Available online at www.sciencedirect.com

ScienceDirect

Information and Software Technology 00 (2025) 1–36

Procedia Computer Science

On Meetings Involving Remote Software Teams: A Systematic Literature Review

Anielle S. L Andrade[a], Victoria Jackson[b], Rafael Prikladnicki[a], André van der Hoek[b]

[a]*Polytechnic School, Pontifical Catholic University of Rio Grande do Sul (PUCRS), Porto Alegre, Brazil*

[b]*Department of Informatics, University of California, Irvine, Irvine, USA*

Abstract

Context: The adoption of remote work models and the global nature of software projects have significantly transformed collaboration and communication within the software development industry. Remote meetings have become a common means of collaboration for software development teams.

Objective: This study seeks to enhance our understanding of remote meeting practices in software teams. It identifies the benefits of remote meetings, the problems associated with remote meetings, tools used to facilitate remote meetings and provides recommended good practices. The study employs a systematic literature review to assist remote teams in improving their meeting practices and identifying areas for future research.

Method: We conducted a systematic literature review that involved searching multiple databases and employing quantitative and qualitative analysis techniques on the identified set of studies to answer our research questions.

Results: The search yielded 30 papers offering valuable insights into remote meeting practices in software teams. Remote meetings offer advantages over traditional in-person meetings such as increased effectiveness and ease of attendance. However, challenges exist such as technological issues, ineffective collaboration, and reduced team socialization. Identified good practices to mitigate the challenges include inserting breaks in longer meetings, catch-up time at the start of meeting, communicating goals in advance of the meeting, and pre-recording demos.

Conclusion: The study explored remote meetings in software teams. We identified advantages that remote meetings have in comparison to in-person meetings, challenges to remote meetings, and good practices along with supportive tooling. While the practices help in promoting effective meetings, additional research is required to further improve remote meeting experiences. Researching topics such as investigating different types of meetings common to software development teams along with the potential for novel tools to better support meetings will help identify additional practices and tools that can benefit remote teams.

Keywords: Remote meetings, Software teams, Systematic literature review, Advantages, Problems, Practices.

1. Introduction

The emergence of remote or geographically distributed software development in the early-to-mid 2000s has revolutionized how teams collaborate on software projects [1]. This emergence was driven by advancements in communication technologies (such as high-speed internet), tools to facilitate remote collaboration (e.g., video conferencing, version control systems, wikis, ticketing systems), and a willingness of teams to work across geographical distances [2]. The globalization of the software industry, with companies operating across diverse countries and regions, further fueled the adoption of distributed software development [2]. In recent years, the COVID-19 pandemic dramatically

accelerated the acceptance and implementation of remote work practices, including remote software development [3, 4]. Software engineers, in particular, quickly adapted to the changes brought about by the pandemic, leveraging new technological affordances and re-purposing existing tools in innovative ways [5].

In today's globalized and technologically advanced world, remote work necessitates remote meetings [6]. Remote meetings involve geographically dispersed participants who connect virtually to collaborate, share information, and make decisions [6]. The increased use of video conferencing platforms, such as Zoom, Google Meet, and Microsoft Teams, both exemplifies and enables this trend, with a significant rise in daily participants [7, 8, 9]. The enduring use of video conferencing is projected to continue even after the pandemic, as Gartner predicts a significant reduction in in-person business meetings by 2024 [10].

Meetings are fundamental in mobilizing teams and organizations to collaborate effectively [11]. They provide a platform for individuals from diverse cultures and personalities to engage in discussions, idea-sharing, brainstorming solutions, make decisions, and resolve conflicts [11]. However, conducting successful remote meetings presents challenges that require careful consideration and the adoption of good practices tailored to the remote work context [6].

This study uses a systematic literature review (SLR) [12] to investigate meetings in remote software teams. Our goal is to build a better understanding of software engineering teams' experiences of remote meetings by identifying benefits, problems, good practices, and tool support. Achieving this goal can aid in informing the development of effective collaboration strategies in this unique context, and overall bring together a body of knowledge that can shape not just good practices in the field [5] but also a research agenda for years to come.

