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Article

Towards a Generic Evaluation Model for Enterprise Architecture

By Tanja Ylimäki

Abstract
During the past few years, enterprise architectures (EAs) have become one of the major interests of both business and information technology (IT) practitioners and academics. It has been suggested that EA is an approach for controlling the complexity and constant changes in the organization's business environment. Research has mainly focused on the development and modeling of EAs, while the quality aspects of EA have only recently gained attention, especially in the form of EA maturity models. These models have been developed to provide a means to evaluate the stage – and the quality – of the organization's EA. While most existing maturity models seem to be domain-specific, this study aims at developing a more generic evaluation model for EA usable in private sector organizations, regardless of their lines of businesses. The generic evaluation model is based on the combination of the potential critical success factors for EA, defined in the previous steps of the project, and the maturity stages. The initial generic evaluation model for EA was trialed in three organizations. The experiences and needs for improving the evaluation model derived from these cases are also represented.

Keywords
enterprise architecture, critical success factors, quality, maturity, evaluation, assessment, evaluation model, maturity model

INTRODUCTION

During the past few years, enterprise architectures (EAs) have become one of the major interests of both business and information technology (IT) practitioners and academics. It has been suggested that EA is an approach for controlling the complexity and constant changes in the business environment of an organization, enabling a real alignment between the business vision, business requirements and information systems (Armour et al., 1999a; 1999b; Kaisler et al., 2005). In brief, EA can be seen as a collection of all models needed in managing and developing an organization. It takes a holistic, enterprise-wide and consistent view of the organization instead of a looking at it from the point of view of a single application or system (Kaisler et al., 2005; Lankhorst, 2005).

Typically, EA studies have focused on the development and modeling of EA (see e.g. Armour et al., 1999a; Halttunen et al., 2005; Lankhorst 2005; Pulkkinen & Hirvonen, 2005; The Open Group, 2002; Ylimäki & Halttunen, 2006; Zachman, 1987), but recently, the quality and assessment aspects have also gained some attention. Specifically, maturity models, which have their origins in the field of quality management (Chrissis et al., 2003; Fraser et al., 2002;), have been developed to assess the stage of an organization's EA and to enhance its quality (U.S. Department of Commerce, 2003; Chief Information Officers Council, 1999; U.S. Government Accountability Office, 2003; Industry Advisory Council, 2005; National Association of State Chief Information Officers, 2003; Office of Management and Budget, 2005).

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

between, eventually moving towards the ideal ultimate state (Klimko, 2001).

I regard these maturity models as one means of advancing the quality of EA by providing at least an initial EA quality management system (see also Cullen, 2006). Something that I consider to be a downside with these maturity models is the fact that they seem to be more or less domain specific; especially developed for the various areas of the public administration (see e.g. U.S. Department of Commerce, 2003; Industry Advisory Council, 2005; National Association of State Chief Information Officers 2003; Office of Management and Budget, 2005; U.S Government Accountability Office, 2003; Vail, 2005). Publicly available maturity models, specifically suitable for evaluating the EA of heterogeneous private sector companies, are still hard to find. Hence, I decided to take another approach to the problem: we applied the concept of a Critical Success Factor (CSF) to the field of EA and defined the potential CSFs for EA. These CSFs represent the factors that have to be carried out exceedingly well in order to attain successful EA (i.e. a high-quality EA) which in turn enables the business to reach its objectives and gain more value (Ylimäki, 2006).

In this article, I present a study that aims at developing a generic evaluation model for Enterprise Architecture (later the model is referred to as gemEA), a model that is suitable for evaluating the stages of EA in private sector organizations, regardless of their line of business. The potential CSFs for EA that were defined during the previous steps of the ongoing research project (see Ylimäki, 2006) provide the basis for the generic evaluation model. These factors combined with the appropriate maturity levels form the initial gemEA.

The article proceeds as follows. In the next section, I present the construction of the generic evaluation model for EA, gemEA. Following this, the trial use of the initial gemEA in three case organizations is presented, and the usability of the model in practice is discussed. Finally, the last section summarizes the article and presents suggestions for further research.

