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AGILE SOFTWARE DEVELOPMENT IN A REMOTELY WORKING GEOGRAPHICALLY DISTRIBUTED TEAM: A SYSTEMATIC REVIEW

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Abstract: In recent years, the distribution of software development has gained widespread popularity. Among the obvious reasons are the wish of companies to save production costs and reduce the time to market. Besides this, the latest years COVID-19 pandemic resulted in the transition of many software development projects into a geographically distributed environment where most employees work remotely. Using Agile practices in such a setup brings a lot of new challenges. This paper presents a systematic literature review of the studies that discuss the use of Agile methods in globally distributed projects, particularly when team members work remotely or from home. Using our search criteria, we found 307 papers, of which 20 were relevant to our research. The results outlined in this review will help researchers and practitioners in understanding the challenges involved in using Agile methods by geographically distributed remotely working teams and figure out how to tackle these challenges to increase the efficiency of project management.

Keywords: Agile; COVID-19; Distributed team; Remote work; Software development.

1. INTRODUCTION

The software development community has widely used agile methods in the past decade. Agile software development (ASD) is a set of methodologies that rely on iterative development, involving continuous collaboration among self-organizing cross-functional teams to evolve requirements and solutions over time. Scrum methodology is currently the most frequently used approach for agile organizations (*The 16th Annual State of Agile Report*, 2022).

In December 2019, due to the COVID-19 pandemic, many organizations were forced to re-organize their current work model and move their businesses from offices to employees' homes. Working from home and regular remote work is not new within software development. To reduce costs and gain access to skilled resources at much lower rates, many companies practice Distributed Software Development (DSD) where employees are working remotely from different geographical locations. When used in conjunction with DSD, Agile software development can provide further advantages, including 24/7 development and accelerated time-to-market. However, this setup has certain limitations that can lead to the failure of projects. These limitations are mainly caused by distance, time, and cultural differences, which may lead to ineffective communication in a team and could affect the project's success.

This paper aims to understand the challenges remotely working geographically distributed Agile team try to overcome and what techniques can be used to handle those challenges.

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2. BACKGROUND AND MOTIVATION

This section briefly overviews Agile software development methods, Distributed Software Development, specifics of remote work, and work from home. At the end of this section, we will define the objective of this review.

Agile software development. The emergence of the Agile methodology was a response to the significant time delay between acquiring requirements and delivering software, which resulted in the failure of many projects. (Eby, 2016). Agility enables the co-located, motivated, empowered, and self-organized team to respond rapidly and flexibly to change through close customer collaboration and to frequently deliver working software while regularly reflecting on team effectiveness (Beck et al., 2001; Eby, 2016).

Distributed Software Development. Many organizations have started developing software remotely to achieve lower costs and access to skilled resources. Continuous development across various time zones and access to a vast pool of talented human resources have made it possible for companies to hire skilled professionals at lower rates. This approach not only enables the recruitment of competent individuals but also allows sharing of best practices, innovation, and diverse cultural and social perspectives. (Conchúir et al., 2009; Haq et al., 2011). Consequently, software development is transforming into a globally dispersed effort that involves multiple sites and diverse cultures.

Remote working. Remote working is the organization of work by using information and communication technologies that enable employees and managers to access their labor activities from remote locations (Pérez Pérez et al., 2004). It includes working from home, a satellite office, a telework center, or even a coffee shop. Remote work became widely used during the COVID-19 pandemic when employees were asked to work from home to prevent and limit the spread of the virus.

The objective of this review. Multiple studies concluded that distributed teams could successfully use Agile practices (Smits & Pshigoda, 2007). During the COVID-19 pandemic, employees were asked to work from home to prevent and limit the spread of the virus. This massive movement of software development practitioners to remote work from various locations introduced a lot of new challenges, and at the same time, new work practices were introduced.

That is why we have decided to investigate more deeply what are the challenging factors in applying Agile practices by geographically distributed teams where members work remotely or from home and what strategies organizations use to overcome these challenges. We will limit the search to research papers written after COVID-19 has started to review the latest findings on remote work in the post-covid period.

