A Decision-Making Case for Collaborative Enterprise Architecture Engineering

Dierk Jugel[1,2] , Stefan Kehrer[1], Christian M. Schweda[1] and Alfred Zimmermann[1]

Abstract: In modern times markets are very dynamic. This situation requires agile enterprises to have the ability to react fast on market influences. Thereby an enterprise' IT is especially affected, because new or changed business models have to be realized. However, enterprise architectures (EA) are complex structures consisting of many artifacts and relationships between them. Thus analyzing an EA becomes to a complex task for stakeholders. In addition, many stakeholders are involved in decision-making processes, because Enterprise Architecture Management (EAM) targets providing a holistic view of the enterprise. In this article we use concepts of Adaptive Case Management (ACM) to design a decision-making case consisting of a combination of different analysis techniques to support stakeholders in decision-making. We exemplify the case with a scenario of a fictive enterprise.

Keywords: Enterprise Architecture, Adaptive Case Management, Analysis

1   Motivation

In modern times markets are very dynamic. Enterprises have to be agile to be able to act fast on changing influences. In particular, their business models are highly volatile and have to be adapted. Changing business models may have several impacts on the enterprise architecture (EA) including business processes, business units, information systems, and IT infrastructure. These architectural elements have manifold relations to each other and form an EA to a highly complex structure. Enterprise Architecture Management (EAM) is a method to support stakeholders in the adaptation and transformation processes. Based on an up-to-date description of the current EA, analyses are performed to understand adaptation needs and implications.

In practice, stakeholders commonly use visualizations to analyze the EA. These visualizations, i.e. views on the EA, is usually created using EAM tools. However, as described in [Ma08] and [RZM14], these tool-created views are often report-like, i.e. static with respect to the displayed information. A more powerful support for EA analysis can be built on the paradigm of the visual analytics, as outlined by Keim et al.

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[1] Reutlingen University, Herman Hollerith Zentrum, Reutlingen, Germany, {dierk.jugel, christian.schweda, alfred.zimmermann}@reutlingen-university.de, stefan.kehrer@student.reutlingen-university.de
[2] Rostock University, Rostock, Germany, dierk.jugel@uni-rostock.de

[Ke08]. For visual analytics, algorithmic analyses performed by the tool are semi-automatically and interactively applied to the structure under consideration. For the field of EAM, this method can be regarded a novelty, as a recent survey on the state-of-the-art of visual EAM conducted by Roth et al. [RZM14] does not identify any related concept in today's EAM tools.

Buckl et al. [BMS09] classify EA analysis techniques described in literature. They identify three types of analysis techniques: (1) expert-based, (2) rule-based, and (3) indicator-based. They further indicate that expert-based analyses are central to the design processes in EAM and are complemented by techniques of the two other kinds, providing hints and indications. Buckl et al. discuss the downsides of expert-based analyses [BMS09] being time-consuming, error-prone, and dependent on the availability of expert knowledge at the organization's disposal.

Rule-based and indicator-based techniques are more formal in their nature and can be described as algorithms. Therefore, these techniques are automatable, repeatable and independent of individual experts. As described in [BMS09] such analyses can be implemented via pattern matching (rule-based) and via aggregation operations (indicator-based).

In this paper, we explore how expert-based, rule-based, and indicator-based analysis techniques can be integrated into a comprehensive process for EA analysis and explore how this process contributes to a collaborative decision-making process. We build this process, among others, on the groundwork provided by Jugel et al. [JSZ15] for collaboratively performing visual analytics. We integrate this groundwork with existing work on EA analysis, revisited in Section 2.1. Further, we explore techniques for collaborative decision-making (cf. Section 2.2) and reflect on the analysis and decision-making processes being knowledge-intensive processes (cf. Section 2.3). In Section 3, we present a process for EA analysis integrated into a process for collaborative decision-making in EAM. The process' underlying meta-model builds on the meta-model provided by Jugel et al. [JSZ15] and its mechanism for annotating EA models with additional information. We exemplify the approach in Section 4 by describing an application case. Section 5 concludes the article and gives an outlook in topics of future work.

