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Max Fiedler

Technische Universität München (TUM), Chair for Informatics 19 (sebis), Boltzmannstr. 3, 85748 Garching by Munich, Germany, max.fiedler@tum.de

Matheus Hauder

Technische Universität München (TUM), Chair for Informatics 19 (sebis), Boltzmannstr. 3, 85748 Garching by Munich, Germany, matheus.hauder@tum.de

Alexander W. Schneider

Technische Universität München (TUM), Chair for Informatics 19 (sebis), Boltzmannstr. 3, 85748 Garching by Munich, Germany, alexander.schneider@tum.de

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Foundations for the Integration of Enterprise Wikis and Specialized Tools for Enterprise Architecture Management

Max Fiedler, Matheus Hauder, and Alexander W. Schneider

Technische Universität München (TUM),
Chair for Informatics 19 (sebis),
Boltzmannstr. 3, 85748 Garching by Munich, Germany
{max.fiedler,matheus.hauder,alexander.schneider}@tum.de

Abstract. Organizations are challenged with rapidly changing business requirements and an ever-increasing volume respectively variety of information. Enterprise Architecture (EA) and its respective management function are considered as means to overcome these challenges. Appropriate tool support to this end is an elementary success factor to guide the EA management (EAM) initiative. Nevertheless, practitioners perceive currently available tools specialized for EAM as not sufficient in their organizations. Major reasons are inflexible data models as well as missing integration with processes and their focus on expert users. Regarding these limitations Enterprise Wikis provide practice proven solutions already exploited by organizations. These Enterprise Wikis are able to extend the capabilities of existing EA tools to cope with unstructured information and leverage a better utilization of structured EA information. In this paper we present the foundations for an integration of specialized EAM tools and Enterprise Wikis. We elaborate scenarios for both tool species using a practitioner survey and differentiate four integration cases.

Keywords: Enterprise Architecture Management, Enterprise Wiki, Tool Support, Collaboration, Knowledge Management

1 Introduction

Organizations are challenged by rapidly changing business requirements and external drivers that compel them to adapt their information technology (IT) management practices [1-2]. EA and its respective management functions are increasingly applied in industry to overcome these challenges and realize a better alignment of business and IT [3-4]. According to the ISO Standard 42010, an EA is 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” [5]. Therefore, the EA covers business as well as IT aspects to provide a holistic view of an organization and support decision makers with appropriately represented structured information thereof. In current practices this information is typically cap-

tured in an EA model that covers the information demands of decision makers and presented in stakeholder specific views [6].

Although organizations already apply notations, models, methods, and EA tools to analyze this structured information content, many of these initiatives are not successful in practice [7]. Aier et al. [7] revealed long-term success factors for EA that were identified within a study of six companies over a timespan of eight years. Besides formal structure and processes the long-term success factors include aspects on the training, communication, intensified EA representation in projects, and tool support. In current practices specialized tools for EAM are developed to support architects with the formal structure and processes, rather than with collaboration among stakeholders in the organization and unstructured information content. We argue that many initiatives do not solely rely on this structured EA information and the long-term success factors for EAM require, e.g., deployment of collaboration tools. In this sense our goal is not to replace existing tools that are specialized for EAM, but rather extend their capabilities with practice proven solutions that are already widely used in organizations for related purposes.

Among these practice proven solutions are Enterprise Wikis that are used in organizations in various operational areas, e.g., requirements management, corporate platforms, project communication and documentation, and knowledge management in IT departments [8]. In comparison to traditional Wikis they often have a larger functionality. In general, their purpose is to improve knowledge sharing and collaboration between employees in organizations. They allow users to easily manipulate content and contribute to the knowledge base. Typically these tools allow the management of unstructured information using, e.g., Wiki pages, file attachments, and multimedia content as well as the interlinking of items. In previous work the application of Enterprise Wikis has been proposed to support the start of an EA endeavor [9]. As a result particular Wiki functionalities were used in this context but not integrated with existing EA tools.

