Studying Software Engineers: Data Collection Techniques for Software Field Studies

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Abstract. Software engineering is an intensely people-oriented activity, yet too little is known about how designers, maintainers, requirements analysts and all other types of software engineers perform their work. In order to improve software engineering tools and practice, it is therefore essential to conduct field studies, i.e., to study real practitioners as they solve real problems. To do so effectively, however, requires an understanding of the techniques most suited to each type of field study task. In this paper, we provide a taxonomy of techniques, focusing on those for data collection. The taxonomy is organized according to the degree of human intervention each requires. For each technique, we provide examples from the literature, an analysis of some of its advantages and disadvantages, and a discussion of how to use it effectively. We also briefly talk about field study design in general, and data analysis.

Keywords: Field studies, work practices, empirical software engineering.

1. Introduction

Software engineering involves real people in real environments. People create software, people maintain software, people evolve software. Accordingly, to truly understand software engineering, it is imperative to study people—software practitioners as they solve real software engineering problems in real environments. This means conducting studies in field settings.

But how does one attain this admirable goal? What techniques are available for gathering data and analyzing the results? In what situations are each of these techniques suitable? What difficulties might the software researcher encounter when performing field studies? To begin to address these questions, in this paper we make a first attempt at providing a taxonomy of data collection techniques for performing field studies. We illustrate the discussion with examples from our own work as well as numerous studies reported in the literature.

The authors appear in alphabetical order and contributed equally.
The techniques we talk about have primarily been adapted from fields such as sociology, psychology, and human–computer interaction. In particular, these methods rely heavily on the use of field study techniques. Field study techniques are a group of methods that can be used individually or in combination to understand different aspects of real world environments.

The results of such studies can be applied when one has several different types of research goals. First, they can be used to derive requirements for software tools and environments. For example, we have performed field studies where we learned about software design and maintenance, and then successfully applied our results to tool design and integration (Singer et al., 1997, 1998). Second, the results can be used to improve software engineering work practices. For example, one of us (Sim) was able to make useful recommendations following a study of how newcomers adapt to a software team (Sim and Holt, 1998). Third, analysis of the results can yield new theories or hypotheses that can then be subjected to controlled experimental validation (Seaman and Basili, 1998; Singer, 1998).

The taxonomy we have created is based on the degree of human intervention each data collection technique requires. We begin in the next section by providing an overview of the taxonomy and describing how the taxonomy can be used in selecting a technique for a field study. In Section 3, we talk about each of the techniques individually, providing examples from research where it was applied, and giving advantages and disadvantages of its use. We talk briefly in Section 4 about study design and recording and present a brief discussion of data analysis. We conclude the paper with a discussion of how to use these techniques in the most appropriate fashion.

2. Data Collection Methods

When conducting field studies it is important to obtain accurate and reliable information about the phenomenon under study. Interviews and questionnaires are the most straightforward instruments, but the data they produce typically present an incomplete picture. For example, assume your goal is to assess which programming language features are most error-prone. A developer can give you general opinions and anecdotal evidence about this; however you would obtain far more accurate information by recording and analyzing the developer’s work practices—their efforts at repeatedly editing and compiling code. Methods such as think-aloud protocols and work diaries are used for this type of research.

To learn about different aspects of a phenomenon, it is often best to use multiple data collection methods. One then analyzes the resulting data to triangulate the work practice. In the remainder of this section we survey the range of techniques that can be used in this triangulation process, and discuss some of the criteria that can be used to choose techniques.

2.1. A Taxonomy

In Table 1, we present a taxonomy for the data collection techniques. Each technique is categorized according to the degree of human contact it requires. First degree contact