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Critical Issues in Enterprise Architecting – A Literature Review

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ABSTRACT

Enterprise Architecture (EA) has been identified as a means to Business-/IT-Alignment, cost reduction or to facilitate change. Research has been focusing on the effectiveness of EA management while the enterprise architecting process is the process of developing, managing, utilizing and maintaining architectural descriptions (ADs) for EA. In this paper we present the results of a literature review on the process of enterprise architecting. Our research contribution is a consolidated view on the challenges and issues arising throughout the architecting process.

Keywords

enterprise architecture, EA process, enterprise architecting, literature review.

INTRODUCTION

The interest in Enterprise Architecture (EA) has grown significantly over the last years (Schekkerman, 2005). The most important issues and drivers for companies as well as other organizations are IT/business alignment, cost reduction, organizational change and transformation and legal requirements (Schekkerman, 2005; Schöenherr, 2009). A lot of research has been undertaken to evaluate the usefulness and targets of EA from a governance perspective. A smaller number of publications exist so far, investigating the whole enterprise architecting process (Espinosa and Boh, 2009).

ISO/IEC 42010 (International Organization for Standardization, 2007) describes architecture as fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution. Enterprise architecture captures the essentials of the business, IT and its evolution and is 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 (Lankhorst, 2005).

This paper presents the results of a literature review on issues arising throughout the enterprise architecting process. We give a macroscopic overview of the EA process and how it is described in literature. Section 3 explains our research approach. Section 4 and 5 present the results of our literature review. Section 6 concludes with a summary on our work and a look ahead.

THE ENTERPRISE ARCHITECTING PROCESS

In this section we investigate the typical enterprise architecting process to gain a good understanding of what activities make up its constituent elements. This will be the basis to decide whether issues described in investigated literature really are enterprise architecting issues.

A clear understanding of the terms "architecting" and "enterprise architecting" is important. The ISO/IEC 42010 standard defines architecting as "set of interrelated activities of conceiving, defining, describing, documenting, maintaining, improving, and certifying proper implementation of, an architecture throughout a system's lifecycle". Armour and colleagues describe enterprise architecting as "the process of developing enterprise Information Technology architecture – both its

description and its implementation" (Armour, Kaisler and Bitner, 2008). Kaisler et al. see enterprise architecting as "the scaling of system architecting to the enterprise – to a system of systems" or more detailed as "the set of processes, tools, and structures necessary to implement an enterprise-wide coherent and consistent IT architecture for supporting the enterprise's business operations" (Kaisler, Armour and Valivullah, 2004). 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" (Op't Land, Proper, Waage, Cloo and Steghuis, 2009). All these definitions and several more (Boster, Liu and Thomas, 2000; Espinosa and Armour, 2008) agree upon development and management of ADs being the main aspects of the enterprise architecting process and emphasize the necessity of maintaining and keeping these ADs up-to-date (International Organization for Standardization, 2007; Op't Land et al., 2009).

Steps of the enterprise architecting process

Given the numerous and very similar definitions given in the previous paragraph, we assume that the term "enterprise architecting" is prevalent and agreed by the community. Subsequently, we investigate steps (or phases) of four enterprise architecting process models and see that there are certain similarities.

Armour et al. (1999b) and Boster et al. (2000) name phases very similar to each other, that make up the enterprise architecting process (cf. Figure 1):

1. Initiate the process: Develop an architecture framework. Build the architecture team.

2. Characterize the baseline architecture: Describe where we are.

3. Develop the target architecture: Identify where we'd like to be.

4. Plan architecture transition: How to get there.
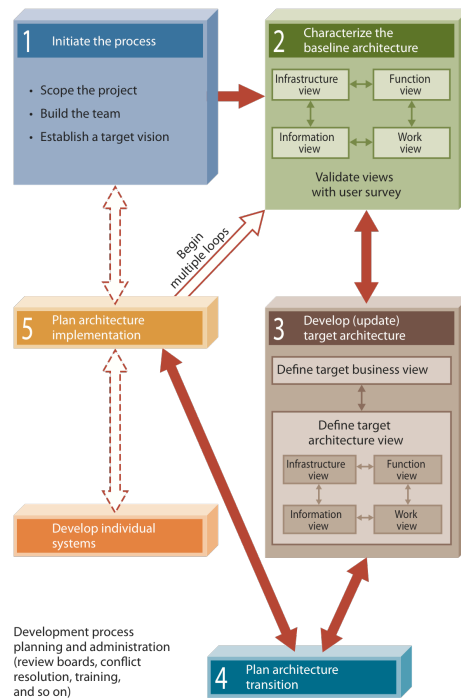
5. Plan architecture implementation.

