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Integration of Agile Practices: An approach to improve the quality of software specifications

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Abstract. Customer unavailability and insufficient requirements gathering are challenges that have compromised the adoption of agile methodologies. This research proposes an exploratory study in the industry to investigate how requirements engineering is used in agile projects. A Systematic Literature Review (SLR) was conducted and its results indicated the existence of problems in requirements engineering activities applied to agile projects. This research plan to perform a Survey with software engineers who uses agile practices, aiming to understand the perception of professionals about the best practices, challenges and limitations of the requirements engineering approaches currently used by the software industry. Then a new approach to the specification of requirements will be proposed using principles such as: Decrease constant dependence customer; Document only what is necessary to implement a requirement; Agile Practices; Quality Requirements. A experiment will be conducted to evaluate the quality and productivity of the proposed approach.

Keywords: agile, quality of software specifications, survey, quasi-experiment;

1 Introduction

1.1 Theoretical Background

Software are increasingly complex, the application of requirements engineering principles is essential to identify, elicit, analyze, specify and manage the needs of users.

According to Thayer [1], the Requirements Engineering (RE) provides the appropriate mechanism to understand what the customer wants, analyzing the needs, verifying the feasibility, negotiating solutions, specifying the unambiguous and managing their changes. Despite the importance of RE in the success of the development of the software and minimization of project risks, this activity is seen in agile methods as bureaucratic, which makes the process less agile.

In 2001, the publication of the Agile Manifesto [2] was a milestone for Agile Software Development. A group of 17 experts proposed practices to improve software development by defining values and principles that guide agile methodologies. More

than a decade has passed since the Manifesto, however, research evidence point out limitations in adopting agile methodologies regarding the activities of requirements engineering [3,4,5,6,7].

The quality of the SRS (Software Requirements Specification) directly affects the success of software development. Saito [17] proposed a quality and evaluation model (PQM - Pragmatic Quality Model) derived from IEEE Standard 830 [18] that contains the following desirable quality sub-characteristics in an SRS: Correct, Complete, Unambiguous, Consistent, Verifiable, Modifiable, Traceable, Ranked for Importance and/or Stability, Perspective and Pragmatics.

1.2 Research Problem

The challenges in adopting agile methodologies stem mainly from the fact that two values defined in the Agile Manifesto [2] do not actually appear as something real in most software development projects.

The value "Continuous collaboration with the Customer" [2] considers the customer's constant presence as essential to explain and detail the requirements, validate and test the application. However, in practice what is observed is that the customer's continuous presence is an exception, not the rule. Most of the time, the user stories (or other specification) are not written directly by customers [8].

Another value is the "Agile Teams respond quickly to changes" [2]. In fact, some changes are easily incorporated, for example, change the position of a field on the screen, remove a validation rule and create a new report. However, there are client requests that imply structural changes in software architecture and database model. In such cases, the response to change is not so quick. In some situations it is not worth to refactor the existing code. It is better to implement all the code again. The approaches currently used to specify requirements in agile projects do not pay attention to the following issues:

- Customer unavailability: In practice, the availability of the customer to explain details of their needs, answer questions and validate functionality does not correspond to the minimum necessary for the smooth progress of the project;
- Turnover Team: software development companies have one of the largest professional turnover rates [16]. So knowledge of business rules, data model, architecture and other important information should not be exclusively in people's minds. It is necessary to document and share the knowledge that adds value to someone else. This prevents people to interrupt their activities to pass on knowledge to others;
- Software Maintenance: Before proceeding with changes in software, it is necessary to understand the current functionality so that you can assess the impact and make the appropriate changes in the source code. A poor quality documentation compromises the execution of those activities;
- Distributed Teams: Increasingly we come across software projects whose developers work in physically distributed locations. Some situations collaborate to this reality: skilled labor in several countries, cost of labor, boosting Home Offices, lower

expenditure on basic infrastructure in enterprises. In this context, communication with the client and among team members is quite limited.

