A Template-Based Design Method to Define Organization-Specific KPIs for the Domain of Enterprise Architecture Management

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Abstract:

Enterprise Architecture Management (EAM) strives for aligning business and IT, fostering communication, as well as supporting the continuous transformation of organizations. Thereby, each EAM initiative is driven by respective EAM goals whose degree of fulfillment has to be measurable. This, however, necessitates the design and application of suitable Key Performance Indicators (KPIs) allowing the respective stakeholders to achieve their goals in a timely and controlled manner. When focusing on the design phase of organization-specific EAM KPIs, extant literature only provides limited information. For many sources, the conception of a KPI is inseparably linked to its subsequent operation leaving unclear which KPI elements should be defined upfront, i.e., in advance to its actual usage. Furthermore, current work often refrains from pointing out distinct requirements such an EAM KPI design method has to meet. By devising and evaluating an artifact-centric design method for EAM KPIs this article seeks to improve this situation.

Key words

Enterprise architecture management, key performance indicators, design method, requirements, KPI description structure

1 Introduction

Originating from the domain of information systems architecture [1], Enterprise Architecture Management (EAM) represents a commonly accepted discipline to cope with the growing internal complexity of organizations. In this sense, an EA can be defined as the "*fundamental organization of a system [enterprise] embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution*" as suggested by the ISO Standard 42010 in 2007 [2]. By covering aspects like business, organizational, application, infrastructure, as well as data elements of an enterprise, EAM considers an organization from a holistic point of view [3].

In essence, the word management refers "*to the process of assembling and using resources - human, financial, material, and information - in a goal directed manner to accomplish tasks in an organization*" [4]. Concerned with the present and

the expected and desired future [5], management functions are usually described by a planning, leading, organizing, and controlling dimension [4].

Like it is the case in other management disciplines, EAM employs the concept of goals. Thereby, each individual EAM goal represents an abstract objective ideally complementing at least one business goal [6]. Common examples for EAM goals are, i.a., increase homogeneity or provide transparency [6]. However, unless the degree of fulfillment of these goals is not made measureable, the controlling dimension of EAM remains pointless. In consequence, concrete Key Performance Indicators (KPIs) as "*an item of information collected at regular intervals to track the performance of a system [enterprise]*" [7] have to be made use of.

As literature remarks, there is a general lack of KPIs for EAM [8, 9]. Moreover, there is only a small set of sources which proposes a concrete method for designing EAM KPIs let alone the specific requirements such a method should hold for [10]. Against this backdrop, the three research questions this article tackles are:

1. What are tangible requirements a design method for EAM KPIs has to meet?
2. How could a design method for the definition of EAM KPIs look like?
3. Is the developed method in line with the expectations of industry experts active in the field of EAM?

This article is structured as follows: in the next section, we present related work, which focuses on approaches for the design of (EAM) KPIs. Based on the findings as well as further IT indicator sources, we then derive requirements a “good” approach for designing EAM KPIs has to fulfill. Subsequently, we devise an artifact-centric design method enabling the construction of organization-specific EAM indicators. In addition, we provide first evaluation feedback knowledgeable industry partner shared with us when being presented to the method. A conclusion section wraps up our work, summarizing the main results and pointing towards further fields of research.

2 Related work

Between June, 1st and June, 25th 2012 we conducted a literature search using the following three search engines: Google, Google scholar, and CiteSeerX. We applied the key words “key performance indicator”, “KPI”, “EAM”, “EA management”, “Enterprise Architecture management”, “IT”, “design”, “method”, “process”, “construction”, “definition”, and “development” in different combinations by using also their corresponding German translation. In total, we identified 29 academic as well as industry articles, books, and PhD theses which we analyzed in regards of a method tailored to the development of (EAM) KPIs. By doing so,

we reduced the resulting set to five substantial contributions, which we describe in the following paragraphs.