Figure 1: EA process by Armour et al. (1999b)

Another process model proven in practice can be found in the Federal Guide to Enterprise Architecture of the Chief Information Officers Council (Chief Information Officer Council, 2001). This process model consists of eight steps (cf. Figure 2).
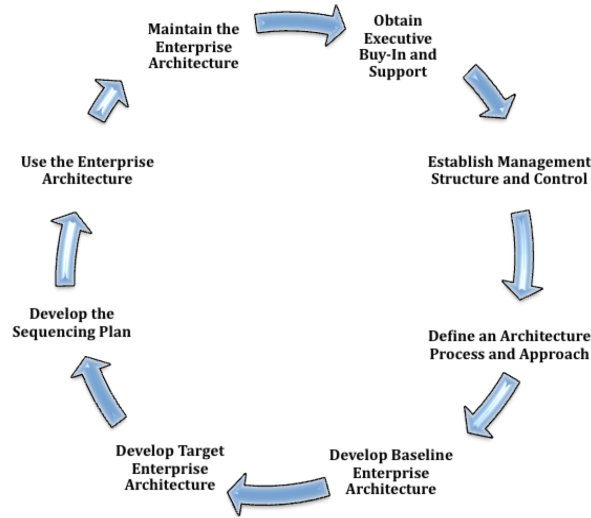
Figure 2: The FEAF EA process model (Chief Information Officer Council, 2001)

Another well known approach to enterprise architecting is the Architecture Development Method (ADM; cf. Figure 3) defined by The Open Group Architecture Framework – TOGAF (The Open Group, 2009). It defines an iterative, cyclic process with eight steps, considering a preliminary phase, which is about defining the enterprise.
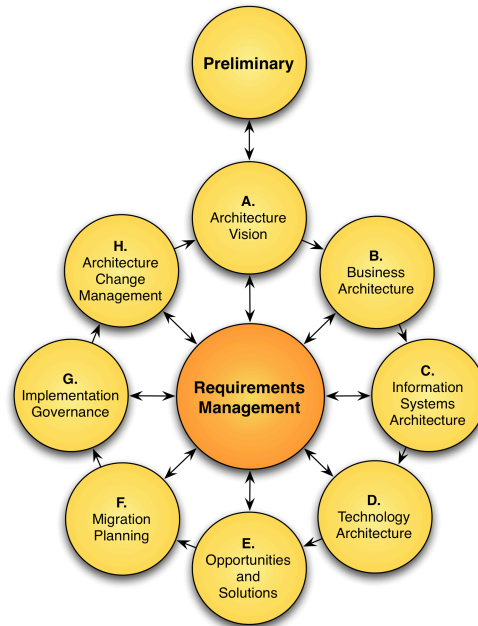

Figure 3: TOGAF ADM (The Open Group, 2009)

Lankhorst describes an architecting process made up of four phases: Idea, Design, Use and Management (cf. Figure 4) "that take an initial idea through design and implementation phases to an operational system, and finally changing or replacing this system, closing the loop" (Lankhorst, 2005).

The mentioned EA process models are a selection of a number of practice-oriented process models. Although these models differ in criteria like the number and sequence of phases they all have a considerable number of similarities. In each model we can identify a process with iterative cyclic steps. Additionally, we find overlap in a number of steps of the proposed model cycles (e.g. definition of EA vision, documentation of baseline and target architecture, etc.). We refrain from defining

"our own process" here and stick with the TOGAF ADM (The Open Group, 2009) to identify issues related to the EA process. It is a well-recognized and up-to-date process model compiled from best practices of many practitioners.
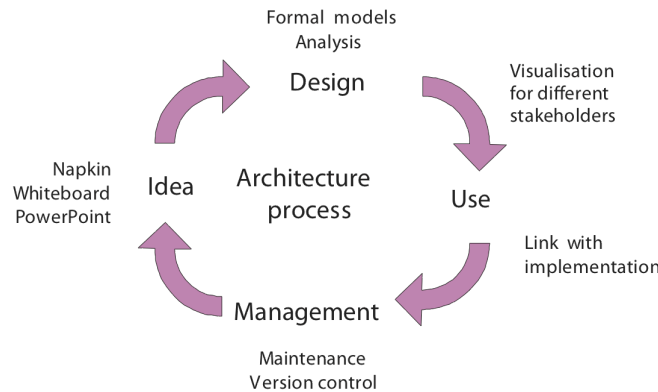

