Reflections on 10 Years of Software Process Simulation Modeling: A Systematic Review

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Abstract. Software process simulation modeling (SPSM) has become an increasingly active research area since its introduction in the late 1980s. Particularly during the last ten years the related research community and the number of publications have been growing. The objective of this research is to provide insights about the evolution of SPSM research during the last 10 years. A systematic literature review was proposed with two subsequent stages to achieve this goal. This paper presents the preliminary results of the first stage of the review that is exclusively focusing on a core set of publication sources. More than 200 relevant publications were analyzed in order to find answers to the research questions, including the purposes and scopes of SPSM, application domains, and predominant research issues. From the analysis the following conclusions could be drawn: (1) Categories for classifying software process simulation models as suggested by the authors of a landmark publication in 1999 should be adjusted and refined to better capture the diversity of published models. (2) Research improving the efficiency of SPSM is gaining importance. (3) Hybrid process simulation models have attracted interest as a possibility to more realistically capture complex real-world software processes.

Keywords: ProSim, software process simulation, systematic literature review.

1 Background

Software Process Simulation Modeling (SPSM) was introduced into the software engineering domain by the pioneering work summarized in [1]. In the last two decades, it has been emerging as an effective tool to help evaluate and manage changes made to software projects and organizations. As a major research event, the ProSim workshop¹ series has taken place since 1998, and focuses on the state-of-the-art theories and applications of SPSM research in addressing real-world problems.

In ProSim’98, Kellner, Madachy, and Raffo (KMR) discussed a variety of aspects of software process simulation in their widely-cited paper, “Software process simulation...
modeling: Why? What? How?” [2], such as the reasons for undertaking simulations of software process models, and simulation approaches/paradigms. However, after almost 10-years (1998 - 2007) progress in software process simulation, it is appropriate to review and update the status of SPSM research, to summarize the 10-years progress, best practice and lessons learned, and propose the possible directions of our future research activities in this domain.

From this viewpoint, this paper reports the preliminary results of a systematic literature review of papers published in the proceedings and journals associated with ProSim since 1998. This paper is part of a larger study and presents only a subset of the research questions and research literature addressed by the larger study. As an anniversary review of the previous work, this paper also partially serves as the latest continuation and enhancement to the topics discussed in the KMR’s paper.

2 Systematic Literature Review

In 2004, Kitchenham et al. [3] suggested software engineering researchers should adopt “Evidence-Based Software Engineering” (EBSE). EBSE aims to apply an evidence-based approach, which was initially developed in medicine and is being adopted in many domains, to software engineering research and practice. In this context, evidence is defined as a synthesis of best quality scientific studies on a specific topic or research question. The main method of synthesis is a systematic literature review (SLR).

In contrast to an ad hoc literature review, a systematic literature review (also known as systematic review) is a methodologically rigorous review of research results. It is a means of identifying, evaluating and interpreting all available research relevant to a particular research question, or topic area, or phenomenon of interest [4]. A systematic review is a form of secondary study, the identified individual studies contributing to a systematic review called primary studies.

A systematic literature review involves several discrete activities, which can be grouped into three main phases: planning the review, conducting the review, and reporting the review. A pilot review is recommended for the reviews including multiple research questions or a large set of primary studies.

3 Method

This study follows Kitchenham’s methodological guidelines for systematic reviews [4, 5], as adapted for PhD candidates. It was carried out in two stages. This paper reports the review process and the preliminary results from Stage 1. Currently, three researchers are involved in this research, one principal reviewer (a PhD candidate), one secondary reviewer (the candidate’s supervisor), plus one researcher acting as the expert panel.

3.1 Research Questions

Each stage of the systematic review is intended to answer the following research questions. This paper only addresses questions 1 to 4.