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# Process-oriented Knowledge Representation of the Requirement Management Phase of TOGAF-ADM: an Empirical Evaluation

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## Abstract

The Open Group Architecture Framework (TOGAF) is one of the most used by large-scale companies Enterprise Architecture (EA) frameworks. It contains the Architecture Development Method (ADM) to represent knowledge used to analyze and build the EA for an organization. It is a very detailed method and covers all phases of EA construction and maintenance. However, the described guidelines are hard to follow as they are rich and numerous. Our goal is to provide a process-based knowledge representation of the ADM method to better guide EA professionals using TOGAF and to facilitate the TOGAF teaching with students. In our previous work, we have already proposed the process-oriented graphical representation of the requirements management (RM) phase of TOGAF-ADM. In this work, we carried out a questionnaire to evaluate the process representation of the TOGAF-ADM RM phase in comparison with its textual representation issue from the TOGAF documentation. The obtained results confirmed that process models are helpful to better represent the knowledge included in TOGAF-ADM textual guidelines; thus, practitioners have a more complete description of how to proceed while using TOGAF.

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## 1. Introduction

TOGAF (The Open Group Architecture Framework) is one of the most applied frameworks for building Enterprise Architectures (EA) inside current organizations, especially for large-scale companies, which need very detailed support to build and maintain their architecture. The goal of TOGAF is to provide a method to develop and maintain the enterprise architecture in an organization aligned to its strategy [1]. To properly characterize an enterprise, TOGAF considers three complementary perspectives: Business Architecture, Information Systems Architecture (Applications and Data Architectures), and Technology Architecture. Therefore, the Open Group framework allows enterprise architects to develop a consistent, feasible, and integrated model from the business, information systems, and IT infrastructure perspectives of any enterprise.

Since the process of architecting an enterprise is technically complex and the design of heterogeneous, multi-perspective architectures is not easy, TOGAF provides the method ADM (Architecture Development Method) that aims to help users while building an enterprise architecture according to project needs. ADM has been conceived as a generic method that can be used in many and different kinds of organizations and contexts [1]. This method is represented in TOGAF-ADM documentation through textual guidelines. TOGAF does not contain any diagram to describe the content of ADM phases. Textual guidelines in general are considered as hard to read and apply [2]. On the contrary, a graphical process representation is very useful to communicate the content and the guidelines in a more efficient way [2].

Our goal is to facilitate the usage of ADM-TOGAF by providing its visual process-based representation for two different publics: EA professionals and students. In a previous work [3], we converted the Requirements Management (RM) phase of TOGAF with BPMN (Business Process Model and Notation) [5] into a graphical representation, that was validated with a group of engineering and master students. The main result of this qualitative validation was that the time needed to read, understand, and adapt method textual guidelines almost doubled the time needed to read, understand, and adapt the proposed process model guidelines. After this experience with students, the time required for understanding what they might do before they have to do it was a key factor for well adapting the ADM RM phase to each of their particular project situations. Therefore, in this context, we consider that visual process models provide better representations of the knowledge described by textual guidelines.

In this paper, we continue this research direction, and we present the results of an empirical evaluation of the TOGAF-ADM RM process models. The goal of the given evaluation is to reinforce prior validation; this time, with a different group of potential users in order to assess the process models representation usefulness for describing the ADM textual guidelines. The results will support the decision of delivering process models representations for the whole TOGAF-ADM, thus, to help to simplify its comprehension and adaptation to different enterprise architecture project contexts. We used the research methodology reported in [4]: we formulated the research questions and prepared a questionnaire that we have sent to IT professionals, researchers, and students. We have gathered 53 answers and obtained quantitative results with several additional qualitative remarks.

The paper is organized as follows. Section 2 presents the related works. Section 3 details the process model of the TOGAF-ADM RM phase. Section 4 outlines the used research methodology. The results are given in Section 5. In Section 6, we sum up different findings. Finally, Section 7 concludes the paper.

## 2. Related Works

In their work [3], the authors reviewed enterprise architecture project development literature. They included main ADM-RM reported works and practices as well as some guidelines provided by some EA supporting tools. However, we did not find any practical or research work offering additional help to understand and implement the ADM phases.

