Understanding Enterprise Architecture through Bodies of Knowledge
A Conceptual Model

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Abstract: There is extensive interest in modeling enterprises from a holistic perspective, showing not only the IT infrastructure of an organization, but also how this IT infrastructure supports business processes and how it contributes to the realization of products and services. This interest has led to a large number of papers reporting on Enterprise Architecture. In this paper, we propose a new conceptual model to describe enterprises from a holistic perspective. The proposed model is based on relationships between the ArchiMate language and bodies of knowledge (BOKs). The conceptual model allows to understand how the bodies of knowledge relate to the enterprise architecture. For this, we propose criteria that allow to relate the bodies of knowledge to the perspectives that are defined in the ArchiMate language. Based on the proposed model, this work shows how bodies of knowledge can be used cooperatively inside an enterprise architecture to improve the quality of internal processes in order to generate value for the interests that support their strategic planning. Studies indicate the benefits of ArchiMate in enterprise modeling. Existing studies have already shown the benefits of using BOKs to represent and share available knowledge in and across enterprises. In this work, we go one step further and show how the conceptual alignment of BOKs and ArchiMate advance the understanding of enterprise architectures.

1 INTRODUCTION

The increasing complexity of business, the advancement of new technologies, the growth of requirements and the need to achieve business goals drive companies and organizations to cover their business processes, organizational structures and technology by a variety of models and specifications. In this context, the complexity of organizational environments and information systems justified the emergence of the term Enterprise Architecture (EA) to denote a comprehensive set of principles, methods and models for defining and implementing organizational structures, business processes, information systems and even technical infrastructures of IT within an organization (Lankhorst, 2005).

Comprehensive enterprise architectures are beneficial to represent a wide variety of organizational structures, processes, technologies and any kind of relationships between modeling artifacts. Thus, enterprise architectures help to understand an organization, its business objects and alignments with the underlying information technology.

These architectures are built from the information capture and understanding of business services and processes, information systems and technical infrastructure (van Hee et al., 2004; Papazoglou, 2003). However, a key challenge is to cover and identify relevant artifacts for a particular architecture and how these artifacts are related to other artifacts within and across architectures. Obviously, this requires knowledge about the whole enterprise, its structure, behavior, technology and its actors.

Covering all artifacts and their relationships for enterprise architectures is challenging by the embracing nature and coverage of heterogeneous architectural domains. These domains reflect the variety of stakeholders in the process of defining and maintaining the architectures. Furthermore, predominant organizational aspects and specific features from the IT make architectures more complex.

The first efforts to capture enterprise architectures were based on sets of diagrams (Bass et al., 2003). Although diagrams involve the use of intuitive graphics, their understanding is still subject of interpretation. More recently, a family of languages for description organizational architectures has been proposed ((Jonkers et al., 2003), (Lankhorst, 2005)), enabling

a comprehensive and precise coverage of enterprises from various views.

To tackle the previously described problem, we propose a new conceptual model that covers enterprise architectures as one building block and organization knowledge sources as an other block. Knowledge of an enterprise is covered by so-called bodies of knowledge (BOKs). While bodies of knowledge are used to represent knowledge that is available to members of a group or organization, there is no integration of this established knowledge representation formalism in the enterprise architecture so far.

We suggest a concept that is able to bring those two domains together: enterprise architecture and bodies of knowledge. The model was structured from relationships created between the ArchiMate language (standardized by The Open Group) and the bodies of knowledge. The choice of the BOKs is justified by complementary natures that emphasize different aspects of the organization. The paper shows how some bodies of knowledge are related to the organizational interests defined in the ArchiMate specification. Knowing these relationships, enterprise executives can work cooperatively on interests based on the knowledge presented by the common BOKs related with these organizational interests.

This paper is structured as follows. Section 2 motivates the need for the proposed model in terms of competence questions. Section 3 presents enterprise architecture languages in general and the ArchiMate language in particular. Section 4 introduces the used BOKs. Section 5 presents a conceptual model for representing bodies of knowledge based on ArchiMate. Section 6 presents how the bodies of knowledge can be related to the interests of the organizational structure from the ArchiMate language. Section 7 presents related work. Finally, Section 8 concludes the paper.

2 COMPETENCE QUESTION

In the following, we exemplify how covered knowledge helps to develop and maintain enterprise architectures for a drugstore. For this example, we outline some competency question that we expect to be able to answer.

When conducting strategic planning, the drugstore defines its mission, values and vision. Accordingly, the drugstore aims to implement and achieve all goals and visions. However, a survey conducted within the drugstore found that many times the proposed projects do not achieve the expected results due to the lack of knowledge about the architecture.

Subject experts argue that it is important to know how the organizational objectives bind business processes, which is the technological structure that supports their processes, how the work is performed, which products are generated and who are the people in the organization.

For example, a proposed project of the marketing sector requested the restructuring of the system "Promotional Package". The sector manager of the drugstore asked the enterprise architect to verify the project's impact on business processes and other enterprise systems. To find the impacted business processes, the enterprise architect has to search for those enterprise sectors that use the system in order to make a manual survey of processes passing through these sectors. To assess the impacted systems, the enterprise architect needs the help of the software development sector in order to get a survey of the affected systems.

