Authors: Eetu Niemi, Niina Hämäläinen and Tanja Ylimäki

Metrics and Criteria for Evaluating Architecture Work

On this page, metrics and criteria for the following evaluation targets are addressed:

- Architecture Documentation: Overview of evaluating the quality of architecture documentation
- Communication: Overview of evaluating the architecture related communication
- Commitment: Overview of evaluating the commitment to the architecture work
- EA Compliance: Overview of the evaluating the EA compliance
- Business-IT Alignment: Overview of evaluating the business-IT alignment
- Benefits of Architecture Work: Overview of evaluating the benefits of architecture work

Architecture Documentation

Architecture documents (architecture descriptions) have a more and more central role in the company management, IT governance and system development. Models are essential elements of architectural descriptions (AD) (Rozanski & Woods 2005). Models act as a medium for communication, helping to explain thinking to others. Models reduce the amount of information the reader needs to understand, and their structure guides the reader through the information (Rozanski & Woods 2005). In addition, models help to understand the situations they are describing and to analyze these situations by allowing to isolate the key elements and understand their relationships. Models also help to organize processes, teams, and deliverables as a result of the structures they reveal in the situation being modeled (Rozanski & Woods 2005).

Architectural documentation is most typically used in business planning for transition from a legacy business or ICT structure to a new structure and in communication, for example between acquirers and developers as a part of contract negotiations (see e.g. IEEE 2000). The quality of architectural documents is crucial for the value of documents: how useful those are for the company's business and ICT development work.

Previous studies have dealt with the quality evaluation of conceptual models (Lindland, Sindre & Solvberg 1994; Claxton & McDougal 2000; Bolloju & Leung 2006) and technical documentation (Smart 2002; Hargis, Carey et al. 2004). Quality dimensions for conceptual models (syntactic, semantic and pragmatic quality) (Lindland, Sindre & Solvberg 1994; Bolloju & Leung 2006) and for technical information (easy to use, to understand and to find) (Hargis, Carey et al. 2004) have also been defined. In addition, quality properties for conceptual models (Lindland, Sindre & Solvberg 1994) and for technical information (Hargis, Carey et al. 2004) are also defined.

In addition, some studies, books and guidelines address, for example, EA descriptions (e.g. Lankhorst 2005; Polikoff & Coyne 2005; Bernus 2003) and SA descriptions (e.g. Rozanski & Woods 2005; Clements, Bachman et al. 2002; Fairbanks 2003; Fu, Dong & He 2002). Qualities of an effective architectural description (e.g. correctness, sufficiency, conciseness, clarity, currency and precision) are also introduced, for example, by Rozanski and Woods (2005).

In the AISA Project, we contributed to the quality assessment of architectural

documentation by identifying and defining a group of questions, criteria and metrics that can be used in the quality assessment of architectural documentation and models. The results of the study aim to help enterprise and software architects to produce architectural descriptions and models of good quality.

Quality of architectural descriptions can be evaluated from the following aspects (see also the figure below):

- **Stakeholder and purpose orientation**: evaluation of how well documents are focused on purpose and on the stakeholder that use these documents.
- **Quality of content**: evaluation of quality of information included in the models.
- **Presentation/visualization quality**: evaluation of how well information is presented in documents.

Figure: Aspects on quality of architecture description.

A set of evaluation criteria and questions to be used for the evaluation of each of these aspects was identified. Furthermore, a set of evaluation factors for the management of architecture documentation was identified. Examples of the evaluation criteria and questions are presented in the table below.

The identified evaluation criteria and questions for architectural documentation can be used by the enterprise and software architects in their architecture design and documentation work, as well as by the reviewers in reviews of architectural documentation.

More information about the evaluation of architectural documentation can be found in report Quality Evaluation of Architectural Documentation and Models and in the paper Quality Evaluation Question Framework for Assessing the Quality of Architecture Documentation.

Table: Examples of evaluation criteria and questions for architecture documentation and descriptions.