Among the most concerned to the problem of guidelines while developing an EA project we cite: the framework TOGAF-SABSA [6], which describes the integration of both perspectives TOGAF and SABSA® (Sherwood's Applied Business-driven Security Architecture) showing how the requirements management processes in TOGAF may be complemented with the SABSA concept of Business Attribute Profiling. The guidance support provided by this integration concerns enabling efficient management of enterprise architecture security requirements: business and risk management and, secure architectures to support business outcomes; the Enfocuss Solutions [7] work

specialized on EA modeling and management service-oriented tools for enabling the capture, development, and traceability of architecture requirements; the EA (Enterprise Architecture) tool and guidelines provided by Sparx Systems [7] that supports ADM requirement activities by providing facilities for manipulating and producing method inputs and outputs artifacts; Additionally, we cited some others modeling tools like iServer for EA from Orbus Systems, Abacus, BiZZDesign, etc., that put into service the OMG ArchiMate notation concepts and other visual notations for facilitating the production and management of artifacts used by ADM phases, including inputs and outputs of the Requirement Management phase.

We also revised some other proposals and practical works where authors expose different ways of managing enterprise architecture projects and EA requirements, like the works of [8] [9] [10]. However, those works present sets of textual guidelines and practical tips, without any proposal of formal or semiformal models allowing to better understand ADM guidelines and, consequently, to facilitate tailoring the ADM Requirements Management process.

### 3. Process-Oriented Visual Representation of the Requirements Management Phase of TOGAF-ADM

The activities of the Requirements Management Phase were described at two abstraction levels [3]: high-level process and detailed level process using BPMN [5]. For instance, figure 1 (from [3]) shows the detailed activities of the Requirements Management phase of TOGAF-ADM using BPMN [5] and the Bizagi Process Modeling Tool. This model contains two pools corresponding to the RM phase and the other ADM phases interacting with RM and the detailed activities inside two pools. As it is described by the ADM guidelines, RM is the core of the method. Thus, it has relationships with almost all ADM phases. RM phase receives inputs coming from Preliminary, Architecture Vision, Business Architecture, Information Systems Architecture, Technology Architecture, Opportunities and Solutions, and Migration Phases. Any of these inputs may reach the RM phase at a different moment while executing an ADM cycle. The detailed process model also represents the sequence flow between different activities of the same pool and the message flow to show the data exchange between two pools and with the requirements repository. The activities are numbered to show their order in the TOGAF documentation. A detailed description of this process could be found in [3]. The sub-processes as well as the representation of the ADM-RM phase at a high abstraction level are not presented here for lack of space.

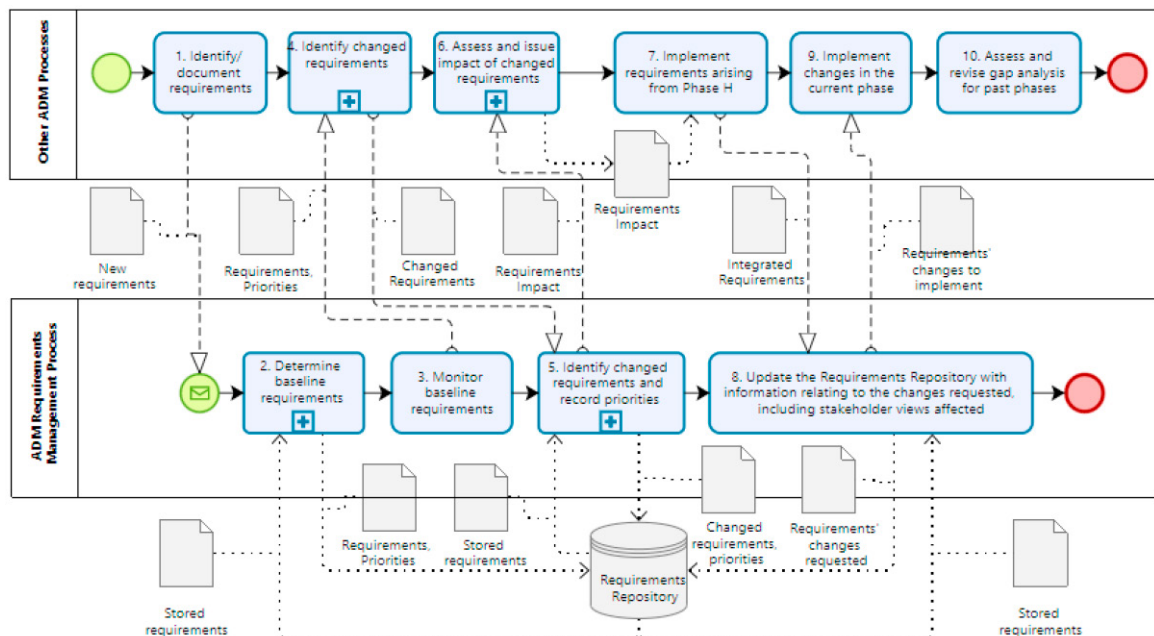


Fig. 1. Detailed RM Process Model [3].