Basili et al. present in [11] their Goal Question Metric (GQM) approach as a three-step method for defining measurements in the field of software engineering. In their approach, the authors firstly identify concrete goals located on a so-called "*conceptual level*". On an "*operational level*", they then assign a set of questions, addressing quality aspects, to each of these goals. Finally, they define metrics and link them to the questions ("*quantitative level*"). Targeting the field of software engineering, the generic approach does not take EAM particularities into account, e.g. specific EAM goals, required information models, enterprise-specific data sources, and involved actors.

Martin Kütz describes in his book [12] a two-step process for the definition of IT controlling KPI systems. In the first phase ("*conception*"), the steering activities are defined and scoped, concrete goals are set, a strategy for achieving the goals is derived, important factors influencing the goal achievement are identified, and suitable KPIs are selected. The second phase ("*realization*") focuses on the processes of data gathering and calculation process, storing and representing of the calculation results, embedding the KPIs in the organization, as well as reviewing and improving the KPIs. His process focuses particularly on the domain of IT controlling, leaving out non-IT aspects of EAM, e.g., business processes and organizational units. However, even though selecting KPI step is part of his process, this important activity is not further detailed on.

In [13] the Office of Government Commerce presents its seven-step CSI–improvement process for IT services. First, vision, strategy, and related goals are set. Then, quality aspects are identified which should and which can be measured. In the third step, the data collection activities are specified (who, how, when, and integrity of data). Afterwards, the data processing characteristics (measurement frequency, data format, and accuracy) are determined. In the fifth step, means to analyze the resulting data are defined. While step six considers the way how the resulting data is presented and used, step seven defines the possible action to be taken. However, this process does not provide detailed information about involved actors gives only a very abstract description of the outcome of the single steps and does not particularly address the field of EAM.

Stutz presents in his PhD thesis [10] a four-phase method for the definition of EAM KPIs based on the idea of balanced score card ([14]). In the first phase, related goals are derived from the enterprise strategy by applying the above described GQM approach. Afterwards, suitable KPIs and KPI systems are developed, and an organizational structure ensuring the continuous measurement is defined. In the second phase, the KPIs are computed for the as-is EA. Subsequently, the interpretation of the results is performed. In the last phase the EA is managed

using the established indicators. Without any doubt, the method Stutz describes is very comprehensive taking an impressive amount of existing literature into account. However, being mainly process-oriented, he refrains from devising the final result the method is creating, thus an (organization-specific) EAM KPI description.

Keuntje et. al. sketch in [15] a three-step approach for the definition of EAM KPIs. Firstly, operational goals, whose achievement has to be measured, are derived from the strategic enterprise goals. Then, "suitable" KPIs are selected in the second step. Lastly, the selected KPIs are computed on an ongoing basis. Due to the fact that the author only provide an overview, aspects as like involved actors, concrete deliverables and required data for the design and application of these KPIs are not discussed.

All examined literature highlighted the importance of a goal-oriented method for the development of (organization-specific EAM) KPIs. However, only a subset of these methods provides actionable examples for KPIs. Furthermore, only two of these approaches provide a concrete structure for the documentation of KPIs. However, there is no link between the resulting structure and the method for designing the KPIs.

3 Requirements

A design method for EAM KPIs has to hold for distinct requirements which are fundamental when conceiving measurements dedicated to validate the actual degree of goal fulfillment. However, to date there are only few publications (explicitly) stating the conditions such a method should meet. Subsequent enumeration lists five salient characteristics literature and we deem the most relevant.

1. "*Define a KPI in a goal-directed manner*"

A KPI should only be designed if an existing or new EAM goal has to be made measureable. Put differently, KPIs are never created for their own sake. Instead, they are always attached to at least one goal the stakeholders aim to achieve. Consequently, a method for designing EAM KPIs should first and foremost start off with the goals a KPI is intended to measure. Regarding perused sources, this requirement is confirmed also by [10, 11, 12, 13, 15].