The difficulty faced by the enterprise is that the knowledge about business processes is tacit, in other words, it is stored in the heads of some company employees and in some cases, there is an isolated mapping. Furthermore, the knowledge about the enterprise software systems is concentrated in the software development sector. The software development sector has documentation of the systems, but has no information related to business processes served. There is little or no traceability between systems and the processes that they automate.

The problem faced by the drugstore is that the teams directly related with an interest of the enterprise architecture, i.e., those people that perform activities related to that interest, have little knowledge about their interests and their relationships with other interests. For example, the professionals responsible for capturing requirements within a project has little knowledge about techniques to perform this activity. The knowledge presented by the BOKs related with the interest, which addresses this activity, can assist these professionals in its execution. Another example, professionals working with the sales processes management of the company are not aware of the relationship between applications that automate activities of such processes. The knowledge presented by the BOKs is related to both interests. Thus, BOKs can assists these professionals in the execution of their activities. This problem prevents the modeling, visualization and understanding of enterprise architecture.

The raised problem can be divided up into three subproblems: 1 - Lack of knowledge about a particular interest of the organization. For example, the drugstore has difficulty to elicit and capture all requirements. 2 - Lack of knowledge about the relationships between interests. For example, it is difficult to assess

the impact on business processes from a technological change proposed by a project. 3 - Difficulty of modeling the enterprise architecture. For example, the organizational architect does not know how and where to find the information needed to model the architecture of the drugstore.

To solve these problems, we propose the collaborative use of bodies of knowledge related to the enterprise interests. Based on a set of enterprise interests, which is predefined in the ArchiMate specification, we show the integration of bodies of knowledge in enterprise architecture languages in order to improve the overall understanding of the enterprise structure, behavior and technology.

3 ENTERPRISE MODELING WITH ARCHIMATE

Building an Enterprise Architecture is a discipline that organizes and structures components from business and IT, and their relationships that seek to increase organizational performance through better management of complexity.

Typically, an enterprise architecture is created so that the different concerns and interests of the key people of the organization are met by a better alignment between business and technology. Its goal is to develop insights into the architecture, which explains how the concerns and requirements are considered and how commitments or agreements are necessary to reconcile potentially conflicting interests (Iacob et al., 2012). For the practical application of enterprise architectures, some frameworks have been created. These frameworks support and guide the development of enterprise architectures, but they need languages such as ArchiMate.

3.1 Purpose of Enterprise Architecture Language

Each stakeholder in an enterprise possesses specialized views, facing the nature of its operations and specific responsibilities. Even in the same part of an organization, these people have clearly different mental models. They speak specific languages and understand preformed concepts by the set of their concerns, policies and objectives themselves. To provide efficient communication, enterprise architects use a standard language to model and communicate the architecture to stakeholders.

ArchiMate is a standard language that aims mainly at providing a *uniform* representation of diagrams to describe enterprise architectures. It offers an integrated conceptual approach that displays the various domains of architectures, as well as the relationships and dependencies among its components. ArchiMate was developed in the context of an European project (Lankhorst, 2005) and it is a standard of The Open Group based on the concepts of Institute of Electric and Electronic Engineers (IEEE) 1471 (Hilliard, 2000). The ArchiMate framework pre-defines concepts and relationships that allow the description of the company as well as of its evolution over time, including changes and migrations. It is simple, yet comprehensive enough to provide a good mechanism for structuring an architecture (Iacob et al., 2012).

3.2 The ArchiMate Language Structure

A precise specification of architecture components and their relationships requires a modeling language that prioritizes the consistent alignment between organization abstraction layers. In a modeling language, specifications of components and relationships that are provided to the architect are formalized in the language metamodel (Iacob et al., 2012).

With respect to its horizontal range (columns), the ArchiMate basic language consists of three types of elements: active structure elements (organization and its stakeholders), behavioral elements (processes) and passive structure elements (information and data). With respect to its vertical extent (lines), the enterprise is modeled in three layers: business, application and technology (Lankhorst, 2005).

According to (Lankhorst, 2005), an active structure element is defined as an entity capable to perform behavior. An behavior element is defined as an activity unit undertaken by one or more active structure element. The passive structure elements are objects in which the behavior is performed.

Layers can be conceptualized as follows: the business layer provides products and services to external clients developed in the organization by business processes performed by business actors; the application layer supports the business layer, with services conducted by software applications; the technology layer provides infrastructure services (e.g., processing, storage and communication services) needed to run the applications realized by computers, the hardware and the communication software of a system (Lankhorst, 2005).

The elements and layers identified above can be arrangedin a framework with nine cells, as illustrated in Figure 1.

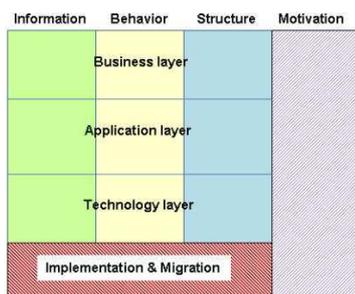Besides the main concepts described above,

Figure 1: Archimate Framework including extensions (Iacob et al., 2012).

