Integrating formal methods into traditional practices for software development: an overview

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Abstract—This paper shows an overview of a research project for integrating formal methods in popular practices for software development in México. The article shows only the main results from the survey about methods and practices and an overview of the initial proposal of practices applying lightweight formal methods to requirement specification and software modelling.

Keywords—requirement specification; software modelling; lightweight formal methods.

I. INTRODUCTION

Software Engineering has been supporting the use of software development methods such as RUP [1], XP [2], UCD [3] and many others; additionally another set of methods with emphasis in software process management such as SCRUM [4], [5] and TSP [6], [7], among others. In addition we have formal methods, which are a set of mathematical and logic techniques to specify, design, implement and verify information systems [8]. Formal methods are not widely used in development for traditional information systems; in Mexico is even more difficult to find documented success stories [9].

II. DESCRIPTION OF THE PROJECT

The main aim of the project was to propose the integration of formal methods with popular software modelling and specification practices used in business organisations in order to increase the reliability of the software. Our list of particular goals is presented as follows:

- to identify popular practices used in software development by business organizations,
- to analyse formal methods with possibilities of integration with traditional practices,
- to adapt and design a proposal for the application of formal methods together with a selected set of traditional practices, and
- to evaluate the proposal with software development teams.

Even with the advance in software processes and visual modelling, failures in software development still persist in recent years [10]. One important cause for mistakes in software development is related with a poor specification from the requirement description to the modelling of particular details of the software. It is our opinion that these problems could be reduced if more software specifications and models take advantage of what formal methods offers. However, developers are reticent to use them, therefore we need to present a simpler way to increase their use without adding a whole additional layer of activities to the development cycle.

This research began doing a bibliography review of the techniques and practices of software development to find the more accepted at the moment, making emphasis in the practices that generate a specification or model artifact. In addition, we did a survey among software development companies in Mexico that helped us to select the most accepted practices. Later we reviewed some formal languages, where we put particular attention to the difficulty, being this a factor that may inhibit their acceptance. Then we related the selected practices with the formal methods, trying to propose a set of modifications which integrates and adapts the practices to take into consideration formal aspects. The proposal will be tested with software development teams. 1 shows the methodology mentioned above.
III. RESULTS ON THE SURVEY OF METHODS AND PRACTICES FOR SOFTWARE DEVELOPING IN MÉXICO

We applied a survey trying to identify, among other things, the main methods and practices used by software development companies in México. The survey was applied online, which was broadcast to multiple groups, including even with the support of a specialised magazine connecting academia and businesses in software development [11]. The survey was divided into the following areas:

- general questions about methods and practices,
- questions about tools and notations
- question about formal methods and web development

Among the main answers that we wanted to know were precisely about the more popular methods and practices used in Mexico, therefore they are the only data we are presenting here. The whole results of the survey can be consulted in [11].

One of the first things that we wanted to know is if developers in México are using software development methods and in which percentage. Fig. 2 shows that only 27% said that they apply some method, while 39% apply a development method but only partially.

In 3 can be seen that, according to our survey, the most popular development method used in Mexican companies is Scrum (22.5%), followed by Extreme Programming, Iterative and incremental approach, and waterfall with almost 12%; the Unified Process and a prototype based approach with almost 9%.

IV. OVERVIEW OF THE PROPOSAL: USING FORMAL METHODS WITH TRADITIONAL PRACTICES

From the survey data but also by analysing the possibilities of particular formal methods we are proposing initially eight practices, four for requirement specification and four for software modelling. We are proposing the use of three lightweight formal methods, attempting to reduce the adoption cost for developers. The practices were divided whether they can or cannot be verified, but considering that the practical output could be already useful even if no yet formally verified. The proposed practices for requirement specifications are as follows:

1. Activity diagram for use case
2. Verification of activity diagrams with task algebra
3. Use case specification with Alloy
4. Verification of use cases with Alloy

And, the proposed practices for software modelling:

1. Modelling class diagrams with Alloy
2. Verifying class diagrams with Alloy
3. Modelling class diagrams with OCL
4. Verifying class diagrams with OCL

Both set of practices were presented using the template proposed in Kuali-Beh by Oktaba [12] and can be consulted in [13].

V. CONCLUSIONS AND FUTURE WORK

If using software development methods, indicate which ones

![Diagram](image)

Fig. 3. If using software development methods, indicate which ones

Based in our survey, there is almost no evidence of use of formal methods in Mèxico. We proposed two sets of practices to include lightweight formal methods in requirement specification and software modelling in order to incorporate them easily to the software development cycle.

In the coming months we are expecting to validate our proposal, refining our practices according to the results. Additionally, in the future we would like to include more practices and promote them with software developers.

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REFERENCES