Introducing Variability in a Client-Oriented Requirements Engineering Process

Graciela D. S. Hadad[1], Jorge H. Doorn[1,2]

[1]DIIT, Universidad Nacional de La Matanza, Argentina
[2] Fac. Ciencias Exactas, Universidad Nacional del Centro de la Provincia de Buenos Aires

ghadad@ing.unlam.edu.ar,jdoorn@exa.unicen.edu.ar

Abstract. It is a good practice to consider the adaptation of any process to particular situations. This applies to Requirements Engineering where the requirements production process becomes adaptable to particular situations. Indicators depicting these situations should be created in order to guide the choice of the requirements process that best suits each specific case. Almost all literature offers a fixed requirements process independent of the context where it will be carried out. Top-down and bottom-up approaches are the most widespread ones, though middle-out approaches or combinations of them sometimes provide more accurate solutions. Our present research project "Adaptability and Completeness in Requirements Process" is centered on improving a well-developed requirements process based on natural language models (a glossary, scenarios and requirement specifications). The idea is to establish the factors that may influence a software project and the adaptations that may be introduced in the requirements process.

Keywords. Requirements process, process variability, situational factors, natural language model.

1 Introduction

Since problem domain knowledge is mostly expressed in natural language, the use of a Requirements Engineering (RE) approach based on natural language representations increases the probability of success of any software project. Natural language models, such as glossaries, use cases and scenarios, promote stakeholders communication and aid in validating requirements. Thus, an RE strategy using natural language models is considered to be client-oriented.

Throughout many research projects since 1995, our group has participated in the definition of a client-oriented RE strategy based on scenarios [1], which has been refined and tested in several organizations, achieving high-quality results. Several real-world applications were developed during this period. Two examples are: i) an integrated complex Student Administration system designed for a university from 2009 to 2010 (109 lexicon terms, 300 current scenarios, 409 future scenarios and 363 high-level requirements), and ii) an ATM Acquisition and Management system corre-

sponding to a full software development put into service in a company on 2003 (55 lexicon symbols, 20 current scenarios, 38 future scenarios and 167 requirements). During the implementation of the strategy in these organizations, sometimes ad-hoc adjustments were required to achieve the objectives of the project in compliance with deadlines and other constraints.

We believe that planning adaptations will improve the overall RE process. Therefore, the different situations that may attempt against a successful requirements process should be identified. Some activities of the RE process are performed in the same manner regardless of situational factors, while other activities are altered, removed or replaced. That is, the process can be assembled like a flexible puzzle using some pieces depending on the situational factors identified at a start point.

Situational Method Engineering, as a sub-area of Method Engineering, can help on this matter since it is advocated to build methods tailored to specific situations for the development of software.

The adaptation of the process is based on indicators describing the situation. Part of the task is to compose such indicators based on observable factors, such as the degree of business processes reengineering, the prior knowledge about the application domain, the domain complexity and the project size, among others. Those situational factors should be taken into account before executing a requirements production process. In practice, these factors are usually not taken into account at the beginning of the project, and some are regarded only during the course of the project. We believe it could be easier to get better requirements solutions following a process that addresses the particular factors surrounding the project, although literature frequently offers unique ways to produce requirements. In summary, our research project is dealing with variability in an RE process driven by the adaptation of the process to situational factors.

2 Objectives of the Research

Our research project aims to improve a well-developed client-oriented RE strategy by establishing a process adaptable to different situational factors. This requires defining which the models to be produced, the process variation points and the activities and techniques to be applied at each process phase. The process will be defined as a set of modular components, where each component will define an activity, the inputs and outputs, and the techniques to be used. It is very important to understand the alternatives adopted to implement an instance of the requirements process.

The specific objectives of the research are the following:

- Identify the different situational factors influencing the RE strategy.
- Define the variation points of the strategy according to the situational factors.
- Define all the components of the process related to the basic strategy and to the alternative instances of the strategy. This includes the identification of commonality and variability of the requirements process.
- Develop a heuristic to guide the configuration of the RE process based on predefined situations.

Therefore, the main idea is to provide an RE process, driven by narrative scenarios, which is configured according to specific project and domain characteristics. This type of research provides a rational base to define more agile requirements processes when it is suitable. At the current stage, these objectives have been partially accomplished since fourteen factors have been already identified and five variation points were defined (see next section), though they still require confirmation.

3 Scientific Contributions

The client-oriented RE strategy, depicted in Figure 1(a), involves all the requirements engineering activities: elicitation, modeling, analysis and management, and consists basically in:

- Understanding the vocabulary used in the application domain, supported by the Language Extended Lexicon model [2];
- Understanding the application domain, supported by a set of current scenarios that represent the situations observed in the domain [3];
- Defining the software system context, by producing a set of future scenarios that represent situations envisioned in a future application domain where the software system will be operating [4]; and
- Making explicit the requirements, by producing a Software Requirements Specification (SRS) where the requirements are clearly individualized from the set of future scenarios [5].