Figure 4: EA process model by Lankhorst (2005)

RESEARCH APPROACH

Our method is a database-driven literature review (vom Brocke, Simons, Niehaves, Riemer, Plattfaut and Cleven, 2009; Webster and Watson, 2002) using the AIS Electronic Library (AISel) and IEEE Xplore. The search was conducted on November 17th, 2009 and double-checked on December 8th, 2009. For the selection of relevant conferences and journals we used ranking lists (German IS lists for conference proceedings and journals 2008) published by the IS chapter of the "Gesellschaft für Informatik" (GI IS chapter, 2008).

The literature databases were chosen for a number of reasons. They provide access to a noteworthy number of journals and publications with a high rating in ranking lists – see Table 1 for an aperture. Both databases provide access to journals and conference proceedings. We cover publications with presumably higher quality (i.e., journal publications according to vom Brocke et al.) as well as content that is more likely up-to-date (i.e., conference proceedings). Also, in the adjacent discipline computer science conference publications are considered to be more "valuable" than in IS and in our approach we cover this stream of literature as well. AISel and IEEE Xplore provide a good coverage of scholarly and practice-oriented publications. We see AISel's focus mainly in scholarly publications and the IEEE Xplore contents to be more focused on practice.

AISel	IEEE Xplore
Journals	
Information Systems Journal (ISJ)	IEEE Software
Journal of the Association of Information Systems (JAIS)	IEEE Transactions journals (IEEET)
Management Information Systems Quarterly (MISQ)	IEEE Computer (IEEEC)
Communications of the Association of Information Systems (CAIS)	IEEE Intelligent Systems
Management Information Systems Quarterly Executive (MISQE)	IEEE Internet Computing
	IEEE Pervasive Computing
Conference proceedings	
European Conference on Information Systems (ECIS)	EDOC Conference (The Enterprise Computing Conference)
International Conference on Information Systems (ICIS)	Hawaii International Conference on System Sciences (HICSS)
Americas Conference on Information Systems (AMCIS)	IEEE Conference on E-Commerce Technology (CEC)
Pacific Asia Conference on Information Systems (PACIS)	IEEE Conference on Enterprise Computing, E-Commerce and E-Services (EEE)
	IEEE International Conference on Data Mining
	IEEE Security and Privacy

Table 1: Journals and proceedings accessed by AISel and IEEE Xplore and considered in this study

We use the search term "enterprise architecting" in both databases. We conducted a full text search 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.

