Evaluating the REMO-EKD Technique: A Technique for the Elicitation of Software Requirements Based on EKD Organizational Models

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***Abstract*—One of the most common problems regarding software quality is the software's incapability of offering effective and efficient support to business operations. A possible reason for this lack of support is the inconsistency of the requirements related to the business needs. Therefore, strategies that help the identification of requirements based on organizational processes and context are welcomed. This paper reports on our empirical work that aimed at evaluating the REMO-EKD technique. REMO-EKD is a technique that consists on a set of heuristics for the elicitation of software requirements based on organizational models. These heuristics are based on the Enterprise Knowledge Development approach. We discuss the quantitative results of the study and how they can help improving the REMO-EKD technique. Results of the evaluation suggest that our technique supports the extraction of requirements from EKD organizational models, maximizing the number of total requirements found.**

***Index Terms*—Requirements elicitation, Organizational models, Enterprise knowledge development, REMO-EKD, controlled-experiment, evaluation.**

I. Introduction

Requirements elicitation should consider the analysis of the organization structure with its business domain and processes [1]. The adoption of models that describe the business processes and the organizational context can add value to software development. For instance, it can (i) help the requirements to represent the real business needs, (ii) reduce the number of redundant requirements, and (iii) be used to guide the development life cycle as a whole [2].

The non-adoption of business processes and organizational-context modeling as a mechanism to elicit software requirements can end up generating software with inconsistent and incomplete requirements regarding the real business needs. Such requirements can lead the developed software to not meet the business needs it was created based on in the first place [3].

An effective way to understand the organizational context is by using the Enterprise Knowledge Development (EKD) approach to define organizational models. This approach describes elements to characterize organizational context models from different perspectives [4]. Such context models are a rich source for requirements elicitation.

We defined the REMO-EKD technique - Requirements Elicitation oriented by business process MOdeling for EKD in order to support the elicitation of software requirements based on EKD models. The REMO-EKD technique supports the identification of functional and non-functional requirements as well as business rules based on organizational models previously defined based on the EKD approach.

This paper presents the empirical study, a controlled experiment, defined and conducted to evaluate the REMO-EKD technique. We discuss the quantitative findings of our empirical study and their potential for improving the REMO-EKD technique. These findings indicate that our technique allows the extraction of requirements from EKD models.

The remainder of this paper is organized as follows. Section 2 introduces concepts and techniques related to organizational modeling. Section 3 presents the REMO-EKD technique in details. Section 4 presents the empirical work conducted to evaluate the proposed technique. Section 5 concludes the paper with final remarks.

II. Organizational Modeling

Organizational modeling is the process of creating an integrated and negotiated organizational model that describes the organization from different perspectives such as Business Process and Actors and Resources [4]. An organizational model is used to represent the understanding of the organizational structure and context. In additional, it also helps the understanding of the business processes and their reengineering [5]. The adoption of such models is relevant to help the organization to reach a structured knowledge about its business processes, to support identified changes to the business, to explicitly define business rules, and to define actors and resources involved in the execution of the business processes [5].

The organizational model, resulting from the organizational modeling activity, represents the structure, processes, activities, flow of information, resources, behavior, goals, and limitations of the organization. It helps the understanding of complex interactions between the organization processes and areas, and people [5].

A. Organizational Modeling Approaches

Literature has several representations for an organization. Some authors propose representations through models that allow for the elicitation of software requirements. Such representations focus on defining social aspects like organizational goals, policies, and structure. These representations adopt diverse notations [6]. Table I briefly summarizes some of the most relevant organizational modeling approaches.

TABLE I. ORGANIZATIONAL MODELING APPROACHES

Approach	Description
ORDIT [7]	The Organizational Requirements Definition of Information Technology Systems, proposed in 1972, is an approach that aims to help organizational personal to define techniques for identifying the future of the organization, which includes the role of information technology.
Bubenko approach [5]	Bubenko proposed in 1993 an approach that, based on the organization's goals defines models that describe organizational objectives, processes, activities, and actors.
KAOS [8]	Knowledge Acquisition in autOmated Specification is a requirements engineering approach proposed in 1993 that defines a formal way to elicit functional and non-functional requirements. It guides the structured definition of organizational goals, events, actions, alternative actions, and actors and their responsibilities.
i* [9]	Proposed in 1995, it aims at expressing the reasons associated to the definition of a process, i.e. why certain actions need to be taken by an organization to develop its activities. This approach is composed of two main models: the strategy dependency model that describes the actors relationships with the external world and the strategy reasons model that describes the main interests and future directions to be taken by the organization.
Furlan approach [10]	This approach aims to help the organization to define its mission. An organization's mission is defined as the purpose for which it was created. The mission is defined based on the executive goals and strategic objectives related to the organization's functional areas.
EKD [4]	The Enterprise Knowledge Development approach, proposed in 1998, is an evolution of the Bubenko's approach. It consists of a set of models that define elements and their relationships into sub-models. These sub-models aim at supporting the understanding of the organization, its processes, and future directions as well as anticipated changes. This understanding is then used to support the definition of information systems to support the business processes.