3. METHODS

This research has been carried out by following Kitchenham and Charters (Kitchenham & Charters, 2007) guidelines for conducting a Systematic Literature Review (SLR) or Systematic Review (SR).

This study aims to answer the following research questions:
RQ1. What challenges or risk factors remotely working distributed Agile teams face?
RQ2. What strategies do Agile teams practice to overcome these challenges?

3.1 Data sources and search strategies

We restricted our search to only papers with free online access and written in English. The search strategy included electronic databases and manual searches of conference proceedings.

This research used the following digital libraries:

- IEEEXplore;
- Wiley InterScience;
- Google Scholar;
- ScienceDirect;
- SpringerLink;
- ACM Digital library;
- SCOPUS.

An overview of the review protocol and the volume of papers in each phase of the selection process is presented in Table 1.

Table 1: The selection process of primary papers

Stage	Description	Number of papers
1	Electronic Database and Conference Proceedings after 2019	307
2	Exclusion criteria: ● Duplicate Article ● Papers are written in a different language than English.	231
3	Exclude papers based on titles and keywords	141
4	Exclude papers based on abstracts	72
5	Obtain primary papers	20

In stage 1, we searched the databases using the search terms listed in Table 2. Keywords show many variations of the same term. Also, as mentioned above, we looked only at articles written after COVID-19 started. This search strategy resulted in 307 "hits" for stage 1.

Table 2: Search terms used in this review

Type	Category	Keywords
1	Agile methodology	Agile Scrum
2	Remote Work	Remote work Work from Home Telework
3	Geographically distributed team	Distributed Software Development Geographically Distributed Software Development Global Software Development Offshore Onshore

3.2 Managing studies and inclusion decisions

The citations found during the search were imported into a JabRef tool, where we merged them into one library. In the second stage, duplicates and articles written in languages other than English were excluded we end up with 231 studies. Then, in the third stage, we reviewed the titles of the papers to understand if they are relevant to our review. We identified 141 studies with relevant titles. Although a paper's title is typically meant to summarize its content, there are cases where the title does not accurately reflect what the paper is about. In the fourth stage, abstracts were reviewed. At the end of 4th stage, 72 papers were left.

3.3 Final selection

We applied the following inclusion criteria for our final selection:

1. Paper discusses the use of Agile methodology by distributed teams where team members work remotely or from home
2. Paper presents real-life experience obtained by remotely working Agile teams in a distributed environment

For additional quality assessment, we included the following two criteria related to the quality of each paper's description:

3. Is the paper's objective clearly stated?
4. Does the paper conclude any practical implications for distributed Agile teams?

Finally, 20 papers are left for the data extraction and synthesis phases. Table 3 represents the description of selected primary studies.

Table 3: Description of selected primary studies

Ref	Title	Author	Year	Place published	Type
S1	Remote agile: Problems, solutions, and pitfalls to avoid	Reunamäki, Fey	2022	Business Horizons	Journal Article
S2	When is Good Good Enough? Context Factors for Good Remote Work of Agile Software Development Teams. The Otto Case	Rometsch, Wegner, Brusch, Neumann	2022	arXiv	Journal Article
S3	Scrum Team Competencies in Information Technology Professionals in the Global Software Development Environment	Hidayati, Budiardjo, Purwandari	2022	International Journal of Human Capital and Information Technology Professionals	Journal Article
S4	Factors affecting task allocation and coordination in distributed agile software development	Nundlall, Nagowah	2021	Progress in Advanced Computing and Intelligent Engineering	Conference paper
S5	A Goal-driven Risk management approach for Distributed Agile Development Projects	Shrivastava, Rathod	2019	Australasian Journal of Information Systems	Journal Article
S6	An empirical investigation of geographically distributed agile development: The agile enterprise architecture is a communication enabler	Alzoubi, Gill	2020	IEEE Access	Journal Article
S7	A survey on agile practices and challenges of a global software development team	Lautert, Neto, Kozievitch	2019	Springer International Publishing	Journal Article
S8	A Survey of Key Challenges of Adopting Agile in Global Software Development: A Case Study with Malaysia Perspective	Batool	2019	International Journal of Industrial and Manufacturing Engineering	Journal Article
S9	Remote communication in Scrum teams – a COVID-19 preventive measure or work time optimisation?	Brodnicki	2021	e-mentor	Journal Article
S10	Respond to Change or Die: An Educational Scrum Simulation for Distributed Teams	Christensen, Paasivaara	2022	Proceedings of the ACM/IEEE 44th International Conference on Software Engineering: Software Engineering Education and Training	Conference Paper
S11	Framework for Effective Utilization of Distributed Scrum in Software Projects	Shahzad, Naeem Awan, Fazal-e-Amin, Abro, Shoaib, Alyahya	2023	Computer Systems Science and Engineering	Journal Article
S12	Hard and Soft Skills for Scrum Global Software Development Teams	Hidayati, Budiardjo, Purwandari	2020	Proceedings of the 3rd International	Conference Paper

