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ABSTRACT

In this paper we explore goal-oriented requirements engineering (GORE) as a means to address stakeholder-related issues in the enterprise architecting process. We elaborate on a recent literature analysis on enterprise architecting issues. We refine this literature analysis results by identifying problem areas that we consider solvable by increasing the focus on the stakeholders in EA. We develop a conceptual model, which we use to provide reasoning about means to foster stakeholder orientation and thereby to address stakeholder-related issues. We argue that a stronger focus on the stakeholders' benefits EA and that this increased stakeholder orientation can be reached by leveraging intentional modeling used in software engineering.

Keywords

enterprise architecture, stakeholders, goal-oriented requirements engineering, GORE, intentional modeling, goal modeling.

1. INTRODUCTION

A recent literature review on critical issues of the enterprise architecting process indicates a number of problem areas [1]. One particular problem area that has been identified is concerned with the stakeholder topic. Stakeholder focus is a relatively new topic in EA literature. Until 2008 EA literature was rather focused on overview on EA, best practices, EA frameworks and enterprise modeling in general [2]. Recent publications show that the attention being paid to stakeholders in EA increases [3-10].

In this paper we elaborate on the results of the aforementioned literature review on issues in enterprise architecting [1] and argue that stakeholder orientation is crucial in EA since a significant number of problem areas in the EA process are related to stakeholders, stakeholders' goals and requirements. We develop a conceptual model to capture critical issues, the relations between critical issues and the role of stakeholder management. We argue that the goal-oriented approach [11-13] to requirements modeling applied in requirements engineering is a means to an increased stakeholder focus in EA and allows to address stakeholder-related issues in the EA process.

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This paper is structured as follows. Section 2 provides the theoretical foundations for this paper and section 3 describes the research method. In section 4, we describe the predominant focus areas of issues occurring during the EA process. Section 5 presents our conceptual model of stakeholder orientation and section 6 provides reasoning for our proposition that GORE is a means to address stakeholder-related EA issues. Section 7 concludes this paper with a brief discussion of our argumentation.

2. THEORY

2.1 Stakeholders in Enterprise Architecture

Stakeholder theory is a concept originating from strategic management addressed in disciplines like business ethics [14], project management [15] and also information systems [16]. An important proposition of stakeholder theory is, that financial benefit of its shareholders should not be the only obligation of a company. Stakeholder theory recognizes, that organizations are as well dependent on a number of constituency groups and have moral and ethical obligations over these groups [14, 17]. These constituencies are referred to as stakeholders. Mitchell et al. present a chronology of the stakeholder term [18]. According to this chronology, the term can be traced back to 1963 where it appeared in a Stanford memo describing it as "those groups without whose support the organization would cease to exist" [18]. In Freeman's seminal publication a stakeholder is defined as "any group or individual who can affect or is affected by the achievement of the organization's objectives" [19].

The stakeholder notion is also discussed in information systems and more specifically in enterprise architecture literature (cf. [3-5, 7, 9, 10, 20]). ISO/IEC 42010 defines the stakeholder of a system as "individual, team, organization, or classes thereof, having concerns with respect to a system" [3]. "EA stakeholders are individual or grouped representatives of the organization who are affected by EA products, either by providing input to EA decision making or having to conform to the EA products" [8]. Closely connected to the notion of EA stakeholders is the recognition of their concerns [3, 21] as well as the selection of viewpoints, framing their concerns [3, 7, 9, 10]. A viewpoint is defined as a "work product establishing the conventions for the construction, interpretation and use of architecture views and associated architecture models" [3] and a concern marks an "area of interest in a system pertaining to developmental, technological, business, operational, organizational, political, regulatory, social, or other influences important to one or more of its stakeholders" [3].

Stakeholder Management in EA comprises stakeholder identification, stakeholder classification, communication of architectural information and tailoring of architectural work products [7]. Stakeholder Management is concerned with managing the relationships between various stakeholders and their concerns [8]. These management activities are supposed to take care of stakeholders impacted by an EA effort as well as these sponsoring an EA effort [8]. Thus, an EA stakeholder is not only an individual or group that is affected by EA (cf. [8]), but also something or someone that can affect an EA effort. This bi-directional relationship conforms to the aforementioned stakeholder definition of Freeman [19].

2.2 The enterprise architecting process

The ISO/IEC 42010 standard defines architecture as "fundamental conception of a system in its environment embodied in elements, their relationships to each other and to the environment, and principles guiding system design and evolution" [3]. This definition generally refers to a system's architecture. More specifically, "enterprise architecture" may be defined as "a coherent whole of principles, methods and models that are used in the design and realization of an enterprise's organizational structure, business processes, information systems, and infrastructure" [22]. An enterprise in this context is any kind of organization or part thereof (e.g., a company or an agency) [23].