ArchiMate contains a core set of relationships. They establish the connections between the concepts.

In ArchiMate language modular extensions can be added with goal of creating new concepts, relationships, or attributes. The 2.0 edition of the ArchiMate specification addresses two such extensions: the Motivation extension and the Implementation and Migration extension (Iacob et al., 2012). These two extensions are included in Figure 1.

The ArchiMate Motivation extension adds the motivational concepts as objective (or goal), principle and requirement. It discusses how the enterprise architecture is aligned with its context, as described by motivational elements.

The ArchiMate extension of Implementation and Migration adds concepts to support subsequent phases related to the implementation and migration of architectures: Opportunities and Solutions, Migration Planning and Implementation Governance (Iacob et al., 2012).

ArchiMate advocates a more flexible approach in which architects and other stakeholders can define their own views on an enterprise architecture. In this approach, views are specified by viewpoints. Viewpoints define abstractions in the set of models that represent the enterprise architecture, indicating a particular type of stakeholder and pointing to a particular set of interests. Viewpoints can be used to isolate certain aspects but also to relate two or more aspects (Iacob et al., 2012).

An ArchiMate viewpoint is a selection of a relevant subset of ArchiMate concepts (and their relationships). A number of these viewpoints were developed based on practical experiences.

Other viewpoints exist to cover motivational aspects. Each of these viewpoints presents a different perspective on the motivation modeling that underlies some enterprise architecture and allows a designer to concentrate on certain aspects. Other viewpoints allow to model aspects of implementation and migration. The model definition of viewpoints is presented in Section 5.

4 BODIES OF KNOWLEDGE IN ENTERPRISE ARCHITECTURE

Generally, the bodies of knowledge formalize various concepts and identify a set of knowledge, which is recognized as good practice and applicable within a particular context. Thus, concepts, information, activities, tasks, practices, tools and standards are structured around knowledge areas into a body of knowledge. The goal is to provide this knowledge to the members of a group or organization that has an interest in a certain area.

In order to assist organizational modeling, some bodies of knowledge were selected for study. The criterion for choosing the BOKs was defined by the authors according to the nature of each BOK with regard to the emphasis given to different aspects of the organization. The authors investigated BOKs, used by organizations and educational institutions, which were related to enterprise interests. We selected the following BOKs: Business Analysis Body of Knowledge (BABOK), Business Process Management Common Body of Knowledge (BPM CBOK), Data Management Body of Knowledge (DMBOK), Project Management Body of Knowledge (PMBOK), Systems Engineering Body of Knowledge (SEBOK), Software Engineering Body of Knowledge (SWEBOK).

According to the International Institute of Business Analysis (IIBA), the BABOK is a globally recognized standard for the practice of business analysis. Their primary purpose is to define the profession of business analysis and to help these professionals to understand problems and to specify appropriate solutions to deliver value to the organization. For this, the guide describes business analysis knowledge areas, their associated activities and tasks, and the skills necessary to be effective in their execution. Moreover, it describes techniques and practices generally accepted, proven and widely used in the discipline of business analysis (IIBA, 2009).

The guide to the BPM CBOK is a reference for business processes management practitioners. It is organized into knowledge areas that are segmented into two perspectives: organizational oriented perspective and process perspective. These areas reflect BPM capabilities that may be considered by an organization implementing Business Process Management (ABPMP, 2013).

The purpose of this guide is assist business processes management professional in optimizing the results of organizations by improving business processes. The guide provides a list of common activities and tasks associated with each knowledge area. It also provides a comprehensive overview of best prac-

tices and lessons learned collected by the Association of Business Process Management Professionals (ABPMP) and affiliated associations (ABPMP, 2013).

The DMBOK guide structures the process of Data Management (DM) to effectively manage and leverage the use of data assets. Its goals are to meet and to exceed the needs for information of concerned parts (stakeholders) of the company in terms of availability, security and quality. For this, the BOK introduces concepts, identifies data management goals, describe about functions, activities, primary deliverables, roles, principles, commonly accepted good practices, technology and organizational/cultural issues related with DM (Brackett and Earley, 2009).

The PMBOK guide is a recognized standard for the project management profession that defines project management and related concepts. Based on the statement that the application of appropriate knowledge, processes, skills, tools and techniques can have a significant impact on project success, the BOK provides guidelines and describes the project management life cycle, the related processes, the sum of knowledge and best practices within the profession of project management (PMI, 2013).

The SEBOK provides a compendium of the key knowledge sources and references of systems engineering. It is organized and explained to assist a wide variety of users with respect to the development, management and application of systems. Their objective is to strengthen the mutual understanding across the various disciplines involved in operating systems. The guide describes the boundaries, terminology, content, and structure of systems engineering (Pyster et al., 2013).

The purpose of the SWEBOK is to provide a consensually validated characterization of the bounds of the software engineering discipline and to provide a topical access to the body of knowledge supporting that discipline. The BOK is widely used in disciplines related to software development, both in academia and in practice. It directs the software engineer in the development of their activities throughout the development life cycle of software (IEEE Computer Society, 2004).

