Knowledge Management Framework for Early Phases in TOGAF-based Enterprise Architecture

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Abstract: Consulting firms in enterprise architecture that develop projects through the TOGAF framework may generate valuable knowledge from project to project. However, for this knowledge to create value, it must be supported by an effective ability to capture, store and reuse it. This paper proposes a knowledge management framework focused on TOGAF initial phases to enable reusing lessons from previous projects. Through a specific meta-model, it offers "ways of" thinking, working, supporting, controlling and modelling this process. As a result, we present some steps to develop knowledge management in TOGAF-based enterprise architecture projects through a case study in a consulting firm.

1 INTRODUCTION

Enterprise Architecture (EA) is a discipline that is defined as "a coherent set of principles, methods and models used in the design and/or implementation of an organizational structure, business processes, information systems, and infrastructure" (Lankhorst, 2012). This discipline involves and requires the effective use of both tacit and explicit knowledge, related to both client and consulting companies. Due to the complexity of this knowledge, companies need a flexible processes that allows them to adapt themselves as such knowledge evolves (Arango Serna et al., 2011).

Of existing EA frameworks, TOGAF –The Open Group Architecture Framework– stands out, due to its world-wide acceptance and use. This framework proposes several phases to follow, including two early stages: preliminary and phase A (architecture vision). These phases provide the initial knowledge that allows supporting the rest of the enterprise architecture exercise, requiring crucial knowledge management processes, such as identification, acquisition, and development (Struck et al., 2010). Moreover, resulting knowledge in EA consulting firms may become their most valuable resource.

TOGAF has an associated lifecycle to develop the enterprise architecture called "Architecture Development Method " - ADM (The Open Group, 2009), that presents specific steps that generate information which can be converted into knowledge in order to be used by the client as well as the consulting firm. When a company doesn't have a model or policy for knowledge management, its knowledge can be lost or not effectively re-used.

This article provides a research proposal, based on knowledge management, to support communication, transmission and appropriate use of knowledge for decision-making. It gives support to the patterns of enterprise architecture management, such as the definition of methodologies, visualization and representation of information models (Ernst, 2008). Thus, by using management services centered on explicit knowledge generated through ADM within the TOGAF frameworkand stored in the architecture repository, it allows effective governance ot the implementation process.

This paper presents the research problem, the methodology used, followed by the presentation of the case study used as application domain. In the next section, the article shows the proposed knowledge management framework and its composition.

Finally conclusions and future work derived from the project are presented.

2 RESEARCH APPROACH

This section has two parts: the explanation of the research problem and the methodology used to face it.

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2.1 Research Problem

TOGAF enterprise architecture is supported in the ADM method (The Open Group, 2009). In each phase, a number of deliverables and associated knowledge is generated, but it may become lost or not effectively reused, due to lack of monitoring in consulting firms. This knowledge is important due to the possibility of taking advantage of it in later enterprise architecture projects. Information that becomes knowledge, by being linked to experience, will help to deal with future projects, allowing the project manager to not repeat the same mistakes or indeed to take advantage of good practices identified in previous projects. These good practices will guide the development of new activities, for instance, in activities applied to government-related projects or within the same industry sector.

The initial phases of TOGAF are a particularly rich source of potentially valuable knowledge. In the preliminary phase of TOGAF-ADM, the EA group defines the project's goals and expectations according to the aims and vision of the business and the definition of stakeholders, their requirements and priorities. All this implies a process of knowledge identification and acquisition related to frameworks, methodologies and other tools that support the rest of the project. After defining this initial stage, the architecture vision goes on to further specify knowledge from the point of view of business, data, application and technology (Struck et al., 2010). However, there is no evidence of effective future use of these outputs in future projects in a governed and systematic fashion, attached to ADM.

Although enterprise architecture is often supported in knowledge management tools through the implementation of enterprise wikis or digital libraries that allow information retrieval (Tu et al., 2012; Fiedler et al., 2013), and other kind of project-oriented search-based tools for enterprise architecture management (Anajafi et al., 2010), EA has not been sufficiently supported in tailored knowledge management processes.

The contribution of this paper is aimed at communicating and/or transferring knowledge for EA decision-making. This decision-making may be reflected, for instance, in activities such as reviewing the current architecture (Buckl et al., 2010) or in supporting the patterns of enterprise architecture management, like methodologies definition, visualization and representation of information models (Ernst, 2008). This flow of knowledge is a special challenge because of the number and diversity of stakeholders.