2 Related Work

In this section, we revisit related work in the field of EA analysis techniques, collaborative decision-making, and adaptive case management. In Section 2.1 we start with presenting different analysis techniques. Afterwards we address collaborative decision-making in Section 2.2 and finish in Section 2.3 with related work in adaptive case management.

2.1 EA Analysis Techniques

Buckl et al. [BMS09] identify three types of EA analysis techniques, on which we will subsequently reflect. We start with expert-based techniques described in literature.

Jugel et al. describe in [JS14] an interactive cockpit approach to support stakeholders in EA planning. The authors identify several interactive functions that are useful in this field. Two interactive functions named "graphical highlighting" and "graphical filtering" are of interest. These functions enable stakeholder to annotate architecture elements that are of interest or not. The annotation mechanism described provides adding notes and grouping elements. In addition, visual variables can be assigned to highlight architecture elements, which are of interest or to filter elements, which are not of interest. These functions are part of expert-based analysis techniques, because stakeholders are doing the analysis by hand without formalization.

Whereas expert-based techniques are dependent on expert knowledge, rule-based techniques can be described as algorithms to support automated analysis execution [BMS09]. Hanschke provides a rule-based approach to EA analysis with the so-called analysis patterns presented in the appendix A of [Ha13]. These analysis patterns are described as practice-proven and generalized templates to find needs for action and potential improvements concerning the EA. Hanschke identifies five different categories: 1) redundancy, 2) inconsistency, 3) organizational need for action, 4) implementing business requirements and 5) technical need for action and potential improvements. Each analysis pattern is structured using a canonical form including the following characteristics: id, name, version, description, context, dependencies, result, and example. Each pattern provides a textual prescription on how to identify shortcomings and derive improvements in the architecture. This prescription gives guidance to an experienced enterprise architect, but is not translated to a formal, i.e. algorithmic, manner. Whereas these analysis patterns cannot be automated directly, Jugel et al. address this issue in [Ju15] and propose an automated analysis technique to increase the level of formalization. Thereby the authors use a generic annotating mechanism to enrich EA models with additional knowledge emerged in discussions and performed analyses during decision-making processes [Ju15].

Ramos et al. propose in [Ra14] a characterization of analysis functions including a specification of the algorithms. Therefore, the authors perform a rule-based analysis technique. The structure for each analysis function contains the following information: name, description, dimension, type, layer, entities and relations, structural attributes and algorithm. An algorithm describes the information extraction of the analysis function from the model. The analysis process itself is depicted as a cyclic procedure of querying and enriching the EA model until the result is achieved. The authors are currently working on a catalog of so called analysis functions. We consider their approach to be similar to the concept of Hanschke's analysis patterns with a stronger focus on implementation.

Indicator-based analysis techniques can be implemented via aggregation operations. Matthes et al. [Ma11] present quantitative, metrics-driven EA analyses by quantitatively assessing architectural properties and therefore use an indicator-based analysis technique. The proposed KPIs provide necessary measurement capabilities for EAM, needed to aid planning and controlling the EA. The EAM KPI Catalog contributes in presenting ten common EA management goals and 52 KPIs including the underlying EA model. Each KPI is described by the following characteristics: description, underlying EA model, goals, calculation, code, sources, organization-specific instantiation and the affected layers of the EA. The EAM KPI Catalog also provides a good basis for implementation purposes. Especially the calculation section describes the algorithm for calculation of each KPI concisely. While KPIs can be used to detect need-for-action, optimization potentials in the EA itself are not identified. As stated by Buckl et al. the results of indicator-based analysis techniques have to be interpreted carefully [BMS09]. An experienced enterprise architect would be needed to identify the elements of the EA causing the value of a KPI. However, the catalog only consists of KPIs that are defined in COBIT [IT07]. KPIs like the number of applications in operation or used technologies are not part of this catalog. Legner et al. mention such measurements [LL12]. The authors state the importance of suitable KPIs to monitor the EA and related activities. To implement KPIs they introduce a so-called "EAM cockpit" that is a multi-dimensional KPI system that covers three important dimensions: impacts in business terms, status of the current EA and EAM adoption in the organization. Each dimension includes several KPIs. For instance, the dimension "EA status" includes the KPI "Total instances" of particular types within an EA. In addition, the authors relate the dimensions with stakeholders, which are interested in. For instance, enterprise architects are interested in KPIs of the dimension "EA status". The presented KPI system is very useful to introduce an EA monitoring. However, in contrast to [Ma11] the authors do not describe calculations and the KPI's underlying metamodel to perform them.