In the ISO/IEC 42010 standard, architecting is defined as a "set of interrelated activities of conceiving, defining, describing, documenting, maintaining, improving, and certifying proper implementation of, an architecture throughout a system's lifecycle"[3]. Armour and colleagues describe enterprise architecting as "the process of developing enterprise Information Technology architecture – both its description and its implementation" [24]. Op't Land et al. provide a similar description: "Enterprise architecting is a continuous process involving the creation, modification, enforcement, application, and dissemination of different results. This process should be in sync with developments in the environment of the enterprise as well as developments internal to the enterprise, including both its strategy and its operational processes" [20].

Careful consideration of EA stakeholders and their needs is of critical importance to the success of any EA endeavor [4, 7, 9, 10]. Different analyses highlight challenges occurring during the enterprise architecting process [1, 25, 26]. A recent literature review [1] identifies critical issues, related to stakeholders. Requirements Engineering is a means to understand stakeholders and their needs [27, 28]. The importance of requirements engineering for EA is acknowledged in a number of publications [7, 29] and management of requirements is a central aspect in the Open Group Architecture Framework (TOGAF) architecture development method (ADM) [7], which is a widely adopted process model for enterprise architecting. Lankhorst et al. present a model (cf. Figure 1) that points out the relationship between requirements and architecture models [29], indicating the importance of understanding architecture requirements for the architecting process.

According to them, "the first step is to analyze the problem and elicit goals and requirements that address the problem". A requirements model represents these goals and requirements. Should the baseline enterprise architecture not sufficiently fulfill these requirements, a to-be architecture model has to be conceived in a second step, which defines a composition of products, services, processes and applications fulfilling the defined requirements. "Both steps can again be repeated for (the problem of) realizing the elements of the architecture" [29].

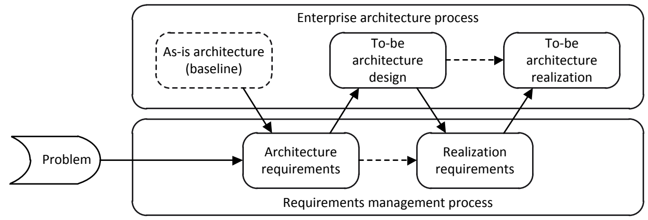

Figure 1: Relation between requirements and architecture models (cf. [29])

Figure 1 visualizes that requirements engineering and the enterprise architecting process are tightly coupled and requirements models play an important role in the architecture design and realization.

2.3 Requirements Engineering and EA

"Requirements engineering is the branch of software engineering concerned with the real-world goals for, functions of, and constraints on software systems. It is also concerned with the relationship of these factors to precise specifications of software behavior, and to their evolution over time and across software families" [30]. The critical importance of requirements engineering (RE) in software engineering is reflected by the statement of Brooks, who writes: "No other part of the work so cripples the resulting system if done wrong" [31]. RE tasks are requirements elicitation, modeling, analysis, validation & verification and requirements management [27, 28]. More specific areas of research focus on requirements technologies (i.e. notations, methodologies and techniques) to accomplish these tasks (cf. [27]).

Stakeholders are of critical importance in RE as they are the main source of requirements [32, 33]. RE aims to find solutions for stakeholder problems. Requirements elicitation and modeling offers two approaches to describe a solution – a problem-oriented or a solution-oriented view [30, 34]. Problem-oriented RE has its origin in systems engineering, emphasizing the analysis of a problem domain whereas solution-oriented RE represents a classic software engineering view on RE [35]. The problem- and the solution-oriented view are also referred to as early and late RE phases in [36]. A common solution-oriented approach is object-oriented analysis (OOA) [37]. OOA models typically utilize the Unified Modeling Language (UML) to create object models, behavioral models or domain descriptions (cf. [27]). A popular problem-oriented RE approach is goal-oriented requirements engineering (GORE) [11-13]. "Goals capture, at different levels of abstraction, the various objectives the system under consideration should achieve. Goal-oriented requirements engineering is concerned with the use of goals for eliciting, elaborating, structuring, specifying, analyzing, negotiating, documenting, and modifying requirements" [12]. Like problems, goals are closely related to stakeholders. The main GORE approaches are the NFR framework [38], i*[36], KAOS [39] and the Goal-based Requirements Analysis Method (GBRAM) [11, 40].

We argue that goal-oriented modeling is a promising approach to a better understanding and documentation of the motivation for EA undertakings (i.e., the WHY or intentions behind an EA effort). It can be a means to provide a sound reasoning and justification for EA endeavors. Efficient collaboration between architects and EA stakeholders is seen as one of the main critical success factors for EA [1] and we consider GORE approaches as aid in this respect.

The remainder of this paper explores the impact and importance of goal-oriented requirements modeling on the enterprise architecting process and how increased attention to stakeholder goals and requirements can help to address stakeholder-related problem areas that are predominant in enterprise architecting.

3. RESEARCH METHOD

We develop a model to capture predominant and stakeholder-related enterprise architecting problem areas and relations between them. This model is subject to and aid of our argumentative reasoning on the support of goal-oriented requirements modeling to address the depicted EA issues.

