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Evaluating Architecture Work

On this page, the following topics are addressed:

- Overview - Measurement and Evaluation in General: Introduction to measurement and evaluation issues on a general level
- Needs and Triggers for Measurement and Evaluation: Description of measurement and evaluation needs and drivers in architecture work
- Evaluation Aspects in Architecture Work: Description of the various aspects of measurement and evaluation in architecture work
- Status of Measurement and Evaluation in Architecture Work: Description of the status of measurement and evaluation in organizations' architecture work

Overview - Measurement and Evaluation in General

Evaluation and measurement pervades almost every facet of our lives and daily activities. Much of what we do, decisions we make, and decisions made about us involve measurement or evaluation of one kind or another. A discipline of evaluation is needed because companies and societies in general require systematic, unbiased means of knowing if their products, processes, programs, and personnel are good (Shadish et al., 1991).

Evaluation and measurement concepts and practices are developed in different domains, such as in

- program management,
- software engineering, or
- quality management.

Evaluation and measurement may therefore mean different things to different people. **Evaluation** can be defined as

> "the process of determining the merit, worth, and value of things, and evaluations are the products of that process" (Scriven, 1991)

or as

> "a study designed and conducted to assist some audience to assess an object's merit and worth" (Stufflebeam, 2001).

Evaluation can also be seen as a means to generate information that assists in making judgments and decisions, for example about a program, service, policy, organization, or person (Stufflebeam, 2001).

Measurement can be defined as the assignment of numbers to aspects of objects or events to one or another rule or convention (Stevens, 1968) and as the process by which numbers or symbols are assigned to attributes of entities in the real world in such a way as to describe them according to clearly defined rules (Fenton, 1994).

Evaluation and measurement are carried out for many different purposes in companies;

for example to ([Behn 2003](#))

- **evaluate**: how well is the organization/unit/team/people performing?
- **control**: how to ensure that the subordinates are doing the right thing?
- **budget**: on what programs, people or projects should resources be allocated?
- **motivate**: how to motivate e.g. line staff, middle managers, and stakeholders?
- **promote**: marketing/public relations aspect; how to convince stakeholders that the organization/unit/team is doing a good job?
- **celebrate**: what accomplishments are worthy of the important organizational ritual of celebrating success?
- **learn**: why is what working or not working?
- **improve**: what exactly should who do differently to improve performance?

More information on the issue can be found in the dissertation [Evaluation and Measurement in Enterprise and Software Architecture Management](#).

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Needs and Triggers for Measurement and Evaluation

Architecture evaluation is a way to get answers to organization's information needs and problems relating to its business and ICT. Some of the reasons for the increasing interest in the evaluations and measurements of architectures are the facts that companies have needs to move towards business value driven ICT-development and there are pressures to improve the cost-effectiveness of ICT. However, the role and the meaning which architecture evaluation may have in companies are not clearly identified or defined.

In the AISA project, a study was conducted to gain an understanding of the roles and meanings of architecture evaluation and measurement in business organizations. Triggers for evaluations and measurements were identified and analyzed. The study revealed that architecture evaluation may

- enhance the understanding of organization's business and ICT-environments from financial and structural viewpoints, or
- be used as a tool in change management, quality assurance, process planning, IT cost management and architectural choice making.

It seems to be difficult for the practitioners to directly specify evaluation needs that relate to each architectural view (views are described in more detail in the article [The Role of Architecture Evaluations in ICT-companies](#)). It was suggested that organization's business and ICT-related problems, questions, topics of concern and information needs may be triggers for architecture evaluations.

The triggers can be categorised to the following categories:

- **Company and business management**: Needs to support organization's structural design (e.g. business process design) and distribution of the work (e.g for out-sourcing).
- **Holistic view**: Needs to understand the current status of organization's business and ICT-environment.
- **IT cost management**: Financial information needs relating to ICT (applications and technical infrastructure).
- **Change management**: Change pressures relating to architectures and

architectural principles - identification of probability and nature of changes that should be made and decision making about changes.