2. "*Deliver an actionable KPI*"

A KPI should always be adapted to the operational context it will be used in. This implies that the respective design approach should consider organization-specific circumstances while incorporating those conditions in the KPI's description. In doing so, the KPI becomes actionable, hence can be entrenched on the actual operations of the enterprise. [10, 12, 13] advocate the creation of an applicable KPI

in pointing to important aspects, which should be considered already during the design (e.g. frequency of measurement, target values, and stakeholders).

3. "*Take interdependencies with existing KPI(s) into account*"

A KPI may interfere with existing KPIs. Vice versa, long-lived and proven KPIs may exert influence on a recently established measurement. A design process for KPIs in the domain of EAM has to account for these interdependencies. By defining so-called (EAM) indicator systems, [10, 12] account for relations between existing and newly established KPIs.

4. "*Enable a cost-effective and time-efficient KPI design*"

A KPI requires constant investment covering its initial creation, continuous operation, as well as final retirement. For this reason, a design method for EAM KPIs has to be as inexpensive as possible, both time- and monetary wise. [10] alludes to the significant costs a KPI may incur, but does not point out activities to reduce these expenses.

5. "*Allow the conjoint execution by multidisciplinary actors*"

A KPI in EAM may focus on different aspects in an organization given the overarching nature of the discipline [16]. As a result, an EAM KPI affects many persons from different organizational units in a number of different ways. Consequently, the method for the KPI design has to render the possibility to involve multidisciplinary actors, representing future stakeholders and/or KPI stewards of the indicator. The most comprehensive picture of actors either responsible or interested in a KPI for IT controlling is given by [12]. However, Kütz does not link the actors to his method. While [11, 13, 15] completely lack a method role schema, [10] does not specify the actors being in charge of provisioning the KPI data. Especially the latter actors group should be part of the design phase to ensure a smooth and timely implementation of the KPI.

To sum up, the sources mention all of the above listed requirements. However, none of the examined approaches covers all of them.

4 Contribution

The core contribution of this paper is a method for the definition of EAM KPIs. The proposed artifact relies on a structure for EAM KPI documentation which we will introduce first.

4.1 A standard structure for EAM KPIs

Using a uniform structure for the design and application of EAM KPIs provides many benefits, i.e., it ensures their comparability, fosters their reuse, and guides their development process. A foundation for such a structure is depicted in Figure 1. On the one hand, it consists of general structure elements, e.g., title, descrip-

tion, and calculation. On the other hand, it includes elements responding to organization-specific demands, e.g., mapping and properties. In this vein, the resulting KPI is rendered actionable. Furthermore, several dedicated elements are used to capture the characteristics of KPIs applied in the domain of EAM. This comprises ten EAM goals as proposed by [6], the extract of the underlying EA meta-model, and the KPI's classification according to typical layers of an EA (cf. [9]).

The KPI structure's elements are mainly derived from respective EAM and KPI literature. To validate each element, an expert survey comprising 35 questions has been carried out in April 2012. In total, 24 closed questions were posed using a confirmatory five-point Likert scale. The participants were employed in different industries, e.g., consulting (9x), finance (7x), manufacturing (3x), and education (2x). On an element level, more than 68% out of the 29 participants agreed with the inclusion of each individual element. Besides this survey, we were able to successfully map 52 KPIs from literature and industry projects to the structure (cf. [9]), hence validate the artifact in a theoretical sense.

Applying and customizing the introduced structure asks for the development of an artifact-centric method. Such approach provides concrete guidance along the process while its progress is always incorporated within the artifact.

4.2 An artifact-centric design method for EAM KPIs

Based on the presented structure we now devise the four-step design method. The method's activities as well as the participating actors are depicted in Figure 2 using the Business Process Modeling Notation (BPMN). Even though the method aims on the design of a single EAM KPI and disregards all steps related to its operation, the underlying structure contains information about the indicator's actual enactment. Put differently: already in the process of a KPI's design, its operations is considered to a certain but not definite extent.

When executing the method different actors are involved. This includes enterprise architects responsible for the EAM function. In addition, a KPI stakeholder is involved who demands for the design of a new measurement. Finally, KPI stewards, i.e., employees taking charge of the KPI's operation (e.g., data collection, visualization, archiving), are also involved.