We studied each one of the approaches presented in Table I in order to decide which one was going to be used to guide our research. We used the following evaluation criteria: (a) number of related work that has used the approach in the last years and (b) whether the approach consists of models representing distinct views. In our research, we aim to cover the higher number of organizational requirements as possible. Thus, such models with distinct views can provide us with information regarding diverse organizational aspects.

There are no publications in the last years describing the use of the ORDIT approach to the best of our knowledge. We did find though publications comparing this approach with others (e.g., [6]). The Furlan approach [10] targets business administrators. We could not find any evidence that it supports the definition of software requirements. Both approaches do not define models with multiple views and also do not propose how to define business rules [6]. Bubenko and KAOS approaches define models with multiple views. However, we could not find recent publications describing their adoption in practice. The Bubenko [5] approach was discontinued by the authors and replaced by the EKD approach.

The i* and EKD approaches are used to guide practical studies and considerably cited in recent publications (e.g., [11][12]). Literature that indicates the usage of the i* approach is vast including studies about elicitation of use cases using the defined organizational models. Despite its large adoption, i* consists of only two supplementary models [13]. The EKD approach fulfills our two evaluation criteria: it is used in recent practical studies and consists of models representing distinct views. Therefore, we chose this approach as the reference for the definition of our technique and of our study.

B. The EKD Approach

The EKD approach consists of a systematic and controlled way for analyzing, understanding, developing, and documenting the structure of an organization and its components using the organizational modeling theory [4].

The main goal of the EKD approach is to define how an organization functions. Its proposal consists of a set of techniques for describing the organization considering the participation of selected stakeholders and a set of guidelines to guide the modeling work. Such techniques and guidelines help those involved in defining the organizational model to define which are the perspectives and organizational restrictions aiming to help them reach a consensus about what is being defined [6].

The EKD organizational model proposes a set of six interrelated sub-models. Each sub-model represents a distinct aspect of the organization. The 'Goal' sub-model describes the reasons and motivation that inspire the business activities clarifying why the business processes and rules are as is [4]. This model focuses in describing the organization itself [11]. It highlights what the organization and its collaborators want to achieve or to avoid in the business context.

The 'Business Rules' sub-model is used to define and track the business rules, which should be consistent with the 'Goal' sub-model. The business rules define which actions the organization can take in certain situations [4]. External business rules are modeled as restrictions in the 'Goal' sub-model.

The 'Concepts' sub-model defines the elements that are described in other sub-models. It also conceptually defines entities and application data [4]. This sub-model serves as an organizational dictionary. It summarizes relevant information about the overall organizational model.

The 'Business Process' sub-model describes the organizational functions and processes. The business processes are the core of an organization. They contribute to the identification of the added value that the organization provides to others [4]. This sub-model allows for the decomposition of the organizational processes into subprocesses and the representation of external processes. Actual or future processes should be described.

The 'Actors and Resources' sub-model define the actors and resources that are somehow involved in the organization's activities. It also describes how the actors and resources interact with each other and with the 'Goal' and 'Business Process' sub-models [4]. The actors are characterized according to the role they play in the organization. Resources are considered the non-human actors such as machines and systems.

The 'Requirements and Technical Components' sub-model describes in high-level the requirements of the information systems that support the organization and its business processes.

III. The REMO and the REMO-EKD Techniques

The REMO-EKD technique aims to reach a better quality of the elicited software requirements allowing systems analysts to better identify requirements more aligned to the organizational context. The REMO-EKD technique is an adaptation of the REMO technique [2]. Our adaptation considers organizations that use the EKD to define their organizational models.

A. The REMO Technique

The REMO technique—*Requirements Elicitation oriented by business process Modeling*, consists of a technique for the elicitation of software requirements in which business process modeling is used to comprehend and represent the organizational context in which the software will be used [2]. It defines heuristics to elicit software requirements from business processes diagrams defined using BPMN, the *Business Process Modeling Notation*. Such heuristics aims to support system analysts in early phases of the software development life cycle.