2.2   Collaborative decision making

Making good decisions concerning the design and evolution of the EA is key to the field of EAM. Johnson et al. recommend in [JE07] a goal-driven approach for EAM. The authors especially address how to derive decision-relevant information from EA models. Johnson et al. discuss that architecture-related goals have to be operationalized to provide a foundation for the decision-making processes. Therefore, the authors propose a set of activities related to decision-making: (1) The decision maker must settle on a goal or success criterion, (2) Alternative designs have to be identified, (3) Effects of the alternative designs on the goals must be elicited, (4) The decision-maker needs to decide on what detail information to collect with respect to the different design alternatives, (5) Information needs to be collected, (6) Collected information has to be consolidated into an aggregated assessment, (7) Finally, the decision is taken.

These activities underline the need of a clear decision-making process to make good decisions concerning architectural efforts. Johnson et al. do not focus on how the EAM organization is structured [JE07]. Whereas these outlined activities can be aggravated by disruptive factors such as unclear goal definitions, a lack of expert knowledge or uncertain information in a hierarchical organization, these activities can be much more difficult in a collaborative EA environment. The authors stress the specific creation of viewpoints to support stakeholders in their decision-making tasks [JE07].

EAM uses models and visualizations of relevant information to support stakeholders in their collaborative tasks [Ma08]. The models are used in describing, documenting and sharing relevant knowledge needed for decisions in a collaborative EA environment. Many EA modeling approaches advocate collaborative modeling concepts and their advantages. Sandkuhl et al. propose a workshop approach for participatory modeling [Sa14]. The authors deem the involvement of stakeholders with the best knowledge needed to reach a particular workshop goal as valuable. Additionally, stakeholders' involvement increases the acceptance of created models [Sa14].

Hamm et al. combine the aforementioned approach of Johnson et al. [JE07] with collaborative modeling techniques to reach a model-based, goal-oriented decision-support for EA decision-making [HK15]. The authors utilize an enhanced version of the ArchiMate Motivation extension to cover goal-oriented information demands in collaborative EA environments [TOG12]. The presented approach focuses on strategic-alignment in collaborative EA decision-making processes and omits procedural aspects as EA analysis, which establishes an information base for EA decision-making [HK15].

Plataniotis et al. describe an approach focusing on ex-post modeling of EA decisions [PDP14]. The presented metamodel contains new concepts not covered by ArchiMate [TOG12]. The approach of Plataniotis et al. has some limitations: (1) the authors assume that a single stakeholder takes the decisions. In practice, many stakeholders are involved in decision-making. (2) The approach's intention is an ex-post documentation of decisions. This is not adequate particular in a collaborative EA environment. (3) An EA Decision is associated with exactly one layer of ArchiMate. This hinders the documentation of complex interdependencies within two or more EA layers. Whereas Plataniotis et al. contribute in presenting a metamodel for ex-post modeling EA decisions, collaborative and process-oriented aspects are left [PDP14]. We consider procedural information in complex decision-making as an integral part, especially in collaborative EA environments. This enables stakeholders to retrace and understand decision-making processes and resulting decisions.