5 A CONCEPTUAL MODEL FOR KNOWLEDGE INSIDE ARCHITECTURES

The overall goal of this work is to create a conceptual model that allows understanding how these bodies of knowledge relate to the enterprise architecture. In

Figure 2: Interests, related to the enterprise architecture, defined in the ArchiMate specification.

this section, we show the proposed conceptual model, which is based on two pillars: bodies of knowledge (BOK) and the ArchiMate language. The viewpoints defined in ArchiMate were used to create the relationship between bodies of knowledge and the enterprise architecture.

5.1 ArchiMate Viewpoint Model

ArchiMate allows that views are specified through *viewpoints*. Viewpoints define abstractions on the set of models representing the enterprise architecture, each aimed at a particular type of stakeholder and addressing a particular set of concerns. Viewpoints are a means to focus on particular aspects of the architecture. These aspects are determined by the concerns of a stakeholder with whom communication takes place. What should and should not be visible from a specific viewpoint is therefore entirely dependent on the argumentation with respect to a stakeholder's concerns (Iacob et al., 2012).

Different interests related to the enterprise can be shown by the viewpoints. Figure 2 summarizes the interests related to the enterprise, addressed by viewpoints.

An architect is confronted with many different types of stakeholders and concerns. To help him in selecting the right viewpoints for the task at hand, ArchiMate introduces a framework for the definition and classification of viewpoints and views. The framework is based on two dimensions: *purpose* and *content* (Iacob et al., 2012).

The following three types of architecture support the *purpose* dimension of architecture views: Designing, Deciding and Informing. Designing viewpoints support architects and designers in the design process from initial sketch to detailed design. Deciding viewpoints assist managers in the process of decision-making by offering insight into crossdomain architecture relationships, typically through projections and intersections of underlying models, but also by means of analytical techniques. Informing viewpoints help to inform any stakeholder about the enterprise architecture, in order to achieve understanding, obtain
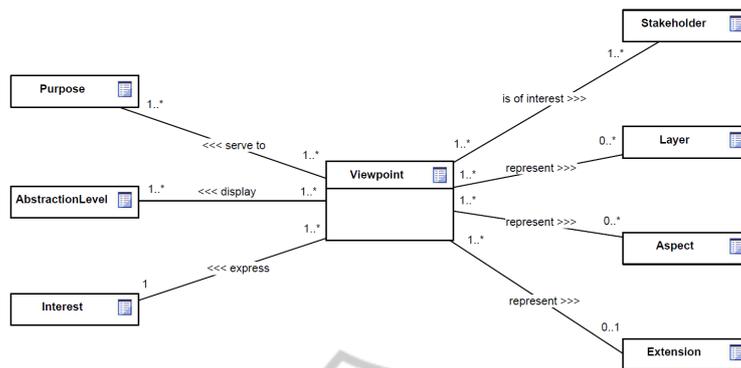
Figure 3: ArchiMate Viewpoint Model in Database.

commitment and convince adversaries (Iacob et al., 2012).

For characterizing the *content* of a view, Archi-Mate defines the following abstraction levels: Details, Coherence and Overview. Views on the detail level typically consider one layer and one aspect from ArchiMate. At the coherence abstraction level, multiple layers or multiple aspects are spanned. Extending the view to more than one layer or aspect enables the stakeholder to focus on architecture relationships like process-uses-system (multiple layer) or application-uses-object (multiple aspect). The overview abstraction level addresses both multiple layers and multiple aspects (Iacob et al., 2012).

Some viewpoints have a scope that is limited to a single layer or aspect. Others have a broader scope and can address more layers and aspects. However, a viewpoint is related to only one enterprise interest. A viewpoint may be related to the extensions defined in ArchiMate. An extension can relate to multiple viewpoints. We show all these relationship in the model presented in Figure 3. This structure was modeled in a database to collect all relationships between the ArchiMate viewpoints and the knowledge areas of the BOKs.

5.2 Bodies of Knowledge Model

The introduced BOKs are structured around knowledge areas. A knowledge area is related to just a body of knowledge. Each body of knowledge cites and / or defines roles related to the activities and good practices detailed in the BOK. A role can be cited and / or defined in multiple BOKs.

Figure 4 shows the structure of the bodies of knowledge with regard to the knowledge areas and roles cited and / or defined. This structure was modeled and built into a database to allow the creation of relationships between the ArchiMate viewpoints and the knowledge areas of the bodies of knowledge.
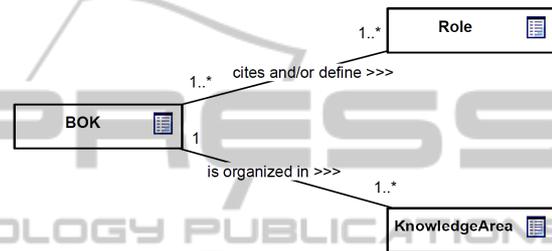

Figure 4: Bodies of Knowledge Model in Database.