Previous empirical study (e.g., [2]) suggests that the REMO technique is more efficient than the traditional way of defining software requirements, i.e. not based in any other technique. By applying the Technology Acceptance Model (TAM) [14], it was possible to identify that system analysts have large acceptance of this technique due to its ease of use and to its usefulness in supporting their work.

However, the REMO technique imposes a restriction: the business processes need to be represented by BPMN. This restriction motivated us to adapt this technique to contemplate a larger number of business process modeling notations. We then defined the REMO-EKD technique, presented next.

B. The REMO-EKD Technique

The REMO-EKD technique consists of a set of ten heuristics. Each heuristic is composed of three pieces of information: (i) the component or a set of components of the EKD model it is related to, (ii) the description of the heuristic, and (iii) the guideline about how to elicit the functional and the non-functional requirements or the business rules.

The technique should be used as follows: based on an EKD model, a certain component should be observed and evaluated according to the heuristic related to that component. If the description of the component expresses a software requirement then the guidelines for the elicitation of the requirement provided by the heuristic should be followed. Table II presents the heuristic H01 of the REMO-EKD technique as an example.

TABLE II. Heuristic H01 of the REMO-EKD Technique

Components	Heuristic	Guideline
Goal; Opportunity	**H01:** Goals To express the business goals or anticipated opportunities to be achieved. It can be automated for functions or characteristics the system shall present.	**Functional Req:** To extract one or more functional requirements if the goal or opportunity presents one system functionality; and/or **Non-functional Req:** To extract one non-functional requirement if the goal or opportunity presents a desirable restriction for the system

The remaining heuristics of the REMO-EKD technique apply to the following components of the EKD model: problems, restrictions, rules, external processes, data, actors, and resources. Since the EKD sub-models are interrelated, we chose to define heuristics by component instead of by specific model. This way the heuristics can be applied independently to the created models.

IV. The Controlled Experiment

The controlled experiment was designed aiming to verify the technical feasibility of the REMO-EKD technique. To achieve such goal we compared our technique to the traditional approach which consists in eliciting software requirements without any support from another technique or specific tool. The goal of our experiment is presented in Table III following the GQM (Goal/Question/Metric) paradigm [15].

TABLE III. Goal of our Empirical Study

To analyze	The REMO-EKD technique
For the purpose of	Characterizing
With respect to	Effectiveness and adequacy of the identified requirements using the organizational models
From the point of view of	Software Engineering Researchers
In the context of	A requirements elicitation from a web based system having as basis EKD organizational models.

Our controlled experiment was conducted in March 2013 with undergraduate students taking the Software Modeling course of the Computer Science program at the Federal

University of Amazonas, located in Manaus, Amazon, Brazil. The students developed knowledge about requirements elicitation during the course. Some of them also have previous experience from industry. All students were trained and developed exercises about modeling processes using the EKD approach before the experiment was conducted.

The controlled experiment had the participation of 25 subjects. The subjects were separated into two balanced groups. The distribution was based on the results of a questionnaire that aimed to identify the experience of the subject in eliciting requirements. The questionnaire consisted of two main questions: one about overall requirements elicitation and one about requirements elicitation using models as a reference. The subject had to indicate a response from the presented choices, namely: 'no experience at all', 'learning requirements elicitation from models in class or books' 'experience in academia', or 'experience in industry'. The subjects signed a Free Consent Form to indicate their volunteer participation in our study.

To evaluate the feasibility of the technique we used two indicators:

a) **Effectiveness:** indicates the ratio between the number of real identified requirements and the number of total known requirements obtained from the EKD models. It indicates how much the technique supports the requirements identification.
b) **Adequacy:** indicates the percentage of adequate identified requirements regarding the organizational context. After identifying the requirements using the organizational models, we categorized them in real or "false-positives". A requirement was considered "false-positive" when it was wrong (e.g. a misunderstanding about the organizational context) or in the case that it could not have been elicited through organizational models. This indicator is considered relevant because it prevents the specification of requirements that are not in conformity with the identified needs identified from the organizational models.

The respective hypothesis, null (H0) and alternative (AH), defined for our controlled experiment related to the effectiveness and adequacy indicators are as follows:

a) **H01:** There is no difference in terms of effectiveness in using the REMO-EKD technique to elicit requirements regarding organizational models, when compared to a traditional approach;
b) **AH1:** There is difference between the effectiveness indicator of the REMO-EKD technique and the effectiveness indicator of the traditional approach;
c) **H02:** There is no difference in terms of adequacy in using the REMO-EKD technique to elicit requirements regarding organizational model, when compared to a traditional approach;
d) **AH2:** There is difference between the number of requirements considered adequately identified by the REMO-EKD technique and the traditional approach.