Our content analysis approach is depicted in Figure 5 and is as follows. The database search yielded a total of 86 publications matching our search criteria. 13+2 articles contained just a table of contents (TOC)[1] of proceedings or were duplicate papers – these were not reviewed. We read the remaining 71 articles and identified 28 referring to EA issues and 43 dealing with other topics. We used a content analysis approach analog to grounded theory literature (Glaser and Strauss, 1999). In those 71 articles, statements indicating EA issues were identified using open coding in a bottom-up comparative process. Identified issues were considered relevant and assigned one or more codes, when they could be related to a step of the enterprise architecting process (i.e., a step in the TOGAF ADM) and thus, were in our scope of interest. Similar collections of codes were grouped by inductive reasoning to identify underlying concepts – we describe these generalized concepts in our results section. Numbers in brackets behind concept names (cf. Figure 5) denote the number of articles (i.e., literature references) referring to a code belonging to the concept. Further, we grouped similar concepts into categories. The two main authors conducted the detailed coding and concept identification to reach better intersubjectivity and we led discussions with fellow practitioners to agree upon reasonable concepts and categories.
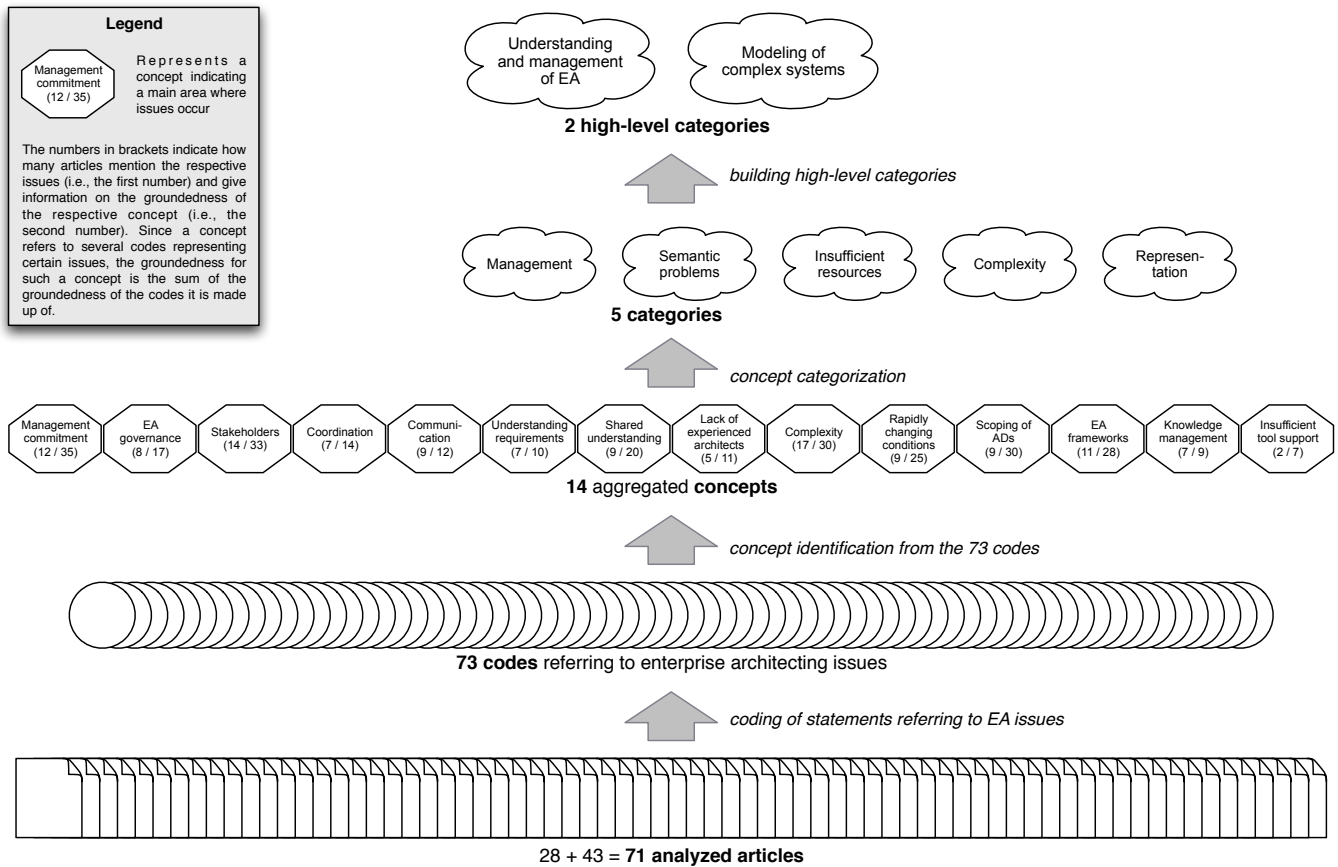

Figure 5: Content analysis approach analog to Glaser and Strauss (1999)

ENTERPRISE ARCHITECTING PROBLEMS – RESULTS OF THE LITERATURE REVIEW

The following sections describe the EA issues we identified. Each section identifies a concept that emerged from the grouping of identified codes.

Management commitment

An important issue is insufficient management commitment (Armour et al., 1999b; Espinosa and Boh, 2009; Kaisler et al., 2004; Lam, 2004; Seppanen, Heikkila and Liimatainen, 2009; Wilton, 2008). The lack of meaningful metrics (Kaisler et al.,

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[1] That is a side effect of the full-text search because paper titles matching the search term caused the IEEE Xplore search engine to return plain TOC documents as a match.

2004) makes it hard to provide justification for EA efforts to management and to develop meaningful value propositions (Kaisler et al., 2004; Lam, 2004; Namba and Iljima, 2004). This is a weakness because return on investment is often expected within a too short amount of time (Armour et al., 1999b; Kaisler et al., 2004; Lam, 2004; Namba and Iljima, 2004).