Jugel et al. [JSZ15] enhanced the approach of Plataniotis et al. [PDP14] with collaborative aspects. Their decisional metamodel for collaborative EA engineering enables real-time modeling of information concerning EA decisions, and thereby a retraceable documentation of decision-making work. The presented metamodel contains only a few elements to fuel practicability through reduced modeling overhead [JSZ15].

Whereas stakeholder can document information for EA-decision-making during an expert-based analysis process (e.g. related viewpoints), procedural aspects of EA decision-making are not covered by the developed metamodel.

The upcoming standard Decision Model and Notation (DMN) of OMG [Om14b] discern three usage models: for modeling human decision-making, for modeling requirements for automated decision-making, and for implementing automated decision-making. DMN bridges the gap between business decision designs and their implementation by providing a common notation for decision models. The purpose of DMN is to facilitate a decision model framework, which is easily usable for decision diagrams and as a base for optionally automating decisions. Decision-making support is addressed from basically two perspectives: normal BPMN business Process Models can be expanded by defining specific decision tasks, or decision logic can be used to support individual decisions, e.g. business rules, decision tables, or executable analytic models. DMN can additionally provide a third perspective to bridge between business process models and decision logic by introducing the Decision Requirements Diagram. Complementary to the DMN notation, which is used to model decisional relationships and concepts like Decision, Input Data, Business Logic, Application, Application Risk, etc. DMN introduces an expression language to represent decision tables, decision rules, and function invocations. Today we are exploring the suitable usage and close link of DNM for decisional support logic within our architectural engineering and analytics research.

2.3   Adaptive Case Management in EAM

Adaptive Case Management (ACM) [Sw10] and [Sw13] offers a lightweight model to support knowledge-intensive processes, which are driven by user decision-making. Knowledge processes of usually high-skilled stakeholders, like enterprise architects, require process adaptations at run-time. ACM is not dictating a predefined course of action [HPM14] and provides the necessary information and knowledge support to be able to solve a case. A case [Sw13] is typically a collection of all relevant information into one place, which is handled by one or more knowledge workers during solving this case. The case is the jointly used focal point for assessing the situation, initiating activities and processes, implementing the work, and reflecting results based on a history record about what was really done. A case brings together all the necessary resources and also tracks everything that has happened into a record history, which can be mined to synthesize best practices, patterns of success, and used and extended instruments.

Fundamental aspects and requirements, which are relevant for ACM, are mentioned in [HPM14]:

1. The adaptation aspect of ACM consists of content, people, and reporting capabilities to be able to change the knowledge process at run-time by end-users. Additionally to the adaptation aspect a knowledge worker should be able

to continuously improve his case templates.

2. The organization aspect groups policies, processes, and data. In ACM data is the dominant factor as opposed to the process-oriented view from BPM. Knowledge work requires the integration of data [HPM14] into the execution process.

3. The case handling aspect is about collaboration, decision support, and integration of resources, events, and communication. Complex problems are typically solved collaboratively by involving individual stakeholders in respect of different necessary knowledge types and stakeholder concerns. Decision support requires transparency within a shared understanding of analyzed EA scenarios by named stakeholders.

Opposed to routine work, which can be supported by business process management because of its repeatable kind, knowledge work is typically unpredictable. Knowledge workers [Fi11], [Fi14] are acting under uncertainty. An unpredictable process [Sw13] does not repeat in routine patterns and emerges as the work is done. The practice of preparing for many possible courses is called agility.

Differentiating seven domains of predictability [Sw13] case management can be focused on two main types:

1. Product Case Management: Supports design-time knowledge processes with a well-known set of actions, having much variation between individual cases. It is not possible to set out a single fixed process. Knowledge workers are actively involved in deciding the course of events for a case.

2. Adaptive Case Management: Knowledge workers are involved not only in the case, and picking predefined actions, but they are constantly adapting the process and striving for innovative approaches, and may want to share and discuss process plans.