At the same time specialized tools for EAM provide sophisticated capabilities for the modeling of the EA and the generation of visualizations thereof. These visualizations are common means to support decision makers with stakeholder specific representations of relevant information. While previous efforts integrated Wikis and modeling tools for software architectures [10], related efforts in the field of EAM are not available to the best of the authors' knowledge. Main goal of our research is to enhance existing structured information, present in the form of models on the EA level, with unstructured information provided by Enterprise Wikis, in order to support long-term success factors. We expect future research to investigate the integration of structured as well as unstructured information in the context of EAM.

Therefore, we provide a research fundament on the integration of Enterprise Wikis and specialized tools for EAM using a practitioner survey as empirical evidence for our approach. In order to lay the ground for future research we elaborate the following research questions:

- Can the integration of Enterprise Wikis and specialized EA tools provide added value for an organization?

- Which EAM scenarios are more suitable for which tool?
- What are challenges that have to be solved for this approach?

The main contribution of this paper is the discussion of the first two research questions. To the best of our knowledge, it presents the first study on the integration of these tool species for EAM. The findings presented in this paper are the foundation for our future research goal to integrate unstructured information in EA tools and enable better support for collaboration in this context.

2 Related Work

There is a variety of research on EAM concerning methods, implementation, tools, etc. The research on tools focuses mainly on repository based EAM modeling suits and how they can be used to best support the EAM efforts of an organization.

Keuntje et al. [11] differentiate the main tasks of EAM and how they are supported by different software solutions. They compare the performance of different EAM software packages available on the market on each of these categories regarding specific needs of different companies. For this purpose, they classify them into meta-model centered, method centered or process centered, EAM solution or EAM platform, EAM warehouse or modeling tool reflecting how much configurability vs. off-the-shelf functionality they offer as well as how far they integrate information of other systems.

Braun et al. [12] describe the basic requirements an EAM tool should meet (metamodel-based repository with visualization capability) and strongly advocate the use of such a professional tool for any organization. They find that “Enterprise Architecture is evolving into an active concept that supports business systems design, i.e. to contribute to the analysis and proactively support the optimization of business strategies, organizational structures, business processes, information flows, application structures as well as the underlying information systems” [12]. An adequate EAM tool would thus have to “support the development, storage, communication respectively presentation and enhancement of all relevant enterprise architecture artifacts” [12].

EAM is knowledge intensive and managing the related knowledge is crucial for its long-term success. Buckl et al. [13] evaluate different EAM approaches from a knowledge management (KM) perspective based on the KM cycle of Probst et al. [14]. Strengths of the evaluated approaches lie in the development and use of knowledge, whereas they all show weaknesses in the distribution and preservation of knowledge. The latter is only mentioned as a challenge to be addressed by a tool. Probst et al. [14] state user acceptance and respectively proper maintenance as crucial features for tool support of the distribution and preservation activities. Furthermore, neither of the analyzed approaches specifies how to incorporate knowledge from other sources.

Lucke et al. [15] present a case study of six software projects in six different companies, analyzing how well the chosen architectures support the core KM processes defined by Probst et al. [16] and how much they have been used by different target

audiences. Their observations strongly suggest that the choice of architecture does influence KM and that the chosen architecture can support KM as an interactive index of contents, i.e. as a “knowledge map” [15] (enhanced by hyperlinks between KM artifacts) and by creating a common vocabulary thus facilitating cross-team communication. Proper introduction of the architecture to all required audiences is crucial. Incorporating a well-known architecture and offering different perspectives on each target audience respectively have been proven helpful. Lucke et al. [15] mention the need to keep knowledge alive and accessible for decades as an increasingly important challenge to be addressed by further research.