We elaborate on the results of a recently conducted literature review on critical issues in Enterprise Architecting [1]. The research method is a database-driven literature review [41, 42] using the AIS Electronic Library (AISel) and IEEE Xplore. The search was conducted on November 17th, 2009 and double-checked on December 8th, 2009. The two literature databases were chosen as they provide access to a noteworthy number of publications with a high rating in the ranking lists (German IS lists for conference proceedings and journals 2008) published by the IS chapter of the "Gesellschaft für Informatik" [43] – see Table 1 for an aperture. Both databases provide access to journals and conference proceedings. Thus, publications with presumably higher quality (i.e., journal publications according to [42]) as well as content that is more likely up-to-date (i.e., conference proceedings) are covered. Furthermore, AISel and IEEE Xplore provide a good coverage of both scholarly and practice-oriented publications with AISel's focus mainly in scholarly publications and the IEEE Xplore contents being more focused on practice.

Table 1: Journals and conference proceedings accessed by AISel and IEEE Xplore

AISel	IEEE Xplore
Journals	
Information Systems Journal	IEEE Software
Journal of the Association of Information Systems	IEEE Transactions journals
MIS Quarterly	IEEE Computer
Communications of the AIS	IEEE Intelligent Systems
MIS Quarterly Executive	IEEE Internet Computing
	IEEE Pervasive Computing
Conference proceedings	
European Conference on Information Systems	EDOC Conference
Int'l Conference on Information Systems	Hawaii Int'l Conference on System Sciences
Americas Conference on Information Systems	IEEE Conference on E-Commerce Technology
Pacific Asia Conference on Information Systems	IEEE Conference on Enterprise Computing, E-Commerce and E-Services
	IEEE Int'l Conference on Data Mining
	IEEE Security and Privacy

The search term "enterprise architecting" is used, since we consider it a well-accepted term in the EA community (cf. section 2.2). A full text search was conducted for peer-reviewed contents in AISel and a search without any other filters limiting the search request in IEEE Xplore. The AISel search yielded 40 publications dated from 1996 to 2009, with 18 articles dated from 2005 or earlier. The IEEE Xplore search yielded a number of 46 publications dated from 1999 to 2009, with 43 articles dated from 2005 or earlier. The database search yielded a total of 86 publications. 13+2 articles contained just a table of contents (TOC) of proceedings or were duplicate papers – these were not reviewed. The remaining 71 articles were read, identifying 27 referring to EA issues and 44 dealing with other topics. A content analysis approach analogous to grounded theory literature [44] was used.

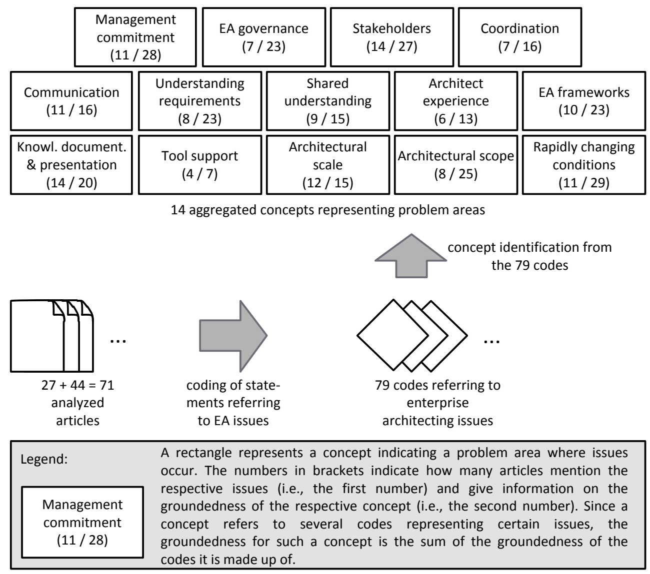

Figure 2: Content analysis approach

Our content analysis approach is depicted in Figure 2. In comparison to [1] the content analysis was completely repeated, utilizing the qualitative data analysis tool Atlas.TI [45] instead of spreadsheets for the detailed analysis of the 27 articles describing enterprise architecting issues. Statements indicating EA issues (i.e., describing an obstacle or gap between a current unsatisfying and a desired more satisfying situation) are identified using open coding in a bottom-up comparative process. Identified issues were considered relevant and assigned one or more codes, when they could clearly be related to a step of the enterprise architecting process. The widely accepted TOGAF ADM [7] was used as reference model for the architecting process. Thus, an issue was considered an architecting issue, when being relatable to a step in the TOGAF ADM. Similar collections of codes were grouped by inductive reasoning to identify underlying concepts. Numbers in brackets behind concept names (cf. Figure 2) denote the number of articles (i.e., literature references) referring to the codes making up a concept and the groundedness (cf. [44]) belonging to the respective concept. The detailed coding and concept identification was conducted by two researchers and discussed with fellow practitioners to reach better intersubjectivity and to agree upon reasonable concepts and categories. The use of the aforementioned qualitative data analysis tool for content analysis instead of spreadsheets and the formulation of concise definitions for these concepts resulted in a refined categorization model compared to [1]. Section 4 will present definitions for the 14 aggregated concepts. Since the 14 problem areas were developed by inductive reasoning, the definitions are developed from coded quotations rather than a theoretical body of knowledge.

