

Enterprise and Software Architecture Work

In this section, we deal with the following topics:

- **Architecture Approaches:** Brief description of the various architecture approaches used in organizations
- **Definitions for Enterprise and Software Architecture:** Overview and definition of the concepts of EA and SA
- **Potential Critical Success Factors for Enterprise Architecture:** Overview and description of the factors enabling the success of EA
- **Success and Failure Factors for Software Architecture:** Overview and description of the factors that enable or prevent the success of SA
- **Stakeholders of Architecture Work:** Overview and description of the stakeholders of EA
- **Benefits of Architecture Work:** Overview and description of the benefits of EA
- **Status of Architecture Work:** Overview and description of the status of architecture work in organizations

Architecture Approaches in Organizations

Organizations develop their architecture capabilities based on different architecture management approaches. Currently, a variety of approaches for architecture management are studied, developed and applied both by industry and academia. Examples of these are:

- Enterprise Architecture, EA
- Information System Architecture
- Software Architecture, SA
- Integration Architecture
- Technology Specific Architectures (such as J2EE, .Net)
- Service Oriented Architecture, SOA
- Information / Data Architecture
- Process Architecture
- Computer Architecture

Each of these architecture management approaches has its particular scope, emphasized aspects, and architecting activities. Some of the approaches cover a wide part of organization's structures and describe those in a high level (specifically EA). Others focus on particular area and aspects and describe these in more detailed levels (e.g. SA). Furthermore, the utilization of the results (such as enterprise models) produced by these different approaches varies. Some results can be used in the company management and some results are used to support the design and development of information systems.

While there is no single agreement in the industry or in academia on the meaning of these architecture management approaches or on their relationship to one another, an organization may handle the confusing situation, for example, by being

"aware that these different terms exist, but that there is no consistent definition of these terms in the industry and how they relate. The recommendation, therefore, is for you to select the terms relevant to your organization and define them appropriately. You will then achieve some consistency at least and reduce the potential for miscommunication". (Eeles,

2006b)

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

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Definitions for Enterprise and Software Architecture

In AISA project, the focus was on enterprise and software architecture approaches. Next, we will define these concepts.

Enterprise Architecture: In the modern turbulent business environment, companies are constantly encountering challenges in coping with the changes and complexity in the market. Moreover, the companies have to manage the complexity of their information and communication technology (ICT) environment brought on by the many decades long legacy of ICT, and to assure that ICT supports the business as well as possible. To facilitate companies in responding to these challenges, a recent approach called Enterprise Architecture (EA) has emerged in the last decade ([Goethals et al. 2006](#); [Hjort-Madsen 2006](#); [Kluge et al. 2006](#); [Morganwalp & Sage 2004](#); [Veasey 2001](#)). Consequently, the approach has become one of the major concerns of practitioners and academics, and it is being implemented in a multitude of companies and government organizations worldwide.

Basically, EA is a holistic approach for managing and developing an organization, adopting an overall view of its business processes, information systems (IS), information and technological infrastructure ([de Boer et al. 2005](#); [Jonkers et al. 2006](#); [Kaisler et al. 2005](#)). EA includes a set of principles, methods and models used to describe the current and future state of an organization, as well as a transition plan to describe the steps needed to transform from the current to the target state ([Armour et al. 1999](#); [Lankhorst 2005](#)). The transformation is usually conceptualized as a continuous, iterative process ([Armour et al. 1999](#); [Kaisler et al. 2005](#); [Pulkkinen & Hirvonen 2005](#)).

One of the most promising definitions of EA is the following:

"Enterprise architecture (EA) 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." ([Kaisler et al., 2005](#))

Software Architecture: SA, on the other hand, depicts information from all of the dimensions of EA in more detailed form from the viewpoint of information systems. Thus, it has significantly narrower scope than EA. SA a tool for planning, developing and managing software-intensive systems.

SA has emerged as the principled understanding of the large-scale structures of software systems ([Shaw & Clements, 2006](#)). It offers guidance for complex software design and

development ([Shaw & Clements, 2006](#)). Software architecture management is utilized in the information system development and it can be defined as follows:

"The software architecture of a program or computing system is the structure or structures of the system, which comprise software elements, the externally visible properties of those elements, and the relationships among them." ([Bass et al., 2003](#))

Typically, SA includes the following viewpoints:

- Functional
-
- Information
-
- Behavioral / Concurrency
-
- Development / External
-
- Deployment
- Operational

Architecting of a system contributes to the development, operation, and maintenance of a system from its initial concept until its retirement from use ([ISO, 2007](#)). Rozanski and Woods ([Rozanski & Woods, 2005](#)) describe architecture development as a process by which stakeholder needs and concerns are captured, an architecture to meet these needs is designed, and the architecture is clearly and unambiguously described via an architectural description. Architecting of software architecture consists of activities of

- capturing architectural requirements of system/software and understanding them,
- designing and analyzing/evaluating,
- realizing, maintaining, improving, and
- certifying the architecture as well as documenting it ([IEEE, 2000](#), [Bass et al., 1998](#)).

In addition, the co-operation with EA planning relate to software architecting, especially communicating and giving feedback about enterprise-wide principles.