The two groups (experimental and control) used the instructions provided for the REMO-EKD and for the traditional approach based on the same set of models. The two groups worked in two distinct physical spaces to avoid contamination during the explanation of the procedures which were distinct for each one of the groups. Both groups started working at the same time and had about 160 minutes to complete the presented tasks. For the group that used the REMO-EKD technique, the experimental group, we explained the heuristics about the provided models in order to support the elicitation of the software requirements based on the models. For the other group, the control group that used the traditional technique, requirements elicitation was based on the visualization of the models. No other resource was used. Participants for both groups received the same EKD models to use as reference to elicit the requirements. Requirements identified by the participants were logged in a provided spreadsheet.

The supporting materials used by the groups were:

a) Document presenting the EKD organizational modeling of a real project (named SIMAC from the Brazilian Health Department [16]). We chose this project for representing a real case modeling;
b) Glossary of technical terms used in the organizational modeling. The SIMAC project consists of other systems and has several acronyms that would be hard to remember without this glossary. This document, which was attached to item (a), is to help the subject to become familiar with terminology and avoid the not execution of the requirements elicitation due to the lack of knowledge;
c) Spreadsheet for recording the identified requirements;
d) Document presenting the task to be completed. This document was presented to the group following the traditional approach only. The following steps were presented: to understand the EKD organizational modeling, to identify the functional requirements, to identify the non-functional requirements, to identify the business rules, and to review the identified requirements;
e) Document listing the REMO-EKD heuristics. This document was presented to the group following the REMO-EKD technique only. A brief presentation on how to use the heuristics was presented before the experiment started; and
f) Evaluation questionnaire defined based on the Technology Acceptance Model [14]. This questionnaire was applied to the group following the REMO-EKD technique only. The subjects were instructed to rate their satisfaction based on their perception of ease of use and usefulness of the technique.

A. *Quantitative Analysis*

This section describes our quantitative analysis and findings. A set of known requirements was defined (named *oraculo*) based on the modeling developed by three experts. During the data collection additional requirements were added to the '*oraculo'*. A total of 42 requirements composed the '*oraculo'* database. This set of requirements was used to describe the false-positive requirements that could be identified. All 42 requirements of the '*oraculo'* were evaluated and considered valid in the context of the SIMAC Project.

Another decision was taken before data analysis. Data of two subjects were discarded. One of them had skipped the EKD training session. This could have influenced his ability to elicit requirements. In the second case the experts perceived that the subject had not understood how to use the EKD technique, therefore suggested discarding his responses. Both eliminations were balanced for each group since the subjects had similar levels of experience and belonged each to one group. Table IV presents the results for each one of the groups.

TABLE IV. SUBJECTS' PERFORMANCE PER GROUP

P	IR	DR	FP	ER	EI	AI
GROUP: TRADITIONAL METHOD						
01	20	1	8	11	26.19%	55.00%
03	15	1	5	9	21.43%	60.00%
05	19	0	4	15	35.71%	78.95%
06	20	0	2	18	42.86%	90.00%
07	14	0	1	13	30.95%	92.86%
10	8	0	2	6	14.29%	75.00%
12	24	0	4	20	47.62%	83.33%
16	14	0	7	7	16.67%	50.00%
18	23	1	7	15	35.71%	65.22%
20	18	0	1	17	40.48%	94.44%
22	24	3	6	15	35.71%	62.50%
25	11	0	5	6	14.29%	54.55%
GROUP: REMO-EKD						
02	17	1	4	12	28.57%	70.59%
04	30	0	7	23	54.76%	76.67%
08	15	0	5	10	23.81%	66.67%
09	27	0	7	20	47.62%	74.07%
11	16	0	2	14	33.33%	87.50%
13	32	0	6	26	61.90%	81.25%
17	28	0	5	23	54.76%	82.14%
19	21	2	6	13	30.95%	61.90%
21	21	0	5	16	38.10%	76.19%
23	21	0	5	16	38.10%	76.19%
24	18	0	17	1	2.38%	5.56%

(Legend: P=Participant; IR=Identified Requirements, DR=Duplicated Requirements; FP=False-Positives; ER=Existing Requirements; EI=Effectiveness Index; IA=Adequability Index)

Table V presents the overall findings about our data analysis. We can observe that the subjects that used the REMO-EKD technique identified a higher number of real requirements. In addition, they also identified a higher number of false-positives. This result suggests that the REMO-EKD technique can be improved in order to indicate a smaller number of false-positives.