Initialize KPI design

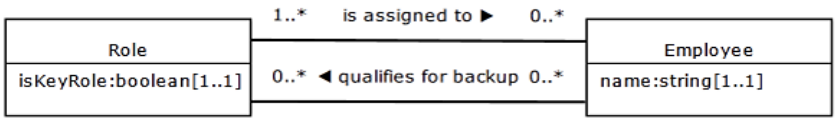
The EAM KPI design method is triggered by a stakeholder interested in measuring the achievement of a single EAM goal. This either the case if a new goal is set up or if an already defined goal should be made measurable. Potential stakeholders are the CIO and other IT/business managers. Whenever more than one KPI should be designed, the method must be carried out again.

Backuped key roles

Description

A measure of how completely qualified personnel has been built up.

Information model



Organization-specific instantiation

Mapping:

Name in model	Mapped name	Contacts	Data sources
Role	Role	John Doe	EA repository
isKeyRole	isImportant	John Doe	EA repository
is assigned to	is assigned to	John Doe	EA repository
Employee	Employee	Jane Poe	HR repository
name	name	Robert Roe	Risk repository
qualifies for backup	qualified	Robert Roe	Risk repository

Properties:

KPI property	Property value	Best-practice
Measurement frequency	Yearly	Quarterly
Interpretation	good if >85% regular 65% – 85% problematic < 65%	
KPI consumer	John Smith	
KPI owner	John Doe	
Target value	90%	
Planned value(s)	50% in 2012 75% in 2013 90% in 2014	
Tolerance value(s)	5%	
Escalation rule	Call John Smith	

Goals

Ensure compliance
Foster innovation
Improve capability provision
Improve project execution
Increase disaster tolerance
Increase homogeneity
Increase management satisfaction
Increase transparency
Reduce operating cost
Reduce security breaches

Calculation

Number of key roles with qualified backup personnel divided by the total number of key roles.

Code

EAM-KPI-0002

Sources

CobiT 4.0

Layers

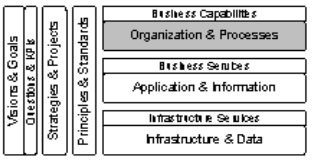


Figure 1: Example for a configured EAM KPI (based on [9])

Map EAM goal

The first activity is performed by an enterprise architect and the measurement's stakeholders. In accounting for a goal-orientation, it comprises a direct mapping of the goal to be measured onto the EAM counterpart provided by the underlying structure.

Referring to the structure depicted in Figure 1, each goal needs to be mapped to one of the ten provided EAM goals, e.g., increase standardization can be mapped to increase homogeneity.

Examine EAM KPI catalog

With the mapped goal at hand, the enterprise architect can assess the EAM KPI catalog to find suitable KPI instantiations. Thereby, the catalog includes all KPIs previously/currently used in a single company (cf. [9]), without specifying details on the information needed for their operation. Thanks to the goal-oriented grouping, the search process within the catalog is facilitated. For a KPI's suitability assessment, general structure elements like the title, description, calculation, and information model can be taken into account. The outcome of this activity is a KPI best suitable for the goal measurement.

Instantiate EAM KPI

The instantiation, thus either the definition of a new, or the adaption or selection of an existing EAM KPI, depends on the outcome of the KPI catalog assessment step (cf. Figure 2).

If no suitable KPI has been found, a new KPI has to be defined. To ease its design and to ensure conformity among KPIs, a plain version of the EAM KPI structure is used. In this sense, a plain version refers to an empty structure, i.e., no KPI-specific information is contained. During the KPI instantiation all general structure elements have to be conjointly filled with content by an enterprise architect and the respective stakeholder. The KPI structure with its graphical layout guides this activity by providing a clear definition of what should be instantiated. As result, a new KPI instantiation is available detailing the measurement's title, description, calculation, and information model (cf. Figure 1).

