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Article

Future Research Topics in Enterprise Architecture Management – A Knowledge Management Perspective

By Sabine Buckl, Florian Matthes, and Christian M. Schweda

Abstract

Identifying, gathering, and maintaining information on the current, planned, and target states of the architecture of an enterprise is one major challenge of enterprise architecture (EA) management. A multitude of approaches towards EA management are proposed in literature greatly differing regarding the underlying perception of EA management and the description of the function for performing EA management. The aforementioned plurality of methods and models can be interpreted as an indicator for the low maturity of the research area or as an inevitable consequence of the diversity of the enterprises under consideration pointing to the enterprise-specificity of the topic. In this article, we use a knowledge management perspective to analyze selected EA management approaches from literature. Thereby, we elicit constituents, which should be considered in every EA management function from the knowledge management cycle proposed by Probst. Based on the analysis results, we propose future research topics for the area of EA management.

Keywords

Enterprise architecture management, EA management function, knowledge management, knowledge management cycle, knowledge goal-setting and measurement

INTRODUCTION

Knowledge is often referred to as a competitive advantage for enterprises in today's ever changing market environment (Niemann 2006). Thereby, this advantage does not only originate from knowledge about the environment, e.g. competitors, future trends, and technologies, but also from knowledge about the internal make-up and processes of an enterprise. This internal make-up forms the management body of enterprise architecture (EA) management. EA is thereby understood as the "fundamental conception of a system [enterprise] in its environment, embodied in its elements, their relationships to each other and to its environment, and the principles guiding its design and evolution" (International Organization for Standardization 2007). The goal of EA management is to enable the enterprise to flexibly adapt to changing market situations via business/IT alignment (Luftman 2003).

Typical application scenarios of EA management are inter alia strategic IT planning, process optimization, and architecture reviews of projects (Aier et al. 2008). Thereby, a major challenge of EA management is to foster the communication between the involved stakeholders, e.g. the project director, the standards manager, and the enterprise architect in case of an architecture review process. Thus, the task of EA management is to support decision making, via providing the required information in an appropriate form to the respective stakeholder. According to Buckl et al. (2009), EA management can be defined as "a continuous, iterative (and self maintaining) process seeking to improve the alignment of business and IT in an (virtual) enterprise. Based on a holistic perspective on the enterprise furnished with information from other enterprise-level management processes [e.g. project portfolio management] it provides input to, exerts control over, and defines guidelines for

other enterprise-level management functions" (Buckl et al. 2009). The definition underlines the importance of information exchange for EA management. Likewise, typical tools providing support for EA management provide functionalities like import, editing, and validating of data, creating visualizations, or communication and collaboration support (Matthes et al. 2008) also emphasizing this aspect.

Similar to EA management, knowledge management (KM) is concerned with managing the "cooperation's knowledge through a systematically and organizationally specified process for acquiring, organizing, sustaining, applying, sharing, and renewing both the tacit and explicit knowledge of employees to enhance organizational performance and create value" (Davenport an Prusak 1998). Although the importance of information gathering, communication, and exchange for EA management is discussed repeatedly in literature about EA management (Aier et al. 2009, Fischer et al. 2007, Lankhort 2005, Shekkerman 2006), no attempt has been performed to analyze and enhance existing EA management approaches from a knowledge management perspective. Derived from this research gap, the article answers the following research questions:

How do existing EA management approaches address knowledge management aspects of EA management? Which future research topics for EA management can be derived from a knowledge management perspective?

The article first gives an overview on KM theories and selects the one of Probst (Probst 1998) as basis for future discussions. Subsequently, a KM perspective on EA management is established and used to assess prominent EA management approaches in the following Section. Subsuming the results of the analyses, especially areas and aspects of KM not yet well accounted for in EA management approaches are outlined in the final Section and areas for future development of EA management are sketched.