We applied the Mann-Whitney U test to perform the statistical analysis of the experiment results. This test is the non-parametric equivalent of the t-Student test. We made this choice because we had two groups to compare, different participants in each condition, and no assumption about the data distribution.

We used a significant criterion (α) – the probability of incorrectly rejecting the null hypothesis – of 0.05, since the sample size was small [17]. Using the values Z, defined by the application of the method, the following values were defined p. Therefore, the following equations are defined:

$$Z_E = 1.230, \text{ then } p_E = 0.8907, \quad (1)$$

$$Z_A = 0.123, \text{ then } p_A = 0.5478. \quad (2)$$

For a significance level α equal to 5%, we note that the null hypothesis cannot be rejected since we see that $p \gg \alpha$ for the two used indicators. However, although the REMO-EKD results are clearly better than the results for the traditional approach, the experiment shows that the REMO-EKD technique presents no significant improvements in term of effectiveness and adequacy regarding the traditional approach. We need to remember that the experiment was run with undergraduate students and that need to be replicated with practitioners to confirm the results. Meanwhile, we can affirm that our current findings point out that the REMO-EKD technique has potential to better support systems analysts in the task of eliciting requirements and therefore, we will use these results to improve the definition of the technique in the near future.

TABLE V. OVERALL FINDINGS

Characteristics	Traditional method	REMO-EKD
Number of identified requirements	210	246
Number of real requirements	152	174
Number of false-positives	52	69
Average number of requirements per participant	12.67	14.50
Average of effectiveness	30.16%	37.66%
Average of adequacy	71.82%	68.98%

B. *Threats to Validity*

Every experimental study possesses threats that can affect the validity of its results. Here we present the threats to validity considered in our empirical study.

We considered three main threats to the internal validity: (a) training effects, (b) subjects' requirements elicitation knowledge, and (c) expertise classification. Regarding the training effects, there could be a risk if the quality of the training of the modeling processes using the EKD approach could influence positively or negatively the study execution. To avoid such threat, we performed a complete training which covered all EKD perspective views. Subject's knowledge could influence the study execution. Therefore, in order to mitigate this threat, we divided the subjects into balanced groups according to their experience. This measure avoided that the subjects' experience affected the overall results of the approaches (REMO-EKD and Traditional). Another identified threat is the subjects' classification regarding requirements elicitation experience. In order to reduce this threat, the degree of each criterion was assessed through an objective questionnaire.

The external validity is concerned with the generalization of the results. In our study, we used students as subjects. However, we argue that since we were looking for systems analysts with the same degree of requirements engineering knowledge and we balanced both teams, students are acceptable as subjects here since none of them had previous experience with any of the techniques. Another identified threat is that academic environments do not represent day to day experience in the industry. To address this threat, we used real EKD models from industry.

For conclusion validity, the most relevant threat is the statistical power. Since the number of participants is low, the data extracted from this study can only be considered indicators and not conclusive.

Regarding construct validity, we verified that the criteria used to measure the feasibility of the technique could be considered a threat if not properly chosen. The effectiveness and adequacy are important criteria for requirements elicitation [2]. We measured adequacy and effectiveness using the same approach proposed in the previous REMO's empirical studies [2].

C. Findings from the Application of the Technology Acceptance Model

After the quantitative analysis, the questionnaires about technology acceptance defined based on the TAM model [14] were analyzed. Data collected was represented in graphic format for analysis. The indicator defined at TAM was operationalized based in two factors: (i) perceived usefulness, which defines the degree in which a person believes that the technology could improve his/her performance at work, and (ii) perceived ease of use, which defines the degree in which a person believes that using a specific technology would be effortless [18]. The reason for focusing on these indicators is that, according to Davis [14], these aspects are strongly correlated to user acceptance. TAM has been applied in the evaluation of several new technologies (e.g., [19]).

In this post requirements elicitation questionnaire, the subjects had to answer how much they agreed with each of the statements regarding the utility and the ease of use of the REMO-EKD technique. In order to assess the degree of agreement, the subjects selected one of the following values from a Likert scale: (1) yes, in all times; (2) yes, in most of the times; (3) no, in most of the times; (4) no, any of the times. We did not use a five level Likert scale containing an intermediate level as suggested by Laitenberger and Dreyer [18] since this neutral level does not provide information regarding the side to which the subjects are inclined (either positive or negative).

Figure 1 presents the perceptions of the subjects regarding the ease of use of our technique. Figure 2 presents their perceptions regarding the usefulness of our technique.