				Conference on Software Engineering and Information Management	
S13	Agility in the online space-agile project management and the home office	Tóth, Csiszárik-Kocsir	2021	Proceedings of FIKUSZ Symposium	Journal Article
S14	The impact of working from home on the success of scrum projects: A multi-method study	Cucolas, Russo	2021	arXiv	Journal Article
S15	Distributed software development in agile projects: a model for the promotion of social interactions	Chaves, Majdenbaum	2020	Revista de Gestão e Projetos	Journal Article
S16	Agile distributed software development in nine central European teams: Challenges, benefits, and recommendations	Stadler, Vallon, Pazderka	2019	International Journal of Computer Science and Information Technology	Journal Article
S17	"When in Rome, Do as the Romans Do": Cultural Barriers to Being Agile in Distributed Teams	Šmite, Gonzalez-Huerta, Moe	2020	Springer International Publishing	Journal Article
S18	The positive impact of agile retrospectives on the collaboration of distributed development teams–a practical approach on the example of Bosch engineering GMBH	Duehr, Efremov, Heimicke, Teitz, Ort, Weissenberger-Eibl, Albers	2021	Proceedings of the Design Society	Conference Paper
S19	How do globally distributed agile teams self-organise? Initial insights from a case study	Licorish, MacDonell	2021	arXiv	Journal Article
S20	Blueprint model: An agile-oriented methodology for tackling global software development challenges	Cruz, Godoy, Santos, Marinho, Jardim, Silva, Pahins, Fonseca, Giuntini	2020	Advances in Science Technology and Engineering Systems Journal	Journal Article

3.4 Data extraction and synthesis

We utilized a predetermined data extraction form to collect data from the studies that were selected. The data was then synthesized by identifying common themes from the findings presented in each of the papers reviewed for this study. In the next section, we will present the frequencies of each theme identified in the different studies, which will reflect the number of times a particular challenge was mentioned in the papers.

4. RESULTS AND DISCUSSION

4.1 Overview of studies

Table 4 shows the number of papers on the issue of using Scrum practices in a remote work context. Table 5 states that most of the existing research conducted in this area are qualitative interviews, case studies, and quantitative surveys. Often, when a researcher needs to understand a complex subject matter, a combination of research methods is used for some questions that cannot be answered using only one method.

Table 4: Selected papers by the year

Year	2019	2020	2021	2022	2023
Frequency	4	5	6	4	1
%	20	25	30	20	5

Table 5: Selected papers by research conducted

Research type	Research method	Frequency	%
Qualitative	Case Study	6	30
	One-on-one interview	7	35
	Focus groups	1	5
Quantitative	Survey	10	50
	Observational method	1	5

4.2 Findings about Research Questions

In this section, we will explore how the data extracted from the reviewed studies relates to the research questions.

4.2.1 Challenges or risk factors

In this section we will present our findings regarding first research question:

RQ1. What challenges or risk factors that remotely working distributed Agile teams face?

The main challenges in implementing Scrum by remotely working distributed team can be seen in Table 6.