Agile practices and RE can together provide benefits to the development process. However, for this to happen, it is necessary changes in how RE has been conducted in current projects adopting agile methodologies. In this context, the general objective of this research is to investigate in more detail the techniques and processes of requirements engineering being used in projects that adopt agile methodologies in order to understand which are the benefits, best practices, challenges and limitations. As a result of this investigation and observing the problems described above, it is proposed a new approach that contributes to improving the quality of software specifications and consequent increase of productivity development. For this, the following Principal Research Question (PRQ) was defined: Which practices can improve the quality of specifications in software requirements without compromising productivity?

1.3 Related Works

NORMAP Methodology [9] is a framework for identifying and modeling NFRs (Non-Functional Requirements) and linking them with functional requirements in agile processes. But the adoption in practice is compromised because the complexity and amount of proposed artifacts. Paetsch [5] suggests practices to improve the adoption of RE in agile projects, but has no evidence that the suggestions were validated in real projects. An extension of Scrum to support requirements in accordance with CMMI-DEV is presented in [11], but there is no evidence of validation.

2 Proposed Solution

This research aims to bring contributions to the Requirements Engineering, specifically when applied to projects that adopt agile methodologies. Next, it is highlighted the main contributions obtained from this research:

- The first contribution was the realization of an inductive and qualitative research through a Systematic Literature Review (SLR). The purpose of the SLR was to investigate how the RE has been conducted in agile projects. The review gathered evidence that supports the other activities of this research;
- Conducting a qualitative research through a Survey in order to investigate the customer's participation in the activity requirements specification, which techniques are used to specify and validate requirements. The Survey also aims to investigate the perception of respondents in respect to the benefits, best practices, challenges and constraints identified during systematic review. It will be assessed whether there is convergence or divergence between the data obtained from two research instruments (SLR and Survey). It will also be investigated whether there is a connection between how the requirements are specified and the quality of those requirements.

- Development of a new approach for requirements specification using agile practices and adherent to quality models like PQM [17] and CMMI. This new approach is a process for requirements engineering, describing the techniques to be used, the inputs and outputs provided. In this paper, this new approach will be called BRA.
- To evaluate the proposed approach, a quantitative research will be conducted through a quasi-experiment.

2.1 The Research Design

This research assumes that knowledge to problem solving will be built gradually from observations and inferences, following the positivist position [14].

A) Systematic Literature Review (SLR)

The guidelines suggested by Kitchenham [15] have been adapted for preparing the planning and execution of the SLR. The Specific Research Questions were defined:

- SRQ-1.1: What technical and software requirements specification processes are being used in projects that adopt agile methodologies?
- SRQ-1.2: What are the best practices and limitations of current requirements specification techniques when adopted in projects using agile methodologies?

The String Search was defined based on the terms: REQUIREMENTS, AGILE METHODOLOGIES and SOFTWARE. A manual search was conducted in the Proceedings of the International Requirements Conference and Agile Conference, for the years 2008 to 2013. An automatic search was conducted without year restriction on the engines: IEEE, Compendex, Scopus, ACM, Springer, and Science Direct.

B) Survey

The Survey has an explanatory and descriptive purpose. The Design Survey is the Case-Control type. The Survey should answer the previously described Research Questions and the following Specific Research Questions (SRQ):

- SRQ-1.3: In projects that adopt agile methodologies, is there a relationship between the technique used to specify requirements and the quality of requirements?
- SRQ-1.4: In projects that adopt agile methodologies, is there a relationship between the technique used to specify requirements and the productivity in the implementation phase?
- SRQ-1.5: In projects that adopt agile methodologies, how and how often is customer participation during the development cycle?

Fig. 1 shows the independent and dependent variables that will be analyzed in the study. The execution of the Survey follows the steps and recommendations [13]: Definition of Goals; Survey Design; Preparation of the Questionnaire; Questionnaire Evaluation; Valid Data Collection and Analysis of Data.

