Indicating Potential Risks for Project Success Based on Requirements Fulfillment

Analyzing Requirements Compliance in Student Software Projects

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I. Introduction

Requirements Engineering (RE) contains many different practices to elicit, communicate and document customer requirements. Developers need to understand these requirements properly in order to achieve project success by fulfilling them [1]. A prerequisite for developers' understanding of relevant requirements and their meaning is successful requirements communication [2]. Therefore, the selected RE practice is related with project success by influencing requirements communication which is important for understanding and fulfilling requirements. Beneficial RE supports requirements communication and thus requirements fulfillment respectively project success.

In this context, requirements compliance is one possible measure of project success, since its core message is: *Fulfill all customer requirements, but build nothing else* [3]. It represents the accuracy of implemented compared to customer requirements. This enables a measurable relation between RE practice and project success based on requirements fulfillment, which allows assessing the quality of RE activities.

We analyzed requirements compliance in three student software projects at each review date. Our results show that requirements compliance can indicate potential risks for project success based on requirements fulfillment and thus customer satisfaction.

II. Related Work

Several different approaches identified key aspects of RE practices which are related to project success.

Verner et al. [4] performed a survey with software practitioners regarding development practices. According to their findings, the best predictors of project success are good requirements and their effective management.

Agarwal and Rathod [5] conducted an exploratory survey with developers and project managers to determine their views of project success. The results yield that all participants consider fulfilling the scope of software projects which comprises functionality and quality as most important for project success.

Hofmann and Lehner [6] analyzed team knowledge based on the application domain, used technology, and RE process to establish a link between RE practices and project success. They identified that successful projects allocate a higher amount of resources to RE. Such projects closely cooperate with stakeholders to focus on customer satisfaction by requirements fulfillment.

Schneider et al. [3] introduced the concept of requirements compliance to create a mental model considering project success based on developers' daily work, i.e. fulfilling requirements. Their preliminary evaluation showed that customer feedback on deliverables is necessary to achieve a high requirements compliance.

All approaches identified similar aspects that relate RE practices and project success. Good requirements, i.e. their comprehensibility, and requirements communication are key aspects of RE for project success. We followed Schneider et al.'s [3] approach by applying requirements compliance on three student software projects to indicate potential risks for project success.

III. Methodical Approach

A. Study Design

The Software Engineering Group at Leibniz Universität Hannover offers a yearly course called *Software-Project*. The participants work together for 15 weeks in teams consisting of nine to ten students.

Since 2015, the document-centered project became more hybrid by integrating agile practices like on-site customer. Nonetheless, traditional practices like classical requirements analysis are still part of the ongoing process.

The development process consisted of a 4-week requirements analysis phase followed by two 3-week iterations and one 2-week polish phase. Over the entire project, the customer attends a weekly meeting with the developers.

For the first time, we collected data for requirements compliance within three teams over the entire development. The teams developed the same software product independently. Each team elicited 24 comparable requirements: 18 functional and 6 non-functional ones. The customer filled out questionnaires to report about the current implementation status of his requirements at three review dates: After each iteration and the polish phase. Based on this information, we calculate requirements compliance.

B. Results: Requirements Compliance

We measured the total requirements compliance based on all 24 requirements for each team. In addition, we considered the requirements compliance separately for functional and non-functional requirements.

Regarding the total requirements compliance, all three teams continuously improve over the entire development.

The total requirements compliance ranges from 83.3% (Team 3) to 89.5% (Team 1) at project's end. Team 2 achieved a total requirements compliance value of 87.5%.

Over the entire process, the functional requirements compliance is similar to the total requirements compliance. At project's end, its values range from 88.9% (Team 1, Team 2) to 94.4% (Team 3). During the polish phase, the functional requirements compliance values increase between 11 – 22 percentage points, although the developers should focus on non-functional requirements to improve the software's usability, design, and reliability.

Figure 1 shows the non-functional requirements compliance over the entire development. The results of the polish phase are surprising since they range from 50.0% (Team 3) to 91.7% (Team 1). The value of Team 2 is 83.3%. While Team 1 increases its non-functional requirements compliance by 33.4 percentage points from 58.3% to 91.7%, the measurement result of Team 2 (83.3%) remains the same. Team 3 decreases its non-functional requirements compliance by 33.3 percentage points from 83.3% to 50.0%.

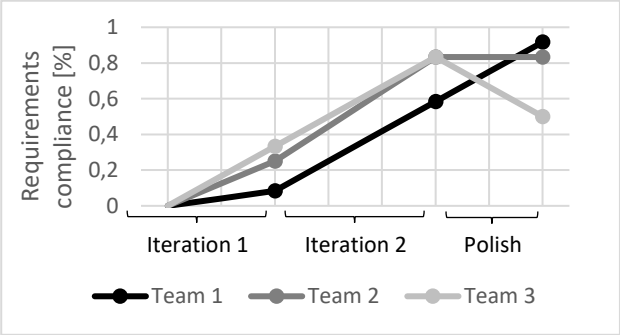

Figure 1 – Requirements compliance based on non-functional requirements

IV. Discussion

By understanding customer requirements, developers can fulfill them and achieve project success. Unfulfilled requirements can be caused due to misunderstandings based on unsuccessful requirements communication. This is a problem of RE practice since the selected practice influences requirements communication. Beneficial RE supports requirements communication and thus project success by requirements fulfillment.

Requirements compliance is based on requirements fulfillment. Therefore, it enables a measurable relation between RE practice and project success, which allows assessing the quality of RE activities.

According to our results, the continuous analysis of requirements compliance can indicate potential risks for project success. While the total requirements compliance of all teams continuously increases to at least 83.3%, the separate consideration of functional and non-functional requirements compliance provides interesting insights.

Especially, the non-functional requirements compliance shows surprising results. During the polish phase, non-functional requirements should have been focused. As a consequence, an increase of the non-functional requirements compliance would be expected. However, only Team 1 increased its result. The measured value of Team 2 remained the same and Team 3 decreased its non-functional requirements compliance by 33.3 percentage points. This difference can be the result of a deviation from the defined development process. Instead of focusing on non-functional requirements, especially Team 3 still implemented further functional ones. Such a high decrease is critical and represents potential risks for projects success since it diminishes customer satisfaction.

Despite our results, the effective value of requirements compliance as an indicator for potential risks of project success is uncertain. Our data is only based on three student software projects and has no direct relation to industry. This work is a first try of using requirements compliance over an entire development to relate RE practice and project success.

V. Conclusion

A core aspect of beneficial RE practice is successful requirements communication. It supports requirements' comprehensibility which is important to fulfill them in order to achieve project success. Requirements compliance considers requirements fulfillment that requires shared understanding and thus successful requirements communication. Therefore, requirements compliance relates RE practice to project success.

Even if the total requirements compliance conveys an impression of project success, the separate consideration of functional and non-functional requirements compliance can indicate potential risks for project success. This can be attributed to difficulties between a defined development process and continuous changes due to agile practices. Our findings demonstrate a practical application of requirements compliance as a possible measure to assess RE activities' quality for identifying good or bad RE.

Acknowledgements

This work was funded by the German Research Foundation (DFG) under grant number 263807701 (Project TeamFLOW, 2015-2017).

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