Designing Enterprise Architecture Management Functions – The Interplay of Organizational Contexts and Methods

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Abstract. Enterprise architecture (EA) management is today a critical success factor for enterprises that have to survive in a continually changing environment. The embracing nature of the management subject and the variety of concrete goals that enterprises seek to pursue with EA management raises the need for management functions tailored to the specific demands of the using organization. The majority of existing approaches to EA management does account for the organization-specificity of their implementation, while concrete prescriptions on how to adapt an EA management function are scarce.
In this paper we present a development method for organization-specific EA management functions based on the idea of reusable *building blocks*. A building block describes a practice-proven solution to a recurring EA management problem. The theoretic exposition of the development method is complemented by an fictitious application example.

Keywords: Enterprise architecture management, enterprise architecture management function, situational method engineering, method base, building block-based design

1 Introduction and motivation

Alignment between business and IT is a major challenge for today's enterprises and in particular for their IT departments. In the past IT took a mere *provider role* fulfilling business requirements. In the future IT must also take an *enabler role* seeking to increase flexibility and adaptability of the provided business support. In order to facilitate the sketched transition [1, 2] and to support IT departments in taking this two-fold role, an overarching management function has to be set in place, targeting both business and IT aspects, but also accounting for

crosscutting aspects, as strategies and projects. The latter is especially necessary as a managed evolution of the organization inevitably connects to the strategies as drivers of organizational change and the projects as its vehicles. The enterprise architecture (EA) aims at such holistic understanding of "fundamental organization of the 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" (adapted from ISO standard 42010 [3]).

Aforementioned holistic understanding forms the basis for EA management, that seeks to foster the mutual alignment of business and IT. As of today, many practitioners and researchers have formulated their particular perspective on EA management and have such promulgated the topic through enterprises (cf. [4–7]). Nevertheless, currently no broadly accepted step-by-step guideline for managing the EA exists. Some researchers doubt that a one-size-fits-them-all management approach satisfies the different EA management goals in the various organizational contexts, but that the approach has to be organization-specific (cf. [8–10]). Details on how to perform an adaptation of the EA management function are scarce. For example, The Open Group Architecture Framework [11, page 56-57] states that the *architecture development method* must be adapted, but abstains from providing information on how to perform these adaptations. This situation is similar to the one in software development, where albeit a general agreement on important activities as e.g. *requirements elicitation* or *testing*, various process models exist, which strongly differ concerning the linkages between the different activities and the level of detail in which the different activities are described. The concrete design of an EA management function varies from organization to organization (cf. [12–14]). This raises the research question of this article:

> *How does a development method for organization-specific EA management functions look like?*

The presentation in this article continues the discussions from [15], where a method framework for EA management functions was introduced, see Figure 1. Based on the activities of this framework, we present re-usable building blocks for substantiated EA management processes. These building blocks are used in a method based on the idea of situational method engineering, as discussed in Section 2. The development method itself is discussed in detail in Section 3 and an application of the method in a real world case study is described in Section 4. Final Section 5 provides a critical reflection of the achieved results, the findings of applying the method, and hints to further areas of research.

2 Related work – Situational method engineering

In [16, page 25] Harmsen introduces the idea of *situational method engineering* as an approach to "tailor and tune methods to a particular situation". The driving idea behind situational method engineering can be summarized as follows: "There is no method that fits all situations" [16, page 6]. Introducing the term *controlled flexibility* Harmsen elicits requirements for a method engineering

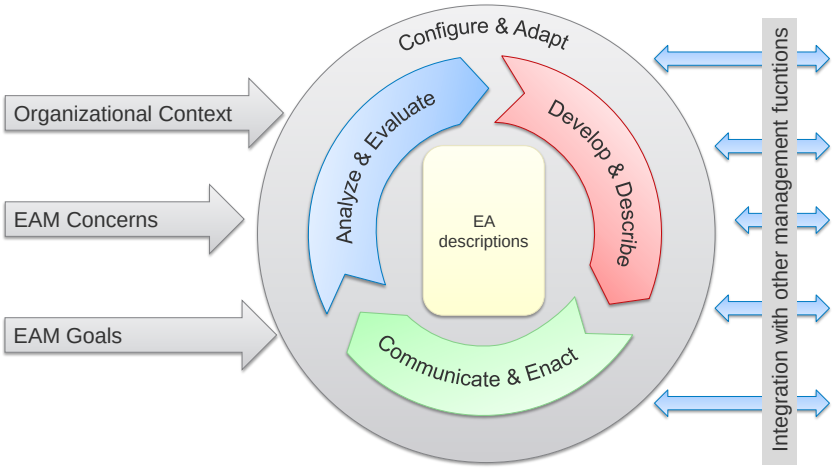

Fig. 1. Method framework for the EA management function

approach, which accomplishes standardization and at the same time is flexible enough to match the situation at hand. A *situation* thereby refers to the combination of circumstances at a given point in time in a given organization [16]. In order to address these requirements, for each situation a suitable method – the so-called situational method – is *constructed*. This method takes into account the circumstances applicable in the corresponding situation. In the construction process uniform method fragments are selected, which can be configured and adapted with the help of formally defined guidelines.