5.3 Relationship Criteria and Relationship Model

According to ArchiMate, an enterprise interest can be represented by one or more viewpoints. A particular role has an interest, therefore, is interested in all viewpoints that represent that interest.

ArchiMate defines which stakeholders are interested in a viewpoint. The BOKs cite and / or define roles according to interests, activities, tasks and best practices. In this work, we link interests, viewpoints and stakeholders defined in ArchiMate with the roles cited and / or defined in the BOKs. An interest of a role has been defined, based on the definition of the role by a BOK, and / or the closeness it has with stakeholders defined as interested in a viewpoint representing that interest.

The SWEBOK and the SEBOK define the roles software engineer and systems engineer. They are defined as those interested in software engineering and systems engineering. These roles have the same interests like the roles defined in Rational Unified Process (RUP) (Kruchten, 2003).

Figure 5 shows one example about the groups of interests and viewpoints that represent this particular group and the corresponding interested roles. These interests, viewpoints and roles are represented in the model from the entities "interest", "viewpoint" and "role" respectively, as shown in Figure 6.

Figure 5: Interest Groups - Example with the interest "Business Behavior".

Figure 6: Relationship between the bodies of knowledge and the ArchiMate viewpoints.

Relationship criteria were created to enable the establishment of relationships between the knowledge areas of BOKs and the ArchiMate viewpoints. *Relationship criteria* - If a knowledge area declares a subset, not empty, of the set of characteristics defined by a viewpoint, so a relationship between the knowledge area and the viewpoint can be created.

Restrictions on the relationship criteria: 1 - The subset related to the set of stakeholder can not be empty. The definition of a stakeholder in a knowledge area can be direct or indirect (see interest group). 2 - The subset related to the set of *Concerns* can not be empty. The definition of a concern in an area of knowledge should be direct. 3 - If the knowledge area declares *Purposes*, at least one of them has to be part of the purposes defined in viewpoint. 4 - If the knowledge area declares *Abstraction Level*, at least one of them has to be part of the Abstraction Levels defined in viewpoint. 5 - If the knowledge area declares *Layers*, at least one of them has to be part of the Layers defined in viewpoint. 6 - If the knowledge area declares *Aspects*, at least one of them has to be part of the Aspects defined in viewpoint.

Figure 6 shows the structure of the relationship between the bodies of knowledge and the ArchiMate viewpoints. This structure was modeled and built into a database to allow the creation of relationships between the ArchiMate viewpoints and the knowledge areas of the bodies of knowledge.

5.4 Questions that Can Be Answered From the Model

The constructed model consists of 3 parts: 1 - ArchiMate Viewpoint Model; 2 - Bodies of Knowledge Model; 3 - Relationship between the bodies of knowledge and ArchiMate viewpoints. The physical structure, based on the models, was represented in a database. The relevant information of the Ar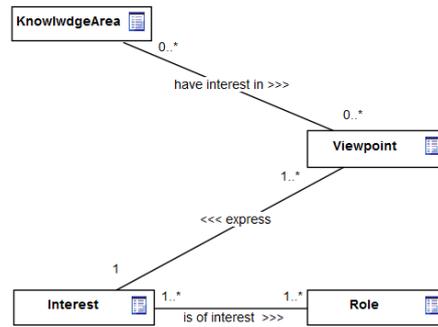chiMate viewpoints, the bodies of knowledge and the relationships between the bodies of knowledge and ArchiMate viewpoints were collected in the database.

Some questions that can be answered from the model. These questions can be answered directly or indirectly. Direct questions can be answered from data that were entered into the database. Data taken directly from the ArchiMate specification or the BOKs specifications. Indirect questions can be answered based on the proposed relationship between BOKs and ArchiMate.

The direct questions that can be answered are divided in two groups: 1 - Direct questions with data from the BOKs and 2 - Direct questions with data from the ArchiMate. Some example questions for group 1 are the following:

- What were the BOKs studied?
- What are the knowledge areas of a BOK?
- What are the roles cited in a BOK?

Some questions that belong to group 2 are:

- What are the stakeholders interested in a viewpoint?
- What are the aspects of the architecture focused by viewpoint? (Concerns, Purposes, Abstraction Levels, Layers and Aspects).
- What are the parts of the enterprise architecture represented by a viewpoint? (Interest)

The competence questions, presented in Section 2, are an example of indirect questions. Other indirect questions are:

- What are the BOKs, knowledge areas and roles interested in a viewpoint?
- What are the layers of interest of a BOK, of a knowledge area, of a role?
- Which is the purpose most often related to a knowledge area, to a BOK, to a role?
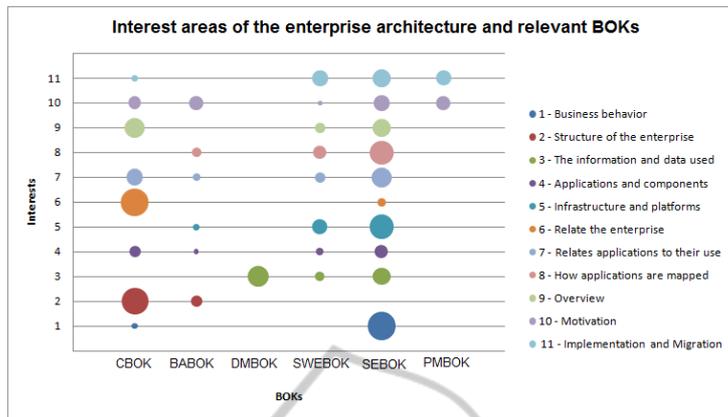
Figure 7: Interest areas of the enterprise architecture and the bodies of knowledge relevant.

