



## Categorization of risk factors for distributed agile projects



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### ABSTRACT

**Context:** Organizations combine agile approach and Distributed Software Development (DSD) in order to develop better quality software solutions in lesser time and cost. It helps to reap the benefits of both agile and distributed development but pose significant challenges and risks. Relatively scanty evidence of research on the risks prevailing in distributed agile development (DAD) has motivated this study.

**Objective:** This paper aims at creating a comprehensive set of risk factors that affect the performance of distributed agile development projects and identifies the risk management methods which are frequently used in practice for controlling those risks.

**Method:** The study is an exploration of practitioners' experience using constant comparison method for analyzing in-depth interviews of thirteen practitioners and work documents of twenty-eight projects from thirteen different information technology (IT) organizations. The field experience was supported by extensive research literature on risk management in traditional, agile and distributed development.

**Results:** Analysis of qualitative data from interviews and project work documents resulted into categorization of forty-five DAD risk factors grouped under five core risk categories. The risk categories were mapped to Leavitt's model of organizational change for facilitating the implementation of results in real world. The risk factors could be attributed to the conflicting properties of DSD and agile development. Besides that, some new risk factors have been experienced by practitioners and need further exploration as their understanding will help the practitioners to act on time.

**Conclusion:** Organizations are adopting DAD for developing solutions that caters to the changing business needs, while utilizing the global talent. Conflicting properties of DSD and agile approach pose several risks for DAD. This study gives a comprehensive categorization of the risks faced by the practitioners in managing DAD projects and presents frequently used methods to reduce their impact. The work fills the yawning research void in this field.

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### 1. Introduction

In last two decades, software development has evolved from being concentrated at a single site to being geographically distributed across the globe and hence, characterized as Distributed Software Development (DSD) [79]. DSD helps the organizations to gain time-zone effectiveness, leverage a large skill pool, develop software closer to the customer's requirements and exploit low labor cost in certain parts of the world [67]. Although, there are other related terms like Global Software Development (GSD), Multisite Development, Dispersed Development, Off shoring, Outsourcing [50], being commonly used in the literature, but Distributed Software development (DSD) is a general term to represent

software development with dispersed teams. We have used DSD in this paper as it does not constrain us to a particular scale [53].

Further, modern organizations are working under tight time and cost constraints and the development of software occurs in highly volatile environment due to the changes in the product requirement, business and market needs. Eventually, many organizations are adopting agile methodology for software development as it is able to deliver products that satisfy customer needs and is faster than the traditional approach [46]. There is an increasing interest in applying agile practices in DSD projects to leverage the combined advantage of both the approaches [80].

Agile when combined with DSD also brings some new challenges and associated risks and makes the software development process more complicated [43]. DSD and agile work on different principles, which makes the distributed agile projects difficult to manage. DSD requires formal communication amongst the geographically distributed team members while agile is based on informal communication with co-located teams working in close collaboration. Several agile best practices including

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collaboration, face to face communication, self organizing teams, retrospectives, showcases become more challenging in the distributed model [56].

Risks are inherent to software development projects and field experiences with traditional development approach in the past six decades have been instrumental in creating a reasonably comprehensive knowledge base in the discipline [58,88]. However, the current literature does not consider all the aspects of risks in DAD software development projects and the corresponding solutions [42].

Some case studies discuss the problems and challenges while executing distributed agile projects. These studies are scattered in different articles and do not provide a comprehensive view of risks in DAD [48,63,68,99]. As a result, software community lacks an overall picture of what types of risks the companies may encounter while attempting to combine the two methods [47].

Lack of understanding about the risks specific to DAD projects may have played a significant role in the failures of several such projects [66,42,47] and thus, raising doubts on the claims made on their ability to deliver good quality software that can satisfy customer needs in given timeframe. Practitioners in the field have always been keen to learn more from the consolidated experiences of the fraternity. Academic and research community has worked together with practicing developers, not only for consolidation of experiences but also for deriving relevant patterns, frameworks, guiding principles and theories for strengthening the discipline of software engineering [74,79,66]. Present study is a similar effort, wherein, in the absence of much work on risks in DAD projects, a comprehensive exploration of related industry experience has been done. The objective has been to understand the risk factors as experienced by practitioners, risk management techniques used by them and mapping the risks in organizational context so that industry practitioners can take decisions effectively.