A MODEL FOR KNOWLEDGE MANAGEMENT

Academic research has brought up quite a few different models for knowledge management. These models greatly differ in respect to the perspective they take on the management area, and can hence be used for multiple different purposes. We revisit four prominent models for knowledge management and decide on the one most useful for answering the above stated research questions. The criterion of usefulness and purposefulness is according to Probst (Probst 1998) a simple but effective one for selecting an appropriate model of knowledge management, as the following quote of Probst subsumes:
While there is no single "right" model of KM, there is a simple criterion for evaluating any model: how useful is it in relation to a chosen question? (Probst 1998)

With the research questions from Section 1 in mind, the KM models of Nonaka and Takeuchi (cf. Nonaka and Takeuchi 1995), Probst (Probst 2009), Spek and Spijkevet (cf. Spek and Spijkevet 1997), and Andersen (cf. Andersen 1996) are analyzed subsequently. Thereby, the results from Holsapple and Joshi presented in (Holsapple and Joshi 1999) are accounted for, who among others analyzed these models. They further elaborated that these models, similar as most of the KM models, are descriptive, i.e., help to understand and explain KM phenomena. In this respect, they can be used in this paper, as the addressed research questions are concerned with understanding EA management from a KM perspective.

Nonaka and Takeuchi (e.g. Nonaka and Takeuchi 1995) take an actor-centric perspective on KM. They identify four kinds of knowledge conversion activities that take place during knowledge creation in an organization. These are socialization, externalization, combination, and internalization. The activities are called conversions there, as they "convert" knowledge between different types, namely between tacit and explicit knowledge on the one hand, and between individual and collective knowledge on the other hand. In this framework of knowledge types, the activity of socialization converts knowledge of one entity to collective knowledge of a group. During externalization tacit knowledge is converted to explicit knowledge, codified in a knowledge representation. Explicit knowledge is in the combination activity combined by an individual into new knowledge. Finally, explicit knowledge is converted to tacit knowledge of an individual during the internalization activity. The model of

Nonaka and Takeuchi (cf. Nonaka and Takeuchi 1995) can be used to understand how individuals act during knowledge creation in an organization and allows for a sociologic perspective on KM processes. This perspective is nevertheless only of minor interest in respect to the questions from Section 1.

Spek and Spijkevet identify in (Spek and Spijkevet 1997) a KM cycle consisting of four activities: conceptualize, reflect, act, and retrospect. This cycle perfectly agrees with other typical management cycles, e.g. presented by Shewart for the domain of quality management (Shewart 1986). The activity of conceptualization is concerned with gaining insights into the existing knowledge resources of the organization; thereby existing knowledge is discovered, classified, and modeled. During the reflection activity, the existing knowledge is evaluated in respect to organization-specific criteria. By doing so, areas of missing or insufficient knowledge are discovered. The act activity encompasses multiple sub-activities aiming at the improvement of the organization's knowledge by developing new knowledge (inter alia by combining existing one), as well as knowledge distribution and storage. Concluding the typical management cycle, the retrospection activity controls the effects of the previously taken measures for knowledge improvement by comparing the organization's knowledge ex-ante and ex-post. The model of Spek and Spijkevet (cf. Spek and Spijkevet 1997) accounts well for the multiple activities of KM, but stays in respect to the activity of improving the knowledge (act) on a very abstract level. While this allows explaining general KM phenomena, a more detailed model might be more appropriate for understanding EA management from a KM perspective.

A very abstract model for KM is presented by Andersen, and the American Productivity and Quality Center (APCQ) in (Andersen 1996). It is taken here as a representative of a practitioner's model for KM. The model identifies seven central activities of KM: share, create, identify, collect, adapt, organize, and apply. While these activities can easily be agreed upon on an abstract level, the model does not provide much detail on how to execute them in an organization. One can expect that similar activities also take place during the management of the EA. Nevertheless, the low level of detail does not support an in-depth consideration of EA management as KM activity. Furthermore, quite some work concerned with EA management (see Section 3) elaborates on the importance of deciding and reflecting on the relevant parts of the EA. A similar activity should be covered by an appropriate KM model used to understand EA management. The model presented by Andersen in (Andersen 1996) does not account for such an activity.

The KM cycle of Probst as presented in (Probst 1998) consists of several building blocks for KM, reflecting typical activities that are carried out to avoid “knowledge issues”. As the cycle forms on the one hand a comprehensive model for KM and is on the other hand explained in detail, it is subsequently sketched to provide the basis for the KM perspective on EA management. The KM cycle actually consists of the following two cycles:

•an outer cycle consisting of the activities goal setting, implementation and measurement
•an inner cycle detailing the implementation activity into the sub-activities of identification, acquisition, development, distribution, preservation, and use