CONSTRUCTION OF THE EVALUATION MODEL

The previously defined set of potential CSFs for EA awoke our interest to study whether this set of factors can be utilized in evaluating the current state of any private sector organization's EA, and furthermore, how holistic and extensive a view of the state of the organization's EA do the factors provide? Consequently, we needed to construct an evaluation model that is based on the set of potential CSFs for EA. In this section, the construction of the generic evaluation model is briefly described.

The set of potential CSFs for EA (Figure 1) were defined in the previous steps of the research project (see Ylimäki, 2006). They provided the baseline for the initial gemEA. In Table 1, brief descriptions of each potential CSF are presented. More detailed descriptions of the CSFs are presented in (Ylimäki, 2006) in the form of key questions assigned to each factor.

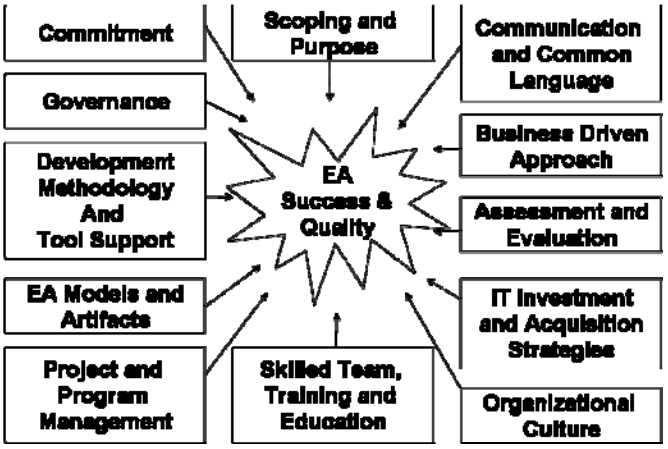

Figure 1. The Set of Potential Critical Success Factors for Enterprise Architecture

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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 targets, evaluation purposes and audience, evaluation process and criteria (metrics), as well as data gathering and analysis techniques.
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.
Governance	Relates to issues such as governance (architecture guidance) structures, roles, responsibilities, processes 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.

Table 1. Potential Critical Success Factors for Enterprise Architecture (In Alphabetic Order)

The maturity levels, shown in Table 2, were derived from the existing maturity models (Chrissis et al., 2003; U.S. Department of Commerce, 2003; U.S. Government Accountability Office, 2003; National Association of Chief Information Officers, 2003; Office of Management and Budget, 2005). The aim was to define the maturity levels in such a way that they can be used for evaluating the stage of all the diverse areas, i.e. the CSFs in the gemEA.

Level		Description
0	Undefined / None	No evidence of any kind of the particular area being taken into account.
1	Initial	The need for taking the particular area into account has been recognized. Artifacts and practices may exist, but they may be incomplete or inconsistent. Processes are mainly informal and ad-hoc.
2	Under Development	Artifacts and documented practices or processes exist. Some may be even complete. Implementation or deployment is not yet carried out. Practices or processes are not yet utilized.
3	Defined	Practices or processes and artifacts have been completed, accepted and communicated to the stakeholders. Implementation, deployment, and utilization have started.
4	Managed and Measured	Implemented or deployed. Practices or processes and artifacts are being utilized and considered as part of normal operations in the organization. Practices or processes and artifacts etc. are measured against a set of predefined and established metrics or criteria.
5	Optimizing (continuous improvement)	Practices or processes related to the particular area are continuously improved. More specifically, clear proofs of architecture benefits, e.g. demonstrable improvements in efficiency, cost savings and service quality, can be seen.

Table 2. The Maturity Levels Defined for the gemEA

As a conclusion, the initial gemEA consists of three main parts:

1) the set of 12 CSFs for EA representing the areas to be evaluated;
2) the key questions assigned to each CSF (see Ylimäki, 2006 for more details); and
3) the maturity levels to evaluate the stage of each CSF.

