, Harrison et al. 2000/2001); (Jenssen and Sage 2000); (May 2005)



APPENDIX 3. Some Quality Attributes Relatable to Architectures (not categorized, in an alphabetical order).

Acceptability	Ethicalness
Accessibility	Evolution, Evolvability
Accountability	Expandability/ Extension
Accuracy	Explicitness
Acquirability	Expressiveness
Adaptability	Extensiveness of use of legacy systems
Affordability	Failure, Failure Frequency / Mean time to failure
Analyzability	Fault Tolerance
Applicability	Feasibility
Authority / user acceptance	Flexibility / resilience
Automatic checks and feedback	Formal Verifiability
Availability	Formality (formal specifications)
Awareness	Functionality
Believability / credibility	Generality
Breadth (Completeness / coverage)	Genericity
Budget compliance	Hazard
Buildability	Hierarchy / structure
Business case attainment	Implementability
Cache performance	Improvement measures
Changeability	Informal Verifiability
Clarity	Initial implementation time
Coherency (Strategic alignment)	Installability
Communicativeness	Integrability
Completeness	Integrity
Complexity	Interface facility
Compliance	Interoperability
Compliance / standardization	Interpretability
Comprehensibility	Lateness
Comprehensiveness	Learnability
Conceptual integrity	Maintainability / serviceability
Conciseness	Management Context
Confidentiality	Measurability
Conformance	Memorability
Consistency	Modifiability
Content presentation	Modularity
Controllability	Objectivity
Correctness	Openness
Cost/effort estimation	Operability
Cost-effectiveness / economy	Operational flexibility
Coverage	Performance
Currency / maturity	Perspiciuity
Cycle Time / time behavior	Physical characteristics
Defect Trend	Portability
Delivery	Privacy
Denial of service	Process Maturity
Dependability	Progress Monitoring
Depth	Provides both current status and trend measures
Ease of development	Purpose/goal
Error-free	relevance/appropriateness
Effectiveness	Readability
Efficiency & estimation	
Error avoidance	
Error handling	



18.10.2006

Recoverability / Survivability
Relevance
Reliability
Repeatability
Replaceability
Resource Usage / resource behavior
Reusability
Robustness
Rollout schedule
Safety / Risk Avoidance
Satisfaction (client satisfaction)
Scalability
Schedule/Priority Estimation
Security
Similarity
Simplicity, Simplicity of use
Size
Space
Stability
Standardization

Steerability
Subsetability
Suitability
Support
Supportability
Targeted market
Testability
Time to market
Timeliness / responsiveness
Traceability
Training/trainability
Transferability
Understandability
Usability
Usefulness
Validity
Variability
Verifiability
Visibility and Control