Farenhorst et al. [17] present a case study creating and using a Wiki for the EA department of a large organization, where none of the involved architects had worked with a Wiki before. They then compare it to existing tools for architecture knowledge management as an alternative to those. In their experiment they used a Confluence Wiki and compared it to existing tools for architecture knowledge management such as ADDSS [18], DGA DDR [19], PAKME [20], and Archium [21]. They find that if properly introduced the strengths of a Wiki solution outweighs its weaknesses when compared to the aforementioned tools, especially when it comes to support for online communication, managing non-architectural knowledge, collaboration support and involving and integrating knowledge and communication needs of other functions within the company. The dedicated tools only prevailed in modeling and retrieving architectural knowledge concepts. The lacking out-of-the-box support for these concepts within a Wiki solution needs to be compensated by specifically developed and introduced plug-ins, templates and enriched meta-data. Other general advantages of the Wiki identified are its support for integration with other tools, its intuitive interface and low learning curve.

Hirsch et al. [10] present and evaluate three prototypes for a Visual Wiki, combining Thinkmap visualization software with three different kinds of Wikis: freebase, Confluence and MediaWiki. Their goal is to enhance the respective Wiki with a visual representation of its knowledge space to be used to navigate and organize the knowledge space (with some additional search algorithms integrated). The three Visual Wikis differ in the way the nodes and edges of the graphical representations can be edited and how they are referenced or “mapped” to the textual Wiki content. They also differ in the consistency between textual contents and graphical representation of the knowledge space (two-sided, one-sided, no consistency). Furthermore, Hirsch et al. [10] describe a conceptual model of a Visual Wiki that can be used to design and analyze different implementations. They discuss the results of a survey with 14 participants answering how much the visual component improved the respective “basic” Wiki with regards to: knowledge-creation, -organization, -distribution and -search. For all four tasks the participants felt the visual components of the prototypes increased the usefulness of the respective Wiki, with the biggest improvements for organization and search. The differences in the ratings of the three prototypes were in part explained by their conceptual differences and in part by their differences in technical maturity and ease of use.

Su et al. [22] describe and discuss a software architecture documentation tool (KaitoroBase) built within the Visual Wiki Thinkbase presented in [10]. The tool

supports non-linear navigation and visualization of Software Architecture Documents (SAD) created using the Attribute-Driven Design. It does not require the use of a specific Architectural Description Language within the SADs. It combines a graph-based interactive visualization of the high-level structure of the topics (nodes) in an SAD and their relations (edges) with detailed documents attached to each of these elements.

3 Research Methodology

In order to substantiate our hypothesis that additional benefits can be achieved if an Enterprise Wiki is integrated with a specialized EAM tool, we started our research with the goal to identify concrete tasks in which such an integration would provide benefits. We analyzed related literature, e.g., [23] and [11], and identified nine potential scenarios. These scenarios serve as a basis to analyze different ways of integrating an Enterprise Wiki and a specialized EAM tool and, additionally, to confirm the relevance of this topic.

To demonstrate the relevance of such a tool mix and to identify scenarios in which an Enterprise Wiki might be better suited than a dedicated EAM tool, we performed an expert survey among 105 practitioners from who 54 describe themselves as Enterprise Architects. Therein, the participants were asked to categorize each of the nine previously identified EAM scenarios according to the tool they prefer for this task. Because the survey results revealed expected as well as unexpected insights, we then analyzed the characteristics of both types of tools on a general level. Consequently, their respective strengths and weaknesses were identified and their preferred usage within the different scenarios could be explained. Since the practitioners' tool preferences for concrete EAM scenarios are mostly homogenous, the scenarios can be divided into three categories: Wiki scenarios, EAM tool scenarios and undecided. Therefore, these categories will form the basis for future research in integrating both tools. As it would be hardly possible to analyze every conceivable EAM scenario, we categorized the identified scenarios into four cases that can be used to understand data flows between an Enterprise Wiki and a specialized EAM tool and respective use cases.

An online questionnaire was sent to over 1.100 domain experts in the field of EA and strategic IT management. Next to these invitations the survey was published in interest groups that are specialized on these topics and distributed during industry workshops and scientific conferences. In total the survey was available for 21 days and published on October 12th, 2012.

The questions investigated in this paper were enclosed within a larger survey that targets to evaluate current practices and challenges in EAM. In the first part of this survey, the dissemination of EAM tools and Enterprise Wikis in organizations were evaluated. These findings are shown in Section 4 of this paper. The second part evaluated the EAM scenarios identified in literature and their support by Enterprise Wikis and specialized EA tools according to the domain experts. These scenarios are shown in Section 5 and form the basis for the identification of four integration cases.