Table 6: Challenges and risk factors

Challenging factors	Papers	Frequency	%
Lack of Communication	S1, S4, S5, S6, S7, S9, S10, S11, S13, S14, S15, S16	12	60
Knowledge sharing	S1, S4, S8, S9, S11, S16, S20	7	35
Knowledge of Agile practices	S7, S8, S10, S13, S16	5	25
Team competency and Team Composition	S3, S5, S11, S12, S19	5	25
Motivation and Mental health	S2, S8, S9, S14, S15	5	25
Lack of collaboration	S4, S11, S14, S16, S18	5	25
Lack of control	S1, S9, S13, S14	4	20
Lack of coordination	S4, S5, S11, S14	4	20
Feedback gathering	S1, S11, S14, S17	4	20
Meetings Organization	S1, S9, S14, S16	4	20
Cultural differences	S4, S11, S16, S17	4	20
Tools and Technologies	S11, S15, S16	3	15
Lack of trust	S5, S11, S15	3	15
Requirement management	S4, S5, S11	3	15
Team Engagement	S1, S9, S15	3	15
Task Allocation	S4, S11, S17	3	15
Work-from-Home Environment	S13, S14	2	10

Lack of Communication. Our findings indicate that communication-related problems pose significant challenges in a distributed environment. Lack of Face-to-Face Communication complicates build of relationships between team members. No more spontaneous and informal discussions existed when the team was co-located (Reunamäki & Fey; 2022, Stadler et al., 2019). Online tools do not motivate people to communicate, so team members only interface through scheduled meetings. Also, the efficiency of communication is affected by tool constraints (Cucolas & Russo, 2021). Remote communication lacks various channels, making it especially hard for non-native speakers to follow conversations and argue with colleagues (Stadler et al., 2019).

Knowledge Sharing. In remote agile settings, limited interaction within the organization can hinder the sharing of knowledge. This can lead

to teams becoming more isolated and insular, potentially resulting in the development of their own unique norms. As a result, best practices keep staying at the team level only (Reunamäki & Fey, 2022). In addition, inside the team, members often try to be self-sufficient, which may impact knowledge transfer inside the team (Shahzad et al., 2023). When working in this type of environment, it is essential to have good project documentation. Lack of good documentation can result in time wasted on rework and other inefficiencies (Nundlall & Nagowah, 2021).

Knowledge of Agile Practices. Studies reveal that professionals have different confidence levels in Agile practices (Batool, 2019; Lautert et al., 2019). Lack of trained staff may influence the efficiency of work organization and project success. Moreover, training team members Scrum practices in a distributed remote environment is incredibly challenging.

Team Competency and Team composition. The analysis of the extracted data has revealed that practical competencies required from agile team members in the co-located environment are not sufficient when the team works in a remote distributed environment (Hidayati et al., 2022). Intra-personal, interpersonal, and organizational skills are especially necessary for those occupying leadership roles (Licorish & MacDonell, 2021). Particular attention should be devoted to team composition. To make rapid decisions and work autonomously without direct supervision, developers need to possess technical competence and maturity. However, teams with many junior members who lack experience in Agile methods may hinder the success of a project, particularly in a remote distributed environment where it can be challenging to provide efficient mentoring and teaching.

Motivation and Mental Health. Studies show that remote work influences employees' self-esteem (the result of isolation, lack of contact with the external environment, organization, and loss of established bonds with colleagues) (Brodnicki, 2021). It is hard to express feelings through a webcam, show empathy, and relate to others. Employees find that working only from home gets boring (Cucolas & Russo, 2021) and influences their motivation for physical activities (Rometsch et al., 2022), which is essential for mental health.

Lack of Control. It is much harder to control the development process in a remotely working distributed team. Employees may perform other tasks during working hours, often without the knowledge and consent of the employer (Brodnicki, 2021; Tóth & Csiszárik-Kocsir, 2021). It became harder for leaders to reach team members. Often, to overcome these issues, leaders stick to old methods of hierarchical leadership (Reunamäki & Fey, 2022), which could complicate things even more and cause conflicts.

