Accepted Manuscript

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PII: S0950-5849(18)30032-6
DOI: 10.1016/j.infsof.2018.02.009
Reference: INFSOF 5963

To appear in: Information and Software Technology

Received date: 21 April 2017
Revised date: 23 February 2018
Accepted date: 26 February 2018

Please cite this article as: Muhammad Usman, Ricardo Britto, Lars-Ola Damm, Jürgen Börstler, Effort Estimation in Large-Scale Software Development: An Industrial Case Study, Information and Software Technology (2018), doi: 10.1016/j.infsof.2018.02.009

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Effort Estimation in Large-Scale Software Development: An Industrial Case Study

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Abstract

Context: Software projects frequently incur schedule and budget overruns. Planning and estimation are particularly challenging in large and globally distributed agile projects. While software engineering researchers have been investigating effort estimation for many years to help practitioners to improve their estimation processes, there is little empirical research about effort estimation in large-scale distributed projects involving agile teams.

Objective: The objective of this paper is three-fold: i) to identify how effort estimation is carried out in large-scale distributed agile projects; ii) to analyze the accuracy of the effort estimation processes in large-scale distributed agile projects; and iii) to identify and investigate the factors that impact the accuracy of effort estimates in large-scale distributed agile projects.

Method: We performed an exploratory longitudinal case study. The data collection was operationalized through archival research and semi-structured interviews.

Results: The main findings of the studied case are: 1) a two-stage estimation process, with re-estimation at the analysis stage, improves the accuracy of the effort estimates; 2) underestimation is the dominant trend; 3) less mature teams incur larger effort overruns; 4) requirements with larger size/scope incur larger effort overruns; 5) requirements developed in multi-site settings incur larger effort overruns as compared to requirements developed in a co-located setting. 6) requirements priorities impact the accuracy of the effort estimates.

Conclusion: A two-stage effort estimation process can improve effort estimation accuracy and seems to address some of the challenges in large-scale agile software development. To improve effort estimates one needs to consider team maturity, distribution as well as requirements size and priorities.

Keywords: Effort estimation, large-scale software development, global and agile software development

1. Introduction

Software is increasingly developed in globally distributed projects [1, 2, 3, 4]. Large, globally distributed projects are subject to particular challenges, like geographical, temporal, and cultural distances [5, 6], which make coordination and communication more difficult and may lead to more software defects [7] and schedule and budget overruns [8, 9].

The literature indicates that practitioners have fallen short of providing accurate and reliable effort estimates in both co-located and distributed projects. A review of surveys on effort estimation by Moløkken and Jørgensen revealed schedule and budget overruns in 60–80% of the covered projects [9]. Inaccurate effort estimates may lead to unrealistic schedules and budgets and might, therefore, constitute a significant business risk.

Estimation and planning become more challenging in the context of large-scale distributed projects [10, 11]. Project managers and analysts find it hard to create and estimate user stories in large-scale distributed projects [11]. In case of distributed agile teams, it becomes more difficult to achieve technical consistency due to the varying competence of the distributed teams [11]. Furthermore, multi-site development introduces additional issues related to

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