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

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Potential Critical Success Factors for Enterprise Architecture

The concept of critical success factor (CSF) has been utilized in Total Quality Management (TQM) to indicate those issues that must be done exceedingly well in order to succeed ([Badri et al., 1995](#), [Claver et al., 2003](#); [Lecklin, 2002](#); [Tari, 2005](#)). While the idea of CSF has later on found its way to many other areas as well (such as project management), it awakened our interest for studying the CSFs in the context of EA: what are the factors that have to be carried out exceedingly well in order to attain a successful EA – a high-quality EA – which in turn enables the business to reach its objectives and gain more value.

In our study, we determined the potential CSFs for EA (see [figure](#) and [table](#) below), more

specifically a set of potential key areas from which the organization should choose the most critical factors of its own based on its business objectives, the role of EA in the organization, and so forth. These factors, when carefully addressed, should enable the achievement of a high-quality EA.



Figure: Potential critical success factors for EA.

Table: Brief descriptions of the potential critical success factors for EA.

CSF for EA	Description
Assessment and Evaluation	The extent to which the architecture and architecture processes are evaluated and improved, and how established the evaluation processes are. Deals with issues such as definition of EA evaluation
Business Driven Approach	The extent to which the business strategies, business objectives and requirements are taken into account in the architecture development.
Commitment	The extent to which both the top-management and the employees of the organization are committed to and involved in the EA effort.
Communication and Common Language	The extent to which the organization has established architecture related terminology (the common vocabulary) and effective means to conduct architecture related communication.
Development Methodology and Tool Support	The extent to which the organization has an established architecture framework and development process, and the extent to which different tools are exploited in architecture development and management.
EA Models and Artifacts	Deals with issues such as developing a documentation plan, collecting and analyzing the requirements, ensuring that all necessary views are modeled in order to provide a coherent and concise picture of the enterprise (current and future models), and developing a transition plan.
	Relates to issues such as governance (architecture guidance) structures, roles, responsibilities, processes

Governance	and activities, change management processes (both organizational and architectural changes) and risk management processes.
IT Investment and Acquisition Strategies	Deals with the relationship (and dependency) between architecture development and governance processes and the IT investment and acquisition processes and decisions.
Organizational Culture	Deals with issues such as the organization's readiness to develop and utilize EA, attitudes towards the architecture approach, attitudes towards changes in general, and the organizational changes the architecture development may lead to.
Project and Program 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.
Scoping and Purpose	Deals with issues such as the definition of EA 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 the EA should be developed in the organization.
Skilled Team, Training and Education	The extent to which the architecture team is organized and established as well as the extent to which required skills are available or acquired.

For more information on CSFs for EA, see either the related [paper](#) or [report](#).

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Success and Failure Factors for Software Architecture

Software architecture is a critical factor in the design and construction of any complex software-intensive system. SA impacts on the quality of the system. A good architecture can help ensure that a system will satisfy key requirements in such areas as performance, reliability, portability, scalability, and interoperability (Garlan, 2000).

Architecture evaluation is a way to increase the understanding of the quality of architecture. A variety of methods is being developed for the evaluation of software architectures, for example

- SAAM (Babar, Zhu et al., 2004),
- ATAM (Bass, Clements et al., 1998),
- ARID (Bengtsson, Lassing et al., 2004), and
- ALMA (Boehm, 1994).

There seem to be no consensus on the evaluation objectives, criteria, or evaluation targets in the SA literature. In some method comparisons evaluation objectives and use cases are discussed (e.g. Clements, Kazman et al., 2002). Also the evaluation criteria and metrics are still unestablished; several evaluation criteria and metrics descriptions exist. SA

evaluation criteria are discussed for example by Hilliard et al. (1996; 1997) and Losavio et al. (2003; 2004). One reason for the non-establishment of architecture evaluation criteria and metrics may be that no common views on what is successful SA and what factors have an effect on achieving successful SA exist. It is not clear what targets and factors should be evaluated and measured. Nevertheless, successful architecture is a widely used concept.

Academia and practitioners have come to realize that a critical success factor for system design and development is to find a successful architecture. They have also become increasingly interested in what makes SA succeed or fail. The identified success and failure factors help system development managers and architects make a number of critical decisions. These decisions relate, for example, to the selection of evaluation criteria and metrics for the quality assessment of architectures and architecture management processes.

It is generally known that the success of SA is typically influenced by factors at various levels. However, these factors are mainly discussed only in a few studies and reports organised and produced by some research institutes and the ICT industry (e.g. Avritzer and Weyuker, 1999; van der Raadt, Soetendal et al., 2004). These factors are, as yet, far from having been fully investigated in detail. Our study contributed to this field with an identification and analysis of success and failure factors of SA.

We identified six system development areas that seem to affect the success and failure of SA (see the figure below).