It is important to mention that the built models correctly reflect the guidelines of TOGAF-ADM; we have just represented them by using process models' notation without changing their original content.

#### 4. Research Methodology

In this section, we present the questionnaire's conception, detail the research questions, and discuss the validity of this evaluation.

##### 4.1. Questionnaire's Conception

We elaborated the research methodology for conducting our questionnaire based on [4]. To evaluate the usage of process models representing the RM process of TOGAF-ADM, we have selected to carry out a survey. A survey is a "collection of standardized information from a specific population, or some sample from one" (definition by Robson C. found in [4]). A survey is exploratory, and its goal is to explore the actual state of things, look at new insights, and generate new ideas [4]. It uses quantitative primary data and a fixed design. The scientific goal of a survey corresponds to our need which is to analyze the opinion of IT people with regards to process modeling of ADM-TOGAF and to find out whether it is justified to propose a complete set of process models for the TOGAF method.

We selected a questionnaire to conduct our survey. We prepared it using a google form and send it to different populations in the field of Information Technology (IT): practitioners, researchers, and students. This corresponds to our double goal: to provide EA professionals with customizable TOGAF process models and to help EA teachers. The questionnaire was prepared during autumn 2018 and conducted between January and March 2019. It satisfies the requirements of the "Data Protection Directive" of the European Union on respect of the privacy and data protection rights: anonymous completing of questionnaire; a specific protocol elaborated for this study; agreement of users to use their answers; preliminary to the questionnaire explanation of the study's goals.

We used the same protocol of conducting the questionnaire as in [11] and [12]. It includes the following steps: explanation of the questionnaire's goals, gathering answers using google forms, data preparation, and analysis of results. The questionnaire was submitted to interviewees using two ways: in groups (used with students) and individually (by sending the questionnaire by e-mail). The questionnaire starts by explaining the questionnaire's goals, principal concepts, and the procedure to accomplish to fulfill the questionnaire. This procedure includes three steps: read TOGAF-ADM textual guidelines, analyze the proposed process models, and answer the questionnaire. The questionnaire contains three parts: about the respondents' profile, about their knowledge in different related fields, and about the usage of process models to present the RM phase of TOGAF-ADM. After gathered the answers, we checked their quality with regards to the data completeness. Then, we analyzed the obtained results with regards to the research sub-questions followed by the aggregation of the results by research question. These results were completed by a cross-analysis based on the profile and knowledge of respondents and by several qualitative results.

##### 4.2. Research Questions

After the validation of the process representation of the TOGAF-ADM RM phase [3], the next step is to check if the process representation enhances the comprehension and facilitates the usage of TOGAF in practice. Our work hypothesis is "The ADM guidelines are easier to use if they are represented with process models".

To answer this question, we have constructed the questionnaire around three topics. Firstly, we aim to analyze the comprehension of the main components of the RM process. Second, we look at the interactions of the RM process with processes from other ADM phases. And, third, we try to know about the usefulness of the process view of the RM process. Following these topics, we have identified three research questions.

- RQ1: Are the activities from the ADM RM phase easier to understand using the process models?
- RQ2: Are the interactions with other ADM phases easier to understand with process models?
- RQ3: Are the process models useful to implement an Enterprise Architecture project?

In the first question, we aim to analyze the comprehension of activities composing the RM process and data transferred inside the RM phase. The associated research sub-questions are:

- RQ1.1: Are the RM steps more clearly represented by the process models?
- RQ1.2: Are the production and circulation of different deliverables/documents inside the RM phase easier to follow through process models?