In total, we received 178 answers with organizations from, e.g., Germany (31.43%), USA (17.14%), Netherlands (6.67%), India (4.76%), United Kingdom (4.76%), Switzerland (5.71%), and Sweden (2.86%). During the survey 73 (41.01%) organizations dropped out or were deleted from the empirical basis in case they answered on behalf of the same organization resulting in 105 complete answers. The distribution of the industry sectors of the participating organizations is shown in Table 1. The majority of the organizations are acting in the *IT Consulting* sector followed by the *Finance*, and *IT Products and Services* sectors. Table 2 summarizes the job titles of the participants with the largest group of 54 (51.43%) being *Enterprise Architects*. *IT Architects* (14.29%) and *Consultants* (11.43%) follow this group. The consultants were asked to answer on behalf of a specific customer in the survey.

Table 1. What is the industry sector of your organization?

Industry Sector	n	% of all
IT Consulting	24	22.86%
Finance	18	17.14%
IT Products and Services	9	8.57%
Telecommunications	6	5.71%
Public Service	8	7.62%
Education	5	4.76%
Production and Manufacturing	6	5.71%
Transportation and Logistics	3	2.86%
Health	2	1.90%
Management Consulting	4	3.81%
Other	20	19.05%

Table 2. What is your job title in the organization?

Job Title	n	% of all
Enterprise Architect	54	51.43%
IT Architect	15	14.29%
Consultant	12	11.43%
Business Architect	6	5.71%
IT Operations	3	2.86%
CxO	6	5.71%
Software Engineer	1	0.95%
Solution Architect	1	0.95%
Business Analyst	1	0.95%
EA Analyst	1	0.95%
Other	1	0.95%

In average the participants have 6.7 years of experience in the field of EAM with a standard deviation of 4.88. The organizations apply EAM methods in average for 5.5 years with a standard deviation of 5.61. Among the organizations 48.57% model the current state of the EA. 29.52% model planned states and only a minority of 14.29% models a long-term target state of the EA.

4 Dissemination of Tools for EAM

In this section we provide an overview of the used Enterprise Wikis and specialized tools for EAM in organizations. For this purpose, the participating organizations were asked which tools they use and whether the tools are integrated or used separately. These questions are necessary to justify our assumption that many organizations already have the respective tools in operation. The results from this question are summarized in Table 3 and explained in the following.

Table 3. Which tools does your organization use for EAM?

Tools for EAM	n	% of all
EA Tool	36	34.29%
Wiki & EA Tool separately	37	35.24%
Wiki & EA Tool integrated	6	5.71%
Wiki	9	8.57%
None of these	14	13.33%
No response	3	2.86%

While 36 (34.29%) organizations only use an EA Tool for the EAM initiative, 37 (35.24%) organizations use a Wiki and an EA Tool separately. Only a minority of 9 (8.57%) organizations use only a Wiki to support the EAM initiative. Among the participants are also 6 (5.71%) organizations that already use an integrated solution of an EA Tool and an Enterprise Wiki. With these results, we confirm our assumption that organizations already apply both tool species for EAM but still struggle to integrate both.

Table 4. Do you think a Wiki can be useful (in addition to another tool) for EAM?

Wiki for EAM useful	n	% of all
Yes	98	93.33%
No	7	6.67%
No answer	0	0.00%

Table 5. Do you plan to use a Wiki for EA management in the future?

Wiki for EAM in future	n	% of all
Yes	63	60.00%
No	13	12.38%
No answer	29	27.62%

When asking whether it can be useful for organizations to use an Enterprise Wiki in addition to a specialized EA tool 98 (93.33%) organizations confirmed this presumption (Table 4). Only a small minority of 7 (6.67%) organizations does not think an additional Enterprise Wiki can be useful to extend an existing EA Tool. The relevance of the research conducted in this paper is also approved with the findings shown in Table 5. 63 (12.38%) organizations plan to use an Enterprise Wiki for EAM in the future. Only 13 (12.38%) organizations can exclude that they plan to use an Enterprise Wiki for EAM in the future while 29 (27.62%) organizations were not able to provide an answer to this question.