The generic process to constructing situational methods consists of four steps. Input to the configuration process is the specific situation in which the method should be applied, e.g. the environment of the initiative, involved users, organizational culture, or management commitment. This situation is analyzed in the first step (*characterization of the situation*) to describe the application characteristics. The gathered information is used in the second step (*selection of method fragments*) to select suitable method fragments from the method base. Heuristics can thereby be applied to foster the selection process. In the third step (*method assembly*) the method fragments suitable for the characterized situation are combined to a situational method. During assembling method fragments, aspects like completeness, consistency, efficiency, soundness, and applicability are accounted for [16]. The actual use of the constructed situational method is performed in the last step (*project performance*). Figure 2 gives an overview on the construction process and illustrates the relationships between the different steps.

In addition to the construction process, Harmsen introduces in [16] the activity *method administration* that captures methodical knowledge, i.e. adds or updates method fragments based on feedback from the project performance step. The different method fragments in the method base are thereby characterized via criteria that facilitate the selection of fragments matching the given situa-

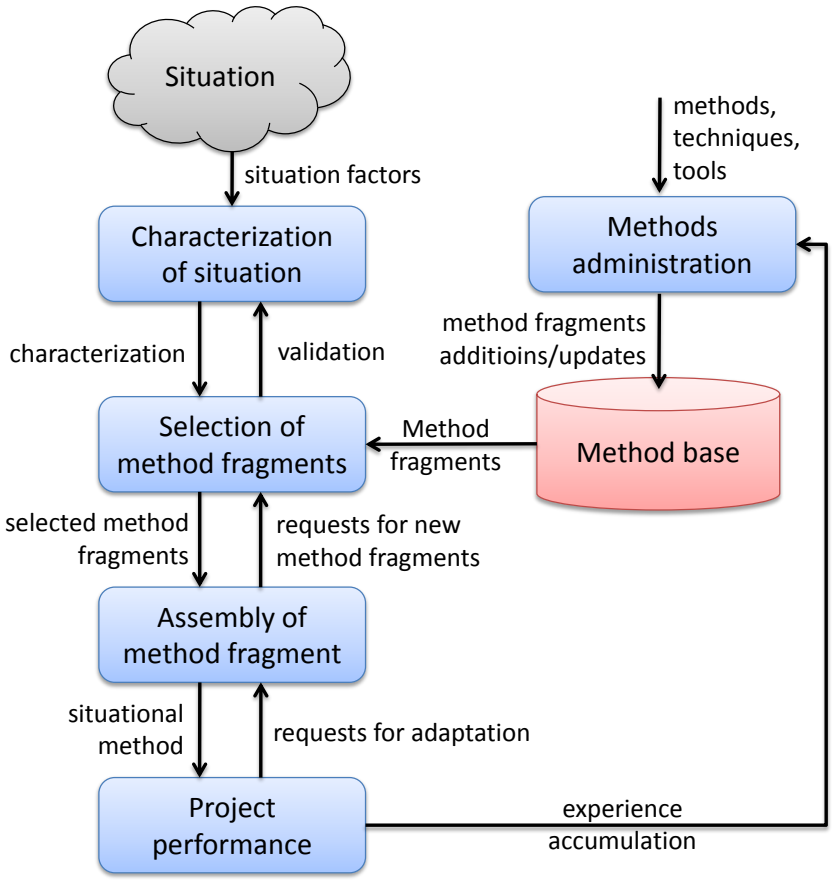

Fig. 2. The process of situational method engineering according to [16]

tion and goals. In the context of EA management we have to account for the fact that these criteria are not *symmetrical*, i.e. that one method may target a criterion that is not applicable for another one. We reflect this peculiarity of the application field via a specific construction of the method base, resembling the structuring of a *design theory nexus* as presented by Pries-Heje and Baskerville in [17].

3 Developing an EA management function using a method base

We present a method for developing an organization-specific EA management function based on best practices collected from literature and practice. These best practices are reflected in so-called *building blocks* that form a central contribution of our approach, a fact also reflected in the name of the approach:

building blocks for EA management solutions (BEAMS). We distinguish two types of building blocks, namely

- **Method building blocks (MBBs)** present practice-proven method prescriptions, i.e. describe who has to perform which tasks in order to address a problem in the situated context and
- **Language building blocks (LBBs)** present practice-proven EA modeling languages, i.e. refer to which EA-related information is necessary to perform a task and how it can be visualized.