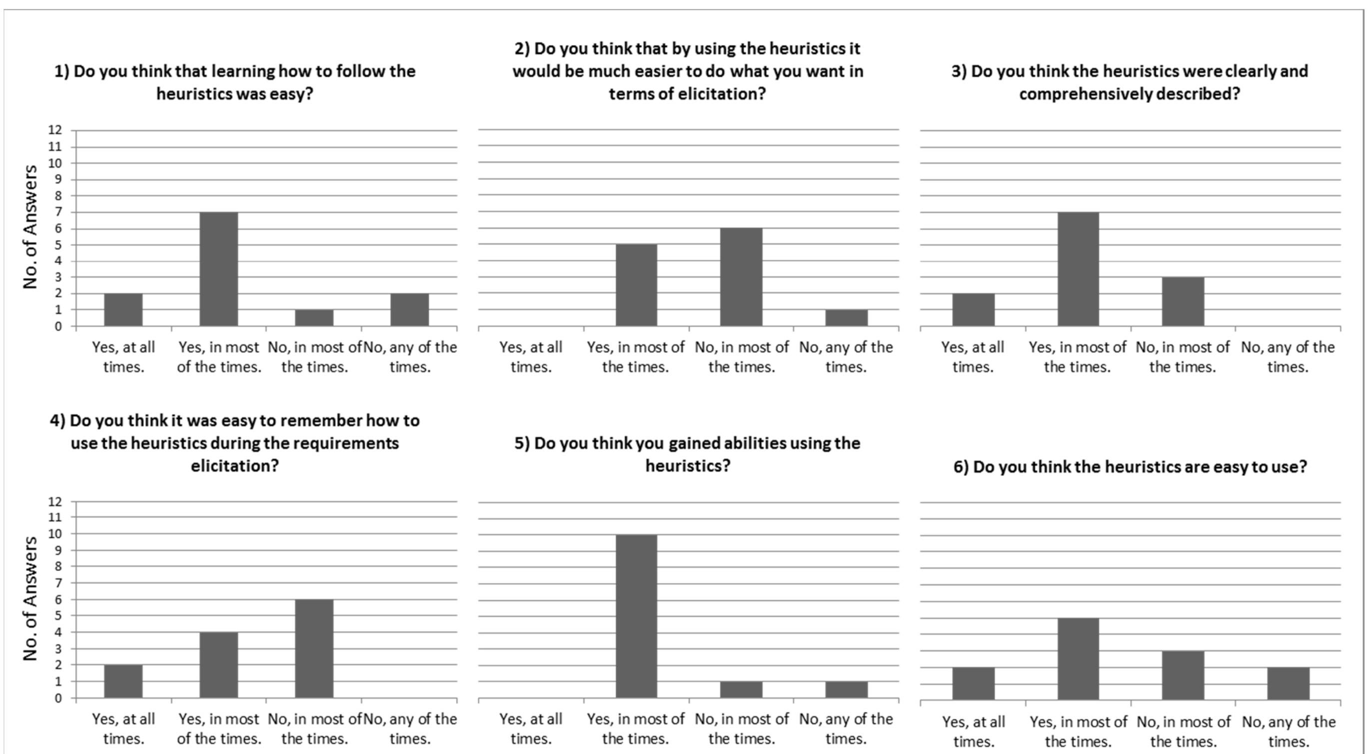

Fig. 1. Subjects' perception about the ease of use of our technique

We can observe that there was no overall consensus about the ease of use and usefulness of our technique when the heuristics where applicable. When responding about the ease of use, the subjects indicated that the heuristics are clear and are easy to comprehend (question 3 in Fig. 1). In addition, they indicated that they learned new skills using the heuristics (question 5 in Fig. 1). When responding about the usefulness of our technique, they indicated that the adoption of the heuristics has helped them to more easily to elicit the software requirements (question 5 in Fig. 2). Despite these positive responses, it was not possible to identify whether our technique has helped on improving productivity related to the elicitation of the requirements (question 3 in Fig. 2). Our findings are suggestive that our technique is advisable of adoption. However, we cannot generalize them to all kind of situations due to the limited number of subjects at this time.

V. FINAL REMARKS

In this paper we motivate the definition of, define, and validate a new technique that aims to aid the extraction of requirements from EKD models: the REMO-EKD technique. The REMO-EKD technique proposes a set of heuristics to extract software requirements from components of EKD organizational models.

We also discuss the results of a controlled experiment that aimed at measuring the effectiveness and adequacy of the produced requirements in comparison to a traditional approach. Results showed that the REMO-EKD technique had performed better than the traditional approach regarding the effectiveness indicator and had similar results regarding the adequacy indicator. However, when we compared the two samples using the U-Mann-Whitney test there was no significant statistical difference between the two groups regarding both indicators.