Aspect	Criteria	Evaluation Questions/Metrics
Stakeholder and purpose orientation	Stakeholders	- Are the stakeholders of a model/AD defined and who are them?
	Purpose	- Is the purpose of a model/AD in relation to these stakeholders defined and what it the relation?
	Model's/AD's suitability for the	- Does the model provide the stakeholder with the desired knowledge? - Is a practical reason for the information

	stakeholders	evident? • Is the information presented from the stakeholders' point of view?
	The use of AD/models - value of AD/models	• Frequency of use • Number of users • Variety of users (the variety of different functional areas or skill levels of personnel who will likely use this documentation) • Impact of non-use
Quality of content	Scope and focus	• Scope: Is it defined what part of reality will be described in the model/AD (e.g. only primary processes)? • Aspects: Is it defined what aspects will be described? • The level of detail: Is it defined what level of detail will be described?
	Currency of EA/SA description	• EA description: Degree with which the current version of the documentation is up to date (Percents, subjective evaluation). • EA description: Number of architecture changes made after EA description has been produced. • SA description: Does information reflect a system? • EA and SA descriptions: Frequency with which AD is kept current (number of updates per year).
	Correctness	Verification of information: • Is the information included in an AD/model verified? • Is there any incorrect arguments, or in-accurate or untrue reasoning?
	Sufficiency/ Completeness	• AD's coverage of required viewpoints: The degree to which AD addresses each required architectural viewpoint • Sufficient amount of information: Is the all required information included in the model? Are all topics relating stakeholder's objectives and concerns covered, and only those topics? • Sufficient level of detail: Has each topic has just the detail that stakeholder needs?
	Consistency	• Are the models presenting different viewpoints consistent with each other?
Quality of presentation/ visualization	Conformance to corporate standards	• Does the presentation of the AD/model conform to the corporate standards (if any) for such documents?
	Retrievability: Presentation	• Does the model have an intuitive structure for the stakeholder?

	familiar to stakeholders	
	Retrievability: Notation and structures	- Do models use a defined notation? - Is the notation/structure of model explained? - Is stakeholder familiar with notation?
	Vocabularity and concepts	- Is the vocabulary and concepts stakeholders' concepts? Are the terms and concepts used known by stakeholder? - Are the terms used defined? Are the (new) concepts defined and explained? - Are the names of elements descriptive?
	Complexity: information amount	Is there too much information included in the model? - The number of elements in the model - The number of types of elements in the model - The number of relations depicted in the model - The number of architectural viewpoints
	Complexity: visual complexity	- Proximity: Are the related objects placed near to each other in a model? - Continuity: Is there any right angles positioned next to each other? - Closure: Are objects symmetry and regular? - Similarity: Are similar objects presented in the similar way? - Common fate: Are similar object presented to move or function a similar manner?
Architecture documentation management	Maintenance of ADs and models	- Ownership: Is the staff responsible for AD clearly identified and supported? - Maintenance practice: - Is it known how the AD will be maintained once it has been accepted? - Frequency of updates: Number of updates / year or project - Needs for updates: Number of architecture changes made (in a year, in projects) that require documentation update - Maintainability of models: The relative easiness or difficulty with which the documentation can be updated, including revision dates and distribution of new versions and the relative ease or difficulty with which the consistency between descriptions can be checked.
	Cost effectiveness of EA documentation	- Costs: Time and resources needed to produce or update EA descriptions or models: Man-days needed - Amount of documentation: Number of

		documents/models
		- Frequency of EA documentation updates: Updates / project or updates / year - Needs for updates: Number of architecture changes made (in a year, in projects) that require documentation update
	Cost effectiveness of project architecture documentation	- Costs: Time and resources needed to produce or update project related architecture description or models - Man-days needed - Amount of architectural documentation: Number of documents/models/project - Frequency of updates: Updates / projectNeeds for updates: Number of architecture changes made (in a year, in projects) that require documentation update
	Architectural framework and views	- Architectural framework: Does an architectural framework for EA/SA exist? Is the framework accepted in the organisation? Is the framework used in the EA/SA documentation work? - Architectural views: Are the suitable architectural views chosen for the company or for the project? Relating to each viewpoint are the following aspects defined: - Viewpoint's name? - The stakeholders the viewpoint is aimed at? - The concerns the viewpoint addresses? - The language, modelling techniques, or analytical methods to be used in constructing a view based upon the viewpoint?
	Tools for AD and models	- Support for organisation's framework and viewpoints: Do the design tools support the framework and viewpoints that organisation has chosen to use? Do the design tools support production of the deliverables required? - Suitability for Stakeholders: Is there ability to represent architecture models and views in a way meaningful to stakeholders (e.g. to non-technical stakeholders)? - Repository for architectural documentation: Is there an EA repository for storage and dissemination of the captured EA information?