5 Scenarios for Enterprise Wikis and Specialized EAM Tools

We identified nine scenarios relevant for EAM tools from literature [11], [23] and our practical experience from industry projects. These scenarios are evaluated in this section on the basis of the aforementioned survey among EA practitioners. The findings from this survey are confronted with key characteristics identified in literature for the investigated tool species:

Definition of terms: A glossary or definition of terms is used in an organization to create a common terminological basis. This definition of terms contains a list of rele-

vant terms within the organization and an informal description for every term. Typically these terms are interlinked with each other in order to identify e.g., synonyms, categories, etc. Next to creating such a definition it also has to be made available to a potentially large community.

Providing references to EA relevant documents: Information about the EA is foremost stored in a central model repository. Besides this structured information on the EA model, additional information is distributed over many documents in the organizations, e.g., excel sheets, power point presentations, and word documents. These documents often contain information highly relevant for EAM and connecting them to the EA tool can yield benefit. Examples for relevant documents are strategy documents, executive board presentations, or governmental regulations.

Document guidelines and FAQs: Guidelines and FAQs published by the architecture teams need to be distributed to EA stakeholders throughout the organization. Thereby, EA stakeholders are allowed to search for specific topics concerning their daily work efficiently. This scenario helps to improve the communication with management and operations processes in the organization.

Annotating visualizations: Visualizations are common means in EAM to support decision makers using stakeholder specific views. These visualizations can be annotated with additional detail or background information on the elements of the application landscape. This can be accomplished by extending a visualization that has been generated before. Examples for annotations are for instance a color-coding of application elements or additional symbols.

Discussion of business and EA requirements: Major goal of EAM initiatives is to improve the alignment between business and IT. This means IT capabilities have to be developed according to the business requirements. The discussion about these requirements and their impact on the EA can be preserved with unstructured information that is linked to elements in the EA model. The versioning of these requirements helps to track changes and supports the planning of future decisions on the EA.

Import, edit and validate EA information: Data previously collected with a spreadsheet or available from productive systems in the organization [24] are imported or used to maintain the EA model. Only a limited number of people are usually involved in this task, e.g., as information providers. This scenario also includes capabilities that deal with data transformations and validations of the model consistency.

Analyze EA information: Typically the analysis of EA information is performed by various kinds of visualizations (for demand management, portfolio management, or infrastructure management, etc.) that are preconfigured and can be customized depending on the information demand of different stakeholders. Besides visualizations, the use of metrics that assess certain aspects of the EA can be used to analyze the development of the organization. Stakeholders for this scenario are usually architects or decision makers in the management board.

Simulate impacts of EA decisions: In recent work, models are evaluated with respect to assessment properties, e.g., [25]. A formalized theory can be then used to describe and compare alternative EA decisions. With such evaluation capabilities, impacts of EA decisions can not only be documented and considered but also analyzed.

EAM Activities and Workflows: Workflows and activities can support the architects and stakeholders with EAM related tasks, such as among others the documentation of the EA, development of planned states, or architecture reviews.

Next to these examples, further scenarios were identified in this research, e.g., collaborative work, support for lightweight access, editing of visualizations, but omitted due to space limitations in this paper, since they can be classified analogously within the identified cases (Section 6). Within the scenario *analyze EA information* several typical scenarios for EAM support, e.g., Landscape Management, Demand Management, Infrastructure Management, are summarized since they are typically targeted by specialized tools for EAM.

Table 6. Please decide whether a Wiki or a specialized EA tool is better to fulfill the following scenarios (n=105)?