We develop a model that depicts those EA problem areas (i.e., concepts) we consider closely related to a weak stakeholder orientation in EA. The relationships between problem areas depicted in our model are explained by causal connections that were identified during the content analysis of reviewed articles. We use this model as an aid for our argumentative reasoning on the expected positive effects of the adoption of goal-oriented requirements modeling in EA. Understandably; this reasoning might to a certain degree be based on the discretion of the authors of the paper at hand.

4. CRITICAL ISSUES IN ENTERPRISE ARCHITECTING

In this section we describe the 14 concepts derived from coded quotations in literature analysis. Each of these concepts represents a focus area of issues occurring during the enterprise architecting process. We use the terms concept and problem area synonymously. Note that these concepts are not in all cases disjunctive or on the same level of abstraction. E.g., *Architect experience* (cf. section 4.8) might for instance be seen as a subset of the *Stakeholders* problem area (cf. section 4.3) because the enterprise architect is an EA stakeholder. The subsequent subsections will provide inductively derived definitions and brief examples of the 14 concepts. More detailed examples and further references can be found in [1].

4.1 Management commitment

This concept is defined as the lack of support for an EA effort from management representatives who are in charge of monetary and organizational resources. Findings are made in two main areas: (1) dimensions and shapes of such insufficiency and (2) influencing factors leading to insufficient management support.

Examples: Lack of meaningful metrics [25] makes it hard to provide justification for EA efforts to management representatives and to develop meaningful value propositions [25, 46, 47]. This is a weakness because return on investment is often expected within a too short amount of time [25, 46-48]. Precipitate expectations for return on investment also seems to result from misunderstanding EA as a project instead of a process [48]. "The reality is that architectural thinking is needed continuously in enterprises because enterprises are 'living things' and in SoS enterprises this need is even greater" [49]. Armour et al. describe that they have seen EA efforts succeed or fail on the basis of this issue (i.e., lack of senior management commitment). "Architecture building often crosses organizational boundaries. The team must be able to capture the information they need. In a large, distributed enterprise, this is a tall order. Your team will need cooperation on many levels, which means they need a strong champion. If the enterprise's senior management doesn't support the effort, don't start it" [48].

4.2 EA governance

This concept stands for lack of authoritative steering, control and process operationalization of EA endeavors. The problem is twofold. Core aspects are the lack of a clearly defined EA process with uncertain goals and the less than optimal organizational structures enforcing EA governance rules.

Examples: Lam [46] describes a lack of governance structures in many EA projects. This is caused by insufficiently defined roles, responsibilities, processes and procedures. There is a need for EA governance "because architectural decisions must be made, coordinated and overseen on several interrelated levels" [50]. Often there exists no common agreement on principles or guidelines for the EA development process [51-54] and although EA frameworks try to address this issue the EA approach is often not rigid enough. Another reason why EA projects sometimes fail is because they do not focus on the right objectives [46, 55] – "one has to first define the key objectives and this would require the inputs of the top management for both, IT and business" [55].

4.3 Stakeholders

The "Stakeholders" concept focuses on the fact that in enterprise architecting there are a plethora of stakeholders that affect or are affected by EA. Dimensions of this problem are identification and classification of stakeholders, management of relevant perspectives suitable to stakeholder needs, a distributed decision making process and connected to this, involvement of relevant stakeholders.

Examples: The plethora of stakeholders is an issue mentioned by several authors [49, 56, 57]. It leads to a number of related challenges like incomplete stakeholder involvement or buy-in [46, 48-50, 54, 55]. Missing relevant stakeholders may lead to the undermining of stakeholder consensus [48]. The large number of stakeholders results in different or even conflicting stakeholder needs and perspectives [4, 25, 46, 47, 53, 55]. A further stakeholder-related issues is distributed decision making [58]. Decision-makers may make local design decisions where they should have incorporated other stakeholders [25, 54, 58, 59].

4.4 Coordination

The concept of "Coordination" describes the challenge of coordinating all parties involved in an EA endeavor, which are highly interdependent due to the multi-layered and multi-faceted nature of EA (cf. for example the rows and columns in the Zachman framework [60]). According to our findings, coordination is needed between people, projects and IT systems. Request for coordination is raised between activities, decisions and roles of people as well as budgets, decisions, priorities and schedules of projects or IT systems in a company or organization. Mediating variables in terms of intensity of coordination issues are time and geographical separation.

Examples: Since enterprise architecting often involves multiple organizational units or even whole branches of an organization, coordination is a major issue [50, 55, 59, 61]. Coordination is directly influenced by two important boundaries: (a) geographic distance and separation and (b) time separation [51, 55, 57, 61]. "[…] systems management is essential in creating timelines for developing component systems and synchronizing them in order to ensure interoperability in a timely manner […] challenge is to balance schedules, while also considering appropriate development lifecycles, risks, configurations, and budgetary issues" [59].

