METHOD ENGINEERING

Master of Business Informatics

Utrecht University

A METHODOLOGY FOR THE SELECTION OF
REQUIREMENTS ENGINEERING TECHNIQUES

Method Description

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NOTICE OF ORIGINALITY

I declare that this paper is my own work and that information derived from published or unpublished work of others has been acknowledged in the text and has been explicitly referred to in the list of references. All citations are in the text between quotation marks (" "). I am fully aware that violation of these rules can have severe consequences for my study at Utrecht University.

Signed: 

Date: 18-02-2010 

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Place: Utrecht
INTRODUCTION

The process of Requirements Engineering (RE) is of vital importance for the development of software products. The success of any software product is contingent on how well it helps its users to accomplish certain tasks and the degree to which it fits to the environment (Nuseibeh & Easterbrook, 2000; Parnas, 1999).

The selection of a suitable set of RE techniques for a given development project, however, is a great challenge for RE practitioners. On the one hand, software development projects are diverse and inherently complex. On the other hand, the techniques and methods for the distinct activities within the RE process are interrelated and thus have to be combined deliberately. Last but not least, the characteristics of the specific project at hand have to be evaluated in order to enable the selection of the most suitable techniques.

The Methodology for Requirements Engineering Techniques Selection (MRETS) proposed by Jiang, Eberlein, Far and Mousavi (2007) provides a framework to help requirements engineers to resolve the those issues in a systematic way.

The methodology achieves this purpose by first providing a techniques evaluation schema with 31 attributes that need to be considered for technique selection. By introducing clustering and decision support mechanisms MRETS secondly, addresses the task of adequate techniques selection taking into account specific project characteristics. Thirdly, MRETS enables the linkage between the project attributes and the attributes of the RE technique to ensure fit between the two.

The MRETS process consists of six consecutive steps performed by requirements engineers (Jiang et al. 2007):

1.) Scoring of the attributes of the given project.
2.) Derivation of the initially recommended RE techniques.
3.) Analysis of RE techniques using the clustering method.
4.) Analysis of the techniques and construction of the recommendation space TRS.
5.) Calculation based on the objective function.
6.) Refinement of the recommended techniques selection.

The creators of MRETS Li Jiang, Armin Eberlein, Behrouz H. Far and Majid Mousavi are researchers at the department of computer science at Universität Trier, Germany.

MRETS considerably draws on the results of previous research of the above listed authors as well as on schemata presented by other authors. This includes a detailed analysis of 46 RE techniques (Jiang & Eberlein, 2003; Jiang et al., 2004) which served as a foundation for the synthesis of the 31 evaluation schema attributes. Similarly the identified software project attributes are based on past empirical research of the authors (Pfeiffer & Eberlein, 2002; Jiang et al., 2004).
Jiang et al. (2007) apply the methodology in the context of a case study on a medium sized software project. Due to the complexity of MRETS and the considerable extent of preparation needed for the performance of each particular step I will use a simplified example by focusing on the major deliverables and tasks within the process steps. Some preparatory steps are excluded from the example. For an extensive description of a real-world application of MRETS the case study by Jiang et al. (2007) is recommended.

The following fictitious project is introduced to exemplify the application of MRETS:

**Development of an innovative Product Lifecycle Information (PLI) System.**

**Table 1** Project definition

<table>
<thead>
<tr>
<th>Project Description</th>
<th>The aim of the PLI system is to manage product information over the complete product lifecycle, taking into account new sources of customer feedback information such as those found in forums and blogs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Attributes</td>
<td>Project size: Large (≥ 1000 and &lt; 1500 requirements) Project complexity: High Requirements volatility: Medium</td>
</tr>
<tr>
<td>Product Attributes</td>
<td>Product quality criteria: High Product type: New</td>
</tr>
</tbody>
</table>

The MRETS process steps to be performed for the PLI project are summarized as follows:

**Step 1.** Scoring the attributes of the given PLI project.

Requirements engineers define the PLI project attributes based on the project description and on the judgment of the engineers. Only the most important attributes are included. Unknown or less important attributes are omitted at this point (see Table 1).

**Step 2.** Derivation of initially recommended RE Techniques **TIR**.

In this step an initial set of RE techniques is selected. The selection is based on project attributes and recommendation rules that are defined in the RE process knowledge base (REPKB). The REPKB displays recommended sets of techniques that are in line with the project and product attributes. The first column in Table 2 lists the initially recommended techniques.