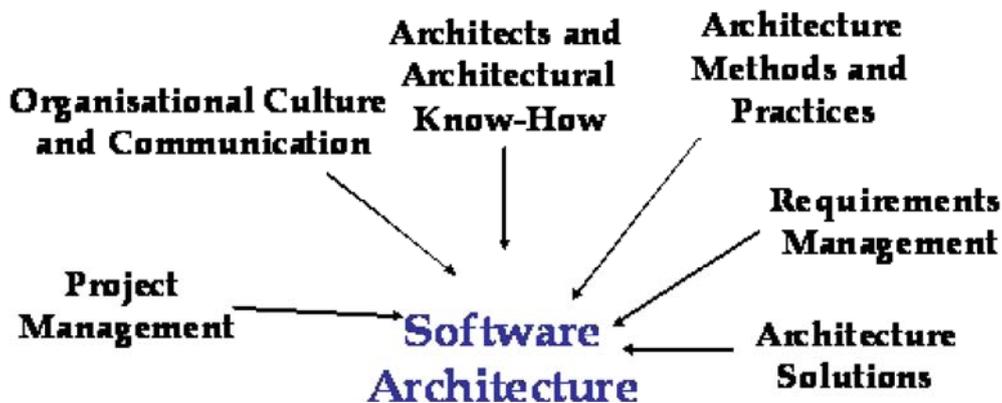


Figure: System development areas affecting the success and failure of software architecture.

Project management offers time, staff and resources for architectural work. Software architecture success factors relating to the project management can be divided into factors relating to staffing, scheduling, planning and funding.

Organizational culture refers to the values, beliefs and customs of an organization. Whereas organizational structure is relatively easy to draw and describe, organizational culture is less tangible. Organizational culture has an impact, for example, on how well the architecture will be adopted and followed.

Architects and Architectural Know-How: The personal skills of architects have an effect on the fluency of the architectural design process in collaboration with the stakeholders. Personal skills may also have an impact on architectural decision making.

Architecture Methods and Practices: The software architecture management process contributes to the activities of capturing architectural requirements and understanding them, designing, analyzing/evaluating, realizing, maintaining, improving, and certifying the architecture as well as documenting it [3, 14]. The process model together with the methods and tools chosen to carry out architectural work, in turn have influence on this work. In addition, the standardization of the architectural concepts and of the descriptions in an organization has an effect on the architectural practices.

Requirements management: Architectural design and decision making is founded on identified requirements. Previous studies do not clearly highlight which factors in the requirements management advance the success of software architecture. However, the problems in requirements quality cause failure for software architecture like as described in the next chapter. Therefore, it is evident that the quality of the requirements and of the requirements management process advances the success of software architecture.

Architecture solutions: Architectural choices and decisions are made in architectural design. Based on these decisions, the architectural specifications are produced.

The main success factors and their relationship are presented in the [figure](#) below.

Similarly, failure factors for SA were defined for the different areas. Examples of both success and failure factors for SA are presented in the [table](#) in the end of this topic.