Another issue linked to insufficient management commitment is limited central architecture authority. "Central architecture groups have influence, but not control, over decisions that affect the information system architecture" (Dreyfus, 2007). This problem is twofold: (a) "business managers with immediate objectives can bypass the review boards" (Dreyfus, 2007) and decide not to follow the rules of an architecture program (Shah and Kourdi, 2007); (b) important managers can decide not "to make the extra investment sometimes required for good architecture" (Dreyfus, 2007).

According to Seppanen et al. (2009) "business and IT managers are primarily responsible for creating a favorable atmosphere that is required in ensuring that the architectural process is granted enough time, money and other resources". Involving experts with important knowledge is essential: "We've seen projects fail because key people were put on them part-time" (Kaisler et al., 2004).

Another mistake is misunderstanding EA as a project instead of a process (Armour et al., 1999b). "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" (Rhodes, Ross and Nightingale, 2009).

EA governance

Lam (2004) 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" (Seppanen et al., 2009). Interviewees in the research of Seppanen et al. (2009) agreed "that the establishment of the governance model is the most important task of enterprise architecting". Often there exists no common agreement on principles or guidelines for the EA development process (Armour, Kaisler and Liu, 1999a; Armour et al., 1999b; Delic, Riley and Faihe, 2007; Shah and Kourdi, 2007) and although EA frameworks try to address this issue the EA approach is often not rigid enough. "There is no rigid approach to manage and develop information systems in the context of enterprise architecture because no formal steps exist for defining, maintaining, and implementing enterprise architecture" (Shah and Kourdi, 2007). That is why EA projects sometimes fail to focus on the right objectives (Espinosa and Boh, 2009; Lam, 2004) – "one has to first define the key objectives and this would require the inputs of the top management for both, IT and business" (Espinosa and Boh, 2009).

Stakeholders

The plethora of stakeholders is an issue mentioned by several authors (Armour, Kaisler, Getter and Pippin, 2003; Henttonen and Matinlassi, 2009; Rhodes et al., 2009). It leads to a number of related challenges like incomplete stakeholder involvement or buy-in (Armour et al., 1999b; Espinosa and Boh, 2009; Lam, 2004; Rhodes et al., 2009; Seppanen et al., 2009; Shah and Kourdi, 2007). Missing relevant stakeholders may lead to the undermining of stakeholder consensus: "Reaching agreement on a target architecture definition in a large, changing, multicultural organization with competitive groups is difficult. The larger the organization, the more difficult it will be. Be sure to have all stakeholders validate the definition" (Armour et al., 1999b). The large number of stakeholders results in different or even conflicting stakeholder needs and perspectives (Delic et al., 2007; Espinosa and Boh, 2009; Kaisler et al., 2004; Lam, 2004; Namba and Iljima, 2004; Niemi, 2009). "Stakeholders have different, sometimes even conflicting needs and perspectives" (Niemi, 2009). A further stakeholder-related issues is distributed decision making (Dreyfus, 2007). So, decision-makers may make local design decisions where they should have incorporated other stakeholders (Bubak, 2006; Dreyfus, 2007; Kaisler et al., 2004; Shah and Kourdi, 2007). "Each group engages in local optimization, but because these optimizations affect the shared information system, each group is affected by other groups' decisions" (Dreyfus, 2007).

Coordination

Since enterprise architecting often involves multiple organizational units or even whole branches of an organization, coordination is a major issue (Bubak, 2006; Espinosa and Armour, 2008; Espinosa and Boh, 2009; Seppanen et al., 2009). "In our model we posit that an EA has layers [...] and segments or verticals [...]. Each layer and each segment usually have their own architect and staff and the work of these people is highly interdependent requiring a substantial amount of coordination" (Espinosa and Boh, 2009). Coordination is directly influenced by two important boundaries: (a) geographic distance and separation and (b) time separation (Armour et al., 1999a; Espinosa and Armour, 2008; Espinosa and Boh, 2009; Henttonen and Matinlassi, 2009). Resulting, a "lack of project synchronization and timing" (Lam, 2004) can be perceived. "Thus, 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" (Bubak, 2006).