**Step 3.** Analysis of RE techniques using the clustering method.

On the basis of the PLI project attributes, requirements engineers identify the important technique attributes for the selection of suitable RE techniques. Next the techniques are clustered based on the before defined technique attributes. A clustering algorithm is used to find the optimal number of clusters in relation to the cost function and to ensure that techniques within clusters have similar characteristics.
Step 4. Analysis of the techniques and construction of the recommendation space TRS.

In step 4 the initially composed list of techniques TR is reviewed to ensure consistency with the project. It is decided that the elicitation technique Interviewing would be too resource intensive in consideration of the project size. Instead the technique Focus groups is chosen. Of the two functionally comparable verification and validation techniques, Formal requirements inspection is favored over Requirements testing. Besides these changes requirements engineers decide to include the remaining techniques without further changes in the recommendation space TRS. The results are listed in column 2 of Table 2.

Step 5. Calculation based on the objective function.

In step 5 the final list of the most suitable techniques is derived from TRS. For this purpose the Objective function formula is used to calculate the cost of each technique and its final score. Subsequently the final overall score for all technique combinations is determined. The combination with the highest score resembles the final recommendation.

Step 6. Refinement of the recommended techniques selection.

In the last step, the final recommendation is eventually reviewed once again by requirements engineers. The engineers realize that due to a lack of tool support for the Goal based analysis (GBA) technique, and the large amounts of requirements, an alternative requirements prioritization technique is needed. After referring back to the REPKB they decide to include the Analytical hierarchy process (AHP) instead in the final selection (see column 3, Table 2).

Table 1 Recommendations and final technique selection

<table>
<thead>
<tr>
<th>Categories</th>
<th>Initial recommendation</th>
<th>Final recommendation</th>
<th>Final decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elicitation</td>
<td>Interviewing</td>
<td>Focus Groups</td>
<td>Focus Groups</td>
</tr>
<tr>
<td>Analysis &amp; Negotiation</td>
<td>Goal based analysis (GBA)</td>
<td>Goal based analysis (GBA)</td>
<td>Analytical Hierarchy Process (AHP)</td>
</tr>
<tr>
<td>Documentation</td>
<td>Unified Modeling Language (UML), Structured natural language specification</td>
<td>Unified Modeling Language (UML), Structured natural language specification</td>
<td>Unified Modeling Language (UML), Structured natural language specification</td>
</tr>
<tr>
<td>Verification &amp; Validation</td>
<td>Formal Requirements Inspection, Requirements Testing</td>
<td>Formal Requirements Inspection</td>
<td>Formal Requirements Inspection</td>
</tr>
</tbody>
</table>
Due to the importance of proper RE techniques selection and combination for software development a variety of methods to support this task has already been introduced. The requirements determination model of Davis (1982) suggests the definition of groups of RE methods. The grouping is based on four broad strategies that are derived of the constraints posed by humans as specifiers. Maiden and Rugg (1996) propose a framework (ACRE framework) that assists requirements engineers to choose RE methods for requirements acquisition. Method engineering (Brinkkemper, 1996) is another important concept which helps to create a tailored RE process for a specific problem area or domain.

Macaulay (1996) stresses the importance of clearly understanding of the objectives of the RE process for the identification of suitable techniques and concludes with a wish list of requirements for RE techniques. This wish list is divided according to the five most common causes of failure in RE: the RE process itself, human communication, knowledge development and documentation and management of requirements. Hickey and Davis (2003) focus on techniques selection for the elicitation process. Through qualitative empirical research they uncovered factors highly experienced experts use in their approaches to identify suitable elicitation techniques.

Jiang et al. (2007) however, recognize that current research still provides little methodological support for:

1) The comparison of RE techniques based on technique attributes.
2) How different techniques should be used in different phases of the RE process.
3) The selection of appropriate RE techniques for the entire RE process.

For the development of MRETS Jiang et al. (2007) drew especially on Kotonya and Sommerville’s (1998) RE process model. This RE process model breaks the RE process down into four phases: requirements elicitation, requirements analysis and negotiation, requirements documentation and requirements validation. A main difference however, lies in the perception of the requirements management function. In the RE process model this function is part of the whole process, whereas in MRETS it is defined as a separate category.

Although the case study presented in Jiang et al. (2007) showed promising results, no additional empirical research on MRETS is performed to date.

In their recent review of empirical research in RE, Goeken and Patas (2010) assert that there is still a significant gap in evidence-based knowledge concerning the advantages or disadvantages of different methods for the selection and combination of RE techniques. Rupp et al. (2009) confirm this assessment. They hold, that due to the lack of knowledge RE technique selection and application is in most cases still conducted on the basis of intuition and experience of requirements engineers.


Parnas, D. (1999). Software engineering programs are not computer science programs. *IEEE Software*, 16(6), 19-30. doi: 10.1109/52.805469