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December 1999

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A Qualitative Assessment of Developers' Perception

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Abstract

Systematic reuse is becoming an increasingly accepted way to improve software development productivity and quality. The implementation of a software reuse methodology requires substantial investments for the company. The factors that contribute to the overall success of reuse for an organization have been examined in prior research. However, even in organizations that are successful in employing reuse, some projects fail to achieve the targeted amounts of reuse. This suggests that there are other factors beyond the overall organizational factors affecting the success of software reuse in projects. This research explores factors that affect reuse success of individual projects in software development. We assess the developers' perception of the project level factors in an environment in which systematic software reuse is conducted successfully. We believe that an organization that can identify the factors affecting potential software reuse will be able to better target investments in the improvement of reuse methodology and thus influence the software productivity and quality.

Introduction

Reuse of previously written code is a way to increase software development productivity as well as the quality of the software (Banker and Kauffman 1991; Chen and Lee 1993; Basili, Briand et al. 1996). Several publications examine what makes companies succeed or fail in their reuse attempts (i.e., Frakes and Fox 1995; Frakes and Fox 1996; Frakes and Isoda 1994). However, even within a company that meets the criteria of a successful reuse approach, software reuse is not consistently successful across all projects.

The purpose of this research is to explore what factors can lead to success or failure of employing reuse in projects of software developers that have an overall successful reuse methodology in place. We selected such a software development company to gain in-depth knowledge as to what factors influence project success. Based on the perception of team members of many projects, propositions are developed that may explain the factors that influence reuse success at the project level in the context of the subject company. The factors observed via this case study can then be tested and the results generalized.

Research Design

Previous research has explored what makes reuse methods succeed or fail (i.e., Frakes and Fox 1995; Frakes and Fox 1996, Frakes and Isoda 1994). Findings considered companies and methodologies as a whole. Although the factors previously identified as being crucial to a successful reuse method are constant within one company, reuse success across projects varies. Hence, there must be additional factors at the project level as opposed to the organizational level that affect reuse. This research identifies a set of factors that affect project reuse success.

We conducted a case study of a software development company to identify the factors that influence project reuse success. The company employs a proprietary Enterprise Model based methodology for development of all their projects. Their methodology facilitates systematic software reuse. Eight individuals who are involved in various roles in a series of five projects participated in the case study. Different reuse success rates have been observed across these projects using a systematic reuse measure (Rothenberger and Hershauer 1999).

To identify the factors for project reuse success, we used the Nominal Group Technique (NGT) in a half-day long session (Delbecq, Van de Ven, et al. 1975) on a group of eight project managers and head analysts at the

company headquarters. The NGT session consisted of three stages: idea generation, clarification, and voting. Prior to the experiment with the actual group, the NGT design was pilot tested with six Information Systems professors and doctoral students. Based on this experience, we designed the introduction and the main question given in Figure 1 for the idea generation stage. No other explanation was given. The session has been facilitated by a person who had successfully conducted over a hundred such sessions with various groups.

For the purpose of this meeting, we make the following assumptions about "reuse":

- We are only looking at code that has been hand-coded (reused or non-reused), such as {company terminology}. We are disregarding the generated part of each project.

- Reuse is defined as code that has been written for an earlier project and that has been reused in the current project without significant modifications (< 25% of development effort of the component). We are not counting the repeated use of the same component within a project as reuse.

- Among the projects we looked at, there is a difference in the levels of reuse.

Judging from your experience with all projects you have worked on in {company name}, what do you think contributes to the variations in reuse levels (reuse rates) across projects?

Please write your ideas in bullet points below:

Figure 1: NGT Introduction and Question

In the idea-generation stage, candidate factors proposed by the participants affecting project reuse success were collected in a round-robin fashion until every participant had completely exhausted his / her ideas. This stage lasted about forty-five minutes. In all, forty-three individual bullet points were generated. The quality of issues raised in this stage was clearly indicative of the reuse knowledge of these experts.

In the clarification stage, participants were encouraged to raise questions, again in a round-robin fashion, to completely understand each and every idea in a common way. This is also the stage where ideas get consolidated into a smaller number as certain ideas subsume others, ideas are grouped / merged into others, etc. This stage

also took about forty minutes. The group identified thirty-seven distinct factors.

The pilot NGT session had shown that it is difficult to keep the participants focused on looking at only the project-level factors, rather than organizational factors. As a result the facilitator stressed the objective of looking at project-level factors at key steps during the NGT session.

In the next stage, the participants were asked to cast two rounds of votes on the factors they considered most important in terms of their influence on the reuse success of software projects. At the end of the first round of voting, the participants eliminated the twenty least important factors. They then voted to select from the remaining seventeen factors and chose ten that most influenced project-level reuse of software (Figure 2). The NGT session was completed at this time.

A further qualitative analysis of the data resulted in identifying four conceptual groups into which the ten factors can be categorized: Client Influence, Project Culture, Project Attributes, and Developer Reuse Experience. Client Influence factors describe the constraints / concerns / attitude of the client towards software reuse for a project. Project Culture reflects the different degrees of emphasis put / incentives offered (tangible or intangible) by the company for various projects. Project Attributes address issues that are inherent to the project itself. Developer Reuse Experience describes experience and knowledge of the project team members regarding reuse and reusable components. Although classifying the factors into high-level conceptual groups is not necessary at this stage, the grouping gives us an excellent framework to think about. By way of follow-up interviews, we asked the participants of our study the efficacy of the conceptual grouping. The group's responses validated our grouping by confirming that the framework did help in enhancing their understanding of the relationships between the various factors.

Contribution

Identifying the factors that influence project success in a systematic reuse development environment allows software development firms to better target reuse investments. Previous research has focused on the critical success factors of reuse methodologies on an organizational level. However, sound methodologies may not achieve their full potential because of implementation factors at the project level. Those factors have widely been ignored so far.

The outcome of this qualitative stage of the research is to propose a set of candidate factors based on developer perception, that attempts to explain why project reuse success varies in an overall successful systematic

software reuse setting. These candidate factors can now be used to generate a set of testable hypotheses. In the next stage of this research, we cross validate the factors by looking for case evidence for their effect on reuse. The cases are the five reuse projects. Next, we conduct structured interviews with project leaders, designers, and developers to gain a deeper understanding of the nature of the relationship between the factors and project reuse success. We attempt to explain our case observations with the insights obtained during this stage.

In a follow-up study we are attempting to validate and generalizes the propositions introduced here using a large-scale survey of software development companies employing systematic software reuse.

Client Influence Factors:
- Client's budget and time constraints
- Perceived value of reuse by the client
- Client's fear of inter-connectivity (threat of multiple failures due to multiple uses of a defective component)

Project Culture:
- Degree of promotion / emphasis of reuse by the leader / developing team during the project development
- Degree of training and incentive for reuse on the project

Project Attributes:
- Project sequence (A project is conducive to reuse if a similar project has been done earlier)
- Type of project (the degree of suitability of reuse for the particular domain – fit of the repository)

Developer Reuse Experience
- Experience in recognizing reuse patterns
- Understanding of the company's reuse model
- Knowledge of component availability / capability

Figure 2: Project-Level Reuse Success Factors

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