If the EAM KPI catalog assessment resulted in the identification of a suitable KPI, this already instantiated measurement is selected.

Alternatively, a selected KPI has to be adapted, meaning that at least one organization-unspecific element is altered. That is the case if, for example, the description fulfills the stakeholder's needs but the information model as well as the calculation should be extended accounting for some additional information.

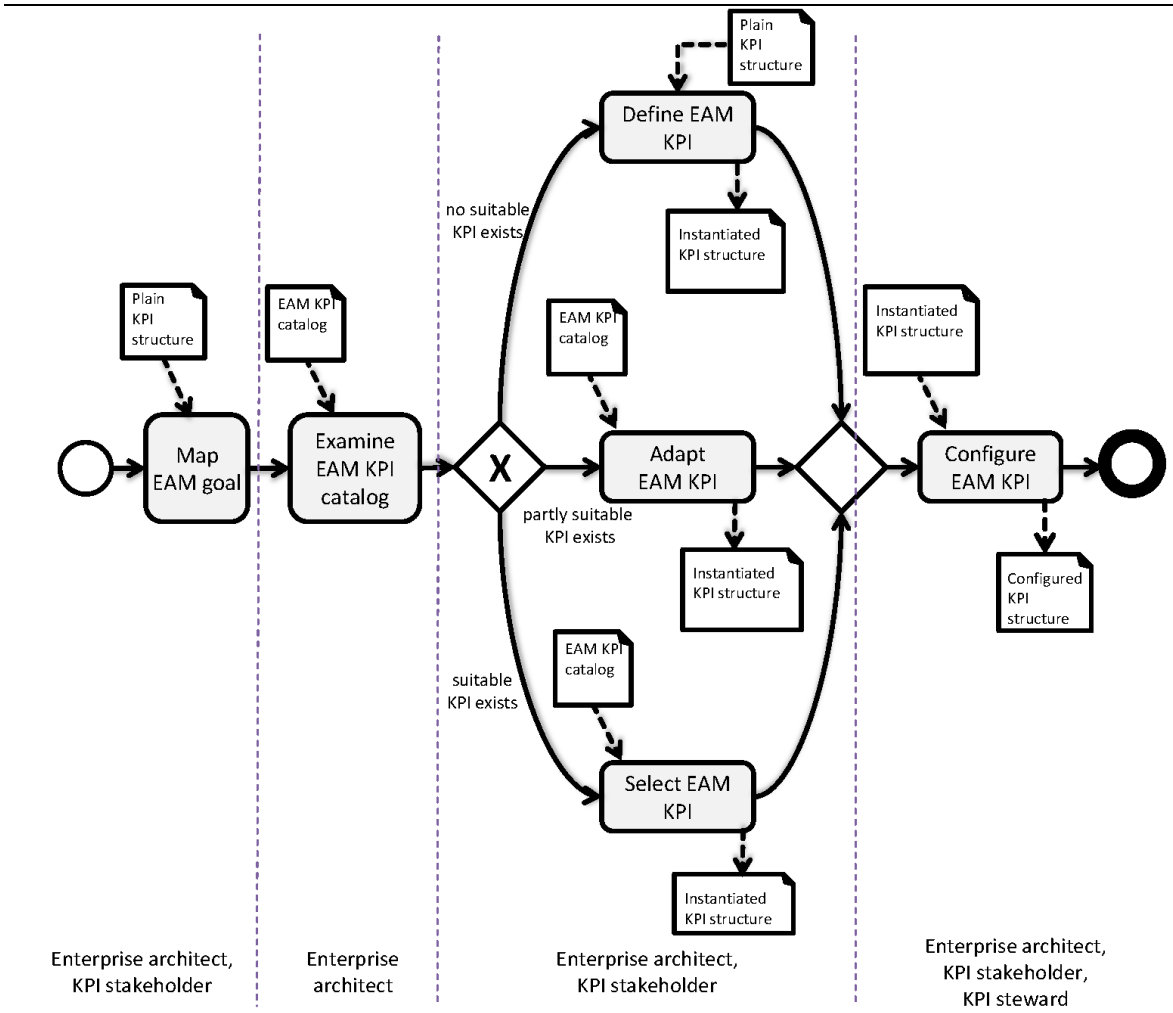


Figure 2: A design method for defining an EAM KPI

Regardless whether the instantiated KPI is newly defined, adapted, or just selected a consistency check has to be performed at the end of this activity. This includes, among others, the setting of a unique identifier as well as a terminology harmonization for the elements used in the information model. However, this also includes the validation if already applied KPIs interfere with the selected KPI, thus have to be adjusted or can even be eliminated. Both, a newly defined as well as an adapted KPI can be added to the EAM KPI catalog allowing its later reuse.

Configure EAM KPI

Up to now, the instantiated KPI is still generic and not tailored to a specific organization. Therefore, the instantiated KPI needs to be configured leveraging the EAM KPI structure as well as the organization's context. During this configuration activity, the mapping and properties elements of the instantiated EAM KPI structure (cf. Figure 1) are filled with content. Similar to the previous activity, a consistency check has to be performed by the enterprise architect together with the KPI stakeholder and a KPI steward. Among others, this ensures a timely oper-

ability of the respective KPI. As result, the instantiated KPI becomes a configured measurement ready to be implemented by the organization.

5 Evaluation

To evaluate the method, we carried out a series of confirmatory interview meetings both, by telephone and personally. The primary objective was to obtain qualitative feedback from EAM experts interested and/or experienced in the usage of KPIs. Furthermore, we intended to capture ideas helping to enhance the artifact in future research.