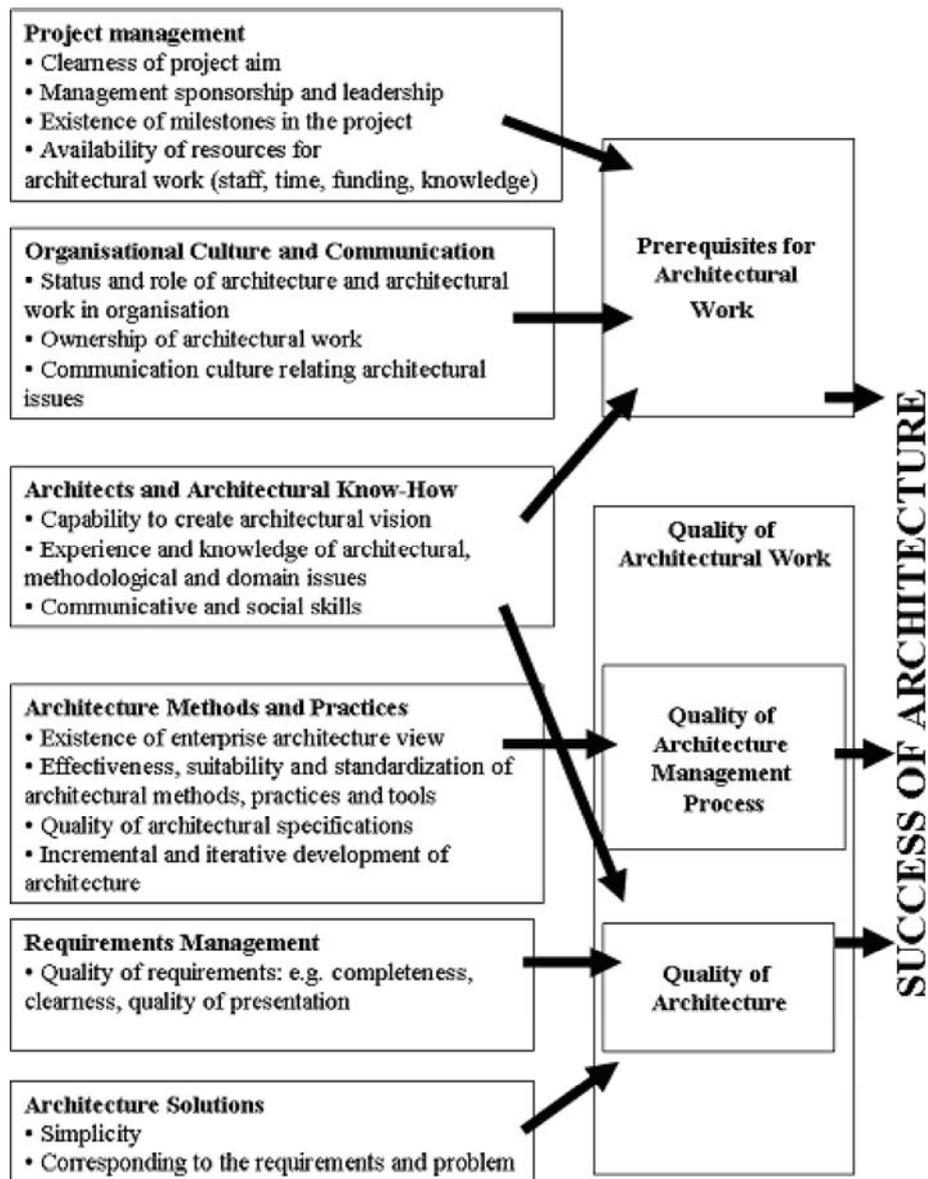


Figure: System development areas affecting the success and failure of software architecture.

The results of this study can be used as a checklist by which practitioners in ICT service providers and user organizations undertaking, or planning to undertake, software architecture efforts can ensure that their software architecture-related efforts are comprehensive and well-implemented. These results can also help to decrease the chance of failure in architecture development.

For more detailed information, see the paper [Success and Failure Factors for Software Architecture](#) or the related [report](#).

Table: Examples of the factors related to the areas affecting the success or failure of SA.

Area	Success Factors	Failure Factors
Project management	<ul style="list-style-type: none"> • Clear aim of the project • Strong management sponsorship 	Problems and deficiencies in the project planning

	<ul style="list-style-type: none"> • Clear milestones in the project • Strong leadership • Clearly defined terms and roles • Available knowledge / staff • Teamwork 	<ul style="list-style-type: none"> • Not a clear statement of the problem • The project scope too broad • No project, system or testing planning • The lack of clear milestones in the project • No measures of success <p>Problems in the scheduling</p> <p>Problems in the project funding</p> <p>Problems and deficiencies in staffing</p> <ul style="list-style-type: none"> • Poor leadership • Stakeholders unclear • lack of resources / talent • Lack of quality assurance organization • Lack of requirement team
Organizational culture	<ul style="list-style-type: none"> • Architecture is woven into the organizational culture • Ownership: Willingness to take ownership of architecture • Approving attitude towards architecture • Training, teambuilding 	<ul style="list-style-type: none"> • Profit-centre and project culture • Quarterly thinking • "Turf" thinking • Organizational politics • Negative attitude towards architecture and architects • Poor communication • Disparity in the perception of the architecture
Architects and Architectural Know-How	<ul style="list-style-type: none"> • Practical experience • Domain knowledge • System development knowledge • Capability to create architectural vision • Conceptual thinking • Capability to argue rationally • The ability to outline large entities • Communicative and social skills • Project management skills 	<ul style="list-style-type: none"> • Unconvincing leadership by architects • Incapability to create an architectural vision
Architecture Methods and Practices	<p>Architecture Management Process model:</p> <ul style="list-style-type: none"> • Incremental and iterative development • Validation of requirements 	<ul style="list-style-type: none"> • Focus is on the methods and tools, not on architecture • No architecture selection decision criteria • No change management • No iterative design

	<ul style="list-style-type: none"> • The evaluation of architecture • Life-cycle thinking in the architectural design <p>Methods, tools and practices:</p> <ul style="list-style-type: none"> • Suitable and effective methods and tools • Well-defined limits for architects • Clear rules in the architectural decision making • Change management <p>Standardization of architectural practices</p> <p>Architectural specifications:</p> <ul style="list-style-type: none"> • Clear and understandable architectural specifications <p>Enterprise architecture:</p> <ul style="list-style-type: none"> • Defined and described EA 	<ul style="list-style-type: none"> • Outputs not identified • Essential architectural views / aspects not documented • Architectural descriptions are at too low a level, are not detailed enough, or are at too high a level • EA is not defined or described, or it is very heterogeneous
Requirements management	<ul style="list-style-type: none"> • Complete • Agreed • Well-represented 	<ul style="list-style-type: none"> • Incomplete or unclear requirements • Unbalanced set of requirements • Requirements not prioritized • Requirements not documented • Insufficient resources to support a new requirement have been allocated
Architecture solutions	<ul style="list-style-type: none"> • Simple architecture • Architecture solves problems 	<ul style="list-style-type: none"> • Architecture does not correspond to the requirements • Architectural decisions are based on the wrong interpretation of requirements • Standards and standard components neglected • External structures or exceptions drive the architecture

