Education for the Remote Work Methods of the Future in Software Development

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Abstract

Software Engineering is a discipline strongly dependent on product development within teams of developers, where communication and coordination is essential to achieve good results. Recommended working models, based on development speed and agility, are traditionally dependent on physical planning meetings with fast including and extensive discussions, and thus particularly vulnerable to demands for remote work, such as is the case during the pandemic-crisis. Today, however, discussions regard potentials of remote working that go beyond that crisis, and rather point out patterns of change in work style. Such transformations though, also need to be reflected in education, to prepare students for realistic future work situations. Software Engineering as a subject in education, thus needs to be reviewed in the teaching context, where tools and working methods should be suitably adapted. This contribution reflects on the mentioned transformation, studies the state in some elected IT-organizations. Suitable change in working processes, and techniques is here investigated, as well as psycho-social consequences of the new forms of working. Furthermore, changes in teaching to correspond well with a shift in the IT-industry towards remote working, is investigated. New teaching elements are proposed in larger project courses, where the focus is on online-based development, including appropriate tools, process models, and suitable skills and attitudes.

Keywords: *Software Engineering, Distributed Development, Future Remote Work Methods, Agile Online*

1. Introduction

During the autumn semester 2020, the course *Software Engineering 2*, at Dept. of Computer Science, Kristianstad University, Sweden, was provided completely online. This is a course with large project groups (up to 15 students per group) that is normally heavily dependent on physical meetings for coordination of work, testing, and integration of solutions. The pandemic forced course participants, as well as teachers, to look at alternatives to enforce the course. The outcome was documented by the teachers during the course through continuous discussions and investigations, with the students' knowledge, [1]. Among the discussions that were about distributed and remote work, it was mentioned that we may experience a 'game-changer', where we, as a norm, in the future may work more geographically distributed, i.e., independent of a localized office.

Globally, we can see several arguments regarding such a game-changer. At the World Economic Forum's Davos Agenda 25-29 January, 2021, the possible future labor market was discussed [2]. This as a reflection on the situation that has arisen which the pandemic has contributed to, and future possible consequences of this.

Furthermore, [3] points out that "On the plus side, the pandemic has accelerated trends that have been a long time coming: digitization of workplaces and the platform economy, the expansion of remote and flexible work, and virtual education".

This contribution intends to see how the labor market changes in the future, and that this can/should have an effect on education by implying adjustments of educational elements. Studies will, furthermore, illuminate on the state of some elected IT-organizations in Sweden, how they respond to the upcoming situation, with respect to aspects, such as, strategies for the future, coordination of work, supporting techniques, and psycho-social consequences.

2. Background

Remote, and geographically distributed work is not a new phenomenon [4]. By *remote*, we here relate to a working situation on an individual level, while by *distributed*, we address an organizational level of control and coordination of work. Today, according [5], more and more companies move into directions of remote, or hybrid ways of working, and [6] claims that “By 2028, study shows 73 percent of all departments will have remote workers”. For that shift to take place there is, however, a need for concerns on organizational process levels, as well as individual psycho-social levels.

2.1 On process improvements

So-called Agile methods have evolved from difficulties in previously heavier process styles, with regard to aspects, such as, quick decisions, discussions in common physical locations ('war-rooms'), and close customer contacts. DevOps can be seen as an extension to Agile, with inherent components suitable for distributed, and remote work, Fig. 1, illustrates this [7]. Moreover, the work processes of Agile, have been based on separate functional teams, with silo orientation as a result. DevOps is based on automated methods for continuous testing, integration, and delivery [8], where such integrated environments counteract 'us-and-them' moods that arise from the silo-oriented functional teams. Surveys show that more and more companies see DevOps as a future potential framework for development in the software industry [9].

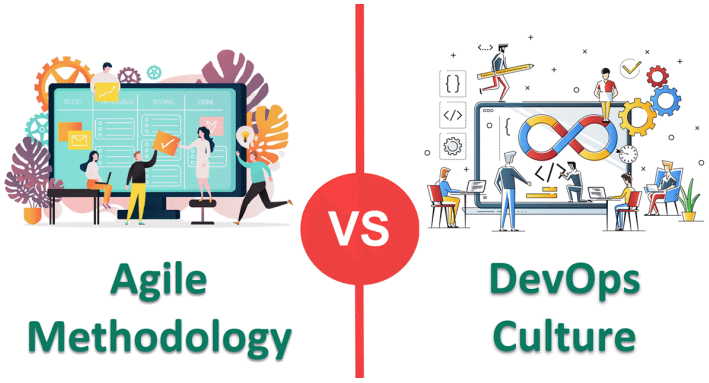

Fig. 1, Agile vs. DevOps, [7]

2.2 On social implications

The ongoing study [10], addresses several possible problems observed in distributed work, including effects of lack of face-to-face communication and interpersonal connections, as well as of differences in time, culture, dialects, customs, regionalism, etc. While some problems have shown to be solved with clearly supportive tools, other problems need organizational strategies, with the need to address aspects, such as, social inclusion, organizational culture, etc.