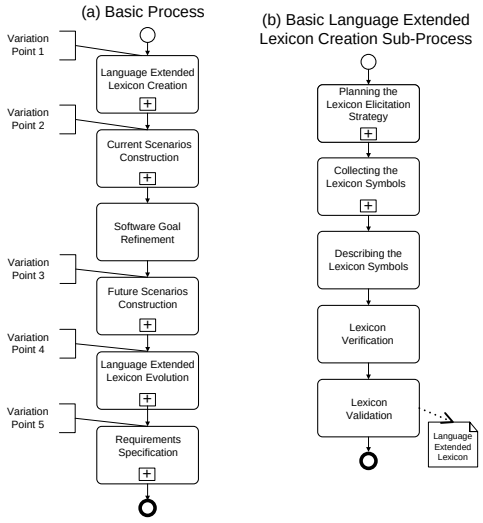

Fig. 1. Basic client-oriented RE strategy using Business Process Modeling Notation (BPMN)

Figure 1(a) presents the basic RE process independent of situational factors, while Figure 1(b) depicts one of the sub-processes, also showing its basic structure. Though both figures present a sequential flow, there are recycles due to verification and

validation activities, and the continuous improvement in understanding the problem. Furthermore, the RE strategy may be applied under an iterative and incremental process, or a spiral one [4]. At the first step of the research, a list of factors was produced, and variation points were identified in the basic process, as shown in Figure 1(a). Two types of situational factors were considered: those related to the specific application domain and those related to the specific software project. The former involves situations in the client context, while the latter takes into account the developer context. The initial factors identified are:

Context Factors	**Project Factors**
- Complexity of the Problem	- Familiarity with the Domain
- Level of Business Innovation	- Size of the Project
- New Business	- Level of Developers Rotation
- Domain Volatility	- Quality Criterion
- Target Customer	- Required Artifacts Reuse
- Level of Users Rotation	- Support for Traceability
- Level of Conflict in the Domain	- Contractual Obligation to produce an SRS

Each factor was assigned a set of possible values, such as: Problem Complexity = {low, medium, high}; New Business = {yes, no}; Target Customer = {market-driven, tailor-made}.

Besides, each factor was studied to establish its influence at the variation points, considering that a situational factor may affect the process at one or more variation points. Variation Point 1 depends on the business novelty, the degree of software customization for the market or a specific client, the familiarity of the requirements engineer team with the domain, the demand of artifacts reuse, and the level of required quality. Variation Point 2 strongly depends on the requirements engineers' knowledge about the application domain, though it is also affected by the complexity of the problem, the size of the project and the volatility of the domain, among some other factors. Variation Point 3 is almost influenced by every identified factor, though the expected level of business innovation is here the main influential factor. Variation Point 4 depends mainly on the degree of changes in the terminology used in future scenarios in relation with the vocabulary used in the application domain. Variation Point 5 is subjected to a contractual obligation to produce an SRS, and also influenced by the project's size and the need of traceability anchored on individual requirements.

As stated above, the configuration process depends on the combination of several situational factors at each variation point, and this combination may have three possible effects on the process: i) the process is performed or not; ii) the process is performed partially; or iii) the activities of the process may be done applying different techniques. The pre-defined combination of factors affecting each point will determine which of these three decisions should be taken. For example, Figure 2(a) shows a situation where the entire process is skipped (not creating the lexicon), and two complementary situations that branch off into different sub-processes (planning the lexicon elicitation) and different techniques (choosing the lexicon validation technique).

Figure 2(b) shows how the instance of a process should be constructed according to specific situational factors by skipping the whole process, by selecting the

corresponding components of Planning Lexicon Elicitation Strategy and Lexicon Validation, and by selecting a specific verification technique within the Lexicon Verification component depending on the quality criterion factor.