Lack of Coordination. Different working hours may lead to poor coordination between teams and between team members inside the team (Nundlall & Nagowah, 2021), which could significantly impact the project schedule (Shrivastava & Rathod, 2019). Managers often complain that coordinating sprint planning activities in distributed settings is much harder, and often causes reduced sprint planning output (Cucolas & Russo, 2021).

Lack of Collaboration. Remote work could cause collaboration discrepancies. It is harder to align with teammates to collaborate due to geographical distribution and temporal differences. There are fewer pair-programming sessions (Cucolas & Russo, 2021; Nundlall & Nagowah, 2021). In remote settings, employees commonly work on big individual tasks with less collaboration (Cucolas & Russo, 2021), but this requires high team members' competency, which is not always possible.

Feedback Gathering. In a remote setup, as co-workers only communicate and collaborate through an online communication tool, shared feedback is decreased and often received with delay (Cucolas & Russo, 2021). Also, getting constant feedback from stakeholders is more challenging, which may lead to misunderstanding requirements (Cucolas & Russo, 2021; Shahzad et al., 2023). When working with offshore teams with a strict organizational hierarchy, offshore team members may feel reluctant to critique or propose alternatives to perceived directives from superiors, which may impact Agile team efficiency (Šmite et al., 2020).

Meetings Organization. Employees complain that remote agile often causes meeting overload (Reunamäki & Fey, 2022). Small discussions held near the table in co-located setup are now tuned into meetings. Employees may be invited to many unneeded sessions. Employees often complain that meetings are scheduled back-to-back, so there is no time to rest between them. Another issue may arrive, in hybrid environments, in meeting sessions where most of the team is co-located in one place, and just a few individuals attending remotely co-located groups did not pay enough attention to maintain proper conduct (Stadler et al., 2019).

Lack of Trust. Lack of trust in the remotely working distributed teams may adversely affect the quality of project outcomes. It is important to gain confidence in others, but it gets complicated due to geographical distance. Team members may have individual perceptions of whether peers are competent and could ignore people they think do not have the same knowledge. For this reason, members spent much effort researching themselves instead of simply asking others (Tóth & Csiszárik-Kocsir, 2021).

Cultural and Language Differences. The adoption of agile methodologies and collaboration may be hindered by organizational and national cultural barriers. In teams with strict management culture, members are willing to say yes to most requests in deference to superiors (Šmite et al., 2020). This can create reluctance to raise concerns about unrealistic deadlines, bring up problems at the earliest opportunity, or discuss failures. Additionally, some team members may be hesitant to admit a lack of understanding or ask questions about the work that needs to be done.

Another important aspect is language differences. Even in teams located in the same country or distributed across neighboring ones, having multiple native languages within a team can increase communication complexity. Strong accents may make it challenging for team members to understand each other, and misinterpretations of shared information can result in rework or the development of the wrong solution, leading to project delays.

Requirement Management. Requirements management is a challenging task in a distributed environment. Lack of documentation often leads to unclear requirements, requirement traceability issues, etc (Nundlall & Nagowah, 2021). Continuously changing the priority of requirements could lead to changes in software architecture, resulting in software architectural understanding issues among distributed team members (Shahzad et al., 2023).

Team Engagement. Studies reveal that engagement is lower in a remote agile setting. Team members practice multitasking, listening "with half an ear." In addition, not every team member feels comfortable contributing during online meetings, which is the so-called "fear of the mic" (Reunamäki & Fey, 2022).

Tools and Technologies. Numerous distributed scrum teams are encountering difficulties related to technical dependencies, which can arise from a variety of issues such as the absence of adequate tool support for Agile processes, ineffective communication tools, and the lack of globally shared unified backlogs. The unavailability of proper tools and infrastructure, or improper handling of such tools, can hinder the success of a project. Additionally, some small companies may find it challenging to afford the costs of the necessary tools and technology.

Effective communication and collaboration within distributed teams depend on reliable internet connectivity and appropriate communication hardware and software. However, one issue that is commonly reported is the absence of these requirements, which can result in an unstable network connection that significantly hampers synchronous and frequent communication (Stadler et al., 2019).