Communication

Communication and a common language can be regarded as one of the main factors helping to succeed in the architectural work (Lankhorst 2005). In order to verify the success in this area contributing to the success of EA in organizations, evaluation of communication and common languag is needed.

Communication studies have been conducted for decades. Even communication audit studies - evaluation of organizational communication (both internal and external) - go back to 1970's and beyond. Communication audits can be carried out in many ways (see e.g. Hargie and Tourish 2000), but the most usual and perhaps the most inexpensive way to evaluate communication is to collect information through a questionnaire. For instance, Downs and Hazen's 'Communication Satisfaction Questionnaire' (Downs, 1988) includes 46 questions. The premise of their work is that the quality and amount of communication in our jobs contribute to both our job satisfaction and our productivity. Another example of questionnaires is presented by Hargie and Tourish's (2000). Their 'Communication Audit Questionnaire' includes 13 sections, each of which many questions or statements.

Based on the above mentioned facts, in our study of evaluation criteria and metrics for architectural communication was to a great extent, an application of communication audit studies. We suggest that evaluation of architecture related communication and common language could be conducted with the help of

- 6 sub-targets in addition to the communication and common language as an evaluation target in its entirety, and
- 13 evaluation criteria in total.

The sub-targets suggested are the following:

- common language/architectural concepts
- communication strategy/plan
- information received through architectural communication
- information sent through architectural communication
- communication channels
- communication skills.

Respectively, the suggested evaluation criteria include, for example,

- Accuracy
- Availability
- Communication Activeness
- Comprehensibility
- Expertise
- Satisfaction
- Timeliness.

Metric examples related to the sub-targets as well as to the communication and common language in its entirety are presented in the table below.

Table: Examples of metrics for evaluating communication and common language.

Evaluation Target	Metric Examples

Common language/ architectural concepts	- Availability: Are the architectural concepts defined and documented? Specifically, has the concept of EA been defined (what does EA mean in the organization)? - Comprehensibility: Are the concepts and terms simple enough, clear and understandable?
Communication strategy/ plan	- Accuracy: Is the communication strategy/plan up-to-date? - Availability: Is the communications strategy/plan available to the key stakeholders (e.g. in a file system or in intranet)? If not, why not?
Information received through architectural communication	- Satisfaction: How satisfied you are with the amount and quality of business information essential for the EA development received from the management/business? (= downward communication) - Timeliness: Extent to which you receive on time the architecture related information needed to do your job.
Information sent through architectural communication	Satisfaction: How satisfied are you with the amount and quality of information you send to management/business? (= upward communication)
Communication channels	- Availability: Which channels do you use in architectural communication? - Availability: Are these channels easily available? Is the information easily available through these channels?
Communication skills	- Expertise: How satisfied are you with the communication skills of yourself/your co-workers/the architecture team/the management? - Comprehensibility: How understandable and clear is the communication/information provided by the architecture team?
Communication and common language in its entirety	- Communication activeness: How actively are you participating to architecture related discussions/architecture development/architecture related briefings/etc.? - Communication activeness: How actively do you provide architecture related feedback to the architecture team/the management/your co-workers? - Satisfaction: How would you change architectural communication to make you more satisfied? - Satisfaction: How satisfied are you with the communication between the departments/business areas/subsidiaries etc.? (= horizontal communication)

Already the examples in table above show that there is an extensive selection of evaluation questions and metrics for communication and common language. The selection is primarily meant to stimulate and help the definition of the organization specific questions and metrics.

It also seems rational that evaluation of communication and common language are related to the phase of the EA development in the organization or, more specifically, to the EA maturity level of the organization. In different phases or maturity levels, different metrics are used. Most typically, simple metrics are needed in the initializing phase, and

more advanced metrics (e.g. quantitative metrics) can be adopted in later phases.

More detailed information on the evaluation of communication and common language can be found in report Assessing Architectural Work - Criteria and Metrics for Evaluating Communication & Common Language and Commitment.

🔺Top of page

Commitment

The importance of gaining commitment to the EA approach and development can be put as follows:

> "Without a shared sense of purpose and mission, effective governance structure, and executive leadership and commitment, enterprise architecture will only have a minimal impact". (Nelson 2004)

Commitment is also regarded as one of the potential CSFs for EA. In order to verify the success in this area, which also contributes to the success of EA in organizations, evaluation is needed.