Communication

In EA diverse groups of interest have to avoid mismatched communication in collaboration (Espinosa and Boh, 2009; Lam, 2004; Seppanen et al., 2009; Shah and Kourdi, 2007; Wang, Ma and Zhou, 2008). "Although each group depends on each other, their levels of specialization have led to group specific languages that thwart effective communication" (Dreyfus, 2007). Especially "IT personnel in EA teams were often too technical in their focus and they lacked the ability to speak the business language" (Espinosa and Boh, 2009). The overall need to establish a beneficial communication mechanism is depicted in (Armour et al., 1999b): "In one large organization we consulted for, different groups were running the EITA development effort and BPR simultaneously, 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 […]". The absence commonly understandable representations, which facilitate cross-group discussions limits the ability to achieve a well-aligned and agreed architecture (Armour et al., 2003; Dreyfus, 2007).

Understanding requirements

Builders and users of architectural descriptions are frequently not the same people. "This division complicates the process of understanding what the application requirements are" (Dreyfus, 2007). 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" (Armour et al., 1999a). Further issues described in literature are a lacking understanding of business requirements (Armour et al., 1999a; Lam, 2004; Wang et al., 2008) and ignoring the business requirements (Armour et al., 1999a; Armour et al., 1999b; Melchert, Winter and Klesse, 2004; Seppanen et al., 2009; Wang et al., 2008). "Therefore, it has to be ensured that strategy changes trigger modifications on the levels of business processes and information systems […]" (Melchert et al., 2004).

Shared understanding

Literature shows that the EA process suffers from the lack of a shared vision (Armour et al., 1999b; Lam, 2004) and a shared/common vocabulary (Armour et al., 1999a; Armour et al., 1999b; da Cunha and de Figueiredo, 2005). "Most teams fully intend to develop a shared vision, they frequently fail to do so – most often because they did not involve key player" (Armour et al., 1999b). A related issue is the lack of a distributed cognition (Dreyfus, 2007; Kaisler et al., 2004; Rhodes et al., 2009; Seppanen et al., 2009). "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" (Kaisler et al., 2004). 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 (Bubak, 2006; Dreyfus, 2007; Seppanen et al., 2009). "Systems were developed in isolation, and this sometimes resulted in duplication" (Bubak, 2006).

Lack of experienced architects

A serious issue is the lack of experienced enterprise architects (Armour et al., 1999a; Lam, 2004; Seppanen et al., 2009) – "competent architects are on high demand" (Seppanen et al., 2009). The field of EA is very complex (Armour et al., 1999a; Dreyfus, 2007; Lam, 2004) and so are the EA frameworks that are adopted (Schekkerman, 2004). 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" (Seppanen et al., 2009). Skilled architects are an insufficient resource (Armour et al., 1999b).

Complexity

Often the immense complexity of EA endeavors is underestimated (Armour et al., 2003; Bubak, 2006; Delic et al., 2007; Dreyfus, 2007; Henttonen and Matinlassi, 2009; Lam, 2004; Meilich, 2006; Namba and Iljima, 2004; Rhodes et al., 2009; Wang et al., 2008) as it "applies to very large-scale, complex open systems which are technologically enabled and have extensive social implications" (Rhodes et al., 2009). The large number of applications in today's organizations (Dreyfus, 2007; Mocker, 2009) and the dependencies that exist between the different layers and segments described in architectural descriptions (Armour et al., 2003; Espinosa and Boh, 2009; Kaisler et al., 2004; Shah and Kourdi, 2007) are resulting in the challenge to maintain inter-view consistency (Armour et al., 1999a; Nordstrom and Cegrell, 2005) and traceability (Armour et al., 1999a; Buuren, Gordijn and Janssen, 2005; Shah and Kourdi, 2007). "The dynamics of cognitive and social processes do not obey static representations and rules of architecture" (Meilich, 2006; Rhodes et al., 2009).

Rapidly changing conditions

Rapidly changing conditions in technology and business are an important issue in EA (Armour et al., 1999a; Shah and Kourdi, 2007). "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" (Armour et al., 1999a). Architects have to deal with high dynamics and constraints that are caused by different (and shortened) lifecycle phases of systems and applications (Bubak, 2006; Dreyfus, 2007; Kaisler et al., 2004; Lam, 2004; Meilich, 2006; Namba and Iljima, 2004). "Deploying the system of systems means that a collection of independently developed component systems are brought together to work collaboratively […] design decisions made when engineering one system may affect the other […] this will likely have a negative impact on interoperability" (Bubak, 2006). Related to dynamics are engineering issues – (a) engineering under the condition of uncertainty (Bubak, 2006) and (b) keeping track with operational changes (i.e. "a tension between the continuing operations and the introduction of enhanced or new systems" (Kaisler et al., 2004)).