4.5 Communication

The "Communication" concept is concerned with the exchange of information between the different stakeholders in an EA undertaking and the fact of ineffective or mismatched communication. The establishment of effective communication mechanisms is a central aspect of this problem area.

Example: In EA diverse groups of interest have to avoid mismatched communication in collaboration [46, 50, 54, 55, 62]. "Although each group depends on each other, their levels of specialization have led to group specific languages that thwart effective communication" [58]. "In one large organization […] different groups were running the EITA development effort […], and the groups did not talk to each other. This is one way to guarantee that the target architecture will be out of sync with any new business requirements from the start" [48].

4.6 Understanding requirements

This concept describes the problem of an insufficient understanding of a business's requirements. Important aspects are disregard of the EA vision and business requirements being ignored or misunderstood because of insufficient domain knowledge at the side of the EA team creating architectural descriptions.

Example: Builders and users of architectural descriptions are frequently not the same people. "This division complicates the process of understanding what the application requirements are" [58]. In a similar way, disregard of the EA vision and objectives is an issue, because "you may develop a great architecture for the wrong business" [51]. Further issues described in literature are a lacking understanding of business requirements [46, 51, 62] and ignoring the business requirements [48, 50, 51, 62, 63].

4.7 Shared understanding

"Shared understanding" is a concept which indicates that different stakeholders perform actions and make decisions at a differing level of awareness of the interrelationships of architectural elements. These stakeholders act with a cleft awareness of EA goals, visions and requirements. Often they also share no common vocabulary and have no perception of the implications of their actions.

Example: Literature shows that the EA process suffers from the lack of a shared vision [46, 48] and a shared/common vocabulary [48, 51, 64]. A related issue is the lack of a distributed cognition [25, 49, 50, 58]. "Individual project managers may understand the impact of such changes on local platforms, but often do not understand the impact of changes on other platforms" [25]. Dreyfus refers to this as "local optimization with global ramifications", where these global ramifications are badly understood. Thus, decision-makers in the EA process often operate with imperfect knowledge and understanding [50, 58, 59].

4.8 Architect experience

This concept describes a lack of experienced architects. Enterprise architects are either insufficiently educated or inexperienced – skilled and experienced architects are considered a scarce resource. The complexity and steep learning curve of EA (e.g., EA frameworks) acts as a mediating factor.

Example: A serious issue is the lack of experienced enterprise architects [46, 50, 51] – "competent architects are on high demand" [50]. The field of EA is very complex [46, 51, 58] and so are the EA frameworks that are adopted [65]. Thus, the learning curve in the EA context is very steep – a "critical problem for EA implementation is the short timeframe for learning and getting acquainted with the frameworks and governance model" [50]. Skilled architects are an insufficient resource [48].

4.9 EA frameworks

The "EA frameworks" concept is defined as the challenge of selection, utilization and applicability of enterprise architecture frameworks (EAF).

Example: "The efforts to characterize enterprises in general has led to a plethora of enterprise architecture frameworks" [49], which complicates the selection of an appropriate framework [51, 66]. Furthermore, several shortcomings of EAF are identified. EAF are often overly complex [49, 50] and provide no sufficiently described process for generating the postulated products [51, 67, 68]. Moreover stakeholder-related and a number of other concerns in EAF are bemoaned to be too abstract [4]. EAF are often not capable of taking organizational concerns adequately into account [4, 50, 54, 68, 69]. Literature also shows that there is a disagreement on essential EA layers and segments [49, 51, 54, 56]. EAF adaptability is another key challenge "to make sure the framework guides overall architectural design but is still broad enough to withstand all the modifications from different groups within the enterprise who will need more specific support" [51].

4.10 Knowledge documentation & presentation

This problem area is concerned with the capture, interpretation, representation, prioritization and presentation of architectural information and knowledge. An important part of representation is the question about which notations and modeling techniques should be adopted. Presentation is to the main extent concerned with the communication of architectural knowledge, typically from the architectural team towards users of EA.

Example: A serious knowledge management related EA issue is poor documentation [46]. Architecture rationale is often poorly documented, making it difficult to track "what decisions were made and why" [48]. "There is no single repository (human or otherwise) containing knowledge of the purpose, functionality, or implementation detail of all the applications and their interdependencies [58]". Documenting and retrieving architectural knowledge is far from ideal conditions [46, 48, 54, 57, 70, 71]. The absence of commonly understandable representations, which facilitate cross-group discussions, limits the ability to achieve a well-aligned and agreed architecture [56, 58].

4.11 Tool support

The concept of "tool support" describes issues in the offering of EA tools. This is a twofold problem. First, tool features are described as insufficient in meeting the requirements of practitioners. Second, the standardization of the tool landscape is considered inadequate, leading to ambiguity in documentation of EA information.