With the method focus of this paper, we put critical emphasis on the MBBs which together form the *method base* of BEAMS. The **development method** for designing organization-specific EA management functions builds on the MBBs contained in the method base. The MBBs are described using a BPMN-like syntax and notation [18]. In Figure 3, we provide an UML *activity diagram* [19] that illustrates our stepwise method consisting of the activities **characterize the situation**, **configure EA management function**, and **analyze EA management function**. Therein, the configuration cycle which is concerned with configuring the EA management function in a stepwise fashion taking one EA management-related problem at a time is illustrated.

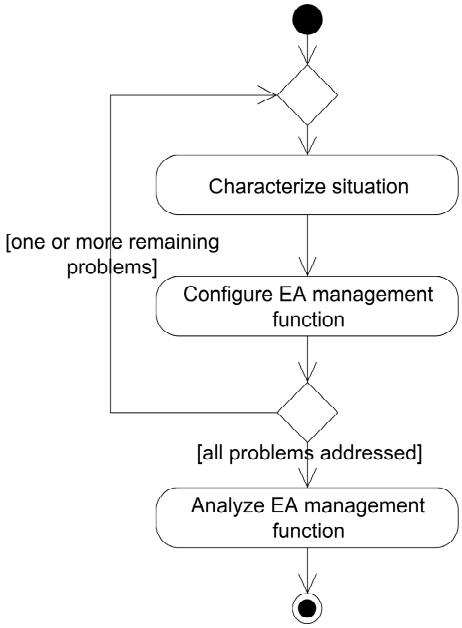

Fig. 3. Activity diagram illustrating the development method

The characterization of the situation provides the input for selecting appropriate MBBs from the method base, i.e. is concerned with a black-box perspective

on MBBs. In contrast, configuring the EA management function is concerned with selection, customization, and integration of MBBs and thus takes a white box perspective. Starting with an empty EA management function, a first EA management-related problem to be addressed is selected as part of the characterization of the situation for which an appropriate EA management function is configured. This EA management function is stepwise enhanced with methods addressing further EA management-related problems, which are identified and integrated into the already configured EA management function in an iterative manner. Preliminary output during the development method is stored in an **organization-specific configuration** for the EA management function. If all identified problems are addressed, the resulting EA management function is analyzed for organizational implementability in the final activity [20].

Subsequently, we detail the single steps of the development method and designate the involved participants. While we assume the enterprise architect to be the typical user of the method other stakeholders of the EA management initiative need to be consulted during the development method in order to identify the problems that should be addressed. The development method is subsequently presented in a twofold way: an overview on parts of the method is given by an UML activity diagram and the single activities of the diagram are described textually.

3.1 Characterize situation

The first activity of the development method **characterize situation** consists of three sub-activities, namely **determine organizational context**, **identify and operationalize EA-related problem**, and **specify existing information sources**. The outputs of the characterize situation step are a set of defined organizational contexts, an actual problem to be pursued, and information on the already existing data, i.e. EA-related content. Figure 4 shows a detailed activity diagram describing the single steps to be performed to achieve the aforementioned outcomes.

To develop an organization-specific EA management function, the enterprise architects have to characterize the situation in which the management function should be embedded in the step determine organizational context. Different factors and criteria influencing the applicability of an EA management function exist. To support the enterprise architects in characterizing the situation, a **catalog of organizational context** descriptions that impact the applicability of the MBBs in the method base is provided. The enterprise architects browse the catalog and select the organizational contexts that reflect the current situation in the organization. Output of the step is an organization-specific configuration containing first characterization of the situation with respect to the organizational context, i.e. a set of selected organizational contexts that describe the environment in which the EA management function should be embedded.

Besides the environment in which the EA management function should be embedded the enterprise architects have to identify the EA-related problems to be pursued. Therefore, the stakeholders of the EA management initiative