Stakeholders of Architecture Work

The commitment of key stakeholders, such as top management, is crucial to EA success (see e.g. [Syntel 2005](#)) and the significance of identifying, involving and managing key stakeholders is also emphasized in other domains, such as SA, information systems (IS), requirements engineering, and management (see e.g. [Boehm 1996](#); [IEEE 2000](#); [Mitchell et al. 1997](#); [Pouloudi 1999](#); [Sharp et al. 1999](#)). Stakeholders may have different, even conflicting needs and perspectives ([Jonkers et al. 2006](#); [Kaisler et al. 2005](#); [Morganwalp & Sage 2003](#)), which should be identified and utilized in architecture work. For example, communication is essential in architecture work (see e.g. [Lankhorst 2005](#), and thus the key stakeholders and their requirements for architectural content and its representation need to be identified (see e.g. [Armour et al. 1999](#); [Lankhorst 2005](#)). Also while planning architecture evaluation, the architecture work stakeholder groups that may need or require evaluation results need to be defined, and potential ways these stakeholder groups will use the information should be discussed and determined (see the paper on [Enterprise Architecture Evaluation Components](#)).

Several definitions for a stakeholder have been proposed (see e.g. [Mitchell et al. 1997](#)), including the substantially cited one by Freeman ([1984](#)):

"A stakeholder in an organization is (by definition) any group or individual who can affect or is affected by the achievement of the organization's objectives".

However, in this study, the following, even broader definition from the architecture domain was adapted from the IEEE standard [1471-2000](#):

Stakeholder is an individual, team, or organization with interests in, or concerns relative to architecture.

Although the standard originally describes a recommended practice for architectural descriptions of software-intensive systems, a system by definition encompasses IT platforms, applications and systems, and even whole enterprises, making the definition appropriate in the architecture context. Stakeholder concerns, on the other hand, are defined in the following way:

Concerns are interests related to the development of architecture, its use and any other aspects that are important to one or more stakeholders ([IEEE 2000, adapted](#)).

In literature, many architecture work stakeholders are proposed. Stakeholders have certain roles (such as Architect or Acquirer), that can essentially be filled with various individuals, teams and organizations ([IEEE 2000](#)). At least 13 architecture work stakeholder roles can be identified and from these (with some additional stakeholders from literature), approximately thirty stakeholder individuals, teams and organizations can be derived. Therefore, to gain any control of this myriad of stakeholders a classification scheme based on some of their common characteristics is needed. A few classification models are provided (e.g. [Mitchell et al. 1997](#); [Preiss & Wegmann 2001](#)) but none are validated in the architecture context. Therefore, we applied a simple model by Liimatainen and Koskinen ([2007](#)). The model originally classifies IS research into three contexts, including the viewpoints of

- IS producers (e.g. software developers),
- facilitators (e.g. information management and ICT maintenance) and
- users.

In the architecture domain, these roles can be defined as follows:

- **Producers** are the stakeholders carrying out architecture planning and development. They differ from facilitators and end-users in the sense that they not usually manage or maintain architecture, or use it for any other purpose than their primary work. However, some stakeholders such as architects can also be involved in management, maintenance, and even use of architecture.
- **Facilitators** are the stakeholders performing architecture governance, management and maintenance. The role also includes stakeholders that sponsor and support architecture work by e.g. providing resources, requirements or ideas. This role differs from producers because it does not directly conduct EA planning or development. Facilitators are not architecture end-users in the sense that their work directly affects architecture.
- **Users** utilize architecture work and its products (e.g. the architecture itself) in their daily work. The difference between the users and the other roles is that the users do not carry out architecture work or directly affect architecture. However, they can be involved in architecture work by e.g. providing business requirements.

A number of common characteristics can be defined for these stakeholder classes:

- **Producers** could be concerned with carrying out architecture planning and development in a way that (to a reasonable extent) satisfies facilitators' and users' requirements for 1) the content, presentation and quality of the work products (e.g. the architecture), and 2) the impacts (e.g. benefits) of the work or architecture.
- **Facilitators** could be concerned with strategic or operational management, maintenance, or sponsorship of architecture or architecture work. In turn, they may require that 1) certain requirements are taken into account in architecture planning and development, and/or 2) certain impacts are realized by architecture or architecture work.
- **Users** could be concerned with receiving architecture work products and/or impacts that satisfy their requirements (e.g. enable or ease their work). In turn, they could be involved in architecture work by e.g. disclosing requirements and feedback.

In spite of these commonalities, some stakeholders may have multiple roles related to architecture and their concerns could also be diverse. In addition, stakeholders could be classified differently depending on the organization and the phase of the EA program, and they could also be organization-specific. Therefore, differences may exist depending on e.g. organizational size, type (e.g. hierarchical or matrix) and industry, and the scope and phase of the EA program. A generic hierarchy or organizational position for an architecture function or governance organization would thus be difficult to define. In organizations worldwide, the architecture function has been commonly situated under CIO or information management, but there seems to be a shift to top business management ([Schekkerman 2005](#)).

By successfully identifying and managing architecture work stakeholders, their requirements and other concerns could be more comprehensively and extensively considered in architecture work, potentially resulting in increased organizational satisfaction towards the architecture program. In turn, this may facilitate the diffusion of the architecture approach in the organization. This is especially important because in many organizations, particularly EA is a relatively new discipline. Some stakeholders in organizations may not even be aware that they essentially are architecture work stakeholders.