In the following section, the usability of the initial gemEA is described on the basis of the model's trial use in three case organizations.

TRIAL USE OF THE INITIAL EVALUATION MODEL IN THREE CASES

The initial gemEA was tested in the three organizations participating in the research project, as is shown in Table 3. Each organization operates in a different line of business and represents an enterprise of different size. In organization 2 and organization 3, the current stage of their EA was evaluated. In organization 1, the evaluation was two-fold: on one hand, the organization's ability to deliver architecture development and management services, as well as practices in customer projects was evaluated; and on the other hand, the average state of its customers' EA was evaluated from the consultants' viewpoint. Suggestions for modifying and improving the evaluation model were collected during the following steps:

1. Data Gathering: For each company, one semi-structured focus group interview (Krueger and Casey 2000) was carried out. The option of a complementary interview existed and was applied as a phone interview in the case of Organization 1. The evaluation model – specifically, the CSFs together with the key questions – formed the basis for the interviews, which were carried out by three researchers. The interview was moderated by one researcher while the other two took notes. The interviews were also digitally audio-recorded for the purposes of reviewing and completing the notes. Moreover, the companies provided some documentation to support the interviews.

2. Data Analysis: The interview notes were checked against the recordings and necessary corrections and additions were made. Descriptive text was written according to the notes. Documentation, such as organization charts, was used to add information. In addition, a ballpark estimate for the maturity level was made for each of the areas (CSFs) in the gemEA.

3. Reporting the Results: A separate report was compiled for each company. Before completing the reports they were reviewed by the researchers, who focused especially on the maturity measures of each CSF as well as on the conclusions drawn from the study in order to verify the consistency of the researchers' views. In addition to the company specific reports, an analysis of the current status of architectural work, underlining the challenges and developmental potential in organizations, is described by Niemi (2006).

Industry	Number of Personnel[1]	Number Interviewed
Business & IT Consulting and Development	1,400	3
Finance and Insurance	12, 000	3
Telecommunications	4,700	1

[1] approximate number (Year: 2005)

Table 3. The Case Study Companies

USABILITY OF THE EVALUATION MODEL

In this section, I describe the usability of the evaluation model in practice, as well as provide ideas and suggestions to improve the gemEA, that were perceived during the trial use of the model in three heterogeneous case organizations.

Based on the trial use of the gemEA, it seems that the model – the set of 12 CSFs for EA together with the maturity levels – is suitable for evaluating the current stage of EA in various types of private sector organizations (representing IT user organizations). Furthermore, the gemEA provides a tool to evaluate an IT service-provider organization's ability to deliver EA development and management services and practices for its customers.

The CSFs in the gemEA take various viewpoints into account and provide a more holistic and extensive view to an organization's EA than most of the existing models. In addition, the gemEA is also generic enough to enable the evaluation of the state of EA in various

organizations representing different lines of businesses; whereas, most existing maturity models that have been used in the EA evaluation are defined in terms of public sector organizations (administration) only. Furthermore, even if the EA maturity models for private sector organizations exist, they are seldom publicly available. It should be noted, however, that organizations may have different means and paths to move from a maturity level to a more advanced level, particularly depending on the industry and the size of the organization. For instance, in an organization consisting of five consultants in total, EA issues can possibly be communicated alongside with every day business actions without hundreds of pages of EA documentation; whereas, in large organizations employing hundreds or thousands of people, successful communication on EA issues needs more careful planning and established channels.