Example: A general issue described in literature is unsatisfying tool support [25, 54, 57, 70]. "There is minimum tool support to track and maintain this diverse collection of entities" like strategic goals & objectives on different hierarchy levels, stakeholders, business process descriptions, applications, data and so on [25]. Additionally, the multitude of available tools is described as an issue. "People use different tools to produce different models, resulting in an ambiguous documentation of the architecture" [54].

4.12 Architectural scale

"Architectural scale" is comprised of two aspects which cause a major problem of integration. The first aspect which defines the problem area of "Architectural scale" is the typically large scale of the organization to be modeled, often having an application landscape of hundreds to thousands of applications. The second aspect is that a system of interest is modeled from a number of different perspectives which are highly interdependent and thus need to be integrated to allow for a traceability of elements from one perspective to another.

Example: Often the immense complexity of EA endeavors is underestimated [46, 47, 49, 53, 56-59, 62, 70] as it "applies to very large-scale, complex open systems which are technologically enabled and have extensive social implications" [49]. The large number of applications in today's organizations [58, 72] and the dependencies that exist between the different layers and segments described in architectural descriptions [25, 54-56] are resulting in the challenge to maintain inter-view consistency [51, 73] and traceability [51, 54, 74].

4.13 Architectural scope

The concept of "Architectural scope" is centered on the challenge to determine what is in and what is out of EA (i.e., the determination of architectural boundaries). This concept is comprised of two challenges. First, the commitment on activities to be undertaken and second, the determination of a suitable information model (i.e., what information needs to be captured and modeled).

Example: The scope of architectural descriptions (ADs) has to be defined in breadth and depth [25, 47, 49, 56, 59, 70]. Insufficient scoping efforts can lead to overscoping [47, 48, 51] and/or overmodeling [48, 49, 56]. Overscoping means to choose a too broad scope – "when architects are at high levels, they see more things – and everything they see they model" [48]. Overmodeling refers to the "overuse of detail" [48] in architectural descriptions. Not knowing the scope of the architecting effort may lead to "analysis paralysis" – the architect gets "caught in a never-ending series of analyses" [48]. A related issue is the scheduling of architectural activities. "The team's morale suffers if you don't show results early on. Set schedules such that deliverables arrive within weeks, not months" [51].

4.14 Rapidly changing conditions

This problem area is best described as engineering under uncertainty due to changing conditions. Changes might be triggered either reactively or providently. These changes occur predominantly in the IT landscape caused by different lifecycle phases of systems or applications. The other main source of uncertainty is changing stakeholder objectives and needs. It is a problem of keeping track with operational changes.

Example: Rapidly changing conditions in technology and business are an important issue in EA [51, 54]. "It's impossible to specify an enterprise-wide architecture in a single effort. Technology and business conditions change so rapidly that the architecture would be out of date before it's complete" [51]. Architects have to deal with dynamics and constraints that are caused by different (and shortened) lifecycle phases of systems and applications [25, 46, 47, 58, 59, 70]. There is "a tension between the continuing operations and the introduction of enhanced or new systems" [25].

5. A MODEL OF STAKEHOLDER ORIENTATION IN EA

The previous sections define and describe the critical issues of enterprise architecting. We consider 5 of these 14 issues to be caused to a large extent by weak stakeholder orientation in EA:

- Stakeholders;
- Understanding requirements;
- Architectural scope;
- Knowledge documentation & presentation;
- Communication.

The conceptual model in Figure 3 depicts these problem areas and the relationships between them.

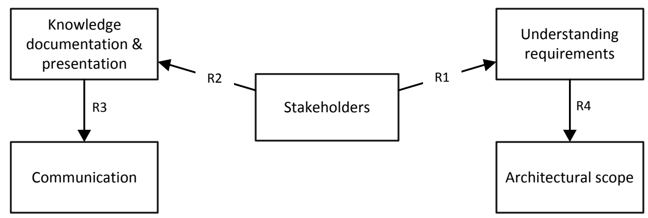

Figure 3: Conceptual model of stakeholder orientation in EA

Subsequently we explain the model. The *Stakeholders* problem area is caused by the plethora of stakeholders relevant in EA endeavors and therefore inherently stakeholder-related. Special dimensions of this problem are stakeholder identification, classification and perspectives suitable to certain stakeholders. According to our findings, the *Stakeholders* problem area is related to two other problem areas: *Understanding requirements* and *Knowledge documentation & presentation*. The problem area of *Understanding requirements* mainly deals with an insufficient understanding of business requirements. Considering EA as a means to Business/IT alignment, business and IT are two very important stakeholder groups involved in the EA process. The large amount of stakeholders involved in EA undertakings, makes it very hard to collect, understand and find a compromise between conflicting requirements (cf. [50, 58, 64]). The problem area of *Understanding requirements* is therefore aggravated by the Stakeholders problem area, which is indicated by relation *R1* (cf. Figure 3).