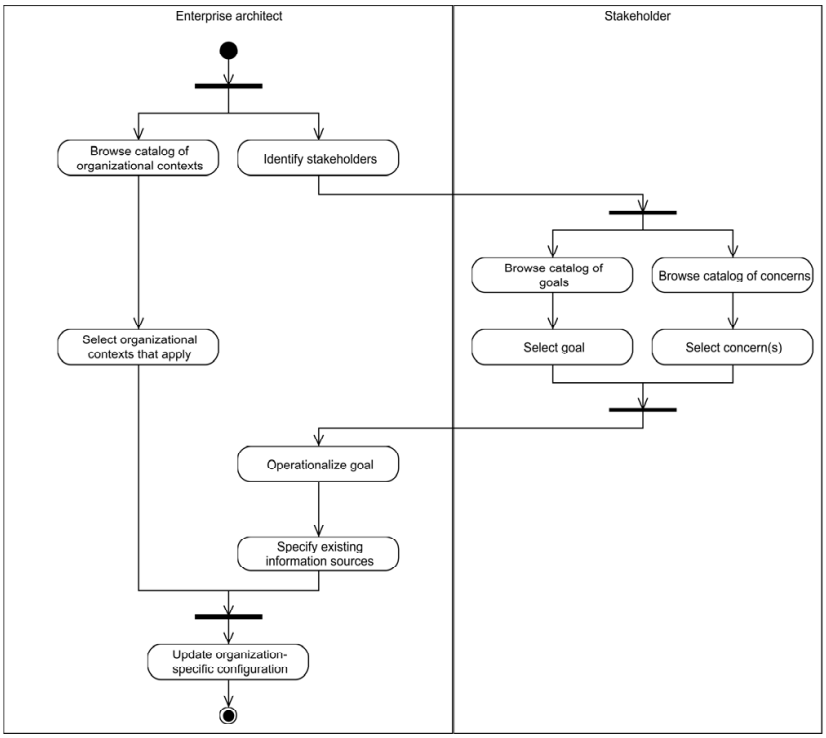

Fig. 4. Development method: Characterize situation

should be consulted. Typically these problems are described by the stakeholders on a rather abstract level. BEAMS provides a collection of such abstract EA management-related problems. This collection is organized in two catalogs, namely the catalog of goals defining *what* should be achieved, and the catalog of concerns specifying *where* the different goals can be applied. Based on the combination of one selected goal and one concern, a problem is defined and an information model describing the concepts relevant for the problem is determined.

Complimenting the characterization of the situation, already existing information sources that contribute to the EA management function by providing required input, need to be specified in the step **specify existing information sources**. Therefore, the concepts of the information model configured in the preceding step are analyzed and contributing sources are delineated. The organization-specific configuration is accordingly updated by the enterprise architects to include the existing information sources.

3.2 Configure EA management function

The activity **configure EA management function** represents an iterative activity consisting of two sub-activities. During the sub-activity **select MBB** the set of MBBs applicable in the current situation is determined based on the criteria stored in the configuration and one MBB is selected. The selected MBB is subsequently configured to the organization-specificities in the sub-activity **customize MBB**. The two sub-activities are iteratively performed until all EA management activities of the framework introduced in the motivating section are covered (cf. Figure 1).

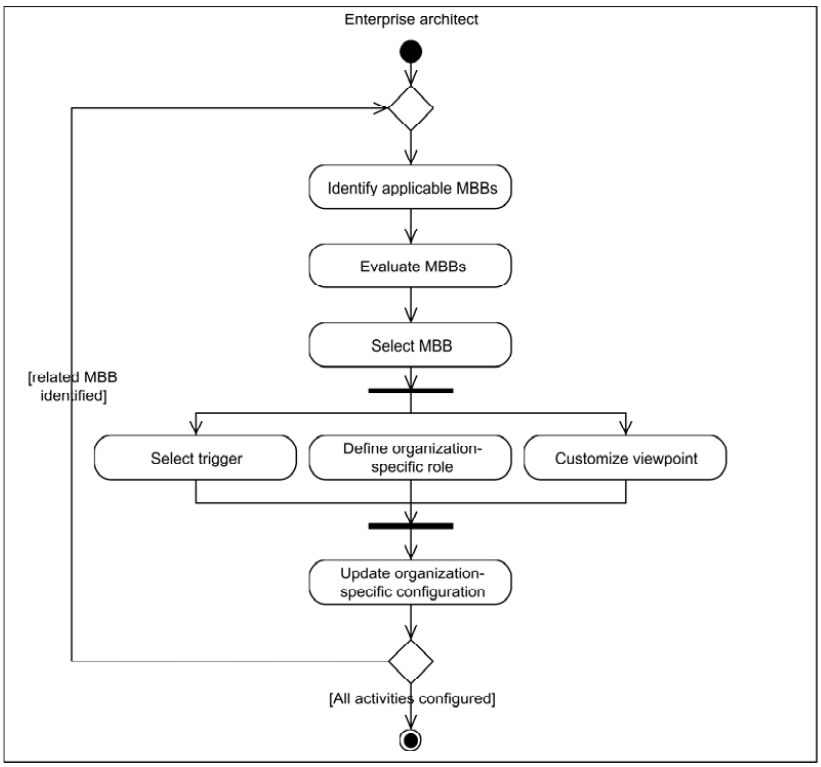

Fig. 5. Development method: configure EA management function

Entering the construction of the EA management function itself, the step **select MBB** is executed by the enterprise architects. The enterprise architects identify applicable MBBs by revisiting the admissibility requirements of all MBBs and comparing them with the information stored in the organization-specific configuration. Putting it more simply the MBBs are assessed according to

- the associated goal,
- the applicability in the defined organizational context, and
- the fulfillment of specific pre-conditions by the information already covered.