Likewise, it is important to manage the generated artifacts as an important part of the enterprise architecture, which are usually stored in the architecture's repository. The problem is that often these repositories are no more than that, a repository where the results of each activity are stored, but do not inform future decisions based on reuse or socialization. Therefore, the use of explicit knowledge management services integrated in the process of ADM - TOGAF, coupled to the repository, should allow the implementation of an effectively governed architecture where the knowledge acquired is exploited beyond the scope of a single project.

2.2 Research Methodology

The research methodology adopted is design science research as a methodology for the design and development of information systems (Peffers et al., 2007), where the designed artefact in our case is the framework for EA knowledge management. In Peffers et al., the process is effectively completed once the artefact is demonstrated, validated and communicated.
For this reason, the development of this project was implemented through this methodology, which focuses on solving real-world problems through a 6-phase approach:

- Identify the problem and motivation
- Define solution objectives
- Design and development
- Demonstration
- Evaluation
- Communication

Development and validation of the solution was done iteratively around the following artefacts: knowledge maps, knowledge processes, process models of the preliminary and architecture vision stages and the overall knowledge management framework.

Specific development of the research method is described in sections 4 and 5.

2.3 Case Study

Development of the knowledge management framework was carried out in the context of a large IT and EA Colombian consulting firm, Indra Colombia, in relation to their TOGAF-based EA consulting projects. Indra is a multinational company with headquarters in Spain and its main core is generating innovative IT services and

solutions. These services are delivered in line with management strategies of customer needs through consulting, development and project management, integration and implementation solutions and outsourcing of information systems, in sectors such as: transport and traffic, energy and industry, public administration and healthcare, financial services, security and defence and telecom and media (Indra, 2014).

Indra has offices in 138 countries with a total of 42 thousand professionals approximately. The company has presence in Latin American countries including Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, El Salvador, México, Panamá, Perú, Uruguay and Venezuela (Indra, 2014). Indra has an 18 year presence in the Colombian market, currently with more than 2000 professionals and 7 offices in Bogotá, Pereira, Barranquilla and Medellin, with solutions and services in cloud computing, outsourcing of BPO (business process outsourcing) and networks and telecommunications, with major clients in the public and private sector. Our scope is focused on EA consulting, which has mostly been oriented to the financial, healthcare and public sectors.

Our first step was getting to know their EA processes. To describe those processes, we gathered information through meetings (1 hour each) with the consulting area manager, leaving as evidence the minutes of each one of them. In these meetings, we uncovered their enterprise architecture processes already undertaken through documents resulting from projects and proposals previously made by the consulting area.

After having the information of the company processes, we matched them against the activities proposed by TOGAF, in order to identify which tasks were completely carried out, which ones were not and which ones could be most amenable for knowledge management.

Subsequently, we analysed documents (proposals and enterprise architecture artefacts), complemented with informal interviews and direct observation of the activities carried out to fully address explicit and tacit knowledge considerations.

3 PROPOSED FRAMEWORK

In this section, we describe how we designed the knowledge management framework (KMF).

3.1 Why a Framework?

The main task for the design of a KMF is the definition of its purpose.

The initial premise of this research is to enable the use and reuse of knowledge. This was motivated by the aim of speeding up the development of the initial phases of an EA project in order to generate knowledge to provide innovation in new proposals of projects (to reuse knowledge and improve upon it). After that, we wanted to manage processes of knowledge generation and its storage. To do this, the framework was instantiated in a prototype, allowing its use and validation. With this prototype, the extraction and dissemination of knowledge were enhanced. The prototype was structured around the early stages of TOGAF trying to maintain or improve delivery times. Indeed, it is important to note that while reuse, per se, is often a time-saving strategy, knowledge management activities that enable such reuse may, by contrast, take up a significant amount of time, which is partly the reason why in practice it is not often found to a large extent.

To meet these goals, first we seek to identify the elements that generate information, through use of ontological engineering and other knowledge management methods, abstracted using the "Ways of" meta-model (Land et al., 2009). In this meta-model, we identified the tasks to develop both the knowledge management framework as well as the prototype, the way these tasks are modelled, the languages to be used for development and how to control the outcome. The complete "Ways of" meta-model guiding our framework is presented in section 4 of this document.