Scoping of architectural descriptions

EA is a holistic approach and compared to system architecture deals with a "larger scope and greater complexity of integration efforts" (Bubak, 2006). The scope of architectural descriptions (ADs) has to be defined in breadth and depth (Armour et al., 2003; Bubak, 2006; Kaisler et al., 2004; Meilich, 2006; Namba and Iljima, 2004; Rhodes et al., 2009). Insufficient scoping can lead to overscoping (Armour et al., 1999a; Armour et al., 1999b; Namba and Iljima, 2004) and/or overmodeling (Armour et al., 2003; Armour et al., 1999b; Rhodes et al., 2009). Overscoping means to choose a too broad scope – "when architects are at high levels, they see more things – and everything they see they model" (Armour et al., 1999b). Overmodeling refers to the "overuse of detail" (Armour et al., 1999b) 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" (Armour et al., 1999b). 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" (Armour et al., 1999a).

EA Frameworks

"The efforts to characterize enterprises in general has led to a plethora of enterprise architecture frameworks" (Rhodes et al., 2009), which complicates the selection of an appropriate framework (Armour et al., 1999a; Goel, Schmidt and Gilbert, 2009). Furthermore, we identify several shortcomings of EA frameworks (EAF). EAF are often overly complex (Rhodes et al., 2009; Seppanen et al., 2009) and provide no sufficiently described process for generating the postulated products (Armour et al., 1999a; Moghaddam, Sharifi and Merati, 2008; Wilton, 2008). Moreover stakeholder-related and a number of other concerns in EAF are bemoaned to be too abstract (Niemi, 2009). EAF are often not capable of taking organizational concerns adequately into account (Janssen and Hjort-Madsen, 2007; Niemi, 2009; Seppanen et al., 2009; Shah and Kourdi, 2007; Wilton, 2008). "The challenges of EA development are seldom technical. More often they arise from political, project management, and organizational issues. […] EA methods and frameworks are not capable of taking organizational concerns adequately into account" (Seppanen et al., 2009). Literature also shows, that there is a disagreement on essential EA layers and segments (Armour et al., 2003; Armour et al., 1999a; Rhodes et al., 2009; Shah and Kourdi, 2007). Often EAF apply an exaggerated emphasis on a technologist view (Janssen and Hjort-Madsen, 2007). 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" (Armour et al., 1999a).

Knowledge management

A serious knowledge management related EA issue is poor documentation (Lam, 2004). Architecture rationale is often poorly documented, which makes it difficult to track "what decisions were made and why" (Armour et al., 1999b). "There is no single repository (human or otherwise) containing knowledge of the purpose, functionality, or implementation detail of all the applications and their interdependencies (Dreyfus, 2007)". Literature shows, that documenting and retrieving architectural knowledge is far from ideal conditions (Armour et al., 1999b; Henttonen and Matinlassi, 2009; Lam, 2004; Meilich, 2006; Shah and Kourdi, 2007; Templeton, Lee and Snyder, 2006). The mentioned lack of a single repository is an important factor in that regard but certainly not the only one. "People use different tools to produce different models, resulting in an ambiguous documentation of the architecture" (Shah and Kourdi, 2007).

Insufficient tool support

A general issue described in literature is unsatisfying tool support (Kaisler et al., 2004; Shah and Kourdi, 2007). "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 (Kaisler et al., 2004). Many "modeling tools, such as Rational Rose, are oriented to modeling software architectures". Another weakness of those tools "is representing system dynamics. […] A mechanism is needed for calculating and/or associating performance data with EA elements" (Kaisler et al., 2004). Additionally, the multitude of available tools is described as an issue (Shah and Kourdi, 2007).