The pre-conditions are described by *meta-attributes*. Meta-attributes represent properties of associated concepts of the information model. If for instance no method is currently selected to document business processes, the business process concept has no meta-attribute defined. After selecting an MBB from the develop & describe activity to gather information on business processes, the meta-attribute "businessProcess.documented" is set to true. Different meta-attributes like *.documented*, *.communicated*, or *.published* exist.

The enterprise architects chose an admissible MBB from the set of appropriate MBBs. The choice can be supported by taking into account the participants that must be involved in executing the tasks as well as the consequences of applying an MBB.

While above step already shifts the process from an analytic one to a constructive one, the step **customize MBB** is clearly related to design and construction. Three parallel activities are performed during this step all relating to the customization of the selected MBB.

- The trigger of the MBB is detailed taking into account possible limitations that are already specified by the MBB.
- The participant variables delineated by the MBB has to be replaced by an organization-specific role.
- For each involvement of a participant in a task the used viewpoint has to be defined. While the constraints provided by the type of viewpoint have to be accounted for, the recommendations and dissuasions can optionally be considered.

After the configuration, the customized method is integrated into the set of configured methods that represent the current status quo of the organization-specific EA management function.

After the enterprise architects have finished customization of the selected MBB, the organization-specific configuration is updated to incorporate the customized method and the conditions on the information model are updated accordingly. If not all activities of the EA management function are yet covered, the development method continues with the identification of the next MBBs that are admissible. The output of the activity configure EA management function part of the method is a coherent and self-contained EA management function that addresses the defined set of problems stored in the organization-specific configuration. Otherwise, the enterprise architects can either start to characterize the next situation and problem to be addressed (configuration cycle) or continue the development method with the analysis of the EA management function.

3.3 Analyze EA management function

Since quick-wins and short-term benefits of EA management are sparse, a stringent implementation of the EA management function is not easy to ensure.

A central challenge for enterprise architects is to ensure organizational implementability. The third phase of the development method is concerned with analyzing the organizational implementability of an EA management function. Central thereto, is a distinction between

- **stakeholder**s who own the problems to be addressed by the EA management function and
- **actor**s who are responsible for or consulted during the conduction of an EA management-related task.

The activity **analyze the EA management function** consists of three subactivities as illustrated in Figure 6, namely **analyze stakeholder involvement**, **investigate stakeholder-actor-dependencies**, and **propose organizational interventions**.

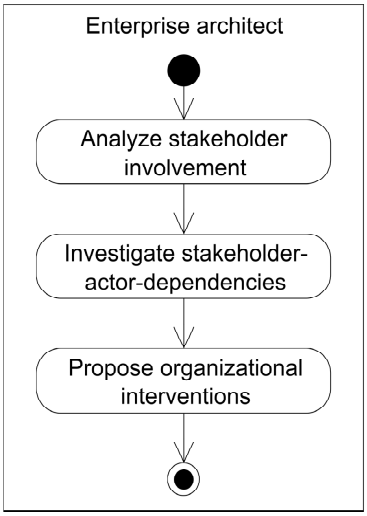

Fig. 6. Development method: analyze EA management function

In the first activity **analyze stakeholder involvement** the involvement of the stakeholders as typical stakeholders of the EA management function is investigated. To ensure long-term investments in the endeavor, we thereby ensure that a defined method fragment to inform the stakeholders on the results related to their specific problem is defined. The second activity **investigate stakeholder-actor-dependencies** the aspect of information demand and supply is analyzed. For each stakeholder, representing an information consumer, the dependencies on actors, who provide information are determined. The resulting dependencies are mapped to the organizational (control) structures. Based on the results different organizational interventions as e.g. tits-for-tats or social competition, are provided in the final activity of **propose organizational interventions**.

In this vein, different mechanisms to ensure the supply of information can be established.

4 A fictitious case study from industry

In our fictitious example, we accompany the enterprise architects from a fictional organization, namely the financial service provider BS&M through their first experiences with EA management. The situation at BS&M can be characterized as follows: Over the last years BS&M has been constantly growing resulting in a heterogeneous application landscape due to a rising number of business request to IT.

To cope with the proliferating application landscape, an IT Infrastructure Library (ITIL) project was launched a year ago, that established a configuration management data base (CMDB) in which the currently used business applications and using organizational units are documented. Furthermore, the federated IT departments were centralized and a process for deciding on the project portfolio based on defined criteria as estimated project costs was set up to increase standardization of the provided IT solutions.