The Object Management Group (OMG) has published the Case Management Model and Notation (CMMN) [Om14a] as a first step to support modeling for case management scenarios. In [Ha14] was implemented a case study of a TOGAF-style process for EAM with CMMN.

3 Collaborative decision making

In this section we adapt our approach presented in [JSZ15] by supporting collaborative decision-making processes in more detail. Firstly, we present a collaborative decision-making case. Afterwards we adapt the collaborative decision-making metamodel of [JSZ15]. Decision-making processes are knowledge-intensive processes that strongly

depend on stakeholders, which participate on. Thus specifying a rigid structure, like the classical business process management does, for decision-making processes is impossible. For that purpose, we regard adaptive case management (ACM) to be more suitable. ACM focuses on cases instead of processes, which reflect decision-making activities. The Case Management Modeling Notation (CMMN) [Om14a] provides flexible processes, like "DiscretiaryItems" to reflect optional tasks. We use this notation to model a collaborative decision-making case to refine EAs. Figure 1 illustrates this case.
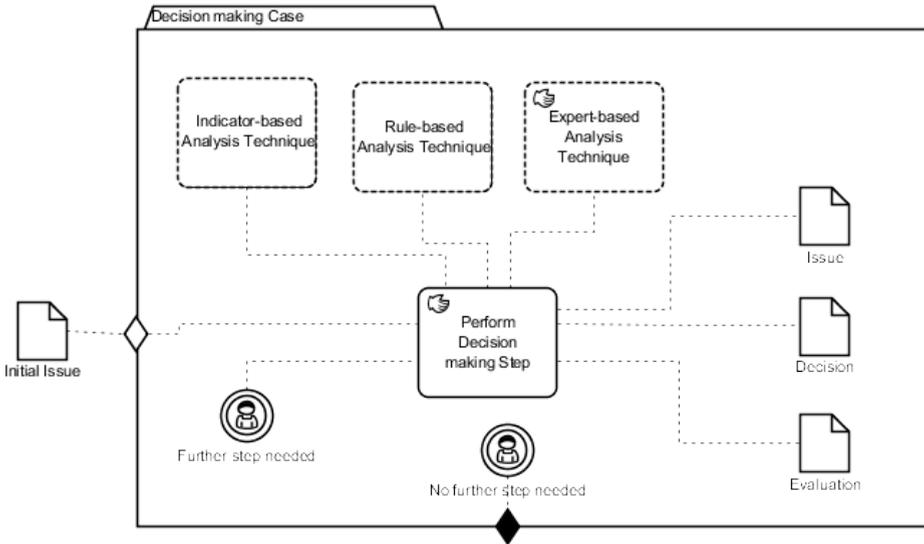

Fig. 1 CMMN model of collaborative decision making case

We regard an "issue" to be the starting point of a collaborative decision-making case. This issue describes the problem space of the decision-making activity, which aligns with the perspective of Mayring [Ma10]. We further assume that goals and success criterions, as required by Johnson et al. [JE07], have already been defined as part of strategic management activities. The issue is the reason why an EA has to be analyzed and a refinement thereof is probably needed. Based on this issue, involved stakeholders have to choose viewpoints they need to analyze the issue and quantitative as well as qualitative analysis techniques are applied to generate additional insights [Ma10]. The stakeholders perform a decision-making step that accounts for and interprets these additional insights [Ma10].

In the decision-making case, described in Figure 1, the central activity is the *decision-making step*. In this step, the stakeholders can employ different kinds of available analysis techniques – indicator-based, rule-based and expert-based – to obtain additional

insights. Analysis techniques that can be chosen are predefined and part of a catalog. The catalog is independent of a particular case. Each decision-making step is based on case data consisting of an EA model and additional insights elicited in previous steps. Consequently, the insights gained during each step contribute to the "case file" of the decision-making case. Values of KPIs, for example, that derive from existing information in the EA model are used to graphically highlight architecture elements performing poor with respect to the analyzed quality. The stakeholders use these highlights in their interpretation that concludes a particular decision-making step. The interpretation yields further items in the case data:

- An evaluation represents the stakeholder's opinion on the analysis results.