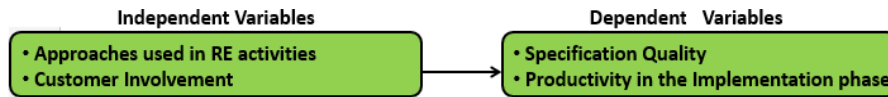


Fig. 1. Conceptual Model Survey

The planned sample includes software companies in Brazil, located in the states of Ceará, Pernambuco and Paraíba. The unit of analysis consists of software engineers (analysts and developers) who work on projects that adopt agile methodologies.

C) Quasi-Experiment

The Quasi-Experiment will be a quantitative research and follows the steps outlined in [10]: Definition of Objectives, Design, Implementation and Analysis. The experiment aims to answer the Specific Research Question (SRQ):

- SRQ - 1.6: Is there a difference between the BRA and the XXX¹ approach regarding the productivity and the quality of the specifications?

Given the existence of a single factor, the experimental design defined is the Within-Subjects type. Three null hypotheses were set up to evaluate if the approaches are equal regarding the quality, productivity of the activity of requirements specification and productivity in the coding phase. To analyze the collected data it will be used a statistical test (TEST-T, for example) in order to ensure greater reliability of completion. Fig. 2 shows the dependent and the independent variable. The PQM [17] will be used to measure the dependent variable “Specification Quality”. Productivity will be measured by the time spent to perform the activities of SRS and coding activities.

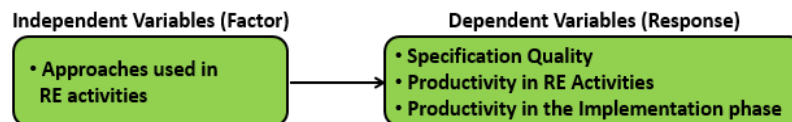


Fig. 2. Conceptual Model of Quasi-Experiment

3 Current Status

3.1 Systematic Literature Review (SLR)

The SLR has been completed. Initially there were selected 2852 articles, of which 2501 came from automatic search and 351 from manual search. After applying the criteria of inclusion and exclusion and the quality of items analysis, the amount of selected articles was reduced to 22 that were used for extraction and synthesis of data. One of the SLR results was the finding that the agile value "Continuous collaboration

¹ XX- Existing approach to be selected from the survey's results

with the customer" is a major challenge to the projects. The SRL also pointed out several limitations in the current techniques used to specify requirements. The answers to research questions, as well as the complete results and SLR limitations will be presented in another article, in time.

3.2 Survey

The first three activities planned in [13] have already been made. The elaborated questionnaire is being validated by performing a pilot as a way to simulate the filling and to evaluate, among other things, the time spent, the clarity and understanding of issues and the response options. After the completion of this pilot, the questionnaire will be put available so that it can be filled by the sample members. Then the data will be tabulated, analyzed and synthesized.

3.3 New Approach

The new approach (BRA) will be developed considering the following guidelines:

- Limitations and benefits pointed in SLR and Survey;
- Low availability of customer;
- Document only the essentials that contributes to the coding or to the maintenance;
- PQM [17] and Area Requirements Development (RD) of CMMI-DEV;
- Agile Practices: Features, Acceptance Criteria, Small Releases, prioritization;
- Repository of Business Rules and UCD (User Center Design) Practice.

3.4 Quasi-Experiment

The first two activities set forth in [10] have already been made, as described in section 2.2.3. Other activities will only take place after the BRA has been defined.

4 Concluding Remarks

It is expected that the SLR results will bring contributions to the state of the art and the controlled experiment can be replicated in other studies. For the industry, we expect that the proposed new approach (BRA) improving the quality of SRS without compromising productivity. BRA is focused on agile projects whose customer does not have availability to work in-site with the development team.

There were identified risks to the research regarding the need of involvement in real projects. There might be difficult to find companies willing to devote time of their engineers to participate in the experiments. Another risk is whether we can have a representative sample for data analysis.

Currently this research is in the 23th month of activity, from a total of 48 planned. All credits required to obtain the doctorate, have been completed with maximum concept (A). The qualification of this proposal is expected to be held in April 2015.

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