Figure 1 gives an overview on the KM cycle, detailing the implementation activity. In the following, the different activities are explained in detail starting with the ones contained in the inner cycle (Probst 1998).
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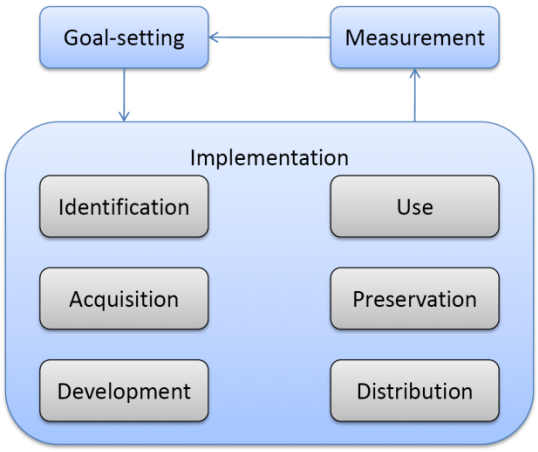

Figure 1. Knowledge Management Cycle

Knowledge identification is concerned with determining the knowledge that exists in an organization, and relating this knowledge to the

one existing in the organization's environment, e.g. at competitors, as far as this is possible. Thereby, the activity increases transparency of knowledge, and may help to identify redundant knowledge as well as to spot areas of missing knowledge. Knowledge identification can, if the number of knowledge sources to process is abundant, resort itself to critical knowledge as defined in the activity of goal setting.

Knowledge acquisition accounts for the fact that due to the growth of overall knowledge an organization is not capable to build up and maintain all needed know-how. Therefore, knowledge is imported over different import channels:

- joint-ventures with or acquisition of highly innovative companies holding the corresponding knowledge,
- stakeholder participation, e.g. by involving the customers of the organization,
- counseling by experts that contribute to the organization's knowledge, and
- acquisition of knowledge products that foster the development of new knowledge (does not directly improve the organization's knowledge).

As a side-note on knowledge acquisition, Probst states in (Probst 1998) that an organization has to balance acquisition for present or short-term use with acquisition targeting long-term organizational development.

Knowledge development is concerned with producing new knowledge on individual and collective level in an organization. The development is a highly creative activity, which can only to a very limited extent be discussed from a management perspective. Multiple sociological and psychological theories center on the activity of knowledge development and may be appropriate to study the process more in-depth. Linking back to the level of organizational KM and organizational development, e.g. an atmosphere of trust in the organization is regarded as a prerequisite to effective knowledge development.

Knowledge distribution means making knowledge available across the organization. Put in the words of Probst, knowledge distribution is about the critical questions of Who should know what, to what level of detail, and how can the organization support these processes of knowledge distribution? (Probst 1998) These questions account for the fact that not everyone needs to know everything, as in contrast information overload might be as detrimental as a lack of information. Concerning the activity of knowledge distribution, the role of supporting tools and techniques should neither be underestimated nor overestimated. Useful and broadly accepted tools, and widely employed techniques can help to facilitate in the same ways as dysfunctional tools and not well adopted techniques can hamper effective knowledge distribution. As user acceptance is crucial for a tool or technique being an effective distribution facilitator, many organizational and non-technical issues have to be concerned regarding knowledge distribution.

Knowledge use forms the actual purpose of KM and refers to the application of knowledge in the production process of an organization. In respect to the later focus on EA management, which is no production process of an enterprise, the above statement can be reformulated more generically as follows: knowledge use refers to the application of knowledge in the purpose-generating process of an organization. Here again, tools and techniques can be applied as facilitators; this is not surprising as especially in knowledge-intensive processes the borders between distribution and use are sometimes unclear. Notwithstanding, knowledge use should explicitly be accounted for, as the goal setting activity purposefully targets the use activity.

Knowledge preservation is concerned with avoiding the loss of valuable and purpose-relevant expertise in an organization. While tacit knowledge is more often subject to loss, e.g. due to an expert leaving the company, also explicit knowledge stored electronically has to be preserved. Probst in this respect refers to outdated storage systems as dead storage systems, colloquially stating that a storage system, which is not longer maintained, may cause knowledge loss quite as well as a leaving expert. Techniques and tools used for knowledge distribution can also be helpful for knowledge preservation.

Complementing the inner cycle of knowledge implementation, two more activities constitute an embracing and sustainable KM. These activities, belonging to the outer cycle, are briefly introduced below.