This study involved in-depth interviews with the practitioners who have handled DAD projects in various multinational Information Technology (IT) consulting companies. The inputs obtained were strengthened by the analysis of work documents of DAD projects with simultaneous discussions with the involved project managers or team members. Further, support from earlier research literature for the findings in related development environments has been consolidated in this work.

The findings of the study contribute in following ways:

1. This study provides a comprehensive classification of risk factors in Distributed Agile Projects. Forty-five risk factors have been identified, which fall under five major risk categories. This work also documents the risk management approaches used in real world for controlling the respective risk factors.
2. Further, the risk categories identified were mapped to four interacting components of the Leavitt's Model of Organizational Change i.e. Task, Structure, Actor and Technology and their interaction. This mapping would help organizations to develop the policies, procedures and guidelines for managing risks in DAD projects.
3. The study relates the cause of occurrence risk factors in DAD projects to the contradiction between the properties of agile development and distributed development.
4. Although, many of these risk factors that occur in DAD projects also exists in DSD or agile projects, but their severity of impact increases in DAD projects. Moreover, the study uncovers certain risk factors which have very less or in some case negligible mention in the research literature. This is an important contribution of the work as the cognizance of these risk factors will help practitioners while executing projects and also, open new avenues for further research work.
5. Corresponding to each risk factor in DAD project, the properties of DSD and the principles of agile approaches which in contrast

with each other and hence become a reason for the risk factor to occur were identified.

As stated above, the initial exploratory work is successful in developing new insights for practitioners and unveiling new avenues for research. The work involves multiple sources of information on risks in DAD projects and so, ensures the depth of the findings and establishes the merit of the work.

The study has some limitations rooted in the reluctance of the practitioners to hand over the project work documents to the researchers due to confidentiality constraints, which may have affected the rigor of the risk identification process. This problem was dealt, by performing analysis of project work documents at the company site and involving the team members of the project in simultaneous discussions.

In this paper, we discuss the research background in Section 2. This is followed by the research method adopted for the study in Section 3, which includes the research objectives, research design and the data analysis approach used. Section 4 presents the results and discussions. Limitations of the work and future scope have been stated in Sections 5 and 6 respectively followed by conclusion in Section 7.

## 2. Research background

### 2.1. Significance of risk management in distributed agile development projects

Agile methodologies work very well in highly dynamic business and IT environment as they help the team to respond to change and continuously deliver business value. Many organizations that develop software using agile approach have started looking for skills and talent available at much lower wage-rates and are anxious to source the development work to these centers [22]. Hence, the organizations are using distributed agile development for developing flexible and evolving solutions to fulfill their business needs.

Most of the agile methodologies (e.g. scrum, Xp) assume that the team is located in a single room. Unfortunately, this principle does not fit in the real scenario where agile teams are also distributed across the geographical locations. A survey conducted by VersionOne, states that organizations are constantly scaling agile beyond single team and single project [101]. These facts clearly show that there is a need to extend the agile practices to distributed software development.

Software application development itself is subject to many fundamental risks posed by the typical characteristics of the product and the process. The incompatibility of DSD and agile leads to problems like to weak social interactions, delays due to time-zone differences, lack of coordination, lack of tool support and infrastructure, dependencies between distributed teams and difficulty in knowledge sharing due to team dispersion in different geographic locations [42,24]. Risks inherent to agile are limited documentation, customer non-agile alignment, lack of team agile skills [42], difficulty in having ongoing negotiations between customer and developers to reach acceptable levels of quality and informal people-oriented approach [80].

A recent survey by Scott Ambler on scaling agile shows that, greater is the level of geographic distribution, greater is the risk due to communication and coordination challenges, resulting in lower success rate [1]. Another survey result shows that 60% of co-located agile projects are successful, while roughly 25% can be considered as failed projects. On the other hand, although, more than 50% distributed agile projects have been successful, but 50% of them have failed too [2].

Higher failure rate of projects using DSD in an agile environment is indicative of the extent of difficulty and associated risks in exe-

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