Scenario	Wiki	Rather Wiki	Neither	Rather EA Tool	EA Tool	No Response
Definition of terms	52	24	5	5	12	7
Providing references to EA relevant documents	40	24	7	14	11	9
Document guidelines and FAQs	54	25	7	5	6	8
Annotating visualizations	10	7	5	32	42	9
Discussion of business and EA requirements	28	22	20	11	12	12
Import, edit, and validate EA information	3	3	4	18	64	13
Analyze EA information	5	1	3	19	69	8
Simulate impacts of EA decisions	2	2	6	18	65	12
EAM activities and workflows	10	8	10	18	50	9

The survey results for the scenarios with the classification according to the appropriate tool species are shown in Table 6. The classification for every scenario ranges from Wiki and rather one of the species to the EA Tool. In the following these scenarios are assigned to one of the tools depending on the assessment of the organizations.

5.1 Enterprise Wikis

The majority of the organizations (49.52%) expect the *definition of terms* to be within the Wiki. Only a small fraction of 12 (11.43%) organizations completely disagree and expect it to be within the EA Tool. The tendency is also supported by 24 (22.86%) organizations that foresee the definition of terms rather in the Wiki. Major reasons for the applicability of Wikis for this purpose can be found in literature. A Wiki allows everyone to view and edit content and create hyperlinks that connect Wiki pages with each other [26-28]. This is especially useful for the definition of terms, since the content needs to be made available for the entire staff in the organization and interlinking of definitions is required.

References to EA relevant documents are better supported by Enterprise Wikis. 40 (38.10%) organizations rate Wikis as more suitable for this purpose. The opposite (EA tool) opinion is only supported by 11 (10.48%) organizations. Furthermore 24 (22.86%) organizations expected the references to EA relevant documents to be rather in the Wiki. The ability of Wikis to create file attachments is the basis for referencing EA documents [28]. The management of these documents is supported by the integrated full-text search [26], [28]. Properly referenced EA documents help architects to find the required information more efficiently. This also includes additional information that is not being captured in the model of the EA Tool.

One of the main goals of the EAM initiative is the establishment of principles and guidelines to manage the evolution of the organization. The *documentation of guidelines and FAQs* is supported well by a Wiki according to 54 (51.43%) organizations. This is confirmed by 25 (23.81%) organizations that mentioned rather the Wiki for this scenario. Only 6 (5.71%) organizations think a specialized EA tool is more suitable. Several of the strengths of a Wiki are useful for this scenario. The possibility to use text formatting and layouting [26], [28], as well as the fast built-in full-text search [26], [28] allows for the creation of appropriate information content by and for EAM stakeholders. In addition, Wikis allow the linking to pages not yet written in order to show a need for information [27-28]. These links are highlighted in the system and help identifying the information need from stakeholders. Another example for this scenario is the technical documentation or manual of the EA tool that benefits of an integration of both tool species.

According to the survey results, the Enterprise Wiki is more suitable to *discuss business and EA requirements*. 28 (26.67%) organizations expect it to be only in the Wiki. In addition, 22 (20.95%) organizations rate rather in the Wiki and 12 (11.43%) organizations in the EA tool only. Especially the possibility to easily edit and view content makes the Enterprise Wiki useful for this scenario [26-28]. Furthermore arbitrary and unstructured content can be placed in Wikis [28]. Integration with the EA tool can be beneficial to relate the discussed requirements in the Wiki to EA elements retrieved from the structured model. At the same time tracing requirements from the EA tool back to unstructured information or documents becomes possible in case they are properly documented.

5.2 Modeling and EA Tools

Among the participants, 42 (40.00%) stated that the *annotation of visualizations* needs to be supported by the EA Tool. With 32 (30.48%) organizations, the second largest group stated that rather the EA Tool is more suitable. Only 10 (9.52%) organizations have the opposite opinion for this scenario and expect it to be in the Wiki. Existing EA tools have already largely adopted visualizations techniques [23]. Therefore, domain experts expect this scenario to be rather in the EA tool.

The scenario *import, edit, and validate EA information* has a strong rating with respect to the EA tool. 64 (60.95%) organizations expect it to be performed in the EA tool. 3 (2.86%) organizations perform this scenario in the Wiki instead. Since the Enterprise Wiki usually does not support the modeling of complex structures, the EA

tool should execute this scenario. Only in case the documentation of the EA does not have enough level of formalization an approach as proposed by Buckl et al. [9] is reasonable. Recent research provided mechanisms to automatically document EA elements from productive system [24]. The proposed solution connects external information systems with the repository of the EA tool to automate the documentation.