Browsing the catalog of organizational contexts the enterprise architects select the following characteristics that are subsequently stored in the configuration, namely

- the initiative can be characterized as *bottom-up initiative* as no official mandate from the management exists,
- the organizational structure supplies a *centralized IT department*, and
- *office tools* should be used in the initiative as no dedicated tool support for EA management yet exists and no official budget is available for the initiative.

At BS&M the enterprise architects identify the project portfolio managers as potential stakeholder of the EA management initiative. During interviews these stakeholders expressed problems with determining the impact of planned projects onto the application landscape. In particular, the impact on the business support provided by the applications is of major interest as well as interdependencies between different projects.

Browsing the catalog of goals, the enterprise architects accordingly select the goal *increasing transparency*. Furthermore, the catalog of concerns is browsed in order to identify relevant elements of the EA on which the goal should be applied. The concern "business application supports business process at organizational unit" is selected, thereby introducing the corresponding concepts and relationships to the information model. Further the cross-cutting aspects "project changes architecture elements" and "project proposal affects architectural elements" are selected and applied onto the concept business application. Figure 7 shows the information model resulting from the integration of the corresponding LBBs.

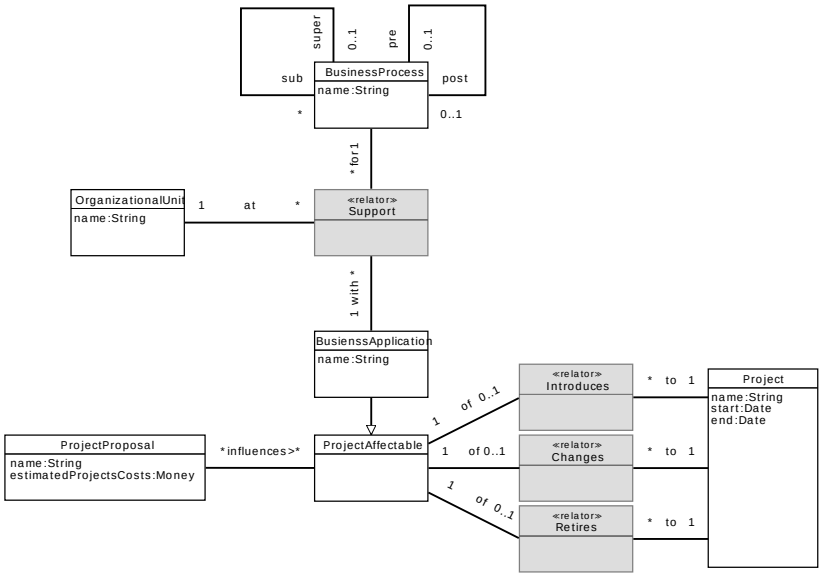

Fig. 7. An exemplary information model for the above described problem

To operationalize the goal, the enterprise architects decide to use the qualitative measure *stakeholder satisfaction*, which is proposed as an operationalization for the goal *increasing transparency* by the BEAMS catalog of goals.

Revisiting the concepts from the information model, the enterprise architects of BS&M identify the ITIL CMDB as information source for their EA management initiative. Therein information on the current landscape is stored covering the information demands for ORGANIZATIONAL UNITS and BUSINESS APPLICATIONS as well as their relationships. Further, information on PROJECT PROPOSALS and their impact on the application landscape can be derived from the project charter demanded as input to the project portfolio management process.

With these contributing information sources, the enterprise architects specifies the meta-attribute ".documented" to hold for the above described parts of the information model. Nevertheless, as not all information is yet available the general condition concern.documented is not yet fulfilled.

At BS&M, the input for the assess suitability technique is the information stored in the configuration, namely

- **goal:** increasing transparency,
- **context:** bottom-up initiative, centralized IT department, office tools, and
- **conditions:**

Based on above criteria the enterprise architects identify applicable MBBs. With respect to the current goal, the set of admissible MBBs can be limited to the ones associated with the activities "develop & describe" and "communicate & enact".

Taking further the empty set of fulfilled conditions into account, MBBs from the activity "communicate & enact" can be excluded from the set of applicable MBBs, such that the following MBBs from the "develop & describe" activity are evaluated to be applicable based on the specified organizational context descriptions:

- describe by interview
- describe by questionnaire
- describe by workshop

The enterprise architects of BS&M decide to use the first MBB (cf. Figure 8) to gather the missing information on BUSINESS PROCESSEs. The convincing argument therefore, was the possibility to individually promote the EA management initiative at the different business departments in a face-to-face interview.