6 VALIDATION

In order to validate this approach, we addressed direct and indirect competence questions, as those mentioned in Section 2. From the responses, a report was created that shows how bodies of knowledge are related to the interests of an enterprise.

The criteria presented in Section 5.3, enabled the establishment of relationships between the knowledge areas of BOKs and the ArchiMate viewpoints. A viewpoint is related to one and only one interest, but an interest may be related to multiple viewpoints. For each interest, we tracked all the BOKs who have knowledge areas related to at least one viewpoint linked to the interest. The relevance percentage of a BOK on a particular interest was calculated from the number of links between the knowledge areas of the BOK and the viewpoints linked to the interest.

Figure 7 shows the interest areas of the enterprise architecture and the bodies of knowledge relevant to these interests. The size of the each circle is proportional to the relevance percentage of the BOK to the interest. Analyzing the figure horizontally, we can visualize the bodies of knowledge that are relevant to the enterprise interests. For example, the figure shows that interest 3 (the information and data used) has three BOKs related to it: DMBOK, SWEBOK and SEBOK. Analyzing the figure vertically, we can see what interests are related to the BOKs, e.g., CBOK is related to 8 interests: business behavior, structure of the enterprise, applications and components, relate the enterprise, relates applications to their use, overview, motivation and implementation and migration.

Figures 8, 9 and 10 show each interest area of the enterprise architecture and the bodies of knowledge separately to these interest with the respective rele-
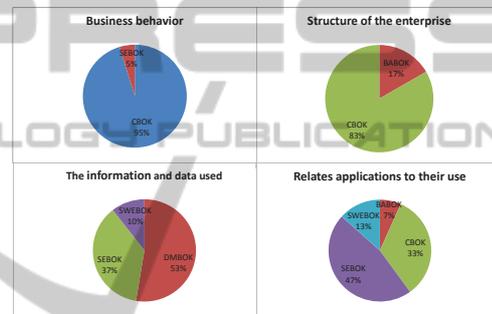

Figure 8: Bodies of knowledge relevant to interests with the respective relevance percentages - Part 1.

vance percentages. We can see separately all BOKs related to a particular interest and their respective percentage of relevance. For example, Figure 8 shows that the business behavior interest is related to the CBOK and SEBOK. The relevance percentage of the CBOK is 95% and relevance percentage of the SEBOK is 5%.

In Section 2, we presented 3 problems: 1 - Lack of knowledge about a particular interest of the organization. 2 - Lack of knowledge about the relationships between interests. 3 - Difficulty of modeling the enterprise architecture.

In the example presented about Problem 1, we described about the issue that professionals, responsible for capturing project requirements, have little knowledge about techniques that perform this activity. According to ArchiMate, the Motivation interest is related to this activity. In this case, the results presented in Figure 9 show that SEBOK, BABOK, PMBOK, SWEBOK and CBOK are related to that interest.

The SEBOK have the knowledge area "Systems Engineering and Software Engineering". The SWEBOK has a knowledge area that talks about require-
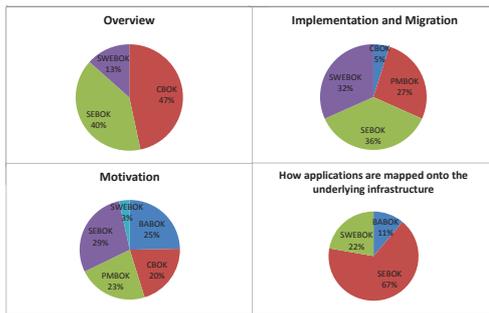
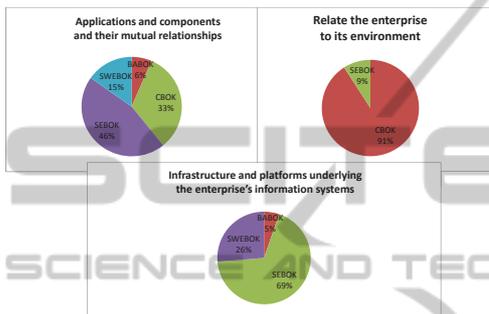Figure 9: Bodies of knowledge relevant to interests with the respective relevance percentages - Part 2.

Figure 10: Bodies of knowledge relevant to interests with the respective relevance percentages - Part 3.

ments elicitation. This area is concerned with the collection of software requirements. It includes requirement sources and elicitation techniques. The BABOK have the elicitation knowledge area. This area describes about preparation for elicitation, conducting elicitation activity, documentation of elicitation results, confirmation of elicitation results and elicitation techniques. The scope management knowledge area in PMBOK describes about the process of defining and documenting the needs of the stakeholders to achieve the project objectives. This knowledge area presents tools and techniques to collect requirements. Finally, the CBOK describes methods for gathering information.