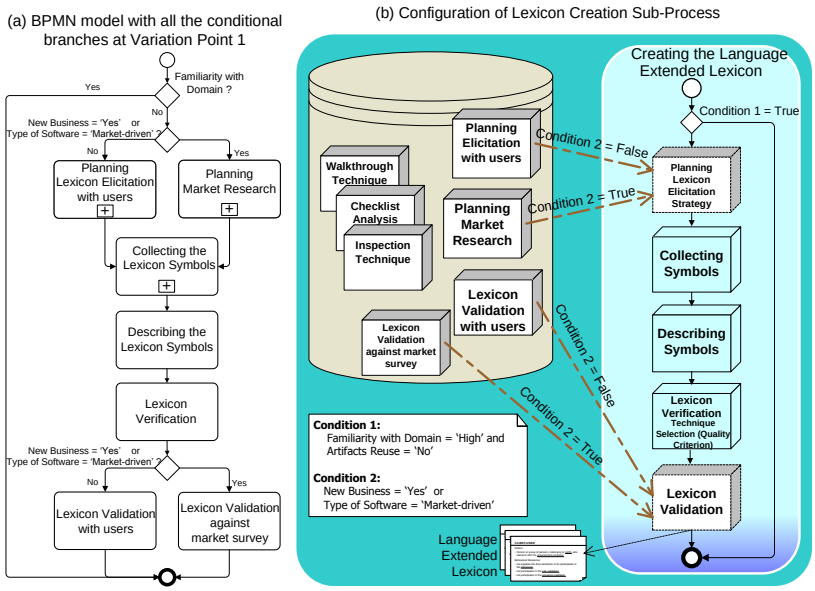

Fig. 2. Lexicon Creation Sub-Process including variants

Regarding Variation Point 3, there may be five different approaches to managing the construction of future scenarios: i) Construct Future Scenarios adapting the existing current scenarios: procedure-oriented approach; ii) Construct Future Scenarios disregarding current business processes, but following software goals supported by existing high-level current scenarios; iii) Construct Future Scenarios by a combination of the two previous approaches: hybrid approach; iv) Construct Future Scenarios using the Language Extended Lexicon derivation technique; and v) Construct Future Scenarios following a top-down approach building high-level abstract scenarios according to software goals. It should be remarked that though five ways of the future scenarios construction process were identified, many sub-processes are common to several of them. At least one real-world experience following every one of these five variants was carried out. Another issue to state is that the different branches derived at Variation Point N-1 and at Variation Point N may not be independent since not every combination is feasible.

4 Conclusions

The basic client-oriented requirements engineering strategy was built based on the experience gained after years of its implementation in the academic and professional practice. Experience has taught us that complex problems have distinctive features that must be taken into account to carry out a successful requirements process.

Requirements engineers must tailor the requirements production process by selecting the techniques that are more suitable for the specific situation. Our proposal aims to help requirements engineers to tailor a client-oriented RE process when the knowledge of certain circumstances surrounding the software project is available in the beginning. The adaptation of the requirements process in the cases we have participated has contributed to the acceptance of the process in host organizations. This should be confirmed by replicating cases with different approaches.

5 Ongoing and Future Work

The variation points were precisely defined since we have acquired enough knowledge about the basic RE process after putting it into practice in more than 200 real cases. These practices have allowed us to recognize the different possible variants of the process and the modular components required. The list of situational factors is quite exhaustive, although it is likely to be extended. Some factors not mentioned here are being evaluated. Several instances of the RE process have been applied in real cases, although they have not been formally defined prior to their application.

Most of the process components have been tested in the field, and in degree and post-degree courses, during the last 10 years. Some remaining components have been defined theoretically based on our experience and some have already been applied in case studies. Additional tests of the different process variants will be carried out to check the effectiveness of the proposed branches. This will allow identifying further commonality and variability. The main idea is to test and confront results against the formulated process variants. The presence of many factors makes nearly impossible to validate every single combination of them, considering the different possible values associated to each factor. This should not impede the exploratory research of the most likely combinations.

In next steps of the research, missing process components will be defined and a heuristic to build a particular process for a specific situation will be developed.

References

1. Leite, J.C.S.P., Doorn, J.H., Kaplan, G.N., Hadad, G.D.S., Ridao, M.N.: Defining System Context using Scenarios. In: Perspectives on Software Requirements, Kluwer Academic Publishers, USA, ISBN: 1-4020-7625-8, chapter 8, pp.169-199 (2004)
2. Hadad, G.D.S., Doorn, J.H., Kaplan, G.N.: Creating Software System Context Glossaries. In: Encyclopedia of Information Science and Technology, IGI Global, Mehdi Khosrow-Pour (ed), Information Science Reference, 2ºed., Vol.II, pp.789-794, EEUU (2008)
3. Leite, J.C.S.P., Hadad, G.D.S., Doorn, J.H., Kaplan, G.N.: A Scenario Construction Process. In: Requirements Engineering Journal, Vol.5, N° 1, pp. 38-61 (2000)
4. Hadad, G.D.S.: Uso de Escenarios en la Derivación de Software. Tesis Doctoral, Facultad de Ciencias Exactas, Universidad Nacional de La Plata, Argentina (2008)
5. Hadad, G.D.S., Doorn, J.H., Kaplan, G.N.: Explicitar Requisitos del Software usando Escenarios. In: 12th Workshop on Requirements Engineering (WER'09), pp. 63-74 (2009)