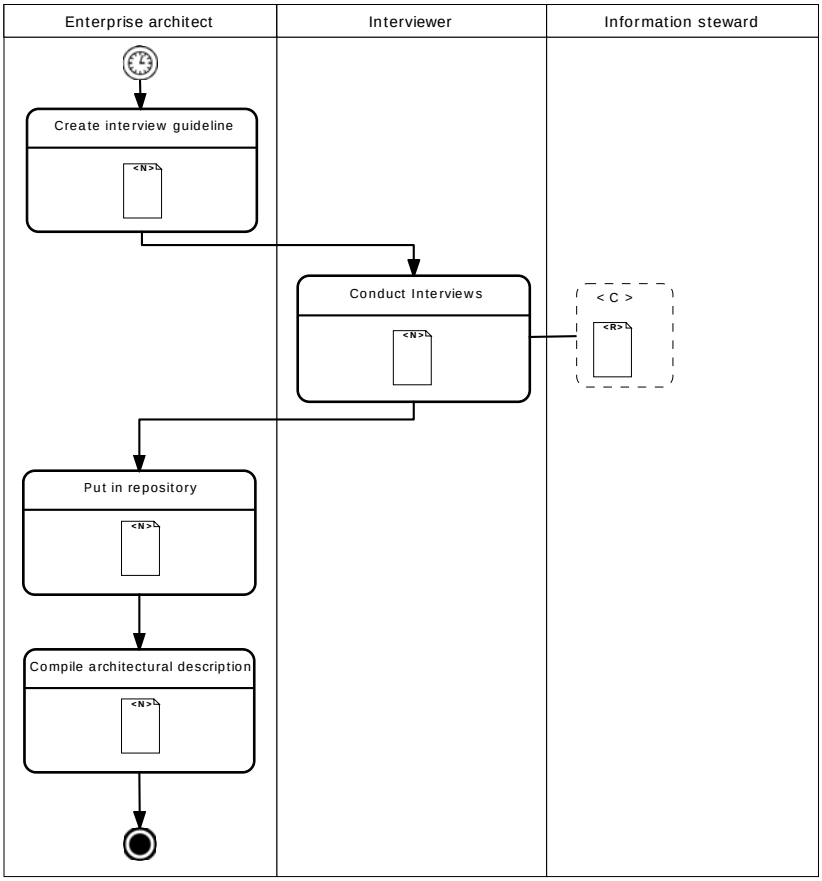

Fig. 8. MBB describe by interview

At BS&M the enterprise architects customize the selected MBB as follows. As the trigger is specified by the MBB to be of type "temporal" the enterprise architects decide to update the documentation of business processes on a yearly basis which reflects the update schedule of the CMDB from the ITIL initiative.

The participant variable INTERVIEWER is defined to be an enterprise architect to facilitate the promotion of the EA management initiative. Further, the process owners are identified as information stewards.

Complementing, the viewpoints used to involve the different participants are defined. Typical office documents are used with one exception. The architectural description used in the last step is displayed in a so-called *matrix card* that relates business processes, business applications, and organizational units.

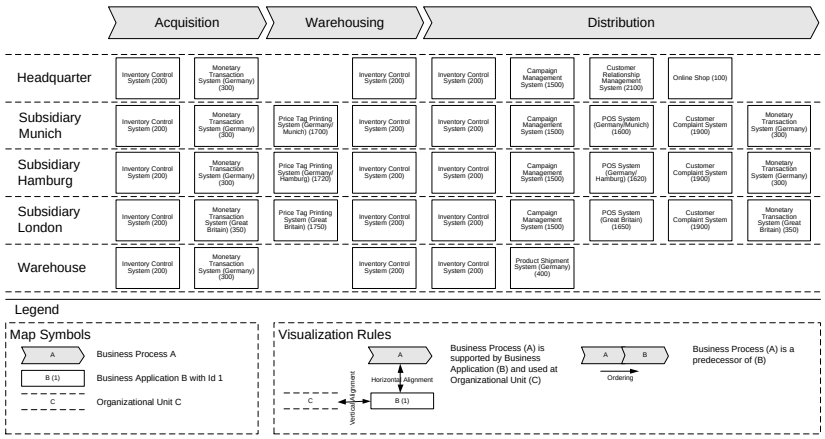

Fig. 9. A matrix visualization

The enterprise architects from BS&M update their organization-specific configuration to on the one hand incorporate the customized method and on the other hand extend the set of fulfilled conditions with the condition "concern.documented" as now all concepts specified by the information model are documented.

Based on the updated configuration a new set of admissible MBBs can be identified. The assessment technique now additionally returns MBBs from the communicate & enact activity as the minimum pre-condition concern.documented is fulfilled. Omitting the iterative steps, we present the resulting EA management function in Figure 10 that addresses the problem of "increasing transparency on the interplay of planned projects" that consists of the following MBBs

- ensure information consistency (develop & describe)
- develop planned states of the EA (develop & describe)
- perform single expert evaluation (analyze & evaluate)
- publish architectural description (communicate & enact)

5 Conclusion and outlook

In this article we motivated the need for an organization-specific approach to develop an EA management function based on the idea of re-usable, practice proven building blocks. Following the idea of situational method engineering the building blocks are selected based on a characterization of the organizational context of the associated organization. While the application of the development method in this paper is only performed using a fictitious case, we are currently evaluating the development method and the EA management function resulting from its application in different cases in industry. First results from these cases hint towards the usability of the development method and prove the suitability and applicability of the resulting artifact at least from the subjective perspective of the industry partners. However, a long-term survey is necessary to demonstrate and prove the utility of the development method and the resulting EA management function.