For more information on architecture work stakeholders, see paper [Enterprise](#)

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Benefits of Architecture Work

Architecture work, especially on the enterprise level, is claimed to facilitate the realization of a multitude of benefits, such as aligning and integrating strategy, people, business and technology, and enabling organizational agility (see e.g. [Goethals et al. 2006](#); [Morganwalp & Sage 2004](#)). However, investments need to be made in organizational, cultural and technical infrastructure to support the architecture program (see e.g. [Kaisler et al. 2005](#)) and be justified to the stakeholders by demonstrating the positive effects of architecture work in the organization (see e.g. [Morganwalp & Sage 2004](#)).

Nevertheless, presenting the benefits of architecture work is difficult since measuring its effects comprehensively is demanding and the architecture itself is changing constantly ([Morganwalp & Sage 2004](#)). This may be one of the reasons why literature provides few academic research results to quantify the argued benefits or value of architecture work, with the exceptions of a few case studies (see [Hjort-Madsen 2006](#); [Kamogawa & Okada 2005](#)) and survey-based studies (see [Infosys 2005](#); [Ross & Weill 2005](#); [Schekkerman 2005](#)). Still, defining the potential benefits of architecture work is important - it might even be the prerequisite for the selection of objectives for an architecture program, measuring the realized benefits and value of architecture work, and thus providing a rationale for key stakeholder support and investments in architecture (see e.g. [Kamogawa & Okada 2005](#)).

On the definition of architecture work benefits, some literature exists and from there, at least 27 individual benefits can be derived, the most referred being

- reduced costs,
- providing a holistic view of the enterprise,
- improved business-IT alignment,
- improved change management,
- improved risk management,
- improved interoperability and integration, and
- shortened cycle times.

The large number of potential benefits suggests that a feasible classification scheme should be applied. However, there does not seem to be an established model for classifying benefits in the architecture context. Therefore, a classification model from the IS domain (see [Giaglis et al. 1999](#)) was applied. The horizontal axis of the model distinguishes between quantifiable and non-quantifiable benefits, and the vertical axis between benefits that can be accounted to architecture or architecture work, and those that significantly depend on other organizational or environmental factors as well. In the model, the benefits are categorized into the following categories:

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

architecture or architecture work.

- **Intangible benefits** cannot be easily quantified, but they can be attributed to architecture or architecture work. These benefits can be realized, particularly, from the development and usage of architectural models and descriptions, leading to better insight of the enterprise and thus supporting e.g. decision making.
- **Indirect benefits** can be measured in quantifiable terms, but cannot be attributed to architecture or architecture work. They are related, especially, to an enterprise's better position in the market, improved management and customer orientation, and more efficient business processes – factors that can be quantified by various metrics but only partially attributed to architecture or architecture work.
- **Strategic benefits** are positive effects that are realized in the long run and are typically affected by a multitude of factors. Therefore, they generally cannot be objectively quantified or completely attributed to architecture or architecture work. These benefits may include, for example, increased stability of an enterprise in an environment of constant change, better strategic agility, and improved alignment with business strategy.

Figure below displays the architectural work benefits derived from literature classified according to the model.

<i>Attributable to EA</i>	Weakly	Indirect	Strategic	
		<p>Improved alignment with partners</p> <p>Improved customer orientation</p> <p>Improved risk management</p> <p>Increased market value</p>	<p>Improved asset management</p> <p>Improved innovation</p> <p>Improved staff management</p> <p>Increased quality</p>	<p>Improved business processes</p> <p>Improved management of IT investments</p> <p>Increased efficiency</p> <p>Reduced complexity</p>
	Strongly	Hard	Intangible	
		<p>Increased economies of scale</p> <p>Increased reusability</p> <p>Reduced costs</p>	<p>Increased interoperability and integration</p> <p>Increased standardization</p> <p>Shortened cycle times</p>	<p>Evolutionary EA development & governance</p> <p>Improved decision making</p> <p>Provides a holistic view of the enterprise</p>
		Quantifiable	Non-Quantifiable	
		<i>Measurable</i>		

Figure: The classification of the architectural work benefits according to the [Giaglis et al. \(1999\)](#) model.

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

At this point, challenges relating to architecture work benefit definition and evaluation still remain. Even though the literature focuses on listing a multitude of potential benefits, it does not clearly define and describe them. Moreover, benefits derived from literature represent different levels of abstraction. Some benefits may also be more like characteristics of architecture or areas of architecture work from which benefits could be gained, even though they are all referred to as benefits in literature. Furthermore, the causes, effects and other relationships between various benefits, architecture characteristics and architecture work activities are not clearly defined, implicating a need for more work on describing the architecture work benefit realization process.

All in all, it is worth noting that architecture work benefits are not automatic. The architecture should be communicated effectively in the organization to realize any benefits (see e.g. [Tash 2006](#)). Even then, architecture work does not guarantee long-term value because a multitude of factors affects the realization of benefits (see e.g. [Boster et al. 2000](#)). In addition, distinguishing the contribution of architecture or architecture work from all the potential factors affecting the realization of the benefits is clearly a challenge. In any case, architecture and architecture work should be seen as assets, not expenses, and that the expenses are actually realized by not investing in the architecture (see e.g. [Tash 2006](#); [Whyte 2005](#)).