The interviews were conducted between June 21th and June 29th 2012. In total, we had the possibility to question five EAM experts (three consultants and one IT architect) from four different companies with an average experience of 6.625 years. Two of them already applied EAM KPI(s) for in average 5 years. The 45 minute long interviews were divided into two parts. First we introduced the method during a 30 minute presentation, afterwards we asked the participants to complete a survey form. Taking the recommendations of [17] into account, the latter was limited to one page, contained 13 concise questions, and was subdivided into two main areas: participant's background and questions about our method.

All experts confirmed that our method is comprehensive and differentiates with good reason between a general KPI definition and its organization-specific configuration. Four experts approved that the method can be embedded in their enterprise context, one refused to give an answer. While the experts were unsure whether the method can be actually applied in their daily operations, they emphasized that it possesses a much higher level of detail than their approach. The support in making goals measureable was acknowledged by four participants. More than the half of the experts appreciated the role schema the method provides. One of them remarked that the term stakeholder is too generic and should be refined, while a second expert suggested renaming the KPI steward into information steward. For a subsequent KPI operation step, experts proposed to make use of a complementary maturity model and support KPI redesign loops.

6 Conclusion

The paper presented an artifact-centric design method for KPIs tailored to the domain of EAM. On the basis of a comprehensive study of current sources, we could prove that the research in this realm is still nascent. Furthermore, we were able to elicit five distinct requirements such a KPI design method has to meet. Afterwards, we devised a four-step method whose pivotal element consisted in a measurement description structure. Already introduced in one of our previous contributions (cf. [9]), the structure turned out valuable for the KPIs' construction. On the one hand it served as an underlying foundation while providing concrete

measurement suggestions on the other. As a last step of our research, we presented the design method to five EAM experts being employed at companies from different German industry sectors. The feedback we received by using a short questionnaire of 13 concise and mainly closed questions highlighted the relevance of the topic as well as the validity of our approach.

