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Software development in startup companies: A systematic mapping study

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ABSTRACT

Context: Software startups are newly created companies with no operating history and fast in producing cutting-edge technologies. These companies develop software under highly uncertain conditions, tackling fast-growing markets under severe lack of resources. Therefore, software startups present a unique combination of characteristics which pose several challenges to software development activities.
Objective: This study aims to structure and analyze the literature on software development in startup companies, determining thereby the potential for technology transfer and identifying software development work practices reported by practitioners and researchers.
Method: We conducted a systematic mapping study, developing a classification schema, ranking the selected primary studies according their rigor and relevance, and analyzing reported software development work practices in startups.
Results: A total of 43 primary studies were identified and mapped, synthesizing the available evidence on software development in startups. Only 16 studies are entirely dedicated to software development in startups, of which 10 result in a weak contribution (advice and implications (6); lesson learned (3); tool (1)). Nineteen studies focus on managerial and organizational factors. Moreover, only 9 studies exhibit high scientific rigor and relevance. From the reviewed primary studies, 213 software engineering work practices were extracted, categorized and analyzed.
Conclusion: This mapping study provides the first systematic exploration of the state-of-art on software startup research. The existing body of knowledge is limited to a few high quality studies. Furthermore, the results indicate that software engineering work practices are chosen opportunistically, adapted and configured to provide value under the constrains imposed by the startup context.

Contents

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1. Introduction

A wide body of knowledge has been created in recent years through several empirical studies, investigating how companies leverage software engineering (SE) [1,2]. However, research on software development activities in newly created companies is scarce. In the past, very few publications have identified, characterized and mapped work practices in software startups [3] and no structured investigation of the area has been performed. Indeed, none of the systematic literature reviews [4] or mapping studies [5] in software engineering (see the tertiary review by Zhang and Babar [6]) address the startup phenomenon.

Understanding how startups take advantage from work practices is essential to support the number of new businesses launched everyday[1]. New software ventures such as *Facebook*, *Linkedin*, *Spotify*, *Pinterest*, *Instagram*, and *Dropbox*, to name a few, are examples of startups that evolved into successful businesses. Startups typically aim to create high-tech and innovative products, and grow by aggressively expanding their business in highly scalable markets.

Despite many successful stories, self-destruction rather than competition drives the majority of startups into failure within two years from their creation [8]. Software startups face intense time-pressure from the market and are exposed to tough competition, operating in a chaotic, rapidly evolving and uncertain context [9,10]. Choosing the right features to build and adapting quickly to new requests, while being constrained by limited resources, is crucial to the success in this environment [3].

From a software engineering perspective startups are unique, since they develop software in a context where processes can hardly follow a prescriptive methodology [11]. Startups share some characteristics with other contexts such as small companies and web engineering, and present a combination of different factors that make the development environment different from established companies [12]. Therefore, research is needed to support startups' engineering activities, guiding practitioners in taking decisions and avoiding choices that could easily lead business failure [13,14].

The goal of this paper is to identify and understand the main contributions of the state-of-art towards software engineering in startups. To this end, we perform a systematic mapping study (SMS) [5,15] aimed at:

- characterizing the state-of-art research on startups,
- understanding the context that characterizes startups,
- determining the potential for technology transfer of the state-of-art research on startups,
- extracting and analyzing software development work practices used in startups.

The systematic map consists of 43 primary studies that were identified from an initial set of 1057 papers. Practitioners may take advantage of the 213 identified software engineering work practices, while considering however the studies' respective rigor and relevance assessments. Furthermore, this first systematic

[1] According to a recent study, solely in the US *"startups create an average of 3 million new jobs annually"* [7].