The gemEA is, however, an initial evaluation model, and during its trial use, the following improvement needs were detected:

- Categorization of the questions attached to each CSF: Two or three levels of questions for each CSF could be determined; general-level questions supported by more detailed questions (see also Taylor-Powell et al. 1996). This categorization would enable evaluators to use the gemEA either on a high-level (only the general-level questions are answered) or on a more detailed level (detailed questions are also answered) depending on the objectives of the evaluation as well as the resources available for conducting it.
- Prioritization or weighting either 1) the CSFs, 2) the different parts of the CSFs, or 3) both: During the analysis of the interview data, it was noted that difficulties may appear in assessing the maturity of a CSF if it consists of several different aspects; which part of a CSF should be emphasized and why? One solution to this problem would be the prioritization of the CSFs, or perhaps the weighting of them, as well as the different aspects within a CSF. Prioritization could be done, for instance, on the basis of the phase of the organization's EA development, or the available resources (time, money, or workload). Specifically, if the organization has just started its EA journey, it is likely that gaining a common understanding and commitment through effective communication and common language, utilizing the EA models and other artifacts in this effort, is important or even vital. When the EA development advances, issues such as establishing the governance structures or the evaluation metrics will gain more attention. As a conclusion, there seems to be a need to develop a more sophisticated mapping between the CSFs and the maturity levels of the gemEA: at the lower maturity levels, the emphasis may be on different factors than on the more advanced levels. However, the initial version of the gemEA already provides a workable tool for revealing the areas important to the EA that the organization may have ignored or neglected.
- Combining or dividing the CSFs: Depending on the organization's needs (or the phase of the EA development), there may be a need to divide some CSFs into several separate parts (such as framework, development methodology and tool support), especially if there seems to be a lot of variation in the maturity or development activity among these parts.
- Organization of the CSFs: During the analysis of the interview data, some questions arose; should the CSFs be organized or categorized further? How should they be categorized? One possible grouping for the CSFs was found, namely:

  1) Architectural starting points (including Scoping and Purpose; Organizational Culture; Commitment; Communication and Common Language);

  2) Methods and tools for architecture work (including Development Methodology and Tool Support; EA Models and Artifacts; Assessment and Evaluation);

  3) Support for architecture work (including Governance; Skilled Team, Training and Education; Project and Program Management); and finally

  4) Integration with the organization's other processes (including Business Driven Approach; IT Investment and Acquisition Strategies).

  This categorization provides one possible way of interpreting the results. For example, it may help in depicting the extent to which

the organization has addressed the architectural starting points, which are crucial in facilitating the further EA development.

CONCLUSIONS

In this study, the first version of a generic evaluation model for EA, gemEA, was presented. The model consisted of:

- the CSFs for EA;
- the key questions assigned to each CSF; and
- the maturity levels to assess the stage of each CSF.

The model was tested in three organizations in which either the current state of the organization's EA or the organization's ability to provide EA development and management services was evaluated. All of the cases demonstrated that the model is comprehensible and usable and that it provides an extensive view on the state of the organization's EA or its ability to support EA development and management in its customer projects. When evaluating our study it should, however, be remembered that the usability of the model is based on only three cases and the subjective views of the interviewees may have been emphasized. More tests are needed in order to develop the model into something truly generic.

Finally, in addition to the improvement needs of the gemEA described in the previous section, some further research questions raised by this study are:

- How stable are the CSFs in the gemEA? Are there any other areas or objects that should be taken into account when evaluating the state of an organization's EA?
- In addition to the determination of the maturity of EA in terms of the CSFs in the gemEA, which sophisticated, yet simple and practical, evaluation criteria and metrics are suitable for assessing each CSF, especially in order to demonstrate the benefits of the EA program to the top management?
- How many evaluation criteria and metrics should be used for evaluating the state of an organization's EA? How many evaluation criteria and metrics are needed to assess each CSF?
- How can an organization choose the most suitable evaluation criteria and metrics for the EA assessment from the array of different criteria and metrics? One primary driver for metrics selection is that they need to be compatible with the other measures and measurement systems used in the organization (such as Balanced Score Card).
- How do the metrics and the phase of the EA development, or the EA maturity level, interrelate with each other? Which metrics are suitable for specific phases of the EA development or specific EA maturity levels?

The next steps of the research project will focus on determining:

- the requirements and targets for more detailed evaluation of EA; and
- suitable and simple metrics for assessing these evaluation targets.

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