- **Quality management**: Quality questions relating architectural documentation, the information/data structures, application and technical infrastructure, as well as systems solutions.
- **Architecture management**: Confirming that architecture related work meets expectations e.g. investments correspond to the architectural principles.
- **Architectural choices**: evaluation of architectural alternatives against quality, cost and other aspects.

We suggest that **these evaluation triggers describe the role and meaning that architecture evaluation** may have in companies.

For more information on the subject, such as examples of triggers which came up in the study and the evaluation needs which arise due to these triggers, see article The Role of Architecture Evaluations in ICT-companies.

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Evaluation Aspects in Architecture Work

In the AISA project, a study was conducted to support the planning of metrics for EA programs by presenting measurement aspects and phases of iterative and goal-oriented metrics development process. A Goal Question Metrics (GQM) (Basili, et al. 1994) approach is perhaps the most well-known goal-oriented approach to measurement planning.

The approach is based on the assumption that for an organization to measure in a purposeful way it must

- specify the goals for itself and for its projects,
- trace those goals to the data that are intended to define goals operationally, and finally
- provide a framework for interpreting data with respect to the stated goals (Basili, et al. 1994).

It is, therefore, important to clarify, at least in general terms, what information needs the organization has, so that these needs can be quantified whenever possible, and the quantified information can be analyzed to whether or not the goals are achieved (Basili, et al. 1994). GQM-approach uses a top-down approach to define metrics and a bottom-up approach for analysis and interpretation of measurement data (Ardimento, et al. 2004). GQM is highly iterative process, e.g. goals are identified during working with questions (Berander and Jönsson 2006).

In the study, the following **measurement aspects for EA program** were identified:

- Benefits of EA program for organization
- Impacts and use of EA program and its results
- Progress and operations of EA program: EA team's and architects' accomplishments, particularly the progress towards the pre-established goals

  - Quality / maturity
  - Maturity of EA program capabilities

- Quality of results produced by EA program

- Architecture structures in organization: evaluation of architecture alternatives and solutions

These aspects can be used to support the identification of company's measurement needs and derivation of related metrics.

More detailed information on the subject, especially the phases of iterative and goal-oriented metrics development process, can be found in paper A Goal-Oriented Way to Define Metrics for Enterprise Architecture Program.

Status of Measurement and Evaluation in Architecture Work

In this section, the current status of measurement and evaluation in both the EA and the SA domains are briefly addressed.

Views about EA evaluation meanings seem not to be yet stabilized. However, roughly categorizing, evaluation approaches and techniques in EA management domain seem to relate to the following two aspects:

- Approaches and techniques that generate information relating to the company's EA program and its results (e.g. EA program's efficiency, effectiveness, maturity, quality of results) to support planning, improvement, marketing (showing value), organization and management of enterprise architecture work in a company. Company's business and IT goals are quite common used as the starting point in these evaluations.
- Approaches and techniques that generate information to support decision-making on the enterprise-wide information system issues through the analysis the EA models. This aspect can also be referred to as property oriented enterprise architecture evaluation.

A variety of metrics, evaluation criteria and methods have been developed for the evaluation of EA programs and their results. These include

- generic process metrics for evaluating EA activities,
- architectural documentation criteria for evaluating the results of EA programs,
- EA maturity models,
- EA acceptance and use metrics, and
- EA benefit and value measures.

However, generic, validated measures for EA acceptance or benefits have not been presented thus far and therefore have to be developed according to the specific requirements of individual companies. On the other hand, the most typical published EA evaluation methods include EA maturity models that measure the overall 'EA capability' of the organization, i.e. the capability of the organization to manage the development, implementation and maintenance of its EA (see e.g. the paper Towards a Generic Evaluation Model for Enterprise Architecture). Some of the maturity models also include the realized benefits of EA or the quality of architecture documentation as evaluation criteria. EA maturity models include, for example

- OMB Enterprise Architecture Assessment Framework (OMB, 2005)
- The Enterprise Architecture Maturity Model, EAMM (NASCIO, 2003)
- The Extended Enterprise Architecture Maturity Model, E2AMM (Schekkerman, 2003)
- A Framework for Assessing and Improving Enterprise Architecture Management, EAMFF (GAO, 2003)
- The COSM (Component Oriented Software Manufacturing) Maturity Model (Herzum Software)
- IT Architecture Capability Maturity Model, ACMM (DoC, 2003).