The study results indicate that the REMO-EKD technique supports the extraction of requirements from EKD organizational models, maximizing the number of total requirements found. Nevertheless, we need to improve the results regarding the adequacy indicator in order to minimize the number of inadequate requirements. Such adequacy will prevent the specification of requirements that are not in conformity with the identified needs that are extracted from the organizational models.

We acknowledge that the small number of data points is not ideal from the statistical point of view. Small sample sizes are a known problem difficult to overcome. In this context, the results are considered indicators and cannot be considered conclusive.

Next, we plan (a) to improve the REMO-EKD technique using the results from this study, (b) to execute further studies to obtain more data points and strengthen the conclusion validity, and (c) to replicate the experiment involving software development practitioners.

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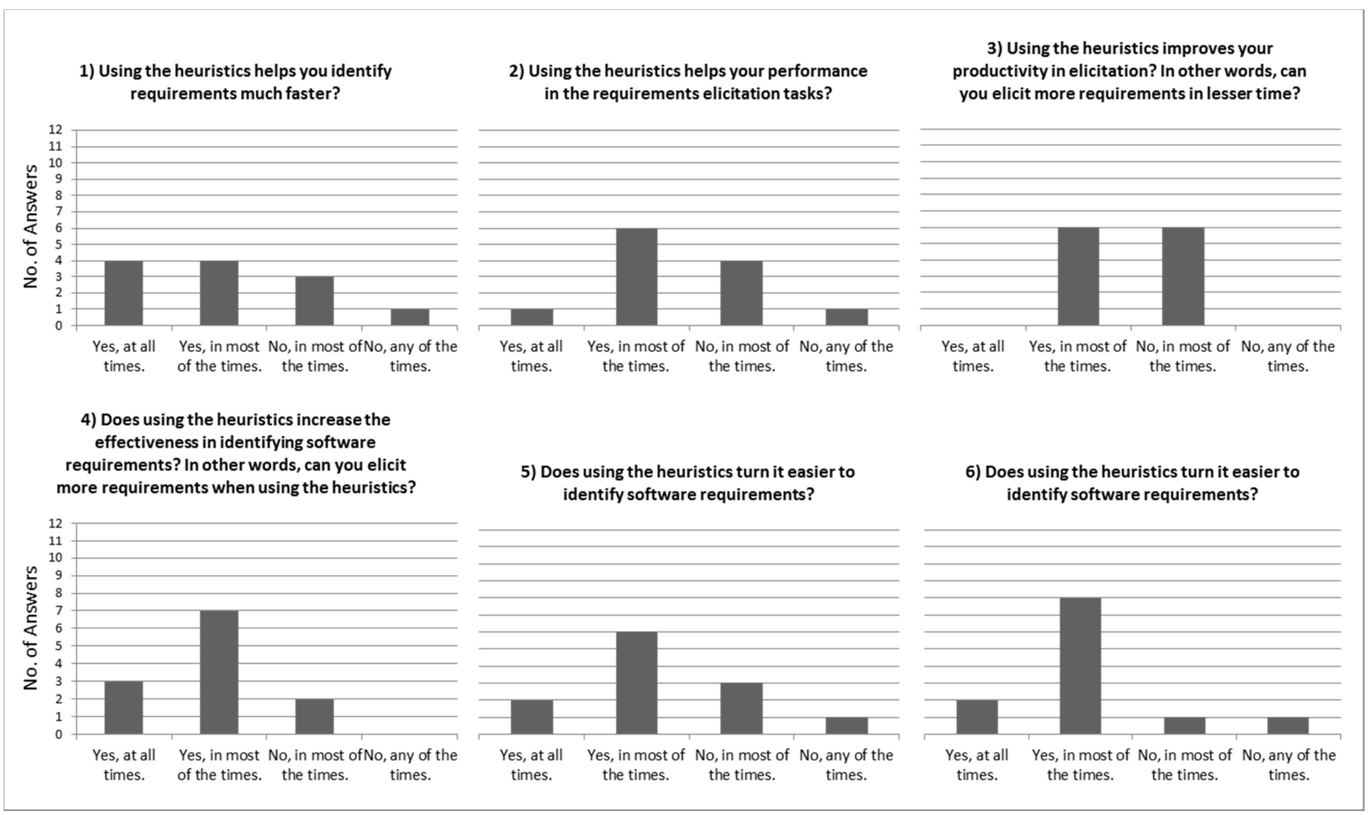

Fig. 2. Subject's perception about the usefulness of our technique

REFERENCES

[1] A. Martinez, J. Castro, O. Pastor, H. Estrada, "Closing the gap between Organizational Modeling and Information System Modeling". Proceedings of the Workshop on Requirements Engineering (WER'03), Piracicaba, São Paulo-SP, Brazil, 2003, pp. 93-108.