3.2 Knowledge-generating Entities

The description of the entities associated with knowledge and learning processes were based on the case study. In this description, we identified two components: the first begins with personal interaction to gather information from face to face meetings, which may be with the consulting firm or the client company. The second was focused in the acquisition and storage of the artifacts generated by each activity. In table 1 we describe the spaces or objects used for information generation, which is associated with the enterprise architecture in the selected phases (see Table 1).

Table 1: Enterprise architecture information.

Object	Description
Personal relationship	For the development of the early stages of TOGAF, people involved create efficient communication, but knowledge is often in conversations and reuse is not possible.
E-mail	E-mail as a tool used to obtain information from customer or to exchange information among those involved in the project.
Previous proposals	We take information from development of proposals already made that were approved or not.
Success cases	Among the projects already developed, it is important to identify success stories that can provide feedback to be used in future projects. This will include artefacts generated in previous projects, and unrealized (projects in which the company made proposal but were not developed, yet contain useful information).
Lessons Learned	In each project proposal, which was developed or not, the project generates some lessons learned in order not to make the same mistakes, if any.

3.3 Meta-model Framework

To develop the framework, we selected the "Ways of" meta-model because this is an appropriate way of abstracting the results of an EA processes, according to (Land et al., 2009). With this meta-model, used as a template, we described how the framework was generated, how it should be used and how it will be supported by IT elements.

Based on this model, we start by describing *the way of thinking*, which shows the understanding of the domain in which the framework will be applied in relation to the issues raised. This *way* helps to understand how processes can be modelled and to take a broad view of the solution.

We also include the *way of modeling*, which identifies how a process is modeled and what language is used for it, the activities and tasks of the framework, as well as identifying the relationship between them.

The *way of working*, is the next step, it describes what tasks are performed in the framework and their order.

The *way of controlling*, indicates the tools that enable monitoring how the framework objectives are being fulfilled, based on the use of resources.

Finally, *the way of supporting* determines the IT that will be used to support the tasks and/or activities in the framework.

The design of this knowledge management framework focused on the first two phases of TOGAF-based enterprise architecture, known as preliminary and Phase A. Vision Architecture.

These stages were chosen because they are sequential and are the initial phases of ADM. This allows developing a knowledge management process of an enterprise architecture project since its inception and with often more reusable content than later stages.

4 A KNOWLEDGE MANAGEMENT FRAMEWORK FOR ENTERPRISE ARCHITECTURE

In this segment, we describe the five “Ways of” that constitute the framework: thinking, modelling, working, controlling and supporting.

4.1 Way of Thinking

The “way of thinking” is designed for the first phases of TOGAF, *preliminary* and *architecture vision*. The aim in the first one (preliminary) is to build the bases needed in order to start the enterprise architecture project, that is, in this phase we define the “where, why, how and who” to build the architecture. The aim in the second one (architecture vision) is to define and validate the principles, goals and strategies of the business. After having this business information, the next step is to determine the architecture’s principles (The Open Group, 2011).

Based on (Rus and Lindvall, 2002), the framework focuses on three main activities: *i)* Accessing knowledge (A), *ii)* Obtaining knowledge (O) and *iii)* Sharing knowledge (S). Those activities are matched against TOGAF’s first and second phases, as shown in Tables 2 and 3, which shows the main activities proposed by TOGAF for the preliminary and vision phasesalong with the knowledge processes to be managed. Both Table 2

and Table 3 use the letters A, O and S, as previously described.

Table 2: Activities in preliminary phase.

Define enterprise	Identify enterprise's elements	Define framework to use	Define tools and infrastructure	Define architecture principles
A	A			
O		O	O	
S		S	S	S

Table 3: Activities in architecture vision.

Define goals	Define architecture's scope	Define requirements	Define value proposal	Create management plan	Identify the impact
					A
O	O	O			
S			S	S	S

4.2 Way of Modelling

This framework includes activity modelling through the BPMN notation. This notation describes the way current processes are managed; this is needed in order to use it in the rest of the framework. The second step of this "Way of modelling" is to classify knowledge through the ontologies generated from the information of existing proposals. The modeling of knowledge through ontologies identifies the stakeholders who generate, access and use knowledge. It also identifies the knowledge that should be managed within the framework, the artifacts used and/or generated, and the relationship between them. In addition, ontologies are used to identify information that must be stored and displayed within the lessons learned system.