We suggest that evaluation of commitment could be conducted with the help of five evaluation criteria:

- Awareness
- Acceptability
- (Customer) satisfaction
- Involvement and participation activeness
- (Adequacy of) resources.

Furthermore, a selection of evaluation questions that demonstrate each evaluation criteria can be used to stimulate the definition of the organization specific evaluation questions/metrics. Examples of the evaluation questions are presented in the table below.

Table: Examples of metrics for evaluating commitment on the EA work.

Evaluation Criteria	Metric Examples
Awareness	- Have you heard/have you been informed about the EA/architecture approach adopted in the organization? - If you have heard about the EA/architecture approach, how satisfied you are with the amount and quality of information you have received?
Acceptability	To what extent do you consider the EA/architecture approach to be important/useful/essential to the success of the entire organization/your department/your team/your personal work tasks?
(Customer) Satisfaction	- To what extent you utilize architecture guidelines, architecture documentation, or architecture guidance given by architects as a normal part of you work tasks? - What kind of improvement is needed to make you utilize

	the architecture guidelines, documentation, or architecture guidance given by architects more often?
Involvement and Participation Activeness	• Does the EA governance team include executive-level representatives from each line of business? Do they have the authority to commit resources and enforce decisions within their respective organizational units? • How satisfied are you with the extent you participate in architecture development/architectural work development (process development)/architecture management and guidance/architecture implementation projects/architecture related discussions, briefings or training? • What kinds of actions are needed to make you participate in the architecture development, discussions, etc. more often?
Adequacy of Resources	• Does a budget for EA exist? How much funding is directed to the EA development and management/to the entire EA program? • Does a schedule for EA development exist? • Has an architecture team (architects) been assigned? Does a chief architect exist? • Have the architecture team member's responsibilities and authorities been defined? • Has the architecture ownership been defined? • Is the architecture team capable of focusing only to EA/architectural work?

In the beginning of the EA journey, the management's (referring to the top management, CFO, superiors, etc.) commitment to the EA approach is more crucial than the organizational buy-in. This indicates that similar to the evaluation of communication, commitment is also related to the phase of the EA development in the organization or, more specifically, to the EA maturity level of the organization. Thus, the number of committed stakeholder groups should increase as the maturity advances.

It can also be questioned whether commitment needs to be evaluated as a separate target at all. When the EA benefits, and also the success of communication practices, are assessed, it is possible to draw some conclusions about the level of commitment as well. If any benefits cannot be demonstrated, it is likely that no commitment exists either in the organization, or the level of commitment does not increase from the level of awareness. Additionally, if the EA budget exists, it proves at least the commitment of the management.

More detailed information on the evaluation of commitment can be found in the report Assessing Architectural Work - Criteria and Metrics for Evaluating Communication & Common Language and Commitment.

▲Top of page

EA Compliance

Compliance in general mainly refers to the conformance with rules - standards, regulations, laws, contracts and so forth (Allman 2006; PEER Center 2006; Quality

Assurance Project 2006), but no single established definition seems to exist. The same applies in the EA context as well. As suggested by literature (Aziz et al. 2006; CIO Council 2001; GAO 2003; Spurway & Patterson 2005; The Open Group 2006) and the results of a focus group interview of practitioners, EA compliance can be divided into the following two parts:

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

Organizations typically evaluate EA compliance to fulfill the following goals:

- **Directing a project or an investment to comply with EA - the proactive approach** (adapted from Spurway & Patterson 2005; see also e.g. NIH 2006; Paras 2005; The Open Group 2006): this includes particularly direction and guidance of projects and investments to ensure that the organization is moving towards the target EA, supporting projects and investments by defining how and when EA artifacts are utilized, and encouraging the organization, especially IT projects, to utilize EA descriptions and guidelines.
- **Assuring the compliance between the output of a project or an investment and EA - the reactive approach** (adapted from Spurway & Patterson 2005; see also e.g. GAO 2003; NIH 2006): this includes EA reviews and assessments within projects and investments, and project and investment follow-up with regard to EA descriptions.
- **Assuring the compliance between EA and internal or external standards, reference models and principles** (adapted from The Open Group 2006): this includes evaluation of EA descriptions to be constructed according to defined standards, reference models and principles, by both the organization and external authorities.
- **Ensuring the usability and appropriateness of EA policies, EA frameworks, EA descriptions, business objectives and so forth**: this is highlighted particularly in the cases where compliance requirements cannot be met, possibly suggesting a need to modify EA descriptions, standards, policies and principles, or even business requirements. Also, experience-based feedback can be received from projects and investment processes to improve EA.

