Abstract. In this paper a new Experimental and Explorative Research (EER) research strategy is proposed. It combines experimental software engineering with exploratory research of new technologies. EER is based on several years experience of using and developing the approach in research of future mobile applications. In large international projects explorative application research includes quite often both industrial software developers and experienced researchers. This kind of an experimental research environment resolves the subject problem found in student experiments. It also does not have the difficulties found in experimental design and control of industrial projects that are constrained by strict commercial conditions. EER strategy provides benefits for both worlds: (1) experimental software engineering research benefits from almost industry level projects that can be used as experimentation environments, and (2) future mobile telecom application research benefits from better control and understanding of the characteristics of the applications and their development methods and processes.

1 Introduction

Software engineering discipline has struggled to become an established field of engineering and/or science. An experimental component is needed in software engineering for scientific validity (Basili 1996). However, there have been debates about the nature of the field and the research methodologies used. Traditionally software engineering has used very little experimentation (Tichy et al. 1995, Zelkowitz and Wallace 1998). According to these two extensive analyses of software engineering research publications, 50-60% of the published software engineering papers were not experimentally validated (Tichy 1998). This is a very high percentage compared to some other fields like optical engineering, where the percentage of invalidated papers is merely 15%. On the other hand some prominent researchers advocate for less need of experimentation in software engineering (Hartmanis 1994).

Research and development of new technologies in fields like mobile applications is often exploratory and constructive. Proof of concept demos or prototypes are used to explore and push the limits of technology. The building of these prototypes is often an extensive project. However, the development is usually done using more or less ad-
hoc process. The end-result is that, in a positive case, the project can only demonstrate the feasibility of the technology but not much more. There is no evidence of the effectiveness of the development methods for that particular technology development nor is there any convincing empirical evidence of the excellence of the technology itself. Therefore, there is a need to combine explorative research with empirical evidence, in specific in this research area.

In this article a new research strategy is proposed. In the strategy experimental software engineering is combined with exploratory research and development of new technologies especially in developing mobile applications for the future. The strategy is based on several years of experience in using and developing this approach in the research of future mobile applications. In large international research projects the research and development includes both industrial software developers and experienced researchers. This resolves the subject problem found in student experiments and alleviates the difficulties found in experiment design and control in industrial projects. The strategy provides benefits for both worlds: (1) experimental software engineering research benefits from almost industry level projects that can be used as experimentation environments, and (2) future mobile telecom application research benefits from better control and understanding of the characteristics of the applications and their development methods and processes.

In the following section a brief introduction of those aspects of experimental software engineering that are relevant for this paper is presented. In section 3 relevant research methodologies and paradigms for explorative research are discussed. In section 4 key issues of the research of future mobile applications are discussed. Mobile applications of the future form the application domain, where most of the experiences of the report were drawn. In section 5 experiences of combining explorative and experimental approaches in a research project are presented. In section 6 the findings and the proposed new research approach are concluded into a new explorative and experimental research (EER) paradigm. In the section also future research efforts are outlined. Due to the multidisciplinary nature of this paper the review of related research is embedded in each of the sections instead of a single review section.

2 Experimental Software Engineering

Experimental research in software engineering has gained popularity in recent years. Various experimental results have been published about experiments carried out both in vivo and in vitro (Basili 1996).

Table 1. Experimentation environment (Basili 1996).

<table>
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<tr>
<th>In vivo</th>
<th>Experiment in the field under normal conditions</th>
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<td>In vitro</td>
<td>Experiment in the laboratory under controlled conditions</td>
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The principle of an experiment is shown in Fig. 1. For example, if we study the effect of a new development method on the productivity we would define the