- A new issue refines the previously analyzed one based on the analysis.

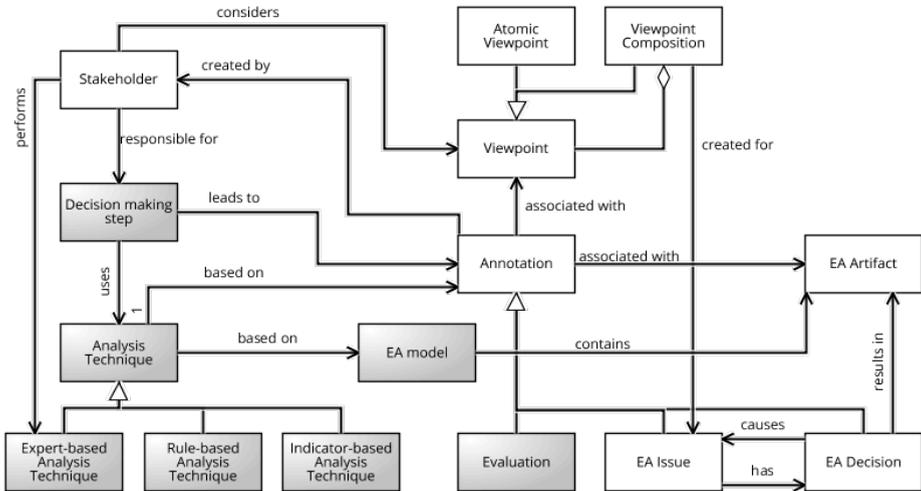- A decision reflects an actual design that is useful to resolve the issue.

Fig. 2 Collaborative EA Decision Making Metamodel

An activity described by Johnson et al. [JE07] is the identification of alternatives, which could be reflected in different decisions. In the final step of the decision-making process, not all previously evaluated designs will prevail. At the end of every decision-making step, the stakeholders have to choose, whether additional information is required or not – represented by to "UserEventListeners" in the CMMN diagram in Figure 1. The case file of the decision-making case has to be structured appropriately to accommodate for the described decision-making process. We propose a structure for the case file that builds on the collaborative decision metamodel presented in [JSZ15]. The metamodel focuses on the documentation of decision and rationalizing information. The extended metamodel from Figure 2 incorporates also the decision-making techniques to retain all

information needed to review a decision case after the fact. In this sense, the concepts presented in the metamodel can be regarded as definitions for case file items in the terminology of CMMN. Figure 2 illustrates the refined collaborative decision- making metamodel. Changed or added concepts of the metamodel described in [JSZ15] are visually highlighted.

The *Annotation* is the key concept of the metamodel and represents additional information gained during the decision-making case. In addition, *Annotations* are the triggers for the next *Decision Making Step*. One or more *Stakeholders* are responsible for a step and perform them. Within *Decision Making Step* stakeholders can choose between different analysis techniques to get additional information needed to satisfy their information demands. *Analysis Techniques* are based on *Annotations* as well on the *EA model*. The *EA model* consists of *EA Artifacts* of an EA, *Annotations* describe additional information related to *EA Artifacts*. In contrast to the metamodel described in [JSZ15], we adapt the refinements of *Annotation*. The metamodel of [JSZ15] distinguishes between *Detailed Information* and *Task*. While *Detailed Information* is defined as any additional information that is relevant for decision-making, a *Task* describes seeking needed information, which is not part of the *EA model*. We redefine the concept of *Detailed Information* by the concept of *Evaluation*. Thus, a *Decision-making step* encapsulates an *Analysis Technique* and the interpretation thereof by responsible stakeholders the gained information of a step conforms to an *Evaluation*. Consistent with the process from Figure 1, we omit the *Task* concept and interpret the task as an *Expert-based Analysis*. Such analysis describes all activities to analyze the model without resorting to predefined algorithms and rules. In particular, activities for collecting information that is not contained in the EA model are expert-based analyses. *Stakeholders* consider *Viewpoints* to satisfy their information demands. These viewpoints represent information from the EA model as well as additional information present in the form of annotations. The concepts of *EA Issue* and *EA Decision* are used in line with Plataniotis et al. [PDP14], but we discuss only the high-level relationships between these concepts.