Based on the formalized EA elements *analyze EA information* provides visualizations to support, e.g., Demand Management, Portfolio Management, or Infrastructure Management, or computes metrics on the EA for decision makers. 69 (65.71%) organizations classify this scenario to be in the EA tool. Only 5 (4.76%) organizations mentioned it should be within the Enterprise Wiki. These organizations conduct a solely Wiki-based approach in their EA endeavor and therefore analyze EA information only in this tool. Similarly, *simulating impacts of EA decisions* is placed in the EA tool according to 65 (61.90%) organizations. This scenario also requires a structured model to create an assessment theory. The execution of *EAM activities and workflows* should be performed in the EA tool according to 50 (47.62%) organizations. However, 10 (9.52%) organizations shared the opposite opinion and expect this scenario in the Enterprise Wiki.

6 Classification of the Tool Scenarios

The results of the survey clearly show that practitioners would prefer an Enterprise Wiki in comparison to a specialized EAM tool in four of our nine scenarios, whereas they prefer an EAM tool compared to a Wiki in five scenarios. If both types of tools should be used within different EAM scenarios, an integration of both is inevitable. To design an optimal integration strategy, the appropriate type of tool has to be determined for every conceivable EAM scenario. Although we were able to analyze nine concrete scenarios with our survey, future research has to proceed on a more abstract level. Therefore, we derived four general tool usage cases that are described in the following.

Case 1 encompasses scenarios in which highly structured models provided by specialized EAM tools are not needed. For example, *definition of terms* and *references to EA documents* belong to this case. The documentation of EA relevant information is performed in a merely unstructured manner and there is no need to add structural overhead in the future.

Case 2 comprises scenarios in which an EA description is initially done without a preexisting structure (model), but after a while transferred to the structured EAM tool. For example, *evaluation of external requirements* belongs to this case. Reasons for using a Wiki before an EAM tool might be that a) the appropriate documentation structure is not known upfront or b) the need for a structured documentation evolves over time.

Case 3 summarizes scenarios in which structured data is transferred from a specialized EAM tool to an Enterprise Wiki. The only scenario already identified for this case is the removal of unused EA data. In this scenario, data for which restrictive data models are not needed anymore is swapped to a Wiki where it remains accessible.

Case 4 describes scenarios in which highly structured data or the special features of EAM tools are needed. For example, *simulate impacts of EA decisions*, *analyze EA information* and *annotating visualizations* belong to this case. Activities in that kind of scenarios often relate to analysis, simulation or validation tasks.

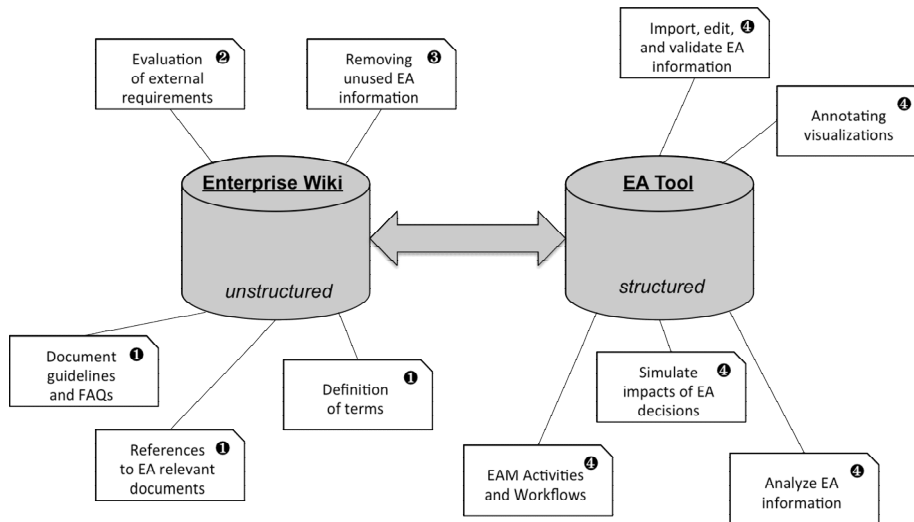


Fig. 1. Scenarios for the Enterprise Wiki and the EA tool

Figure 1 shows the conceptual integration of an Enterprise Wiki and a specialized EAM tool. Therein, each scenario is linked to the tool practitioners prefer to execute it. The small number in the upper-right corner indicates the general case the scenario is part of.