2.2 On distance teaching/learning

Distance-based teaching/learning is today seen as a common alternative to campus-based education, including several disciplines, such as Computer Science [11], and Software Engineering [12]. Here, [11] discusses challenges in lack of interactivity in programming courses when classes go online, and [12] addresses active learning approaches in teamwork, where student-teams may be dislocated in both time and space. Learning approaches are here based on activities aimed at facilitating effective collaboration and peer learning, [12]. The pandemic has further enforced elements of teaching/learning to go online, as is the case in [1]. While certainly stressful in several cases, distance-based teaching/learning is however in principle not new. The novelty of this specific contribution is rather that project-based courses should be consciously provided on distance to prepare students for the future remote and distributed labour market.

3. Empirical study

A discussion-based study, with three respondents, has been conducted to observe the state at some elected IT-based organizations.

- *R1*, is a senior software developer, and a test-leader at an organization with 300-400 co-workers, the organization is used to international working environments.
- *R2*, is a middle-experienced software engineer, at an organization with about 15 co-workers, mostly working in a Swedish context.
- *R3*, is a junior software developer, where the closest team of co-workers is around 10, and where the company has offices in Sweden, as well as outside of Sweden.

The discussions have focused on four themes, with respect to remote and distributed work:

1) How have the organizations handled the situation of the pandemic?
2) Is it possible to see any plans regarding a continuation after the pandemic?

3) What are the prerequisites, in terms of technical support, process support, and psycho-social aspects?
4) What would be desired from universities in order to prepare students appropriately?

3.1 Change of work style

All respondents reported that most employees had difficulties working full-time remotely at the beginning of the pandemic but adapted very quickly to this situation. *R1* and *R3* have worked part-time remotely before the pandemic. *R2* and *R3* experienced that working remotely was fine but less efficient. The most challenging was to find the best communicating solutions, and meeting techniques, but both pointed out that all these solutions do not replace problem-solving through face-to-face meetings. However, according future directions, *R1* and *R2* were sure that software developers will continue remote at least 2-3 days a week. The social talks between employees disappeared and online communication had been reduced to just the job topic (*R2*, *R3*).
An interesting observation (*R1*, *R2*, *R3*) is that employees became divided into two groups, i.e., those for whom remote work became more focused and more efficient (usually the employees with more experience), and those who became more stressful and less efficient (younger developers that earlier only worked in teams).
The companies provided restrictions on meetings, where the camera should be on. To maintain the activities of the social life, the companies (*R1*, *R2*, *R3*) offered various online-games or joint coffee breaks. The company of *R1* offered the employees home office equipment, for reasons of good ergonomics.

3.2 Requests on education

When it comes to adaption to future appropriate education, the study showed a coherence amongst the respondents. The university should prepare students for work in virtual teams, where clear communication, good cooperation, and self-discipline with individual work, are extremely important. Furthermore, the students should practice meeting- and presentation techniques, adaptability to different tools and situations, and techniques for DevOps. Good work-structure was addressed, as well as independence, and courage to break barriers to contact people, curiosity, abilities of initiatives. Therefore, planning, a need to divide work into well-structured units, as well as perseverance, and ability to contact colleagues in situations of need for help is expected. Lastly, a structured documentation and work ethics are also important. Fig. 2, illustrates requested skills and attitudes addressed by the respondents.

Fig. 2. Skills and attitudes expected for remote work.

4. Course adjustments

The project-based course, Software Engineering 2, during autumn 2021, will undergo changes to adjust to practice in distance work. The students are here introduced to the new context motivated by the studies of this contribution. They will be informed by a set of recommended skills and attitudes, and further introduced to appropriate techniques, and where DevOps, as a process model, will be used. Continuous student-close discussions and observations will be ongoing to support their working process, including shedding light on their psycho-social situation, individually as well as in groups. Such, online-held, discussion-meetings will check progress of work, as well as be supportive to approach the recommended skills as attitudes.

5. Conclusions

Performed studies are based on literature research, and surveys at IT-based organizations. A continuous development towards distance work is pointed out. Here, the pandemic has only contributed in that direction. Observations show that new technologies for process control and support tools, have been introduced, as well as that risks from social aspects, such as social exclusion, and moods of 'us-and-them', have been cared for. On the education side, distance-based teaching/learning has been practiced several years, however without clear elements for adaptation to distance-work as such. The experiences behind this contribution have led to distance-based initiatives in project-based courses to prepare students for tomorrow's distributed and remote labour market.

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