4   Collaborative analysis & decision making scenario

In this section, we present a scenario of a fictional enterprise to exemplify the collaborative decision making case described in Section 3. We demonstrate the combination of different analysis techniques we described in Section 2.1 that form a decision making case.

The CIO of a large enterprise tells the enterprise architect John that the IT budget has to be reduced. In the first decision-making step John has the task to consider how cost saving potentials can be detected. Based on his experience John knows that information systems and technical components occasion much costs. Thus, John does not use any

formalization it is an expert-based analysis technique. Based on his finding that information systems and technical components occasion much costs, he involves Mark, the application responsible, and Joe, a technology expert. They meet at a cockpit, like [JS14] describes. The cockpit consists of several screens, which can be used to display coherent viewpoints simultaneously.

First, they choose viewpoints that fulfill their information demands to analyze the issue. They use different types of visualizations described by [Ha13], p. 87. They choose the following viewpoints:

- Information System Overview Viewpoint: This viewpoint gives an overview about information systems. For reasons of complexity, they decide only displaying the names of each information systems.

- Technical Component Overview Viewpoint: In analogous of the Information System Overview Viewpoint this viewpoint includes the name of each technical component

- Business Support Map: This viewpoint provides information about which information is used by which business for which business process.

- Technical Development Cluster: This viewpoint provides information about which technical component is used by which information system.

They start analyzing the information systems by using the "Information Systems Overview Viewpoint" and the KPI "Total instances of information systems" (c.f. [LL12], p. 187) to get an overview about the situation. A KPI corresponds to an indicator-based analysis technique defined by [BMS09]. The value of the KPI is at a normal level, so they decide to do nothing for now by documenting a corresponding decision. Afterwards the next *Decision making step* focuses on analyzing technical components. For this purpose, they focus on analyzing the "Technical Component Overview Viewpoint" by using the indicator "Total instances of technical components" (c.f. [LL12], p. 187) to get information about the total number of technical components. Joe evaluates the number as very high. Therefore, further information about technical components is needed. They create an issue named "Too many technical components". Joe suggests using the rule-based analysis technique "R-T-TB Redundancies in technical development" (c.f. appendix A of [Ha13], p. 76) to get redundant technical components, which are candidates to retire. The analysis technique identifies the following technical components as potentially redundant, because all of them are database management systems: TC1, TC2, TC3, TC4, TC5 and TC6. These candidates are highlighted in the "Technical Component Overview Viewpoint" and "Technical Development Cluster" with a red fill-color. Now the stakeholders can easily identify the candidates in different contexts of the viewpoints. They create an evaluation consisting of these six technical components to document the redundancy of database management systems.

To limit the number of candidates John suggests using the rule-based analysis technique "T-IS/T/B-TZ Technical State of Technical Components" (c.f. appendix A of [Ha13], p. 67) to get information about their state of health. In his opinion it is of advantage if they retire technical components, which have a bad state of health. The result of the analysis technique is shown by different fill-colors depending on their calculated state of health. To avoid an information overflow all technical components, which are not identified as redundant are hidden in the "Technical Component Overview Viewpoint". Result is that TC1, TC2 and TC3 have a bad state of health. They document this interpretation by creating a corresponding evaluation. Mark notes that they have to know how much license costs the candidates cause. Therefore, they use another indicator-based analysis technique "License costs" (c.f. [LL12], p. 187) to get information about the license costs. These costs are displayed as additional column in the "Technical Component Overview Viewpoint". It appears that the license costs of TC1, TC2 and TC4 are very high. Figure 3 illustrates the analysis results. They also document this evaluation.

