

Keynote Talk

Software Engineering Theory and Inter-disciplinary Research

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ABSTRACT

This paper outlines the content of the workshop keynote presentation on the use of theory derived from other disciplines in empirical software engineering research. This presentation uses three previous studies, two of which involved the author, to illustrate this usage and to explore the lessons learned from this work.

Categories and Subject Descriptors

D.2 [Software Engineering]:

General Terms

Experimentation, Theory.

Keywords

Experimentation, software engineering research, theory.

1. INTRODUCTION

Researchers in empirical software engineering struggle with a lack of theory for the software engineering research domain. The result is that they are often unable to explain results that are observed in experiments or they are unable to justify the hypotheses that are being pursued. At times the nature of the research may obviate the need for theory; for example when it is concerned with technology evaluation or tool development. But at other times it is critical if we are to explain the reasons behind the relationships we see. For example in some recent research concerning software reviews, it was noted that certain observed code reading behaviour was associated with greater or lesser effectiveness in identifying defects. However the researchers were limited to an observation of association, rather than any explanation, or understanding, of the reason for the observed association. They had given no consideration to the theory that

could have been used as a lens through which to view this particular empirical result.

2. THEORY IN EMPIRICAL SOFTWARE ENGINEERING RESEARCH

In the first research considered [1], we summarise previous research in the application of the behavioural theory of group performance to explain the outcomes of software reviews. The paper used for this applied the behavioural theory of group performance to explain the outcomes of software reviews. A program of empirical research was then developed, including propositions to both explain review performance and identify ways of improving review performance based on the specific strengths of individuals and groups. In identifying task expertise as the primary driver of review performance, the research program suggested specific points of leverage for substantially improving review performance.

The presentation then summarises more recent work on the application of management theory to the area of process modelling and process improvement [2]. In this work it is shown, using case studies that use macro process modelling along with the reported results of CMMi adoption, that understanding can be achieved through the use of organizational theory, a process improvement research framework, and process innovation theory. It is concluded that the evidence supports process innovation or variations on innovation as a means of achieving large scale improvements in productivity or quality. It also argues (1) for the use of the process research framework to identify research limitations, and (2) that consideration of process alone is unlikely to provide sufficient evidence for generalization.

In the third area of research used [3], findings support the theory that cognitive fit moderates the relationship between comprehension and software modification. The authors argue that “changes in software comprehension and modification performance are positively related when cognitive fit exists and negatively related when cognitive fit does not exist.”

These comparisons reveal support for the use of inter-disciplinary theory in empirical software engineering research explanation. The research case studies presented show how a much deeper understanding of the empirical data can be achieved and how a

program of research can be derived from appropriate theory. They also provide some evidence concerning conditions for successful inter-disciplinary theory usage in software engineering research. Most of these conditions are derived from personal experience however. Finally consideration is given to possible reasons for the limited application of theory in software engineering research and indicators of mechanisms to successfully apply these methods.

3. REFERENCES

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