In the example related to Problem 2, we described about the difficulty to assess the impact on business processes from a technological change proposed by a project. This example is associated with two interests of the organization, business behavior and relates applications to their use. The results in Figure 7 show that these interests have BOKs in common, for example, the CBOK.

The CBOK describes about the realization of business process management and has areas of expertise, such as the Process Analysis knowledge area, that explain the need to understand how applications are used to support one or more business processes, and how they are used by other applications.

Lastly, in the example presented about Problem 3, we reported the difficulty of the enterprise architect to know how and where to find the information needed to model the enterprise architecture. By using BOKs to work in a specific interest, activities related to that interest are defined and organized. By using BOKs to work cooperatively on enterprise interests, the points of intersection between the interests can be mapped, allowing to create traceability between artifacts that are part of the intersection. Thus, the use of the BOKs can assist the enterprise architects to locate the artifacts as well as their relationships. For example, the Motivation and Applications and components and their mutual relationships interests, have four BOKs in common. A point of intersection between these interests, based on the BOKs, are the requirements. These BOKs describe about the importance of traceability between requirements throughout the project.

7 RELATED WORK

As mentioned throughout this paper, there are several initiatives to support organizational modeling. The enterprise architectures modeling is reflected in various frameworks for structuring architectures that followed the seminal work of John Zachman (Zachman, 1987) and are proposed or adopted by international organizations of standardization and government organizations. Examples of such frameworks include: Architecture Framework TOGAF (The Open Group Architecture Framework) (Group, 2011); Department of Defense Architectural Framework (DoDAF) (of Defense, 2010); United States Government Federal Enterprise Architecture (Government, 2012); Extended Enterprise Architecture Framework of Institute For Enterprise Architecture Developments (Schekkerman, 2006); Gartner Framework (James et al., 2005); Pragmatic Architecture Framework (Ltd, 2011), RM-ODP reference model of ISO (Reference Model for Open Distributed Processing) (Farooqui et al., 1995); and Architecture ARIS (Architecture of Integrated Information Systems) (Scheer, 1999).

These frameworks help enterprise architectures modeling in practice. They guide, direct and use other methodologies, languages and tools, such as BPMN (OMG, 2013); ArchiMate (Iacob et al., 2012); architecture repositories, business intelligence, modeling and communication.

In this paper (Section 2), we show that is important to know how the enterprise objectives are linked to business processes and the technological structure that supports these processes. Domi et al. (Doumi

et al., 2011), propose an approach for modeling strategic alignment. The approach proposed ensures that the models of the strategy are linked with models of the functional level.

Was not found literature related to the joint use of enterprise architecture and bodies of knowledge specifically. However, there are some works that address a specific body of knowledge for enterprise architecture and other works that address the modeling of some enterprise interests and bodies of knowledge as complementary approaches.

Kandjani and Bernus argue that Enterprise Architecture is an area of interdisciplinary study relies on models, methods and theories of many disciplines. These authors advocate that the EA discipline (EAD), as any other developing discipline, there should exist a commonly accepted terminology, allowing interdisciplinary theories to be stated, which in turn facilitate the creation of cross disciplinary models and methodologies (Kandjani and Bernus, 2012a) and (Kandjani and Bernus, 2012b). The works of Kandjani and Bernus (Kandjani and Bernus, 2012a) and (Kandjani and Bernus, 2012b) have points in common with this work because, like us, they believe that EA is a discipline that has an evolving body of knowledge. As a discipline, EA is related to other disciplines. These disciplines related to EA may have their own bodies of knowledge. Moreover, the authors show that in the context of EA, different domains may have artifacts in common.

Abran, April and Monsalve (Abran et al., 2012) write about the expressiveness of business process modeling notations for software requirements elicitation. They present some propositions to adapt the BWW (Bunge-Wand-Weber) representation model to allow its application to the software requirements elicitation domain. These propositions are based on the analysis of the Guide to the Software Engineering Body of Knowledge (SWEBOK) and the Guide to the Business Analysis Body of Knowledge (BABOK). The BWW representation model is frequently used for assessing the expressiveness of business process modeling notations. This work relates the BOKs, BABOK and SWEBOK, to the some enterprise interests. The BOKs are worked collaboratively in the interests. But the work, unlike ours, does not have criteria for to relate BOKs with the enterprise interests.

In another paper, Abran, April and Monsalve (Abran et al., 2010) show that proposals for new modeling notations emerge and the evolution of current ones are becoming more complex, often in an attempt to satisfy the many different modeling perspectives required by each stakeholder. They present a method to identify the specific notation construct requirements at multiple levels of abstraction, which satisfy the needs of a stakeholder when performing a specific task. Initially the focus is on two different stakeholders: software engineers (SE) and business analysts (BA), and one specific software engineering activity: requirements eliciting and analysis. The specific body of knowledge of the two stakeholders (SWEBOK for the SE and BABOK for the BA) are used to identify each stakeholder specific notation construct requirements, at multiple levels of abstraction in order to propose a simplification of their notation and constructs set. They presents solution avenues to simplify business process modeling notations by identifying the specific constructs preferred by different stakeholders. Similarly to the above work, this work is related to ours because it shows the ability to work collaboratively BOKs into enterprise interests, but interests are not addressed punctually as in our case.