The second research question focuses on the exchanges between processes of RM and other phases, more precisely: (i) inputs and outputs of the RM phase, (ii) activities sequences, and (iii) document exchanges between RM and other phases. This implies three research sub-questions:

- RQ2.1: Does the process model that represents the RM process at the high-level help to better distinguish what are the RM process's Inputs and Outputs as well as their source and target phases?
- RQ2.2: Are the sequences between RM and other TOGAF-ADM phases' activities easier to understand with process models?
- RQ2.3: Are the documents' exchange between the RM and other ADM phases easier to follow using process models?

The third research question includes different aspects characterizing the usefulness of process models applied to an EA project: are the textual guidelines sufficient, are process models useful, and do they facilitate the implementation of TOGAF. As our main goal is to create a complete set of process models for the whole TOGAF method, a question about its usefulness was added with an additional open question allowing us to explain the answer to this question. The four following research sub-questions were identified:

- RQ3.1: Are the textual guidelines sufficient to implement the RM phase?
- RQ3.2: Do the process models facilitate the adaptation of the RM phase to a given organization or an enterprise architecture project?
- RQ3.3: If you use TOGAF in the future, will you apply process models in addition to the textual guidelines?
- RQ3.4: Is it useful to carry out the complete set of the process models for representing all ADM phases and their relationships?

#### 4.3. Questionnaire Validity

Our goal is double: to provide customizable TOGAF-ADM process models to EA professionals and to facilitate EA teaching with students. Thus, we have diffused the questionnaire to different kinds of population: IT professionals, IT researchers, and IT students to improve the validity of our questionnaire. We have covered different groups of interviewed persons regarding their education level, duration of experience in IT, and their knowledge background. In addition, we did not require a minimal level of knowledge in the field of EA or process modeling to cover the wider population. A preliminary version of this questionnaire was studied by two EA experts and an IT project management expert. The questionnaire was improved following their remarks. The quality of the obtained results was checked before analysis.

This questionnaire has several limitations. First, a bigger number of answers would allow having more precise results. Second, our questionnaire is limited to the RM phase of TOGAF-ADM which is its central phase. This aspect is our pre-condition and a limitation at the same time. Third, the interviewed persons did not have the possibility of manipulating process models to customize them. They have only accessed the mentioned process representations. We believe that using process models in a real project or a case study would add complementary results to our study.

## 5. Obtained Results

We have gathered 53 valid responses from the industry, academy, and students. The questionnaire has three parts. The first part deals with the professional background of the interviewees. The second part is about their knowledge and experience in the field of Enterprise Architecture, RM, and process modeling. Both are analyzed in sub-section A. The third part corresponds to the research questions (sub-section B). Sub-section C details the cross-analysis of results. Finally, sub-section D draws the additional qualitative results.

### 5.1. Presentation of the Interviewed Persons

**Professional background.** Regarding the professional background, we have asked questions about the educational level and the duration of the experience in IT (See Table I and Table II.). Most people (81%) have a Master's degree and 9% have a doctorate. 10% have only secondary education or a Bachelor degree (4% and 6% respectively). With regards to the IT experience duration, 51% have from 2 to 5 years of experience. 25% are the most experienced ones (more than 5 years) and 22% have less than 2 years of experience.

In addition, we have asked about the job area and the age of the interviewees. 60% are working in the sector of IT development. The other most presented sectors are research (19%), education (15%), consulting (15%), and banking sector (13%). Several interviewees combine two or more sectors: for instance, 9% do the research and the education and 11% are researchers and practitioners at the same time. The average age of the interviewed persons is 29.

Interviewed persons' knowledge in the field of EA, RM, and Process Modeling is shown in Table III. We have asked the interviewees about their knowledge levels in Enterprise Architecture, TOGAF-ADM, Requirements Management in general and RM in TOGAF-ADM, Business Processes (BP), and BP Modeling. The used scale describing levels of knowledge is the following: None (Never heard about it), Beginner (Know it but never used it in practice), Junior (Already used it in practice at least once), and Experienced (Use it regularly).

Table 1. Educational Level

Education Level	%
Secondary education	4%
Bachelor (3 years of higher education)	6%
Master (5 years of higher education)	81%
Doctorate	9%

Table 2. Duration of the Experience in IT

Duration of the experience in IT (years)	%
Less than 1 year	11%
From 1 to 2 years	13%
From 2 to 5 years	51%
More than 5 years	25%

Table 3. Knowledge in the fields of Enterprise Architecture, RM, and Process Modeling.