Regarding the actual targets of EA compliance evaluations, the high-level objects as well as the evaluation targets of both internal and external compliance, are displayed in the figure below. Compliance between the objects - the evaluation targets - is depicted with arrows. Block arrows depict primary internal or external compliance evaluation targets and small dotted arrows other possible targets to be evaluated. Additionally, examples of lower-level items belonging to each object are included to illustrate the possible documents that can be utilized in compliance evaluation.
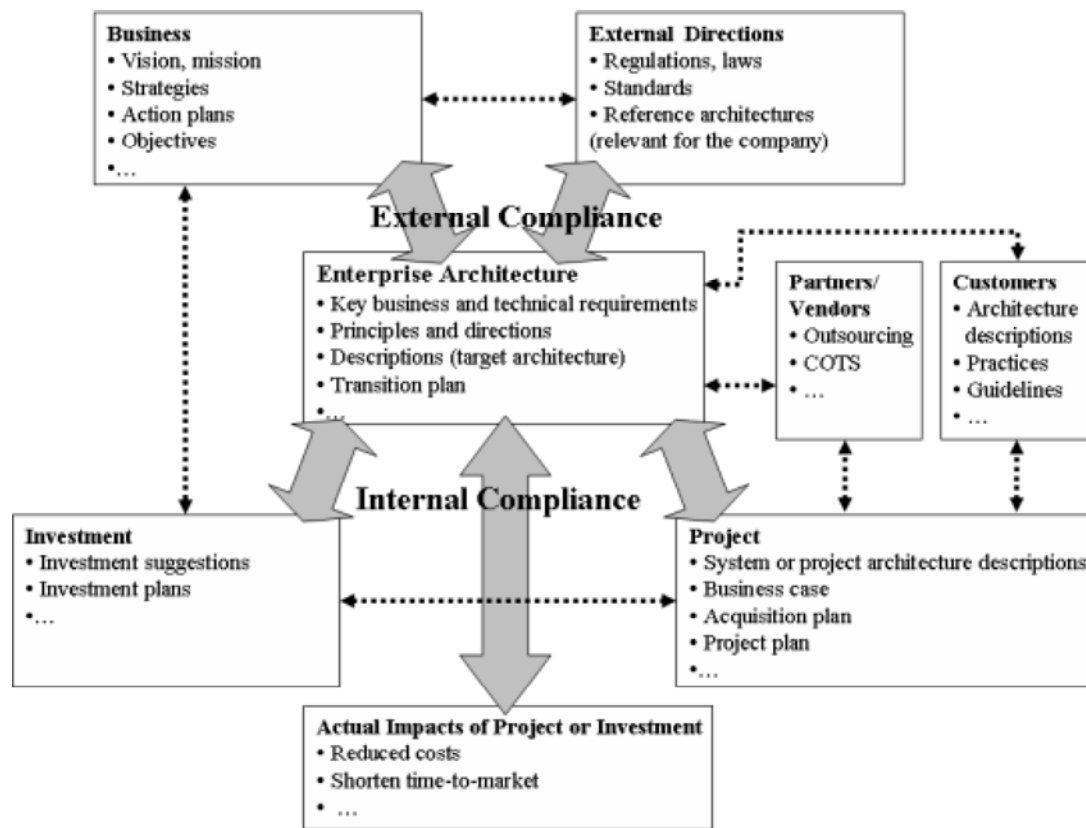
Figure: EA compliance objects and evaluation targets (derived from the focus group interview results).

EA compliance evaluation can be regarded as a part of EA governance. In practice, the persons or teams that have responsibility on the areas of the evaluation objects are suggested to be the evaluators of EA compliance. The EA team is in a key role in EA compliance evaluation by providing guidance and direction to projects and possibly by conducting formal compliance reviews. Business architects and developers, on the other hand, could perform or assist in evaluating the compliance between business and EA. If an EA governance board or EA steering committee exists in an organization (including representatives from various stakeholder groups), it may also have the responsibility of evaluating EA compliance. Thus, possible problems encountered if any single stakeholder evaluates its own work can be avoided.