As this project is based on TOGAF's preliminary and architecture vision stages, we modelled the processes in those phases in order to identify those processes that are susceptible of management within the KMF. In this way, we could identify if there were changes on them that could affect current processes. Unfortunately, given the confidential nature of some of these processes, they cannot be explicitly reported.

The third step is taking into account the way in which knowledge is stored and/or made available. This is important because the documentation of every phase of ADM in TOGAF should be classified and the resulting knowledge must be available easier and faster for the rest of the process.

4.3 Way of Working

According to the activities identified in TOGAF-based proposals for EA projects, the "way of working" has five tasks described below. The first task is the classification of the architecture principles used in each project as well as the business requirements. The classification of the architecture principles identifies which of those principles can be reused. This classification also includes the type of business of the company for which the EA is done, the size and the scope of the project and if this project was planned or integrated with other EA frameworks. These characteristics are transformed into tags in the classification system. The other category, the business requirements, allows the reuse of existing solutions for similar requirement types.

The second task is designed for supporting the knowledge generation process, taking advantage of the results of the first task. Here, a classification of previous completed projects (with varying degrees of success), as well as proposals not carried out, is created. To do that, we take into account some factors (the tags of the classification) like financial success, development time, best practices, customer satisfaction, among others. This classification is supported by the first task. This process supports knowledge traceability, relating it with the projects in which it was generated.

The third task is oriented to reusing the knowledge. In this task, and taking the results of the first and second tasks as inputs, we identify the assigned roles for each project in order to know how they are intervening in each kind of project; in this way, we can have them on the "work table" for future projects.

Those tasks describe how the knowledge we have about projects under development or already developed is managed within the KMF, but this must be supported by a process of knowledge capture and storage, which allows obtaining knowledge in an orderly manner for subsequent optimal search. That's why we define the following two tasks.

The fourth task generates an orderly way to face the process of knowledge capture, focusing on the ADM activity in order to know the user company and to validate its mission, vision and goals. At this point, we use some of the information generating objects like emails, the user company web page and interviews of the members of the company in order to identify and classify in which project they were used.

The last task addresses the process of knowledge storage in order to facilitate its access, taking

account the typical knowledge flow and maintaining its quality. Here we take advantage of the classification of the last task in order to keep the information generating objects (i.e. codified knowledge sources) according to their respective project.

4.4 Way of Controlling

According to (Fairchild, 2002), knowledge management performance may be placed in the context of the Balanced Scorecard. As such, they provide a method to measure the projects done for a company around the evaluation of four perspectives: financial, customer, internal processes and development and learning. This method controls a knowledge management process based on the intellectual capital to, in our case, align the strategy of the enterprise architecture area with the KMF which is been proposed.

This intellectual capital is monitored from the employee's perspective (financial perspective) of the project roles which manage knowledge and the roles which generate, make available and use knowledge in order to avoid the creation of personal dependencies when someone needs access to it. The customer perspective will be evaluated from the point of view of successful projects, especially according to codified factors and executed proposals. The internal processes perspective in this case includes the selected phases of TOGAF: the way in which these phases are currently done, the way in which we propose do them with the KMF and the technology (last perspective) will be faced from the point of view of the KMF's support in information technologies tools, which are presented in the next section. These perspectives may incorporate specific performance assessment tools, such as process mining for the internal perspective, customer satisfaction for customer perspective, financial performance for the financial perspective and acceptance and success models (e.g. TAM or DeLone and McLean) for the learning and development perspective.

4.5 Way of Supporting

The "way of supporting" of the KMF is about the instantiation of the framework in a KMS (Knowledge Management System) prototype. In the next sections, we describe the tools and resources used to design and build the prototype.

4.5.1 Definition of KMS

This definition is given by three phases: i) existing search tools to support the knowledge management framework and the degree of encoding of the information within it; ii) identification of tools or technologies to support the activities described in the way of working; iii) definition of the system architecture to provide a reference model for the KMS implementation.

4.5.2 Existing Tools

According to the case study, we found tools currently used to support the initial phases of an enterprise architecture project based on TOGAF. These tools are presented in Table 4.

Table 4: Existing tools.