Similarly, a variety of methods and techniques have been developed to support the decision-making on the enterprise-wide information system issues. These techniques are also called as **property oriented EA evaluation techniques** and they can be categorized as follows (Winter et al., 2007):

- Dependency analysis exploits the associations between the various EA artifacts to derive direct and indirect dependencies between these artifacts. A typical analysis question might be 'Which business processes are affected if we switch-off a certain server?'
- Coverage analysis usually spawns two or more EA layers. The results of this analysis technique are often represented as matrices relating the two dimensions of interest.
- Interface analysis focuses on the interfaces within a class of EA artifacts. A typical example is the analysis of technical interfaces between software components specified within software architecture.
- Heterogeneity analysis tries to identify those architecture elements which should be reconsidered and re-factored to improve overall architecture homogeneity.
- Complexity analysis is strongly related to interface analysis. The design goal is to reduce the overall EA complexity.
- Compliance analysis aims to check whether certain policies (like process and data ownership) are defined at a certain organizational level of absraction or if certain mechanisms (like authorization and recovery) have been implemented at a certain software system level of abstraction.
- Cost analysis calculates and reports the costs induced by creation and maintenance of various EA artifacts (e.g. the cost for launching a new product). An important application of cost analysis techniques is the calculation of IT-related costs and the allocation of these costs to products, services, processes, organizational units, etc.
- Benefit analysis is complementary to cost analysis. It exhibits the contributions of individual organizational units, products, application systems and similar artifacts to the overall goals of the organization.

A formal **SA evaluation** is seen as an essential standard part of the architecture-based software development life cycle (SEI, 2007). Companies are now adopting architecture evaluations as part of their standard software engineering development practice, and some are including these evaluations as part of their contracting language when dealing with subcontractors (Kazman & Bass, 2002). The software architecture evaluation is designed to answer to the question 'Will the information system to be built from this architecture satisfy its business goals?' (Kazman & Bass, 2002) Furthermore, the purpose of evaluation is

> to determine the quality of an architectural description and to predict the quality of systems whose architectures conform to the architectural description (ISO, 2007, IEEE 2000).

Software architecture evaluations are seen valuable because they (Maranzano et al., 2005)

- uncover design problems early in the development when they are not expensive to fix,
- leverage experienced people by using their expertise and experience to help other projects in the company,
- let the companies better manage software components suppliers and provide management with better visibility into technical and project management issues
- generate problem descriptions by having the evaluation team criticize the descriptions for consistency and completeness,
- rapidly identify knowledge gaps and establish training in areas where errors frequently occur,
- promote cross-product knowledge and learning and keep experts engaged, and
- spread knowledge of proven practices in the company.

Evaluation in the SA domain has been studied a lot. Studies have focused for example on the evaluation of SA management (Bass & John, 2001; Kazman & Bass, 2002; Lee & Choi, 2005) and on the metrics and measurement of SA (Chastek & Ferguson, 2006; Dias et al., 1999; Shereshevsky et al., 2001; Tvedt et al., 2002). In addition, an array of methods is also being developed for evaluation of software architectures. Examples of these are

- Scenario-based Architecture Analysis Method, SAAM (Kazman et al., 1994)
- Architecture Trade-off Analysis Method, ATAM (Kazman et al., 1998)
- Active Reviews for Intermediate Design, ARID (Clements, 2000)
- SAAM for Evolution and Reusability (Lung et al., 1997)
- Architecture-Level Modifiability Analysis, ALMA (Bengtsson et al., 2004)
- MITRE's Architecture Quality Assessment (Hilliard et al., 1996; Hilliard et al., 1997).

In addition, different kinds of checklists are developed to evaluate architecture and its description during designing it (e.g. Rozanski & Woods, 2005). In summary, SA evaluation focuses mainly on the quality of architecture itself, not on the quality of architecture design or planning process like the EA evaluation.

More information on the issue can be found in the dissertation Evaluation and Measurement in Enterprise and Software Architecture Management. See also paper The Role of Architecture Evaluations in ICT-companies.