For more information on architecture work benefits, see paper [Enterprise Architecture Benefits: Perceptions from Literature and Practice](#). For information on architecture work benefit evaluation, see section [Architecture work benefit evaluation](#) and report [Evaluating the Benefits of Architectural Work](#).

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Status of Architecture Work

During the AISA project the status of architecture work was charted with the help of [the Evaluation Model for Enterprise Architecture](#) in the beginning of the year 2006 and again in the beginning of 2008.

The first architecture work status evaluation was conducted in three of the participating companies (see the section on [the case studies](#)). Two of the companies represent IT user organizations, in which we studied their internal architecture work status and the third company is an IT service provider, in which we studied its internal architecture work status and the company's view of its customers' architecture work.

In the beginning of the year 2008, the architecture work status was re-evaluated in two case companies representing the IT user organizations.

Data was gathered by semi-structured interviews using the evaluation model to structure

the interview. Each interview took 2-4 hours. In addition, some internal documents provided by the companies were used to support the analysis and reporting of the interview data. If required, the interview was complemented with an additional phone interview.

The status of each of the architecture work areas in the companies in 2006 can be summarized as follows (see also [the figure](#) below displaying the maturity levels of the areas).

1. **Scoping and Purpose:** The cases show that the benefits and objectives of architecture work and the objectives of architecture are mostly identified on a general level. Yet, the identification is somewhat insufficient on occasion.
2. **Organizational Culture:** The general commitment of either or both management and the IT organization already supports architecture work to some degree. A number of organizational challenges for architecture work have been identified and preliminary solutions considered.
3. **Commitment:** The management of the case companies is committed to the architecture approach and is aware of the importance of architecture. In practice however, gaining management support for architecture work is challenging. In all cases, IT organizations are committed to architecture work, but gaining the commitment of business end-users is evidently a challenge. Guidelines for IT developers for assuring architecture compliance are under construction.
4. **Communication & Common Language:** All of the case companies have established communication between the architecture team and the key stakeholders to some extent. Nonetheless, there is room for improvement in communication with management, IT developers and business end-users. A number of architecture concepts are defined, and communication challenges have been discussed.
5. **Development Methodology, Framework and Tool Support:** There are no specific development methodologies for architecture development defined in the case companies. However, methodologies for individual systems and software development projects are mostly well developed and a number of system architecture development methodologies are available. On the other hand, the framework for architecture development is defined and documented in all cases. However, there are challenges either in communicating the framework to all relevant stakeholders or actively using it in architecture development. Multiple tools, including modeling tools, are used in architecture work. Nevertheless, defined and controlled use of the tools is not yet established. Also, the challenges in transferring architectural descriptions between tools are being considered. The use of UML has been discussed, but it is thought to have its limitations in intelligibility.
6. **Architecture Models and Artefacts:** There are a number of deficiencies in the descriptions of the state of architecture, both current and objective, as well as in the transition plans. They are fragmented or based on incomplete information, or even non-existent. Plans for architecture documentation have mostly been done, but the documentation process is typically not very systematic.
7. **Assessment / Evaluation:** The possibilities of architecture evaluation have not been charted extensively or in detail. Nonetheless, evaluations are occasionally made in one or two case companies. A defined set of architecture evaluation methods and metrics is rarely established.

8. **Governance** The organization, functions and processes of architecture governance have been partially defined and documented, but not implemented. Furthermore, the governance unit is mostly situated under IT management. Therefore, the connection between business and architecture has not been fully established. In architecture risk management and organizational change management, existing practices could be used.
9. **Skilled Team and Training / Education:** Most of the case companies have defined roles and responsibilities for a full-time architecture team. The roles of chief architect and business architect are mostly not named, but there is practically a certain person that works in the role of the chief architect. The training and education needs of the team or other stakeholders, such as management, are not yet thoroughly charted. Training and education is available and personal training and education plans are implemented but not actively used.
10. **Project Management:** The case companies have established project management practices. From architecture point of view, the coordination between projects generally operates well. However, methods for collecting project management best practices are not established in all case companies.
11. **Business-Drivenness:** The architecture work of the case companies is mostly driven by business needs and requirements. However, collecting the business requirements and verifying their traceability to e.g. architecture decisions are a challenge.
12. **IT Investment and Acquisition Strategies** It is perceived that investments should be driven by architecture planning and development. A missing link between the investment process and architecture planning is considered as a risk, and therefore the case companies either have connected or are currently establishing a connection between them.