Knowledge Degree	None, %	Beginner, %	Junior, %	Experienced, %
Knowledge about Enterprise Architecture	11%	58%	23%	8%
Knowledge about TOGAF and ADM	36%	56%	6%	2%
Knowledge about RM in General	8%	57%	26%	9%
Knowledge about the RM phase of TOGAF-ADM	37%	55%	4%	4%
Knowledge about Business Processes	6%	43%	38%	13%
Knowledge about BP Modeling	11%	36%	42%	11%

With regards to knowledge about EA and RM, the most present groups are composed of beginners (people who know but did not use EA and RM in practice), more than 50%. We can observe that the respondents have more knowledge of RM in general (57% for beginners, 26% for juniors, and 9% for experienced) than RM in TOGAF-ADM (no knowledge for 37% and 55% for beginners). Interviewees' knowledge about different EA frameworks represents: TOGAF (38%), IS Urbanization (32%), Zachman (26%), Gartner (7%). The level of knowledge about BP modeling languages and notations is higher. We have obtained almost the same values (around 40%) for

beginners and juniors. UML activity diagram (100%), BPMN (83%), eEPC (13%) represent the most known BP modeling languages.

On the whole, we have covered the main related knowledge fields in a good proportion, and we have targeted people which are representative regarding the profession, education level, and IT experience.

### 5.2. Results with Regards to the Research Questions

This section deals with the main results obtained from the questionnaire (Tables IV, V, and VI). The scale is the same for all questions: the scores from 1 (completely disagree) to 5 (totally agree). The last column shows the average score for each research sub-question.

Table 4. RQ1: Are the activities from the ADM RM phase easier to understand using the process models?

Research Sub-Questions	1	2	3	4	5	Avg
RQ1.1. The RM steps are more clearly represented by the process models	2%	9%	34%	42%	13%	3,55
RQ1.2. The production and circulation of different deliverables/documents inside the RM phase are easier to follow through process models	0%	9%	34%	34%	23%	3,70

The results related to the first research question are given in Table 4. 55% (42%+13%) consider that RM steps are more clearly represented by process models. Only 11% (2%+9%) think the contrary. For 57% (34%+23%), the production and circulation of deliverables are easier to understand using the process models against 9%. 34% are neutral for both sub-questions. Overall, the process models help in understanding the ADM RM phase.

Table 5 details the answers about the interactions of RM with other ADM phases. The inputs and outputs of the RM phase and their respective source and target phases are better shown using the process models for 39% (30%+9%) against 13% (4%+9%). 47% of interviewees are neutral (47%). The sequences between RM and other phases are easier to understand for 58% (47%+11%) and 57% (49%+8%) agree that process models facilitate the follow-up of documents' exchanges between phases. Only 8% of respondents do not appreciate process models for the last two sub-questions and about a third of people (34% and 36%) are neutral. Generally, the interactions with other TOGAF-ADM phases are easier to understand using process models.

Table 5. RQ2: Are the interactions with other ADM phases easier to understand with process models?

Research Sub-Questions	1	2	3	4	5	Avg
RQ2.1. The first process model diagram that represents the RM process at the high level helps to better distinguish what are the RM process's Inputs and Outputs as well as their source and target phases	4%	9%	47%	30%	9%	3,32
RQ2.2. The sequences between RM and other TOGAF-ADM phases' activities are easier to understand with process models	0%	8%	34%	47%	11%	3,62
RQ2.3. The documents' exchange between the RM and other ADM phases are easier to follow using process models	0%	8%	36%	49%	8%	3,57

The usefulness of process models to implement EA is presented in Table VI. The textual guidelines are sufficient for 33% (8%+25) against 17% (13%+4%). 51% are neutral. For 51% of respondents, process models facilitate the adaptation of the RM phase in a given project. 6% do not agree with that. 43% are neutral. 63% (42%+21%) of interviewees would apply the process models in addition to the textual guidelines, and only 6% would not. 32% are neutral. For 47% (32%+15%), it will be useful to carry out the complete set of processes to the whole TOGAF-ADM. 13% do not agree, and 40% are neutral. Overall, the scores are positive for using process models to implement an EA project and to create process models for all TOGAF-ADM phases.

Table 6. RQ3: Are the process models useful to implement an Enterprise Architecture project?