Name...	License Costs
TC1	100.000
TC2	80.000
TC3	85.000
TC4	0
TC5	10.000
TC6	30.000

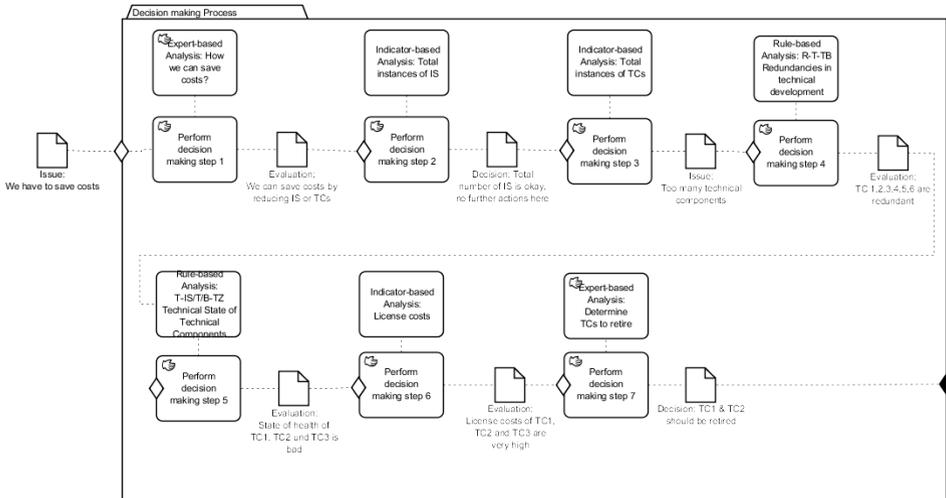Fig. 3 Technical Component Overview Viewpoint (bad state of health is highlighted)

Fig. 4 CMMN model illustrating the scenario

After getting this information the stakeholders feel equal to take an adequate decision. They put together all the information they have and discuss. Result of this discussion is a decision that TC1 and TC2 should be retired, because they have a bad state of health and also cause much license costs. A decision is created to document the design decision. The responsibilities of this decision correspond to the participated stakeholders. By using the description field, which is available for all annotation type, they are able to document the rational, too. Next, they have to analyze the impacts of the technical component candidates on information systems. Here we assume that their suggestion is realizable. Therefore, Joe, the technology expert, agrees, that the functionality of TC1 and TC2 can also be provided by the other technical components. Figure 4 illustrates the steps, used analysis techniques and the steps' result.

5   Conclusion

In this paper, we reflected on the basic structure of collaborative decision-making processes in EAM, interlinked the corresponding knowledge-intensive processes with the prevalent analysis techniques in the field [BMS09], and showed how the insights gained during decision-making can be documented using the annotation-based mechanism introduced in [JSZ15]. We applied adaptive case management to integrate the activity and the result-perspective and explained how annotations become part of the case file documenting a particular decision-making case. These annotations and their relationships to the analysis techniques, which they are based on, provide a reasonable rationalization of the decision making process.

Future works in this field can further the presented approach. In the presented setup, the stakeholders are required to decide on the used viewpoints as well as on the analysis techniques to be applied based on their expert knowledge. The experts have to consider existing EAM goals to choose the appropriate techniques, rules and KPIs. Further, issues regarding particular EA artefacts are likely to call for certain analysis techniques – again the selection of the technique has to be based on experts' knowledge and experience. As we expect that with the advent of new paradigms, like cloud computing and the Internet of Things, new analysis techniques will emerge as well, experts are constantly challenged to expand their knowledge. We would assume that stakeholder profiles and recommendations based thereon, like discussed by Govedarski et al. in [GHS15] can also be applied to analysis techniques to facilitate the selection of the appropriate technique given the current issue, stakeholder, and EAM goals.

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