Research Challenges in Large-Scale Agile Software Development

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ABSTRACT
Agile software development methods are increasingly used in large-scale software development. This article summarizes some of the discussion on research challenges in large-scale agile development at a workshop at the International Conference on Agile Software Development (XP2013), in the form of a research agenda.

Categories and Subject Descriptors
D.2.2 [**Software engineering**]

General Terms
Management, Measurement, Design, Human Factors, Theory.

Keywords
Agile software development, large-scale agile, research agenda

1. INTRODUCTION
Agile software development methods [1] were made for small, co-located development teams, but are increasingly applied in other settings. Large-scale agile software development was the topic of a workshop at the International Conference on Agile Software Development (XP2013), and this article reports on the discussions at the workshop that lead to a proposal for a research agenda.

Why is this topic important? Large projects are currently conducted using agile methods, and often these projects are critical for companies or even nations. There exists some advice on how to organise large agile projects, such as Eckstein´s book *Agile in the large* [2]. However, there are few studies on the topic [3] even though scaling agile methods was identified as a challenging topic in 2003 [4]. Further, "agile and large projects" was voted the "top burning research question" by practitioners at the XP2010 conference [5].

But what is large-scale agile development? This was the topic of a discussion at the workshop and opinions ranged from measuring large in forms of project costs, project duration, size of the software developed, persons involved, number of sites to number of teams. Arguments for a definition depending on number of teams is presented in [3], where large-scale agile is defined as agile projects with more than two teams.

Large agile projects provide new challenges for most software engineering researchers, because large-scale means that many people are involved in often complex projects. Conducting research on large and complex projects introduces new topics, in addition to modifications of research designs. As in agile software development in general, practice is ahead of research [6] and there is a "backlog of research tasks [7]." In order to develop research-based knowledge we argue that it is important to focus research resources on some areas. The workshop at XP2013 provided an initial discussion of what topics should be part of the research "backlog" on large-scale agile software development.

2. RANKING RESEARCH TOPICS
In the workshop we asked all participants to suggest what they understand are the most important research challenges in large-scale agile development. 15 participants generated a total of 44 research challenges. The research challenges where then grouped into topics and discussed. We compiled the ideas, eliminated redundancies and generated new groups. This resulted in 8 research challenges. After the workshop, the participants were then invited to rank these challenges in order of importance. 6 of the participants answered the survey, and the results are shown in Table 1.

3. DISCUSSION
Addressing the question of what should be the main research topics is both a discussion of what is considered most relevant for practice and what topics add most to our understanding of agile practices in large-scale development. Understanding the contingencies surrounding large-scale agile projects is important, like how and when agile practices are applicable under variations in project size, business domain, and team configurations. If we create a better understanding, this can have a large impact on how software is developed, and eventually on how society develops.

What is new in the topics suggested in the proposed research agenda? Some topics are extensions of existing topics in the agile development literature, which get more challenging in large projects. Knowledge management, customer collaboration, release planning and architecture are examples in this category. Other topics, such as scaling agile methods, inter-team coordination and large project organization / portfolio management are novel topics that do not exist in the context of agile development in smaller scale. However, that they are new topics in the agile fields does not mean that the topics have not been investigated in other research fields. Large-scale agile development can draw on a range of relevant theories on these topics for future studies.

With the suggested research agenda in Table 1, we hope this will foster a continuous discussion over research agendas. Identifying important topics, will allocate more research resources in unified directions. This should lead to higher achievements in these areas.

We hope the results of this workshop can inspire studies into areas of high priority as well as initiate further discussions on what is important. The workshop at XP2013 has shown that there is significant interest in the topic of large-scale agile development, and a need for further arenas dedicated to this topic.

Table 1. Suggested research agenda on large-scale agile software development.

Rank	Topic	Description
1	Inter-team coordination	Coordination of work between teams in large-scale agile development.
2	Large project organization / portfolio management	What are effective organizational structures and collaboration models in large projects? How to handle a distributed organization?
3	Release planning and architecture	How are large projects planned? How can the scope be reduced? What is the role of architecture in large-scale agile?
4	Scaling agile practices	Which agile practices scale and which do not? Why and when do agile practices scale?
5	Customer collaboration	How do product owners and customers collaborate with developers in large-scale projects?
6	Large-scale agile transformation	How can agile practices be adopted efficiently in large projects?
7	Knowledge sharing and improvement	When is the whiteboard not enough? How can communities of practice be established? What measurements are relevant to foster improvement?
8	Agile contracts	How can contracts change the mindset of customers from upfront planning to agile principles? What legal limitations exist in contracts that reduce agility in large projects?

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At the workshop there were participants from the following research institutions: Aalto university (Finland), Blekinge Institute of Technology (Sweden), Carinthia University of Applied Sciences, (Austria), Delta (Denmark), Open University (UK), SINTEF (Norway), Åbo Akademi University (Finland). There were participants from the following companies and public institutions: Agilfant (Finland), Cisco Systems (Ireland), Lindorff (Finland), Nokia-Siemens Network (Finland) and The Norwegian Labour and Welfare Administration (Norway).

Further information about the workshop can be found on the XP2013 website: http://xp2013.org/program/workshops-and-tutorials/research-challenges-in-large-scale-agile-development/ We are grateful to Juha Itkonen for comments on an earlier version of this article.

4. REFERENCES

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