Task Allocation. In a distributed setting, task allocation is a crucial activity that requires attention. Several challenges are associated with task assignments, including documentation, pair programming, differences in working hours across different sites, and variations in cultural differences (Nundlall & Nagowah, 2021; Šmite et al., 2020). Additionally, the absence of proper planning or requirements gathering can lead to changes in the current plan, resulting in an increase in the backlog that must be reprioritized (Nundlall & Nagowah, 2021).

Work-from-Home Environment. A substantial number of employees require assistance in identifying optimal ways to organize teamwork while working from home. Many individuals lack a suitable workspace and end up working from their sofas, beds, kitchen tables, and other areas that are not ideal for work (Cucolas & Russo, 2021). Furthermore, avoiding distractions and staying motivated can be challenging while working from home.

4.2.2 Strategies

This section is devoted to the second research question:

RQ2. What strategies do Agile teams practice to overcome these challenges?

Unfortunately, not all the papers have recommendations to overcome the challenges described in them. For each challenge, described in previous section, we passed through all review articles to find efficient practises to mitigate these challenges.

Our findings are presented in Table 7, where for each challenge we listed the papers where we found any strategies or practices that teams or organizations use.

Table 7: Strategies

Challenging factors	Papers	Frequency	%
Lack of Communication	S1, S6, S7, S9, S11, S14, S15, S16	8	40
Knowledge sharing	S1, S9, S11, S16, S20	5	25
Team competency and Team Composition	S3, S11, S12, S19	4	20
Motivation and Mental health	S2, S9, S14, S15	4	20
Lack of collaboration	S11, S14, S16, S18	4	20
Feedback gathering	S1, S11, S14, S17	4	20
Tools and Technologies	S11, S15, S16	3	15
Knowledge of Agile practices	S7, S10, S13	3	15
Lack of control	S1, S13, S14	3	15
Meetings Organization	S1, S9, S16	3	15
Cultural differences	S11, S16, S17	3	15
Task Allocation	S4, S11, S17	3	15
Lack of coordination	S11, S14	2	10
Lack of trust	S11, S15	2	10
Team Engagement	S1, S15	2	10
Work-from-Home Environment	S13, S14	2	10
Requirement management	S11	1	5

Below, we describe these strategies in more detail.

Lack of Communication. To facilitate communication in a large scrum team, some companies practice creating smaller sub-teams within the existing teams. Within such subteams (2-4 employees), members can stay in close contact throughout the day, so it is easier to get rapid feedback and help. When videoconferencing in subteams, members must wait less for their turn to speak, so communication is improved (Reunamäki & Fey, 2022).

When working in a distributed environment, teams try to maximize synchronized working hours (adjust overlapping working hours of distributed teams) (Shahzad et al., 2023). Scrum teams practice extended daily Scrum to accommodate communication issues (Cucolas & Russo, 2021). Teams often have more than one daily Scrum to synchronize the work. Widespread practice is to implement a chat in the organization in which team members can communicate on an ongoing basis (Brodnicki, 2021). Open communication allows the team members to openly discuss their views about things and allow them to add suggestions to things. Distributed teams state the positive effect of bringing people together physically at least once throughout the project to improve social interactions (Chaves & Majdenbaum, 2020; Stadler et al., 2019).

It is essential to select proper communication channels (sync or async). When time and cost are of utmost importance, teams can benefit

from practicing selective communication, rather than engaging in excessive or unnecessary communication, to improve communication efficiency. Communication channels such as instant messaging or phone calls can aid in enhancing response efficiency (Alzoubi & Gill, 2020; Lautert et al., 2019).

Knowledge sharing. To organize effective knowledge sharing, it is crucial to make use of software solutions and new roles that facilitate information exchange. Teams use tools such as issue trackers (e.g., Jira), wikis (e.g., Confluence), and other similar resources to maintain project documentation and project transparency (Cruz et al., 2020; Shahzad et al., 2023). To efficiently record and share information, organizations often adopt standard project documentation templates to be used by all teams. One noteworthy approach to knowledge sharing is to appoint "knowledge owners" responsible for disseminating each team's best practices to others (Reunamäki & Fey, 2022). It is customary for organizations to share business architecture views, technology architecture views, and other integrated Agile Enterprise Architecture views to establish a shared language and increase collective understanding (communication grounding) (Alzoubi & Gill, 2020).