Knowledge documentation & presentation as a problem area describes issues in capturing and communicating architectural information. Thus, information is captured from information providers and presented and communicated to information users – both being stakeholders involved in the EA process. Since, stakeholders have different, sometimes conflicting needs and perspectives [4, 25, 54], the more stakeholders are involved the more perspectives need to be considered. A stakeholder can have multiple roles connected to different needs, which adds to the problem of the many perspectives [4]. Thus, the *Stakeholders* problem area complicates *Knowledge documentation & presentation* because important stakeholders are easily missed and left unconsidered (cf. relation *R2*).

The *Communication* problem area is to a large extent concerned with ineffective information exchange and communication between stakeholders in the EA process. Mismatched communication among stakeholders, and the lack of tools and artifacts that can enable improved communication is seen as an important issue [46]. The absence of notations and representations that facilitate cross-group discussions [54, 56, 58, 66, 71] and allow for a stakeholder- and role-specific communication of architectural aspects [56, 59, 71] are seen as an important reason for existing communication issues. Therefore, *Knowledge documentation & presentation* is one reason for *Communication* problems (cf. relation *R3*).

The problem area *Architectural scope* describes difficulties in the proper determination of architectural boundaries. One of the main problems of defining architectural scope is the decision what information is inside and what is outside of an EA effort [56]. This information is typically defined in an information model. A comprehensive understanding of the requirements of an EA effort is seen as important influence factor for successful scoping [51, 59]. Capturing unnecessary information is cost-intensive and may lead to information overload. Therefore only required information should be captured. Thus, *Architectural scope* is influenced by *Understanding requirements* (cf. relation *R4*). Unclear requirements lead to difficulties in scoping of an EA effort.

Summarizing, stakeholder management issues in EA comprise – according to our literature analysis – keeping track of the stakeholders, understanding their requirements, knowledge documentation and presentation, communication and architectural scoping.

6. ADDRESSING STAKEHOLDER ORIENTATION IN EA

In software engineering, goal-orientation is an established way of understanding stakeholders and their objectives in early phases of a project. In the following subsections we explore how goal-orientation is currently implemented in the EA process and how it can help to overcome stakeholder-related problem areas elaborated in section 5.

6.1 Stakeholder orientation in EA

Requirements engineering literature identifies early- and late-phase requirements engineering [27, 28, 30]. Early-phase requirements engineering (i.e., requirements elicitation) comprises activities enabling the understanding of goals, objectives and motives for building a system [27]. Different models are used during elicitation phase (e.g., use-cases, scenarios, goal models) to facilitate early feedback from stakeholders [27]. In late-phase requirements engineering (i.e., requirements modeling) a project specification is expressed in one or more models which compared to requirements elicitation tend to be more precise and unambiguous [27]. Common notations are object models, behavioral models or domain descriptions. Current EA frame–works mainly deal with "structure, function, and behavior, neglecting the intentional dimension of motivations, rationales, and goals" [75]. Their focus is on late-phase requirements engineering.

The ISO/IEC 42010 standard [3] provides a conceptual model for architectural description which many current EA frameworks use as an orientation (e.g., [7, 76, 77]). Architecture rationale is an element in this conceptual model and is defined as "the reasoning about the architecture decisions made" [3]. "The rationale for a decision can include the basis for a decision, the alternatives and trade-offs that were considered, the potential impact of the decision including its pros and cons on other decisions, and citations to further sources of information" [3]. Yu et al. argue that generally architectural descriptions predominantly identify non-intentional elements [75]. Architecture rationale, if provided, therefore typically relates to these non-intentional elements. The documentation of WHY knowledge (i.e., the intentions and motivations behind an EA endeavor) is poorly supported by current EA frameworks [35, 75]. Therefore, this knowledge is typically "embedded in documents, meeting minutes, or held in the minds of individuals involved. Intentional knowledge is therefore often implicit, hard to get at, not systematically managed, and easily lost." [75]. Goal-oriented requirements models can add to the architecture rationale by providing information on the motivation WHY an architectural description is created in the first place [75] and help to better understand a given problem.

So far, early-phase requirements engineering or more specifically goal-oriented requirements engineering has not been widely adopted by current EA frameworks and practitioners on a broad basis. However, a few publications exist, which indicate that goal-orientation can provide important benefits for EA [35, 75]. Yu et al. assess the potentials of the Business Motivation Model (BMM) [78] and i* [36, 79] intentional modeling languages in the context of EA. They identify three main strengths of integrating intentional modeling (IM) with EA: (1) IM can introduce rationality to the EA construction process and justify decision making; (2) IM can provide traceability between high-level business objectives and low-level EA elements; (3) IM stimulates explicit, structured thinking about business transformation and the underlying drivers [75]. The ARMOR language [35] is another recently presented approach which represents an adoption of some traditional GORE approaches to the field of EA, allowing the modeling of goals and requirements in EA. "The ARMOR language is based on existing requirements modeling languages and is aligned with the standard enterprise modeling language ArchiMate" [35]. It supports the goal concept and further concepts like goal refinement, goal conflicts or assumptions (i.e., a refinement of some goal being based on certain assumptions). Applications of ARMOR are the traceability of stakeholder concerns; evaluation of alternative architectures; or the detection of conflicting interests and solutions.