CATEGORIZATION OF ENTERPRISE ARCHITECTING ISSUES

During the literature research we identified 73 codes, which we described grouped into 14 concepts in the preceding sections (cf. Figure 6). We group similar concepts to build five reasonable categories: (1) management; (2) semantic problems; (3) insufficient resources; (4) complexity and (5) representation. On a more abstract level we see two categories: (a) understanding and management of EA and (b) modeling of complex systems (cf. Figure 6). The transitions between these categories are smooth, which we try to indicate by the gradient colors.
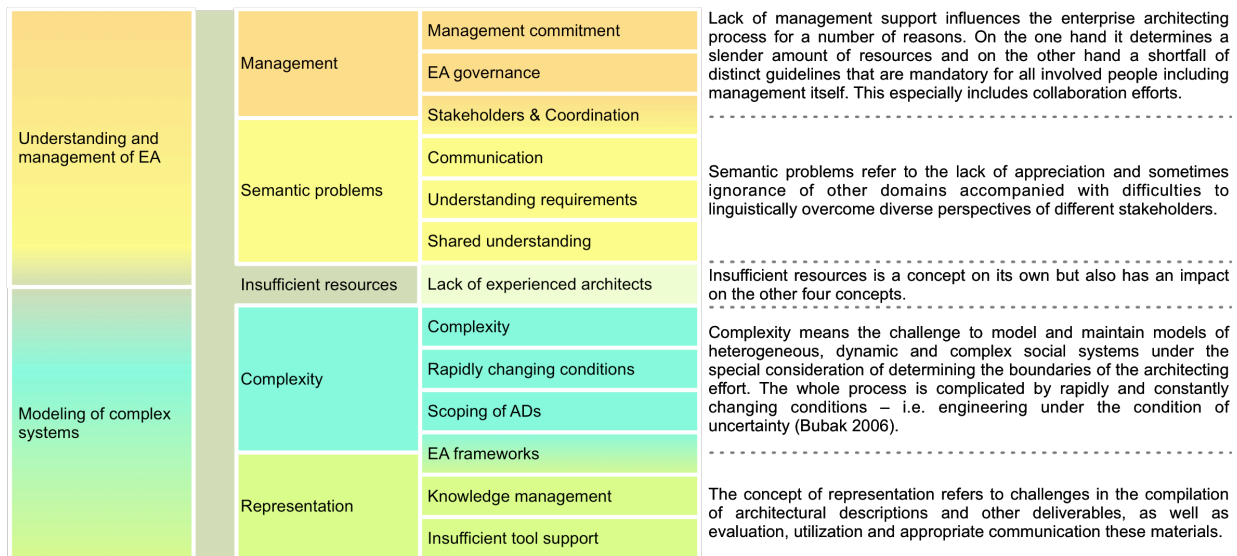

Figure 6: Categorization attempt of concepts emerging from identified codes

CONCLUSION AND OUTLOOK

In this paper the results of our literature review on issues arising in the enterprise architecting process are presented. We investigate and present challenges that in the enterprise architecting process applying the content analysis approach described in grounded theory literature (Glaser and Strauss, 1999). Our analysis leads us to a number of 73 codes, which can be grouped into 14 distinguishable concepts and more abstract into five or two categories. The raw categorization supports the statements of Kaisler et al. (2004) who provide a tripartite categorization based on project experiences: modeling, management and maintenance. Furthermore, we think that our more detailed five categories provide an added-value contribution in the appraisal and understanding of the connections of predominant enterprise architecting issues. The number of articles referring to certain issues (cf. Figure 5) might give an impression of these issues' possible importance but further research is needed in this regard.

Despite the brief description of our results we try to be as accurate as possible. We provide the relevant literature references for each of the described issues, which allow for further investigation and validation by the research community. We are also aware that for some issues more or less helpful solutions exist. Especially the concept of insufficient tool support is to be considered because the tool market is fast moving (Matthes, Buckl, Schweda and Leitel, 2008). Nevertheless, our practical experiences of ongoing enterprise architecting projects surmises that market dominant enterprise architecting tools show particular problems in handling large architectures, federation of architectures, providing appropriate presentation suited to subject matter experts and reviewing capabilities. This correlates with the semantic problems, complexity as well as presentation categories deduced in Figure 6.

We are confident that our contribution contains valuable insights into the enterprise architecting process and its predominant challenges. We reveal several areas that could and should be subject of further investigation (e.g. exploitation of a common

semantic foundation that provides a defined context for AD modeling and further allows for a comprehensive analysis of models independent from the perspective). We will direct further research to the triangulation of our results based on practitioner interviews and furthermore to the development and validation of a conceptual model describing the relationships between the concepts and categories presented in this paper.

ACKNOWLEDGMENTS

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