Knowledge of Agile practices. Well-defined processes increase trust and efficiency of work inside the team. Frequent practice is to provide Agile training or coaching to teams whenever required or demanded. As it could be challenging to teach Scrum in a distributed environment, teams may use a gamification approach, which shows promising results (Christensen & Paasivaara, 2022).

Team competency and Team composition. To better participate in the distributed Scrum project, leaders conduct self-assessment of their abilities, carry out self-learning, and follow the existing training. In a remote environment, management prefers to hire skilled members who are autonomous and can make quick decisions. Programming is the most important complex skill that the development team must possess. Other skills can be improved with time. The most important soft skills are interpersonal and communication abilities (Hidayati et al., 2020).

Motivation and Mental health. Physical activities are standard practices to improve employees' mental health. Some teams introduce short breaks for physical activity as part of working hours (voluntarily) and face-to-face meetings for team actions, such as joint walks (Rometsch et al., 2022). Widespread practice is organizing "Online coffee" with team members or other nonformal meetings so people can meet each other in different contexts. Organizations practice enriching formal meetings with short conversations about everyday life, which can support relaxing the workday (Brodnicki, 2021; Rometsch et al., 2022).

Lack of control. To have more control under teamwork, team leaders often practice reaching out to team members more frequently, expressing empathy, helping employees set reasonable workloads, etc. It is crucial to maintain a continuous and accurate record of tasks. For this purpose, organizations make use of various tracking and accounting systems. Even so, control is important; the majority of teams prefer to establish an environment where members are mostly autonomous and do not need much control (Cucolas & Russo, 2021).

Lack of coordination. It is a widespread practice for teams to maintain a consolidated task backlog, which is regularly updated based on their work progress. Members are automatically notified of any changes to the backlog, updates on task progress, and other relevant information. To ensure efficient coordination of team members who are geographically distributed and have time zone differences, teams attempt to adjust their working hours to maximize synchronized work hours (Shahzad et al., 2023).

Lack of collaboration. To enhance collaboration, teams use practices and tools like pair programming, issue trackers or digital boards, text-based code reviews, or usage of pull requests (Cucolas & Russo, 2021; Duehr et al., 2021). Agile practitioners reveal the importance of well-conducted retrospective meetings that positively improve collaboration in the distributed environment (Duehr et al., 2021).

Feedback gathering. Team leaders in remote settings must reach out more frequently,

conduct 1:1 session with each team member regularly, and establish a streamlined feedback process (Cucolas & Russo, 2021; Reunamäki & Fey, 2022). To ensure that the team is progressing in the right direction, teams set up regular feedback sessions with stakeholders about work done (Shahzad et al., 2023). If an organization works with offshore teams, to obtain honest feedback from offshore team members, it can be advantageous to conduct team retrospectives without offshore (Šmite et al., 2020).

Meetings Organization. To prevent meeting overload, teams adopt a practice of rotating team members who participate in larger meetings and reporting back to the entire team. Additionally, to avoid interruptions, employees block time in their calendars for individual work, particularly before important meetings, to prepare for them. Also, a lot of organizations, adopt a rule that meetings end 5 to 10 minutes before the hour, allowing employees to take a brief break between meetings.

Lack of trust. To tackle the lack of trust between remote working team members, teams adopt different modes of informal communication (i.e., individual or teleconferences, video conferences, emails, and instant messages) with formal documentation (Shahzad et al., 2023). Well-defined processes increase trust when there are well-structured teams, well-established roles, processes, continuous integration, and unit testing (Chaves & Majdenbaum, 2020). Besides this, pair programming is another great strategy to build trust among distributed teams.

Cultural and Language differences. In a globally distributed environment, it may be helpful for organizations to provide training about diverse cultures in different languages to encourage the teams to communicate openly without hesitation and to overcome the language barrier (Shahzad et al., 2023). Management should raise awareness about language issues and the various aspects of remote communication and provide proper software and hardware to improve the quality of the transmitted audio and video channels (Stadler et al., 2019).