Typically, the status of EA compliance is illustrated by compliance levels. For example, TOGAF (The Open Group 2006) defines six levels of compliance between architecture specification and its implementation (internal compliance). Departmenf of Defence (BTA 2006), on the other hand, defines three levels of internal compliance. In addition to these metrics, several tools and procedures have been developed to support carrying out EA compliance evaluation (Eurocontrol 2006; NIMA 1998; The Open Group 2006). However, each organization needs to make its own decisions on the actual steps of the evaluation process, and to implement it as a continuous EA governance activity.

Finally, when planning and conducting EA compliance evaluation, it should be noted that because organizations' environment is constantly changing and so are their EAs, EA compliance has a dynamic nature. Therefore, compliance can be evaluated to be on an acceptable level at the moment, but it does not guarantee that this is the case in the future. EA compliance also seems to depend on the EA maturity level. In the lower levels of maturity (in the beginning of EA development work), EA compliance and its evaluation actually equals quality assurance, and especially the impacts of EA work are a

focal issue. After the EA process has become more established, more profound aspects of EA compliance will become increasingly important. For more information on EA compliance and its evaluation, see report Evaluating Enterprise Architecture Compliance and paper Enterprise Architecture Compliance: the Viewpoint of Evaluation.

Business-IT Alignment

Alignment between business and IT has been considered important in organizations for over 15 years (Luftman 2000). As a high degree of alignment has been associated with improved business performance by empirical evidence (Chan et al. 1997; Papp 1999), it is not surprising that business-IT alignment has been continuously considered as one of the top concerns of company executives such as CIOs (Luftman et al. 2006) and a great number of studies have been conducted on the subject so far (Chan 2002; Luftman 2000). Alignment has also been considered as one of the key benefits or potential objectives of EA (Goethals et al. 2006; Kluge et al. 2006; Ross & Weill 2005).

According to literature, alignment between business and IT is an evolutionary process (Avison et al. 2004; Cumps et al. 2006; Maes et al. 2000), which needs to be maintained over time by planning, design, management, and evaluation activities on both strategic and tactical levels (Hu & Huang 2005; Maes et al. 2000). Moreover, alignment may refer to the extent or amount of alignment, measured by e.g. various maturity models (see e.g. Luftman 2000; Reich & Benbasat 2000). Despite the large number of models developed to depict this complex phenomenon (see e.g. Chan et al. 1997; Cumps et al. 2006; Luftman 2000, the Strategic Alignment Model (SAM) (Henderson & Venkatraman 1993) remains the most commonly referred.

In general, several common factors affecting alignment can be derived:

- **strategic factors**, such as business and IT strategies, plans, objectives and vision (e.g. Avison et al. 2004; Henderson & Venkatraman 1993; Luftman 2000; Reich & Benbasat 1996)
- **structural factors**, such as processes, organizational structure, architectures, governance and competences (e.g. Chan 2002; Maes et al. 2000; Weiss & Anderson 2004)
- **social and cognitive factors**, such as communication, partnership, learning, and common knowledge and understanding (e.g. Ciborra 1997; Luftman 2000; Weiss & Anderson 2004)
- **measurement and evaluation factors**, such as metrics and measurement systems for both business and IT (e.g. Luftman 2000; Moody 2003).

Alignment, in turn, is argued to lead to a multitude of benefits, of which several have been empirically substantiated (see e.g. Chan 2002; Papp 1999). Practically, alignment is suggested to be the responsibility of IT governance (Dahlberg & Kivijärvi 2006; Symons 2005), which in turn needs to be in close relationship with business. However, since research offers little contributions to practice (e.g. Cumps et al. 2006; Maes et al. 2000), alignment remains challenging to improve, sustain, or evaluate in practice. Moreover, factors affecting alignment encompass the entire organization, indicating that an extensive, holistic approach would be needed to address these issues.

It has been suggested that EA could be this kind of an approach (c.f. Hirvonen & Pulkkinen 2003; Morganwalp & Sage 2004), but the relationship between EA and business-IT alignment is more complex than this viewpoint alone. As brought out,

- EA can be regarded as an enabler of improved alignment in organizations (e.g. Goethals et al. 2006; Kluge et al. 2006; Ross & Weill 2005), by providing tools for describing and communicating various aspects of an organization (e.g. the business strategy and objectives), as well as for achieving ISs that support the business.
- The factors affecting the success of EA and the extent of alignment are somewhat similar, even implying that alignment improvement efforts can be regarded as EA work having a slightly different scope and emphasis.
- Alignment in the EA context refers to the concept of EA compliance. The EA compliance evaluation objects may also be the potential objects between which alignment is needed in the EA context to enable the organization to reach alignment between business and IT. However, compliance does not guarantee alignment.
- Alignment in the EA context may refer to the alignment between various architectures, or architectural views, of an organization (c.f. Chen et al. 2005; Pereira & Sousa 2003).
- EA maturity (see the section EA evaluation model) and business-IT alignment correlate, but do not explain one another (van der Raadt et al. 2005).