[2] S. Vieira, D. Viana, R. Nascimento, T. Conte. Using Empirical Studies to Evaluate the REMO Requirement Elicitation Technique. In: 24th International Conference on Software Engineering & Knowledge Engineering (SEKE 2012), 2012, Redwood City, USA. Proceedings of the 24th International Conference on Software Engineering & Knowledge Engineering (SEKE 2012). Skokie, USA: Knowledge Systems Institute Graduate School, 2012. v. 1. p. 33-38.

[3] L. Xavier, F. Alencar, J. Castro, J. Pimentel, "Integrating Non-Functional Requirements to Business Processes: Integrating BPMN and NFR", Proceedings of the Workshop on Requirements Engineering (WER'10), Cuenca, Ecuador, 2010, pp. 29-40 (In Portuguese).

[4] J. Bubenko, J. Sirna and D. Brash, EKD user guide. Dpt of computer and systems sciences. Stockholm: Royal Institute of Technology, 2001.

[5] J. Bubenko, Extending The Scope of Information Moldeling. Proc. 4th Int. Workshop on the Deductive Approach to Information Systems and DataBases, Lloret-Costa Brava, Catalonia, Sept., 1993.

[6] S. Pádua, E. Cazarini and R. Inamasu, Organizational Modeling: Capturing the Requirements Organizational Development in Information Systems. Management & Production Journal, v.11, n.2, 2004 (in Portuguese).

[7] J. Dobson and R. Strens, "Organisational requirements definition for information technology systems," Proceedings of the First International Conference on Requirements Engineering, 1994. pp.158 - 165

[8] A. Dardenne, van Lamsweerde and S. Fickas, Goal Directed Requirements Acquisition. Science of Computer Programming, vol. 20, Apr., 1993.

[9] E. Yu, Modelling organizations for informations systems requirements engineering. In: IEEE International Symposium on Requeriments Engineering, 1993, San Diego. Proceedings... Los Alamitos: IEEE Computer Society, 1993.

[10] J. Furlan, Business Modeling: an integrated approach to strategic modeling functional, of data and the object orientation. São Paulo: Makron Books, 1997 (in Portuguese).

[11] C. Rolland, S. Nurcan and G. Grosz, A decision-making pattern for guiding the enterprise knowledge development process.Information and software technology, v. 42, n. 5, p. 313-331, 2000.

[12] F. Alencar, B. Marín, G. Giachetti, O. Pastor, J. Castro and J. Pimentel, From i* requirements models to conceptual models of a model driven development process. In The Practice of Enterprise Modeling. Springer Berlin Heidelberg, 2009. pp. 99-114.

[13] V. Santander and J. Castro, Deriving Use Cases from Organizational Modeling. In: IEEE Joint International Requirements Engineering Conference - RE 02, 2002, Essen. IEEE Joint International Requirements Engineering Conference, RE 02, University of Essen, Germany, September, 9-13., 2002.

[14] F. Davis, Perceived usefulness, perceived ease of use, and user acceptance of information technology. In: MIS Quarterly, v. 13, n. 3, 1989.

[15] V. Basili and H. Rombach, The TAME Project: Towards Improvement-Oriented Software Environments, In: IEEE Transactions on Software Engineering, vol.14, 1988, pp. 758-773.

[16] A. Monteiro, Business Modeling in Practice: A Method to Support Comprehension and Communication of Requirement of Business, Thesis (Master) - Informatics Center, Federal University of Pernambuco, Recife, 2003 (in Portuguese).

[17] T. Dyba, V. Kampenes and D. Sjoberg, A systematic review of statistical power in software engineering experiments Information and Software Technology, Vol. 48, No. 8. (August 2006), 2006 pp. 745-755

[18] O. Laitenberger and H. Dreyer, Evaluating the Usefulness and the Ease of Use of a Web-based Inspection Data Collection Tool, in: Proc. X Software Metrics Symposium, Bethesda - MD, 1998, pp. 122-132.

[19] V. Venkatesh, M. Morris, G. Davis and F. Davis, User acceptance of information technology: Toward a unified view, MIS Quarterly, v. 27, n. 3, 2003, pp. 425-478.