Findings from our first applications additionally proved the need for a tool support to facilitate accessing the knowledge base as well as to support an enterprise architect during the different activities of the development method. As a first step towards a more sophisticated tool support, we plan to publish the method base, i.e. the collection of MBBs, online in a wiki system. The wiki system should be used to establish a community of researchers and practitioners with are interested in further evolving and enhancing the method base.

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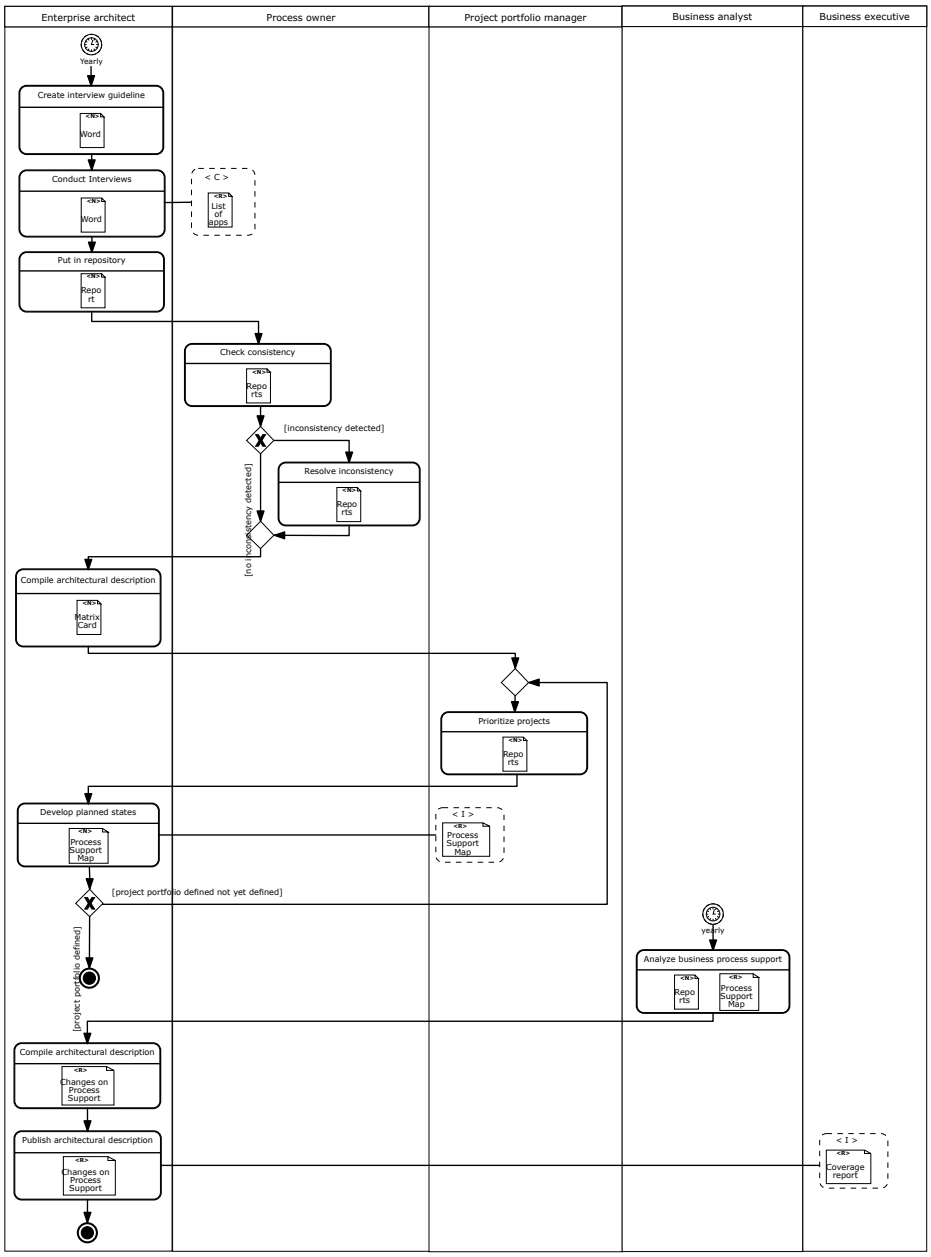

Fig. 10. An organization-specific EA management function developed using the BEAMS method base