Research Sub-Questions	1	2	3	4	5	Avg
RQ3.1. The textual guidelines are sufficient to implement the RM phase.	8%	25%	51%	13%	4%	2,81
RQ3.2. The process models facilitate the adaptation of the RM phase to a given organization or an enterprise architecture project?	0%	6%	43%	36%	15%	3,60
RQ3.3. If you use TOGAF in future, you will apply process models in addition to the textual guidelines	0%	6%	32%	42%	21%	3,77
RQ3.4. It is useful to carry out the complete set of the process models for representing all ADM phases and their relationships	0%	13%	40%	32%	15%	3,49

Globally, we can conclude that the process representation is useful to better understand the inside content (activities and documents' flows) of the RM phase, the exchanges with other phases, and to implement EA. In addition, the average value is higher than the medium one (3) for each sub-question, except RQ3.1 which has an inversed interpretation. Its value lower than 3 confirms the global results. In this manner, we have received confirmation about the utility to model the processes of the whole TOGAF-ADM.

### 5.3. Cross-analysis of Results

We have also carried out the cross-analysis to elicit how the background and knowledge level of the interviewees impact the obtained results (Tables VII-XIV). More precisely, we have calculated the average values depending on different values of the questions about the educational level, duration of the IT experience, and knowledge level in the following fields: EA, TOGAF-ADM, RM in general, RM in TOGAF-ADM, Business Processes, Business Processes Modeling.

An example explaining our approach for cross-analysis is given in Table 7. The average values were calculated depending on the level of education and compared to the global average values by research question. Then, we have left average values in white if they are lower than the global average and colored them in blue if they are higher (except the RQ 3.1 where the values are inverted, and, respectively, the colors too). The next step was to analyze each line. Lines with dominating blue color show that the value of the corresponding group of interviewees is higher than the global average. In this manner, we can observe that people with higher education appreciate better the process models applied to TOGAF-ADM (seven blues slots on nine for doctors, four blues slots for bachelors and masters, only two blue slots for secondary educated persons).

Table 1. Average Values depending on the Education Level.

Q1.2: Education Level	RQ 1.1	RQ 1.2	RQ 2.1	RQ 2.2	RQ 2.3	RQ 3.1	RQ 3.2	RQ 3.3	RQ 3.4
Secondary education	3,50	3,00	3,50	3,50	3,00	3,50	3,00	3,50	4,00
Bachelor	3,33	3,33	3,33	3,00	3,67	3,33	4,00	4,00	3,33
Master	3,56	3,67	3,28	3,67	3,51	2,74	3,56	3,81	3,44
Doctorate	3,60	4,40	3,60	3,60	4,20	2,80	4,00	3,40	3,80

The scale to analyze the IT experience is the same as in Table 2. The scales of levels of knowledge are given in Table 3.

The complete cross-analysis gave the following results:

1. The duration of IT experience impacts the results. Interviewees with 5 and more years of experience recognize the role of process modeling for RM in TOGAF-ADM (six blue slots on nine); others appreciate less (4, 3, and 2 blue slots for people with 2-5, 1-2, and less than 1-year IT experience respectively).

2. The higher level of knowledge in EA increases the appreciation of process models: seven blue slots with very high averages belong to the experienced in EA interviewees. The EA beginners also appreciate it, but with less high values.



3. With regards to the level of knowledge about TOGAF-ADM, only people without any knowledge about this framework do not appreciate the process models (all nine slots are white). Others appreciate it (7, 6, and 8 blue slots for beginners, juniors, and experienced respectively).

4. Concerning the level of knowledge in RM in general, the highest values belong to juniors (nine blue slots), experienced in RM people moderately appreciate the process models (five blue slots), and others prefer the textual guidelines.

5. The beginners have the highest averages regarding knowledge about the RM phase of TOGAF-ADM (nine blue slots). Other levels are reluctant to process modeling: 0, 3, and 2 blue slots for people without knowledge in this field, juniors, and experienced respectively.

6. Interviewees with a high level of knowledge in BP appreciate process models (seven blue slots for experienced and five for juniors), and others prefer textual guidelines (one blue slot for people without knowledge about BP and three blue slots for beginners).

7. Regarding BP modeling, the highest scores belong to experienced people (six blue slots), other groups do not appreciate process models (2, 4, and 4 blue slots for people without any experience, for beginners, and juniors, respectively).