Tool	Use description
Search in company web page	In the early stages of TOGAF we seek to understand the company to which the project of enterprise architecture is implemented, for that reason, often this information initially is searched in the pages of customers. Besides that, we need to define the use of certain technologies of information for the support to the final architecture.
Email systems	Through emails the company requests and provides information throughout the process in early stages.
Repository	In the study case, currently the company has a system for documentation management supported on a SharePoint server, but in this certain documents some there are some documents without any specification or order. Additionally, many documents are also stored for each role in each of the computers they use. In these repositories the company has a series of documents in which the learned lessons from each project are reflected, initially during the generation of the proposal and later in the project.

4.5.3 New Tools or Technologies

In order to understand what kind of tools we needed in our framework and to comply with the requirements presented during the meetings with experts from the area EA of the company, we searched for tools in order to support the framework and its validation through the development of a software prototype. This search allowed us to find tools to classify information such as tagging,

representation of information, lessons learned systems, and enterprise repositories. Among the tools that use tags we identified, as an important characteristic, the need for collaboration between users to share knowledge through keywords. Such collaboration allows an enterprise to have a classification evolve from emergent patterns, because some users will have more tags than others (Golder and Huberman, 2006). The use of tagging can be used by technologies such as "entity linking", this is used in the framework called UnBWiki. UnBWiki identify in a text entities and words to get your relationship automatically (Monteiro et al., 2015).

Some of these tools can also be visual browsers such as Yasiv for Amazon (amazon, 2012), weave (University of Massachusetts Lowell, 2015), Gephi ("Gephi - The Open Graph Viz Platform," 2010), NodeXL (Microsoft, 2015), d3 data-driven documents (Bostock, 2015). These visual tools gave us some ideas to represent graphically the obtained information in the first and second tasks in the way of working of our framework. The goal is to show these classifications according to their labels and easy search.

Finally, we propose lessons learned systems in the development of the prototype. For instance, the Knoco System (Knoco, 2014), shows that we can have services such as design, capture and learning obtained from the analysis of lessons.

This search helped us to decide that prototype should not affect the development time of current EA projects. For this reason, a system of lessons learned must be generated rapidly at the end of each project to provide feedback.

4.5.4 Development of a KMS Method

We propose to use ontologies as the principal tool to the development of KMS that supports the framework. These ontologies will be made from the combination of the ontologies development methods like "Methontology" –it's a method to generate ontologies from scratch– (Corcho et al., 2005) and "On-To-Knowledge" –it's a methodology to build systems from ontologies– (Corcho et al., 2006). The methods have some activities that complement each other and give dynamic to the project because it need prototyping and refinement from expert analysis (Asunción Gómez-Pérez et al., 2004).

4.5.5 KMS Architecture

To define the architecture that will support the framework, we validated those that are applicable to the project because of the size and scope of the initial TOGAF phases and proposed by (Maier, 2007). The architectures proposals were: i) task-based, ii) centralized and iii) distributed (view table 5).

Table 5: Architectures for KMS.

Architecture	Description
Task-based	This architecture allows modular KMS from the context, the articulation of tasks and processes, through a workflow, describing and classifying information sources, generating information acquisition, all supported by good management technologies information (Maier, 2007). With the use of this architecture, we could take advantage of workflow management, context, and resources where the information comes. It will enable reuse these information for the organization.
Centralized	This architecture can be exploited using a single server that allows access of information to all users of the project, taking account the high number of customers and of projects developed and will develop, (Maier, 2007). This allows consolidate knowledge and is useful for knowledge management of small segments of the organization, requiring an infrastructure with high availability and processing especially when the information sources are very high.
Distributed	It can generate KMS with direct communication between each of the members of the project from a peer-to-peer approach, where you can have instant messaging, document sharing and use of collaboration tools, but it must be supported by a systematic order, which allows reuse of knowledge.

5 VALIDATION OF THE KNOWLEDGE MANAGEMENT FRAMEWORK FOR ENTEPRISE ARCHITECTURE

After the framework was designed, we made its validation with the aim to verify its behaviour in the process of building a real enterprise architecture. This validation was made based on (González R. and Sol, 2012). The actual KMS prototype as a software tool will be reported elsewhere.