6.2 Goal-oriented requirements modeling to address stakeholder-related EA issues

We see an increased stakeholder orientation as a way to address the stakeholder-related problem areas (cf. section 5). Goal-oriented modeling approaches allow to capture functional as well as non-functional requirements [38] by providing descriptions of stakeholders and their goals. A goal under responsibility of a stakeholder becomes a requirement [12].

The i* notation [36, 79] offers a so-called Strategic Dependency (SD) model, which describes the dependencies among stakeholders (i.e., actors in the i* context) in a given context and provides information on the type of relationship between these stakeholders (e.g., a dependency or a task relationship). Dependencies may involve goals for example and provide criteria for its fulfillment. Thus, i* emphasizes the WHY that underlies a system's requirements [35]. Goal-oriented modeling helps to (a) depict who the stakeholders are, (b) understand the relationships between stakeholders, (c) depict what functional and non-functional requirements exist and (d) understand which stakeholders have those requirements. Therefore we deem these goal-oriented approaches as a possible means to address the problem areas of *Stakeholders* and *Understanding requirements*.

Typically, a goal-oriented modeling approach comprises a specific notation and provides one or more different model types to capture information about requirements ([11, 36, 38-40]). Thus, these approaches add to the problem space of *Knowledge documentation & presentation* by providing models, which offer help to foster communication about stakeholders and their goals.

Note that some of these notations are formal and it might be difficult especially for business stakeholders to understand them [75]. Nevertheless they provide a proven way of representing information about stakeholders and associated goals. Therefore, we consider them as a means to address the problem area of *Communication*. First, by documenting the information to be shared and second, by disclosing who should communicate with whom in the case of common or conflicting goals or similar.

As mentioned, a main issue in terms of architectural scoping is "clearly identifying what is in, and what is outside, the enterprise" [56]. We see goal-oriented modeling approaches as a solution to this problem (i.e., *Architectural scope*) since they clearly identify functional and non-functional requirements by documenting stakeholders and their goals [12, 38]. Aspects and information that cannot be related to a goal or requirement should not be part of the information model of an EA effort. Thereby, goal-modeling helps to restrict the information model of an EA to the necessary elements. This will help to define a reasonable architectural scope.

7. CONCLUSION AND OUTLOOK

In this paper we elaborate on the results of a recent literature analysis [1] and argue that a number of problem areas identified are to be seen in relationship with stakeholders of EA efforts. We introduce a model to capture these problem areas and the relationships between them and elaborate that an increased stakeholder orientation is a means to address these issues. We provide argumentative reasoning, why we consider the goal-oriented requirements modeling approach adopted in software engineering as a means to address these issues by fostering an increased stakeholder focus. Additionally, we mention two contributions [35, 75] which explore the integration of intentional modeling in EA. These articles show goal-modeling as a promising approach to a better understanding of stakeholders and their objectives in EA. A number of benefits have been mentioned (cf. section 6.1).

Therefore, our message is that EA research should add more emphasis to the stakeholder topic by adopting intentional modeling. Our introduction shows that recently the interest in the stakeholder topic has begun to increase. The popular TOGAF framework can be seen as an example for this trend. The 2007 version 8.1.1 [80] already described requirements management as a central aspect in its ADM but had no chapter dedicated to stakeholder management, whereas the 2009 version 9 [7] offers such a chapter providing guidance on stakeholder management. This latest TOGAF version mentions important tasks like stakeholder identification and classification and provides a template stakeholder map (i.e., a plain table) that helps to identify and capture stakeholder concerns as well as associated viewpoints framing those concerns. However, no modeling techniques or notations to document stakeholders and their goals and requirements are presented in this latest TOGAF version. Scholarly literature argues, that goal-oriented requirements modeling contributes further value to stakeholder management by documenting stakeholders, their relationships and their specific requirements [35, 75]. These approaches model high-level goals in early phases of an EA undertaking in terms of stakeholders and their concerns [35]. High-level objectives can be related to low-level architecture elements like products, services, processes or applications. This means a synthesis of the current EA approach and its models with the GORE approach adopted in the software engineering field. Further research will be needed to determine how to leverage and integrate these requirements engineering principles and approaches from software engineering into EA and how to connect current EA modeling with intentional modeling.

We conclude that goal-oriented models can be considered a very reasonable addendum to existing modeling approaches in EA. They provide a way to capture the goals and intentions of stakeholders [35, 75] and provide rationale for an EA effort as a whole. As we show in this paper, goal-oriented requirements modeling is furthermore an approach to increase stakeholder orientation in EA and can as such help to overcome a significant number of predominant stakeholder-related enterprise architecting problem areas in EA.

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