7 Discussion and Future Research

From the survey presented in Sections 4 and 5, we learnt that the parallel usage of an Enterprise Wiki and a specialized EAM tool is attributed to additional support for typical EAM tasks. At least 40% of the organizations actually use both types of tools and 5% decided to integrate them. We assume that such integration is especially useful in certain scenarios, e.g., in *providing references to EA relevant documents*. The Wiki can provide an easier way to create such references, but knowledge about the references themselves might also be beneficial if an enterprise architect is working with a specialized EAM tool. It can thus be concluded, that the integration of Enterprise Wikis and specialized EAM tools provides added value for organizations, which answers our first research question.

By analyzing the survey results, we were able to show, that at least four EAM scenarios would benefit from the usage of an Enterprise Wiki integrated with a specialized EAM tool. These scenarios are: *definition of terms*, *providing references to EA*

relevant documents, document guidelines and FAQs, and discussion of business and EA requirements.

The third research question posed in Section 1 requires the identification of potential challenges of an integration of an Enterprise Wiki and a specialized EAM tool. The existence of challenges is affirmed by the survey results, which show that 60% of the participants plan to use a Wiki in addition to a specialized EAM tool, while currently only 5% were able to implement an integrated approach.

The challenges in the context of an integration of both types of tools might consist of the following. If, for instance, the Enterprise Wiki should be able to provide links to architecture objects or preconfigured visualizations documented or managed by the EAM tool, the EAM tool would have to provide direct links (e.g. URLs) to its entities. If the Enterprise Wiki is to provide the ability to search for architectural entities managed by the EAM tool a respective interface would have to be provided by the EAM tool. While many of the scenarios described in Section 5 require some kind of information exchange between the two types of tools an appropriate technical implementation remains unclear, since many different technologies could be applied, e.g., Web services or HTTP requests.

When two independent tools use partially the same data basis ensuring data consistency is an additional challenge. In a similar context Hirsch et al. [10] distinguish three types of consistency: no consistency, one-way consistency and two-way consistency. Besides the implementation of a consistency assurance mechanism the identification of the best suitable type of consistency remains an open challenge.

Architectural information, e.g. IT strategy, is often subject to restrictive access policies within an EAM tool. If such information is used or referenced within an Enterprise Wiki the respective stakeholders might require the same access policies in the Wiki as the EAM tool implements them. Such a requirement stands directly in contradiction with the suggestion of Farenhorst et al. [17] to enable a maximum of collaboration in a Wiki. Therefore, appropriate ways to address both requirements have to be explored.

Up to now, the four different interaction cases of Enterprise Wikis and EAM tools as described in Section 6 have not been evaluated in practice yet. They are deduced from the nine scenarios but additional research is necessary to confirm their integrity. Therefore, our future work will elaborate detailed interactions with a prototypical implementation with our industry partners.

8 Conclusion

Existing tools for EAM are mainly focused on formal structures and processes neglecting collaboration among stakeholders as well as unstructured information content. For the latter two, Enterprise Wikis successfully provide solutions already widely applied in organizations. In this paper foundations for the integration of Enterprise Wikis and specialized EA tools are presented. After an identification of common scenarios for EAM, a practitioner survey was performed in order to provide empirical evidence for our approach. The results from the survey indicate potential for a better

integration of both tool species. The identified scenarios were analyzed and assigned to a tool according to the findings from the survey and results from current literature. The findings presented in this paper lay the ground for future research on the integration of unstructured information content with EA models.

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