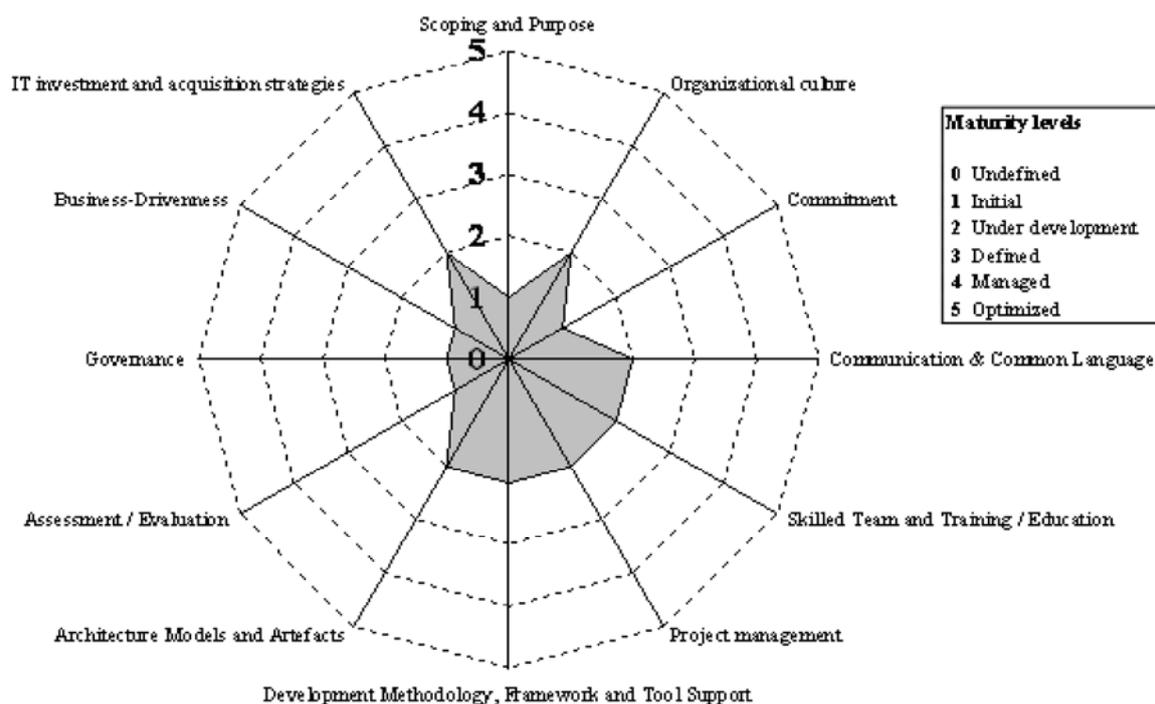


Figure: The average maturity levels of the architecture work areas in the case companies.

The status of architecture work was re-evaluated in the beginning of the year 2008. **The main improvements of the architecture work in the organizations** (compared to the previous status evaluation) relate to the following areas:

- **Architecture framework, development methodology and tools:** Architecture frameworks are better established and are used to guide both the development and management of EA. Actual architecture methods are not necessarily used, but organizations are developing and stabilizing their architecture processes. Architecture toolsets have been further defined.
- **Architecture governance:** Especially the architecture guidance provided to development projects has evolved and proven to be useful in organizations.
- **Teamwork, training and education:** Architecture teams are more stabilized; their roles, tasks, and responsibilities have been clarified. The role of an enterprise architect usually exists in organizations. Architectural skills and capabilities have been acquired e.g. in the form of seminars and lectures. To some extent, architects have also provided training for the in-house stakeholders to increase the commitment and understanding of the architecture work, its objectives and benefits.
- **Business-Driven Approach:** Business linkage has been strengthened; business needs and objectives are taken into account more explicitly in the architecture development and enterprise architects are to some extent involved in the organization-level strategy formulation. Also the linkage between investment and acquisition strategies and architecture development has become more evident.
- **Communication and commitment:** Face-to-face communication is considered to be perhaps the most effective way to communicate the architecture issues to various stakeholders. The down-ward communication towards the development projects is well taken care of and supports the architecture guidance provided to the projects. The up-ward communication towards the top-management remains a challenge until the architecture work is a stabilized activity in the organizations and some explicit benefits can be shown.

Findings from other studies are mostly parallel with our results. All of the organizations studied by Schekkerman (2005) have an architecture framework, and virtually all use tools and modeling techniques. Typically, architecture modeling tools include Microsoft Visio and similar programs (Aziz and Obitz 2007). The majority of the organizations also employ architects of their own, but their education and training is most commonly their own responsibility (Schekkerman 2005). Architecture governance is usually located under IT management but there seems to be a shift to business management (Schekkerman 2005). Furthermore, about 60% of the organizations studied have a full-time architecture team (Aziz and Obitz 2007). However, architecture assessment and evaluation seem to be more established in the organizations studied by NASCIO and Infosys (NASCIO 2005; Aziz and Obitz 2007). According to the former, the most of the organizations have or plan to establish architecture performance metrics, while only a third of them do not. According to the latter, about 40 % of the organizations have no architecture metrics.

For more information on the status of architecture work (year 2006), see

- the report [Architectural Work Status: Challenges and Developmental Potential - A Case Study of Three Finnish Business Enterprises](#),
- the paper [Architectural Work Status: Challenges and Developmental Potential - A Case Study of Three Finnish Business Enterprises](#), or
- the paper [Enterprise Architecture Work Overview in Three Finnish Business Enterprises](#).

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