Various approaches exist for evaluating business-IT alignment. What seems to differentiate these approaches from each other is that they have a slightly different focus on the issues to be evaluated. They also seem to provide metrics of different granularity compared to each other. Both Luftman (2000; 2003) and Reich & Benbasat (2000) provide a wide selection of evaluation metrics, ranging from soft issues (e.g. communication) to hard issues (e.g. business metrics or skills-related metrics). The soft aspects, especially the communication point of view, seems to be missing from the examples provided by Chan et al. (1997) and Symons (2005). Combination of both qualitative (soft) metrics and quantitative (hard) metrics should be implemented to develop a comprehensive measurement instrument for business-IT alignment. In the EA context, the same evaluators that evaluate EA compliance could potentially be the evaluators of alignment as well. An organization may also need a functional EA governance board which is responsible for evaluating alignment periodically (Jayashetty et al. 2004).

For more information on business-IT alignment and its evaluation in general and specifically in the EA context, see report Evaluating Business-IT Alignment in the Enterprise Architecture Context.

Top of page

Benefits of Architecture Work

Even though literature suggests that a multitude of benefits can be realized by architectural work, there is little empirical evidence. This may be due to the extensiveness of architecture, architecture work and their impacts, and their state of constant change that make it difficult to evaluate the benefits and, more importantly, attribute them to architecture work (see Hjort-Madsen 2006; Kamogawa & Okada 2005). However, the need for evaluating the benefits is evident because it provides a rationale for the key stakeholder support and investments in architecture work (see Infosys 2005; Ross & Weill 2005; Schekkerman 2005).

Still, literature on architecture work benefits is rare and focuses almost entirely on referring to a number of achievable benefits without solid evidence. Nearly thirty different benefits can be derived from literature, but they are typically not clearly defined

in literature, their levels of abstraction differ, and their interrelationships remain largely unknown. Moreover, it is not known from which parts or characteristics of architecture or architecture work benefits essentially realize. This implicates that there is a need for describing the architecture work benefit realization process which in turn facilitates the creation of a comprehensive architecture work evaluation model. Currently, no freely available validated models exist, but a few case studies (see e.g. Luftman 2000) and survey-based studies (Rosser 2006; Saha 2006; Schmidt 2005) have been made to present realized benefits of architecture work. In related contexts, such as management and IT, a large number of metrics have also been suggested and could be used to measure individual benefits such as business-IT alignment. Also, guidelines for measuring Return on Investment (ROI) in the architecture context have been presented.

To disentangle the myriad of proposed benefits and metrics a study including a literature review and a focus group interview of practitioners was carried out in the AISA project. Because no guiding evaluation model existed, metrics and evaluation criteria were charted from literature and assigned directly to the architecture work benefits derived from literature. Each of the benefits was complemented with up to 60 metrics. However, the focus group brought out that that the metrics presented were too great in number and would not suit practice without a guiding evaluation model. In turn, the focus group approached the problem from a practical perspective and proposed three main categories into which the proposed architectural work benefits could first be categorized:

- costs,
- growth and
- flexibility.

The categories are based on the basic targets and needs of a business enterprise and its owners. Then, the group suggested a practical view of the architectural work benefits and their evaluation using the three categories of architectural work benefits as a basis for constructing architectural work and corporate evaluation and measurement system. The view takes into account three viewpoints of evaluation:

- corporate metrics consulted by the architecture team,
- metrics of the architectural work itself, and
- metrics of architectural work results.

It illustrates

- corporate level targets (the three architectural work benefit categories),
- layered hierarchy of metrics,
- relationships between architectural and corporate metrics,
- architecture team/unit role and position, and
- role of architectural work ROI.