Goal-setting, i.e., the development of knowledge goals, establishes a conceptual framework for organization-specific KM. The knowledge goals determine which capabilities should be built on which level (Probst 1998). Thereby, different levels of abstraction in respect to the formulation of goals can be distinguished. Most important for the subsequent considerations are the levels of strategic knowledge goals and operational knowledge goals. While the former goals describe a long-term vision of the knowledge portfolio of the organization, the latter goals operationalize the vision, i.e., translate it into action. Making the knowledge goals explicit is regarded highly important for controlling the evolution of the KM.

Knowledge measurement is concerned with measuring to which extent the knowledge goals have been fulfilled during the implementation activity. As knowledge is an intangible resource, indicators and measurement processes are hard to establish. To some extent the operational knowledge goals can be formalized that they can help to objectively assess certain aspects of KM. Nevertheless, a commonly accepted way to measure knowledge has yet not been established, such that managers concerned with KM activities have to rely on their subjective perception of goal fulfillment. Additionally, surveys on user satisfaction with knowledge access in distinct areas, which reflect certain knowledge goals, may be helpful during knowledge measurement.

ANALYZING EXISTING EA MANAGEMENT APPROACHES FROM A KNOWLEDGE MANAGEMENT PERSPECTIVE

Preparing the subsequent analyses of prominent EA management approaches from a KM perspective, the KM model of Probst (1998), more precisely its building blocks, are mapped to the application domain of EA management. To ground the mapping solidly in the application domain of EA management, the outer cycle's activities of KM are mapped first, starting with the implementation activity. This activity can be identified with the core of EA management, i.e., with the "continuous process seeking to improve the alignment of business and IT in a (virtual) enterprise". This part of the definitional statement towards EA management (as discussed in the initial Section) sketches the main goal of the implementation of EA management, but does not provide further details on the implementation. These are later discussed along the activities from the inner cycle. Continuing with the activities from the outer cycle, both knowledge measurement and goal-setting can be identified with the aspect of "self maintenance" of the EA management process, i.e. the EA management governance. More precisely, an effective and continuous EA management, established as a management function within an enterprise, must define the share of the overall architecture of the enterprise that it covers. This can be understood as goal-setting, i.e., defining which knowledge about the architecture is needed; multiple EA management approaches target this topic. The knowledge measurement closes a feedback loop in this respect by assessing to which extent the knowledge goals could be satisfied. Put in the EA management terminology, the measurement activity assesses, if the architecture concepts defined as relevant during goal-setting have adequately been considered during EA management. This provides input for revisiting the knowledge goals, if e.g. albeit a good coverage of relevant architecture concepts, an increased alignment between business and IT could not be achieved.

The above considerations on EA management from a knowledge perspective partially neglect process related aspects of EA management. Therefore, they should not be overly advocated for, but have to be complemented with process considerations. To some extent this narrow focus is broadened by diving into the details of implementation activity, whose sub-activities are mapped below. Nevertheless, the focus in this paper clearly lies on the knowledge and information aspect of EA management not on the process aspect thereof. The sub-activities of the building block implementation can be mapped as follows to the domain of EA management. During knowledge identification possible sources of information about the EA are identified. These sources may be both people, e.g. business or enterprise architects, but also documentation tools.

Knowledge acquisition relates to activities as EA management counseling by consultancies, more detailed with incorporating best-of-breed EA-related solutions into the EA knowledge of the company. In the context of EA management, knowledge development can refer to planning and decision activities, where additional

knowledge about the (future) EA is created. Knowledge distribution maps to the EA management activity of communicating architectural knowledge, i.e., as information on current and planned states of the architecture, to people involved in other enterprise level management functions, as e.g. project portfolio management. In this vein, knowledge preservation can be understood as storing this architecture knowledge in a way that interested stakeholders can access it. Additionally, preservation is also concerned with making accessible not only the most recent architectures, but also former plans and documentations. Finally, knowledge use can be identified with management activities in the enterprise-level management functions, not solely in EA management, that access the architecture knowledge for deciding, planning, executing, or measuring.

Based on the KM perspective on EA management derived above, existing approaches to EA management originating from academia and practice are detailed and discussed subsequently.

A multitude of approaches to EA management exist, e.g. (Bittler and Kreizmann 2005, Department of Defense 2007, Ross et al. 2006, Schekkerman 2006, Spewak and Hill 1993, Wagter et al. 2005). In the following an overview about selected ones is given. The approaches are selected deliberately but equally cover approaches originating from practice and academia; the different approaches are reviewed from a KM perspective based on the activities of the KM cycle of Probst.