We are aware of the introductory character of our study especially with regards to the limited evaluation activities. As a result, further work should concentrate on the actual usage of the method within an industrial EAM environment, hence testing the artifact against predefined goals and KPIs. Since a newly created measurement remains fruitless unless it is finally put into action, future research could center on the subsequent operation of the designed indicators. Besides a potential reconfiguration of organization-specific details, a KPI may be also subject to suspension or even elimination once it is not needed any longer or is superseded by a successor. With the EAM KPI catalog [9, 18] we have already provided 52 KPIs serving as an inspiration for the selection and adaption phase of our design method. However, given that existing (and in the best-case practice-proven) measurements can significantly speed up the process of designing a new KPI, further efforts should also attempt to strengthen this underlying candidate repository. Furthermore, we consider the KPI consistency check we only briefly discussed as being useful whenever a new KPI is conceived. By examining the new measurement in the context of existing indicators, the situation where it is possible to derive a KPI from a second one (i.e., overlapping) or where the operation of two indicators would be technically infeasible could be avoided upfront. Finally, we also see potential for research in the KPI structure itself. Future examinations could comprise the adding or modification of (organization-specific) elements within a preceding restructuring step.

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References

1. J. F. Sowa and J. A. Zachman. *Extending and formalizing the framework for information systems architecture*. IBM Systems Journal, 31(3):590-616, 1992.
2. International Organization for Standardization. *ISO/IEC 42010:2007 Systems and software engineering - Recommended practice for architectural description of software-intensive systems*, 2007.
3. Aier, S., Riege, C., & Winter, R. (2008). *Unternehmensarchitektur – Literaturüberblick und Stand der Praxis*. Wirtschaftsinformatik, 50(4), 292-304.

4. J. Black and L. Porter. *Management: meeting new challenges*. Prentice Hall, 2000.
5. P. F. Drucker. *The Practice of Management*. Harper Paperbacks, Oxford, UK, reissue edition, 2006.
6. S. Buckl, T. Dierl, F. Matthes, and C. M. Schweda. *Building blocks for enterprise architecture management solutions*. In F. e. a. Harmsen, editor, Practice-Driven Research on Enterprise Transformation, *PRET 2010*, Delft, pages 17-46, Berlin, Heidelberg, Germany, 2010. Springer.
7. C. Fitz-Gibbon. *Performance Indicators*. Bera Dialogues. Multilingual Matters, 1990.
8. S. Kaisler, F. Armour, and M. Valivullah. Enterprise Architecting: Critical Problems. *Proceedings of the 38th Annual Hawaii International Conference on System Sciences (HICSS'05)*, IEEE Computer Society Washington, DC, USA. 2005
9. F. Matthes, I. Monahov, A. Schneider, and S. Christopher. *EAM KPI Catalog v1.0*. Technical report, Technische Universität München, München, Germany, 2012
10. M. Stutz. *Kennzahlen für Unternehmensarchitekturen: Entwicklung einer Methode zum Aufbau eines Kennzahlensystems für die wertorientierte Steuerung der Veränderung von Unternehmensarchitekturen: Univ., Diss.*, St. Gallen, 2009.
11. V. R. Basili, G. Caldiera, and H. D. Rombach. *The Goal Question Metric Approach*. Wiley, New York, 1994.
12. M. Kuetz. *Kennzahlen in der IT. Werkzeuge für Controlling und Management*. dpunkt.verlag, Heidelberg, Germany, 4th edition, Aug. 2010.
13. Office of Government Commerce (OGC). *ITIL - Service Delivery*. IT Infrastructure Library (ITIL). The Stationery Office, Norwich, UK, 2000
14. R. S. Kaplan and D. P. Norton, *The balanced scorecard – measures that drive performance*. Harvard Business Review, 70(1):71–79, 1991.
15. J. H. Keuntje und R. Barkow, *Enterprise Architecture Management in der Praxis – Wandel, Komplexität und IT-Kosten im Unternehmen beherrschen*, symposion, Düsseldorf, 2010.
16. The Open Group. *TOGAF Enterprise Edition Version 9*. http://www.togaf.org (cited 2012-06-23), 2009.
17. Frazer, L., Lawley, M. 2000. *Questionnaire Design and Administration: A Practical Guide*. 1st ed. John Wiley & Sons Ltd, Milton/Australia.
18. R. Lagerström. KPI:er för EA. http://www.idg.se/2.1085/1.434625/ %20kpier-for-ea (cited 2012-06-22), 2012.