8 CONCLUSIONS

The relationships presented in this work between BOKs and interests of the enterprise architecture enable collaborative use of bodies of knowledge. These relationships can be used as drivers to promote the dissemination of knowledge within each interest area from the BOKs related to this area, as well as dissemination of knowledge about the relationships between these interests. This collaborative use of the BOKs with the enterprise interests, defined in the ArchiMate specification, facilitates the modeling, visualization and understanding of enterprise architectures.

How correlated work, a study will be conducted to verify which support processes, executed in organizations, can help the building of enterprise architecture. This study takes into consideration the architectural subdivision proposed by TOGAF. The TOGAF divides enterprise architecture in 4 sub-architectures: Business, Application, Infrastructure and Data. The study, based on state of the art, will verify which support processes are capable to assisting the construction of each sub-architecture.

As a complementary part, a new study will be conducted, based on the results presented in this paper to determine how the bodies of knowledge can help create and improve these support processes and the relationships between them. The end result will be applied in a real organization, with the aim of improving support processes and promote communication and traceability between them to support the modeling, construction and maintenance of enterprise architecture. This will be done in the context of a drugstore.

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REFERENCES

ABPMP (2013). *Guide to the Business Process Management Common Body of Knowledge: ABPMP BPM CBOK®*. Association of Business Process Management Professionals.

Abran, A., April, A., and Monsalve, C. (2010). Representing unique stakeholder perspectives in bpm notations.

Abran, A., April, A., and Monsalve, C. (2012). On the expressiveness of business process modeling notations for software requirements elicitation.

Brackett, M. and Earley, P. S. (2009). *The DAMA Guide to The Data Management Body of Knowledge (DAMA-DMBOK Guide)*.

Doumi, K., Baïna, S., and Baïna, K. (2011). Modeling approach for business it alignment. In *ICEIS (4)*, pages 457–464.

Farooqui, K., Logrippo, L., and deMeer, J. (1995). The iso reference model for open distributed processing: an introduction.

Government, U. F. (2012). *The Common Approach to Federal Enterprise Architecture*. U.S. Federal Government.

Group, T. O. (2011). *The Open Group Architectural Framework (TOGAF Version 9.1)*. The Open Group.

Hilliard, R. (2000). Ieee-std-1471-2000 recommended practice for architectural description of software-intensive systems. *IEEE*.

Iacob, M., Jonkers, H., Lankhorst, M., Proper, E., Quartel, D., et al. (2012). Archimate 2.0 specification.

IEEE Computer Society (2004). *Software Engineering Body of Knowledge (SWEBOK)*. Angela Burgess, EUA.

IIBA (2009). *A Guide to the Business Analysis Body of Knowledge*. International Institute of Business Analysis.

James, G. A., Robert, A., Handler, A. L., and Nicholas, G. (2005). Gartner enterprise architecture framework: Evolution 2005.

Jonkers, H. et al. (2003). Architecture language reference manual. *Telematica Instituut*.

Kandjani, H. and Bernus, P. (2012a). The enterprise architecture body of knowledge as an evolving discipline. In *ICEIS*, pages 452–470.

Kandjani, H. and Bernus, P. (2012b). Evolution of enterprise architecture discipline - towards a unified developing theory of enterprise architecture body of knowledge as an evolving discipline. In *ICEIS (3)*, pages 145–154.

Kruchten, P. (2003). *The Rational Unified Process: An Introduction*. Addison-Wesley.

Lankhorst, M. (2005). *Enterprise architecture at work: Modelling, communication and analysis*. Springer.

Ltd, P. E. (2011). Peaf - overview.

of Defense, U. D. (2010). *DoD Architecture Framework (Version 2.02)*. U.S. Department of Defense.

OMG (2013). Business process model and notation (bpmn).

Papazoglou, M. (2003). Service-oriented computing: concepts, characteristics and directions. In *Web Information Systems Engineering, 2003. WISE 2003. Proceedings of the Fourth International Conference on*, pages 3–12.

PMI (2013). *A Guide to the Project Management Body of Knowledge: PMBOK Guide*. PMI Standard. Project Management Institute, Incorporated.

Pyster, A., Olwell, D., Hutchison, N., Enck, S., Anthony, J., Henry, D., and Squires, A. (2013). *Guide to the Systems Engineering Body of Knowledge (SEBoK) version 1.1.2*.

Scheer, A. W. (1999). *ARIS Business Process Modeling*. Springer.

Schekkerman, J. (2006). Extended enterprise architecture framework essentials guide.

van Hee, K. M. et al. (2004). *Workflow management: models, methods, and systems*. The MIT press.

Zachman, J. A. (1987). A framework for information systems architecture.