A wide-spread and well-known approach to EA management is The Open Group Architecture Framework (TOGAF) (The Open Group 2009). The main constituent of TOGAF is the Architecture Development Method (ADM), which describes a cyclic, project-oriented process for EA management, which can be complemented with other EA management frameworks. According to the ADM, each EA management project starts with the preliminary phase, which defines the scope and reach of the project (knowledge goal-setting). Furthermore, decisions about other frameworks and tools to be utilized are undertaken in this phase (knowledge acquisition). The preliminary phase is followed by the architecture vision phase concerned with the development of future states of the EA (knowledge development).

The current state of the EA is documented in three distinct phases, which focus on different parts of the architecture - the business architecture phase, the information systems architecture phase, and the technology architecture phase. Although information has to be gathered and consolidated in these phases, TOGAF only addresses the challenge of knowledge identification via a stakeholder management. Means and methods to draw existing knowledge from other resources as e.g. tools are not referred to. Based on the current and future states of different parts of the EA, the opportunities and solutions phase develops plans for the future evolution, which are decided upon and detailed during the migration planning phase. The migration plans are subsequently realized in the implementation governance phase, in which other management functions, as e.g. project portfolio management are provided with knowledge in order to support their decision making process (knowledge use). Finally, the phase architecture change management assesses the quality of the developed architecture and handles change requests during the execution of the project. Although this phase includes to a certain extent the activity of knowledge measurement, important aspects of this KM activity are not considered, e.g. a continuous improvement of the overall process. Whereas the task of knowledge distribution is indirectly mentioned in some phases of the ADM, see e.g. the objective "confirm the transition architectures [...] with relevant stakeholder" (The Open Group 2009), methods and means how to conduct this task are not further detailed. Similarly, the challenge of knowledge preservation does not form a focal point of TOGAF. Therefore, viewpoints as means to communicate between different stakeholders are mentioned and textually described but no further explanation how a specific stakeholder can access and use the respective information is given.

The Enterprise Architecture Management Pattern Catalog (EAMPC) (sebis 2010) was developed at the Technische Universität München and contains a collection of best practice methods, visualizations, and information models for EA management. The intent of the EAMPC is to support EA practitioners in the concern-driven development of an enterprise-

specific EA management function. Thereby, concerns represent typical problems, which occur in the context of managing an EA. An exemplary concern is for instance, "Which business processes, if any, are suitable candidates for outsourcing?" (sebis 2010) The concerns contained in the EAMPC address the following areas: standardization and technology homogeneity management, business process support management, application landscape management, project portfolio management, infrastructure management, interface, business objects, and service management as well as metrics. The topic of application landscape management especially emphasizes on evolution aspects (knowledge development). In order to use the EAMPC, the enterprise under consideration has to select the appropriate concerns (goal-setting). Based from the selected concerns, the corresponding methodology patterns (M-Patterns), addressing the concerns can be derived. These M-Patterns are documented according to a fixed structure containing among others a problem, solution, and implementation description as well as possible consequences of the application of the M-Pattern. Within each M-Pattern one or more viewpoint patterns (V-Patterns) are referenced. These V-Patterns describe how the information, which is necessary to address the concern, can be visualized and presented to the involved stakeholders (knowledge preservation). A description of the corresponding information including the types of elements, their attributes, and relationships to each other as well as a glossary is given in the information model patterns (I-Patterns), which are referenced by the respective V-Patterns. Methods and means to gather the respective information are described as part of the solution description of the M-Pattern (knowledge identification). The implementation description contains information about required governance structures, roles, and responsibilities. Thereby, the links to other enterprise-level management functions, e.g. the project portfolio management, are discussed and the type of relationships, ranging from information provision to enforcing, is described (knowledge distribution and use). No methods and means for assessing the performance of the existing EA management function are explicated in the current version (knowledge measurement). Similarly, the aspect of knowledge acquisition is not directly referred to in the approach. Nevertheless, a possibility to combine the aforementioned approach of TOGAF with the EAMPC is detailed in (Buckl et al. 2009).