#### 5.4. Additional Qualitative Results

An additional not mandatory open question was asked to complete question 3.4 (Is it useful to carry out the complete set of the process models for representing all ADM phases and their relationships?) to explain shortly the answer. We have obtained the following results (16 qualitative comments on 53 answers): 11 interviewees on 16 agree that the additional process view of TOGAF will facilitate its understanding. “It will be very useful for people who understand process models as visual graphics are usually more understandable than only text (and quicker to understand).” Three persons precise that textual descriptions are useful but not sufficient (“Textual descriptions are useful but not sufficient”). One person suggests the usage of the process models to easily adapt the guidelines depending on the need (“It can let us adapt the model in function of the need”). On the other side, one interviewee puts a condition that it should not become too complex (“yes to facilitate understanding only if the scheme does not become too complex”). One interviewee mentions that BPMN is useful but too complex as it is not a notation easily understandable and sharable by all potential participants (“Thus, when I have to ensure the overall understanding, commitment and feedback, I would prefer not to use process models but the plain text”).

Globally, the interviewed persons support the description of the whole TOGAF-ADM with process models. In addition, three interviewees go further by asking to add more details on the process models such as data/documents circulation and actors.

## 6. Findings

In this section, we discuss the main findings in general and with application to our future work; also, we will suggest several improvements that could be done within TOGAF method phases’ descriptions, based on our findings.

We consider that a process representation is a useful tool to capitalize knowledge about guidelines and, consequently about TOGAF-ADM practice and experiences. It means that a process representation allows to describe and complete what is expressed by textual guidelines. Thus, visual guidelines may facilitate dealing with the whole TOGAF standard which is a very detailed and complex framework. The process vision adds an intermediate level between the global and abstracted ADM process and very detailed textual guidelines. These advantages work for both of our targeted usages: (1) customization for professional practice and, (2) facilitating teaching activities. Thus, we have also confirmed the results from our first qualitative study with students reported in [3]. This study was undertaken with 18 students and aimed to adapt the TOGAF-ADM RM process to a specific project situation. The first group of students used only textual guidelines, and the second group used additional process models. The second group has adapted the RM process more quickly and easily.

We have noticed, based on our working process and several remarks from respondents, that several aspects of TOGAF-ADM could be improved. First, it would be useful to make more evident the sources of the phases’ inputs. In the current TOGAF version, we can find inputs for each phase, but to find which phase produces the given input,

the user should check textual documentation of each other ADM phase. We would suggest directly relate the input with the phase producing it. Second, TOGAF phases could be completed by their graphical representations. Third, a respondent mentioned that “the processes are actor-less”. Thus, TOGAF textual guidelines could also be completed by an explicit role’s affectation when explaining the phase steps.

Overall, by carrying out this questionnaire, we validated the need for the construction of the set of process models for representing the whole TOGAF-ADM. In addition, based on the qualitative results, we defined the following requirements for the construction of the TOGAF-ADM process models: (i) be simple and comprehensive avoiding unnecessary complications, (ii) show documentation flows inside each TOGAF-ADM phase and between different phases, (iii) be adaptable/customizable to a given context regarding the process activities, (iv) be adaptable to add any additional document to the TOGAF-ADM process, (v) be adaptable to add actors and their roles on the customized process, and (vi) be storable as process model blocks or fragments so it could be reused through assembly to fit particular project requirements.

## 7. Conclusion and Future Works

This paper reports on an empirical evaluation made in order to justify the creation of the complete set of process models for TOGAF-ADM phases. It is quite hard work, and our goal was to test its usefulness by gathering opinions from IT professionals, researchers, and students.

Taking into account the qualitative validation reported in [3], we prepared and conducted a survey using a questionnaire. We gathered 53 answers coming from people with different IT professions, knowledge levels, and experience duration. The obtained results confirmed that it would be useful to create the whole set of process models for TOGAF-ADM. However, the real support given by the proposed process view depends heavily on the degree of conceptual and practical knowledge that users have of the selected notation for developing process models. This statement arises, indirectly, from the results obtained in the questionnaire.

Our main future work consists of preparing the process models covering all TOGAF-ADM phases making them available through a process modeling tool thus potential users will have the possibility to customize and store process models according to specific enterprise architecture projects and/or for teaching purposes. Another work direction is to develop a detailed TOGAF objects/documents model to provide a customizable conceptual model that can be adapted by organizations to facilitate their understandability of TOGAF, as well as to provide them with a knowledge management tool that supports enterprise architecture new projects as well as reuse and maintenance of both activities and products.

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