5.1 Construction and Validation of a Prototype with the Technology Acceptance Model - TAM (Varela et al., 2010).

In this phase, we developed a prototype to verify if the knowledge management of the lessons learned was possible in a process of EA construction. This prototype was implemented in the case study company and we applied a survey that was developed based on TAM. This survey had the aim of identifying the utility and ease of use of the framework, as perceived by the user. These perceptions helped to identify the attitude towards use and the use intention.

The prototype is a software that graphically represents the learned lessons obtained in the development of enterprise architecture projects. These lessons are stored and sorted by description, status, date of generation, phase in which it was presented and / or project. This storage is done inside the software through to enter, edit or delete the lesson's information. After having lessons, the software allows filtering them based on each item of classification. The result of this search is a graphic relationship between related lessons. For instance, two lessons generated in the same phase of EA will be linked. Those links generate a relationship graph of lessons where each kind of data has a different color: a link between two lessons generated in phase A will have a different color than a link of lessons generated in the preliminary phase. All this helps to understand what kind of lessons exist and how they are related inside an enterprise context.

5.2 Enterprise Architecture Experts' Opinion

During the development of the framework and its validation, two case study company experts provided information about real EA projects and gave us some requirements on knowledge processes. In addition, they performed a validation of both the framework and the prototype.

The experts were an engineer, enterprise architecture senior consultor on the study case company and a consulting area manager of enterprise architecture and member of the research committee of The OpenGroup - Latin America, who is in charge of the TOGAF's internalization.

The developed framework was presented to these two experts and they could use the prototype too. Their opinions were:

- The knowledge management of the prototype is really helpful to the company.
- They highlighted the visual facility and the use facility of the prototype in order to manage the lessons learned, especially because it generates a unified structure to identify best practices and minimizes errors. Also, this improves the availability and use of the lessons learned and identifies the lessons with relationships they have in common in order to define actions that must be repeated or mistakes that should not be repeated.
- Having a knowledge management process in order to access, obtain and share knowledge systematically enables feedback about the lessons learned in each of the projects.
- Once you have used the prototype, it is possible to determine that the use of a KM of completed or in progress projects are helpful for starting a new one.

In addition, the framework and its validation supports the management of knowledge gained in the development of the selected phases. Also, we found that once the prototype was used by experts, the requirements presented by them could be satisfied without significant additional workload or time.

6 FUTURE WORK AND LIMITATIONS

The prototype was designed with two main limitations. First, the limitation to the two first phases in TOGAF, and, second, an expert validation based on potential (not actual) utility.

As future work, we propose the application of the framework in a full EA project. The next one is to obtain conclusions not only with expert's

opinions, but also with measurement certain of indicators set for an EA project. Also, the framework can be extebnded to other phases of EA proposed by TOGAF, so that more knowledge processes can be identified and managed. Finally, we propose that the KM system use semantic web technologies to generate knowledge from documents, text, emails, among other artifacts developed in previous EA projects.

7 CONCLUSIONS

To identify the knowledge creation in consulting in a technology company's projects, focused on enterprise architecture, we defined which of these processes are susceptible for knowledge management, giving to the EA area the chance to reuse knowledge to their advantage.

Working with an important company of EA projects, based on TOGAF, as case study for improving knowledge management we were able to design, build and validate a knowledge management framework, using real cases.

This framework supports the generation of knowledge, in this case for the initial TOGAF phases, to later retrieve that knowledge that is valuable for the company and use it to make decisions in subsequent proposals. This supports a cycle of knowledge management that allows to company to know its processes, the way how they are developed and the way how the company can implement the framework in order to do the processes better.

The knowledge processes are improved through the proposed cycle in the framework, because this framework organizes the identified knowledge in the initial phases through tagging and ontology engineering. This cycle generates, reuses, adds and stores knowledge, because it is aligned with the company's current processes that are in turn defined by a standard TOGAF framework. These proposed processes did not generate extra work for the company because they are embedded in the "normal" processes; for that reason, we propose the use of the framework in order to support EA knowledge management in an orderly and productive way.

In the end, we learned that studies about KM must count with a well-defined delimitation to support its development in order to get an integral management of the selected processes, because working with whole organization or all its projects can bring problems about the specifications for an KM because of the amount of data, information, knowledge and/or resources. As to the obtained results, the KM framework's validation with a software protoype also enabled potential users, who are not experts in KM, to understand how knowledge can be managed in a tangible way, getting visible results for the organization's EA area.

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