Requirement management. In a distributed environment, it is vital for the team members to have an equal understanding of the work to be done. Product owners practice asking follow-up questions to ensure a correct and clear understanding of requirements. A good practice is maintaining a formal requirement document with a standard template understandable to all distributed teams (Shahzad et al., 2023). To keep track of the requirements and changes, organizations maintain a unified repository with the traceability process for requirement changes, accessible to all development teams. Teams get notified whenever any change is requested against predefined requirements.

Tools and Technologies. Projects in distributed environments rely heavily on a wide range of software. Agile teams use collaborative communication tools, including Plan Poker, White Board, Slack, Jira, Git, Confluence, desktop, application sharing, etc (Chaves & Majdenbaum, 2020). Organizations equip teams with advanced technology and invest in quality hardware and stable internet- and wireless connections (good microphones, speakers, TV screens, or headphones). Employees often configure backup routines like text-based channels, alternative internet access, and general standby hardware to eliminate issues with unsteady network connection while working remotely (Stadler et al., 2019).

Team Engagement. There are many ways to promote the engagement of team members in a remote agile setting. To promote a sense of unity, teams can establish a policy to keep their cameras on during meetings. Having cameras on can lead to increased attention and engagement among members, as they are more focused on what others are saying (Reunamäki & Fey, 2022). It is crucial to promote openness to listening to different opinions and organizing votes on key issues, so everybody is involved in decision-making (Brodnicki, 2021; Chaves & Majdenbaum, 2020). Scrum Master is responsible for capturing team attention in agile meetings and ensuring that everybody participates.

Task Allocation. Agile distributed teams should spend additional efforts to set up an efficient task allocation process. When assigning tasks to teams, managers should examine all dependencies and take into account

the competencies needed to accomplish the task. Once the task is assigned, the manager should clearly define the responsibilities of each team member regarding that particular task and use tools to monitor the team's progress and the work being done (Nundlall & Nagowah, 2021; Shahzad et al., 2023).

Work-from-Home Environment. To find the best solutions to organize teamwork from home, organizations could help enhance their employees' home working environment. Also, standard practice is to ask for help from trained agile coaches for training on better time and work management (Cucolas & Russo, 2021; Tóth & Csiszárik-Kocsir, 2021).

5. CONCLUSION

We carried out a systematic review of the papers that discuss the use of Agile methods in a distributed environment. This review was particularly interested in studies that reveal the challenges of Agile teams whose members work remotely or from home. Also, we constrained papers by publication year, starting from 2019, to reflect the latest experience and practices that resulted from the massive movement of software teams to remote or work-from-home environments due to COVID-19.

First, this review presents quantitative data about research papers, including the number of papers published each year, as well as the types of studies reported in those papers. After this, data extracted from studies were analyzed and interpreted to address the research questions. The findings were subsequently classified into categories and sorted based on their frequency of occurrence in the reviewed papers.

Per our findings, the main challenges for efficient Agile development in a remote distributed context are lack of communication, coordination, and control, complicated knowledge sharing, and lack of knowledge about Agile practices among team members. Besides this, team competency, motivation, and employees' mental health should also be considered. The most widely used strategies to overcome mentioned challenges are to organize efficient sync or async communication between team members and provide teams with necessary hardware and software tools, improve project documentation, and organize Agile training for employees.

The strategies and techniques discussed in this review may be helpful to mitigate certain challenges, but the efficiency of these strategies may vary in different teams and organizations and may not always be possible to apply. Since this is a review of previous work, it is recommended that future researchers do more research in this area, especially to overcome issues that arise due to a lack of communication, collaboration, and knowledge sharing in a geographically distributed team where members work in different timezones.

The findings of this review offer insights that may be valuable for remote software development practitioners operating in geographically dispersed environments. It may help to understand the various challenging factors impacting project success in such a configuration. Additionally, project managers can leverage synthesized knowledge regarding the strategies employed to address the challenges that are identified in the review.

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