Niemann presents an approach to EA management, which is organized similar to a typical management cycle and consists of the phases document, analyze, plan, act, and check (Niemann 2006). According to Niemann, the objective of EA management is to support an enterprise in "doing the right thing right, with minimal risk" (Niemann 2006). He does not account for enterprise-specific goal-setting, which is also reflected by the standard information model that the approach provides. This model consists of three submodels for the business, application, and systems architecture. Information about the current state of these architectures is gathered in the document phase. Whereas the description of the document phase emphasizes on what should be documented and how it should be documented to satisfy the respective stakeholders (knowledge preservation), the question where to gather the respective data from (knowledge identification) is only briefly sketched. Based on the results of the document phase, the analyze phase assesses certain architectural properties, e.g. heterogeneity, complexity, or costs. According to the results of the analyses, future plans for the EA are derived, evaluated, and decided upon in the plan phase (knowledge development). The developed roadmap is realized in the act phase, in which EA management influences demand and portfolio management as well as the program and service management functions (knowledge usage). Finally, the check phase provides key performance indicators for the EA and key success factors for the EA management initiative. Although Niemann mentions marketing as one key success factors of EA management, the methods and means described therefore stay on a very abstract level (knowledge distribution) (Niemann 2006). Similarly, the performance measurement approaches described by Niemann mostly refer to measures for the EA and not the EA management function itself (Niemann 2006). One exception is given by the architecture management scorecard, which is briefly discussed. This scorecard assesses the performance of the EA management function itself. Although other frameworks and tools for EA management are shortly mentioned in (Niemann 2006), a combination with other approaches is not referred to (knowledge acquisition).

Hafner and Winter propose a process model for architecture management, which is derived from three case studies (Hafner and Winter 2008). The process model consists of the following four phases: architecture planning, architecture development, architecture communication, and architecture lobbying. One activity of the architecture planning phase is the identification of strategic requirements. Although this activity is not further detailed in (Hafner and Winter 2008), it can be interpreted as defining the share of the enterprise that should be considered by the EA management (goal-setting). This assumption is further supported by Kurpjuweit and Winter, who propose a "viewpoint-based meta model engineering" (Kurpjuweit and Winter 2007) approach to facilitate the creation of information models capable of addressing the concerns of multiple stakeholders (knowledge preservation). Although the aspect of knowledge identification is not mentioned in the description of the phase, a "federated approach to enterprise architecture model maintenance" including a process and involved roles is given in (Fischer et al. 2007). Further activities of this phase are the assessment of current architectures, the update of architecture principles including the development and update of future states of the EA (knowledge development). Whereas the architecture planning phase focuses on strategic aspects, architecture development focuses on operational aspects. Main activities of this phase are to identify and manage further requirements as well as piloting, developing, and integrating architecture artifacts. Architecture communication is concerned with identifying relevant stakeholders and communicating architecture artifacts (architecture distribution). Finally, the phase architecture lobbying targets aspects like assistance for projects via consultancy or direct project collaborations. Thus, the knowledge obtained in the preceding phases is used (knowledge use) to influence, control, and assess projects. Whereas assessment and analyses of different states of the EA are discussed in the process model of Hafner and Winter, a process phase to analyze the EA management function itself (knowledge measurement) is not part of the process model (Hafner and Winter 2008). Similarly, the possibility to complement the process model with other external resources, e.g. frameworks, (knowledge acquisition) is not discussed.

The systemic enterprise architecture methodology (SEAM) developed by Wegmann is based on the perception of an enterprise as a complex system that evolves continuously (Wegmann 2002). Addressing this evolution, SEAM proposes a method based on the iterative development of enterprise models, which account for the multi-disciplinarily of the environment but go beyond specific models for each discipline.

These models are validated against reality and adapted according to the validation results (knowledge measurement). Three different types of activities for a SEAM iteration exist: multi-level modeling, multi-level design, and multi-level deployment. The activity of multi-level modeling is concerned with knowledge identification via the collective development or refinement of a model of the enterprise. Thus, not only models of the current state of the EA are developed but also target states of the EA are planned and documented (knowledge development). The goal of multi-level design is to identify the gaps between the current and target states of the EA. Finally, multi-level deployment is concerned with the transformation of the enterprise via federation of efforts of the specialists from the enterprise-level management functions (Wegmann 2002) (knowledge use). Although SEAM points out that for the successful execution of this task, the different stakeholders need to be informed and directed, no methods to address this challenge are presented (knowledge distribution and preservation). Whereas possibilities to acquire knowledge via the complementary utilization of other frameworks and tools are not discussed, a tool SeamCAD realizing the method is presented by Wegmann et al. in (Wegmann 2005).

PROPOSING TOPICS FOR FUTURE EA MANAGEMENT RESEARCH

Table 1 on the next page summarizes the results of the literature analysis from the previous Section, preparing a discussion on common strengths and weaknesses of existing approaches. From there, we derive future areas of research on EA management.