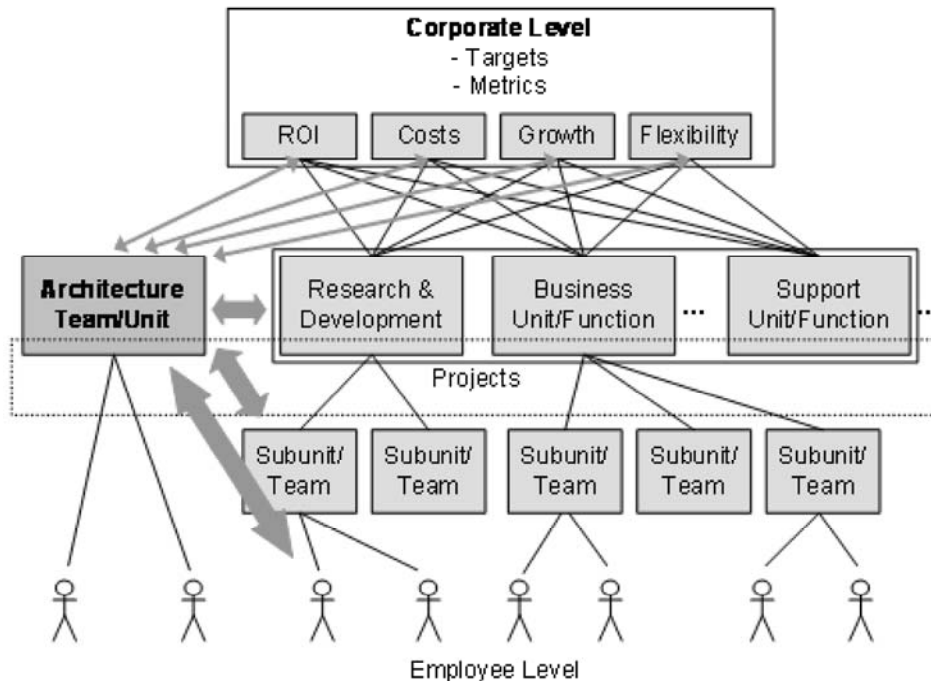The practical view is depicted in the figure below.

Figure: The practical view of architectural work benefits and their evaluation (developed by the focus group).

The practical view depicts a hierarchy of metrics used in an organization, starting from the corporate level, where metrics for the enterprise's most important targets, such as costs, growth and flexibility, are implemented. From there, management implements the metrics derived from the top level targets to the unit or function level below. From the unit or function level, middle management implements metrics for subunits or teams of employees, and from there, metrics are implemented to individual employees. In addition, projects usually have their own metrics as well as the architecture team or unit. For each unit, function, subunit, team and individual, 3-5 metrics should be implemented. In addition to implementing the metrics from top to bottom, feedback from bottom to top is also needed to preserve the links and compatibility between the metrics on adjacent levels. From the metrics in the hierarchy, management should be provided with 3-5 metrics which can be used to evaluate architectural work benefits. Because of the hierarchy, the architecture team or unit can rationalize that benefits are received from architectural work in the organization's functions and units. A ROI metric for architectural work should also be implemented to measure whether the architectural work carried out is profitable in the long-term.

Managing the integrity of the measurement system as a whole is vital. The hierarchy of metrics should be low enough to preserve the chain of causalities between the metrics on adjacent levels. If the hierarchy grows too high, it may result in inconsistent metrics on the lower levels of the hierarchy. The size of the hierarchy is dependent on the size of the enterprise, 5-6 levels would be a feasible example. The implemented metrics should also be selected carefully, taking into account the goals of the evaluation, especially the guiding effect of evaluation on individuals, teams, units and functions. In addition, it is essential that architectural work metrics are connected to other organizational metrics.

The focus group identified a few additional challenges related to architectural work benefit evaluation. Firstly, a baseline or standard for evaluation results does not typically exist in organizations since especially EA is a new discipline. Secondly, it is challenging to find a mutual understanding of the time scale of presenting benefits between

management and the architecture team, and a balance between producing short-term and long-term benefits. On one hand, quick wins are essential in gaining management support, but on the other hand, architecture work is long-term in nature. Finally, the focus group agreed that the results of architecture work evaluation should also be communicated in the organization, taking into account 1) what is to be communicated, 2) to whom the communication is aimed, and 3) when is the right time to communicate (see the section on communication for more information).

For more information on architecture work benefit evaluation, see report Evaluating the Benefits of Architectural Work. For information on the benefits of architecture work in general, see section on the benefits of the architectural work and paper Enterprise Architecture Benefits: Perceptions from Literature and Practice.