	TOGAF	EAM patterns	Niemann	St. Gallen	Wegmann
Goal-setting	◐	●	◐	◐	◐
Measurement	○	○	○	○	◐
Identification	◐	◐	○	◐	○
Acquisition	◐	◐	○	○	○
Development	◐	◐	●	●	●
Use	◐	●	●	◐	●
Preservation	○	◐	◐	◐	◐
Distribution	◐	◐	◐	◐	◐

Table 1. Knowledge Management Perspective of Existing EA Management Approaches

Four of the five approaches analyzed provide a reference method for EA management (cf. Hafner and Winter 2008, Niemann 2006, The Open Group 2009, Wegmann 2002). These "one-size-fits-it-all" methods contain generic goals for EA management, as architecture road-mapping and transformation planning. TOGAF additionally mentions the importance of enterprise-specific goals, but does not provide exemplary ones (The Open Group 2009). The EAMPC in contrast lists typical EA management concerns, which can be used to support the goal-setting for an enterprise-specific EA management function. The absence of concrete goals might explain the lack of methods for assessing and measuring the EA management function itself, which is a common weakness of most of the analyzed approaches. From this weakness, we derive a first topic for future research: Operationalizing knowledge goals for EA management.

While existing approaches currently focus on general tasks of the EA management function, typical EA management goals are of interest in order to derive the necessary knowledge demands. Via the selection of the relevant goals, an enterprise can configure the reference method according to its specific demands. Accordingly, methods and means for assessing and measuring the achievement of these goals can be developed based on explicit goals, which lay the foundation for an EA management governance method.

Identifying, gathering, and maintaining knowledge about the EA is a challenge emerging in the context of EA management, which is only recently addressed by isolated approaches (cf. Aier et al. 2009, Fischer et al. 2007, Moser et al. 2009). Nevertheless, as the analyzed EA management methods do not detail on how to acquire and incorporate knowledge from other sources, the reusability of these approaches is limited. Therefore, future research should focus on the integration of existing EA management approaches in an enterprise or from literature instead of developing the wheel over and over again. Additional guidance on how to accomplish this integration, e.g. via openly configurable EA management reference methods needs to be developed and researched.

From a KM perspective, common strengths of the analyzed EA management approaches are the development and use of knowledge. All these approaches provide means and methods to develop target states (to-be and ideal states) of the EA and to construct roadmaps for the evolution. Nevertheless, these means and methods are mainly approach-specific and cannot be reused in other approaches. Future research in this area should therefore be focused on interoperability of these methods.

Although the analyzed approaches agree that an enterprise is a complex socio-technical system, only one approach (cf. The Open Group 2009) details on the aspect of human stakeholders and their involvement in EA management. Therefore, the distribution of knowledge is mostly only discussed by referring to the related management processes, as e.g. project portfolio management, without explicating stakeholders involved. Similarly, the preservation of knowledge is mostly only mentioned as a challenge, which should be addressed via a tool

support for EA management. Future research could target the establishment of a more systematic stakeholder model for EA management in conjunction with a structured approach to describe the corresponding viewpoints. Additionally, the topic of knowledge preservation class for techniques that help to access and compare past (planning) states of the EA.

SUMMARY

Summarizing, the analysis of existing EA management approaches from a KM perspective indicated some areas for future research. This becomes especially obvious with the KM activities that are only partially addressed by the current approaches. As with them, future research can target two different directions, namely theorizing and designing. In theorizing, possible explanations for the lower importance of some KM activities in the field of EA management could be investigated. Thereby, especially the practical relevance of these activities should be assessed in enterprises that actively manage their EA. On a possible empiric basis, one could determine, if the KM activities under consideration are neglected due to low practical importance, are omitted due to insufficient information from practice, or are not relevant, as companies perceive them as adequately addressed. In the latter case, proven practice methods for distributing and preserving EA knowledge could be documented to complement the existing EA management approaches in literature.

In designing, a hypothesis from this article's introduction, namely that EA management is a KM endeavor, is used as basis for improving existing EA management approaches from literature and practice. In this vein, future research could draw from the broad literature on KM topics to develop techniques, methods and tools to be used for operationalizing knowledge goals for EA management and to improve stakeholder-centric knowledge distribution and preservation. Especially the latter two activities of KM present themselves as valuable subjects for future research, when conducted in cooperation with practitioners.

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