1.1. Scope and Definitions

This study examines meetings involving fully remote software teams. Such teams are also known as fully dispersed or entirely virtual teams. A fully remote team is defined as a group of people who work together on a project while being dispersed across geographical locations [13]. More precisely, using the Domino framework [14] that provides a mechanism for precisely describing the configuration of a fully or partially distributed team, a fully remote team is characterized by having an equal number of team members (T) and team locations (L), i.e., T=L. Examples of such remote teams include a team where all team members work from their own homes, potentially in different cities or countries, or a team where the members are in the same office but distributed across different floors so they do not sit near one another. More commonly, though, remote is understood to be referring to the first example – a convention we adopt in this paper.

In this study, we adopt definition of meetings from the meeting science literature. Meeting science is the study of what takes place just prior to, during, and right after the meeting [15, 16, 17]. While various definitions exist (e.g, [18]), in this paper we adopt the following definition of meetings: a meeting is "purposeful work-related interactions between at least two individuals with more structure than a chat but less than a lecture" [15]. This definition allows us to consider both planned meetings that are typically organized in advance, such as daily stand-ups in agile methodologies like Scrum [19], unplanned meetings that arise spontaneously, such as impromptu design discussions [20], and also meetings involving two people as there has been an increased number of meetings involving only two people in recent years [21]. However, for the purpose of our study, we do not consider collaborative activities like pair programming, as they fall outside our scope and are addressed in another systematic literature review [22].

In subsequent sections, we identify and discuss good practices that contribute to an effective meeting. We consider a meeting to be effective (or good) if it achieves the goals of the attendees and the wider organization [23]. One example of a good practice for improving the effectiveness of meetings is to provide clear goals and direction for the meeting [24]. Another example is to encourage proactive meeting behaviors in attendees such as taking responsibility [25].

Regarding software teams, we encompass teams involved in professional software development, including those working on commercial software projects and those contributing to Free and Open Source Software (FOSS) projects. We do not consider academic settings such as teams made up of students for the purpose of university courses.

2. Motivation and Related Work

This section discusses the motivation for undertaking this SLR on meetings involving remote software teams and identifies previous related literature reviews.

2.1. Motivation

Given the importance of meetings in the day-to-day life of a software engineer and the growth of distributed software development throughout the 21st century, it is unsurprising that researchers have considered meetings involving distributed software teams. Such research has considered the use of tools to support a variety of different types of meetings common to software teams, such as requirement elicitation sessions [26] and design sessions [27]. As highlighted by Whitworth et al. [28], agile methodologies emphasize a people-centric approach to software delivery. With the rise of distributed teams, research has focused on agile practices within these teams, including meetings [20, 29] and specific agile ceremonies like daily stand-ups [20], retrospectives [30], and scrum-of-scrums [31]. Not all of the research focuses on using tools to support distributed meetings. For example, social science theories such as Distributed Cognition Theory [32], and Media Synchronicity Theory [33] has been used as a lens to examine the working practices of distributed agile teams, including meetings (e.g., [34], [35]).

Since the start of the COVID-19 pandemic in January 2020, studies have focused on remote software teams given the reality of many co-located or distributed teams moving to a fully remote model. While much of this research has focused more broadly on the immediate impacts of transitioning to remote work, such as productivity impacts [36, 37] and well-being of engineers [38, 39], the impact of remote work on collaboration effectiveness including meetings has also been considered. For example, since remote working was adopted, the number of planned meetings has increased, and the duration of meetings has reduced, with the net impact that less time is spent in meetings than when the team was co-located [40]. These findings resonate with similar research on the impact of remote work on the broader society [41]. It is expected that as part of the new work normal, fully remote teams will continue to be commonplace as employers (e.g., Airbnb [42]) choose to fully support remote working or promote the use of hybrid teams where some part of the team is co-located in an office and some team members continue to work remotely. For such hybrid teams to succeed, it is recommended that they adopt a remote-work mindset [43] to ensure an inclusive workplace where all staff can contribute and feel valued irrespective of whether they are located in the office or remote.

With remote work here to stay, the software engineering community must understand how remote software teams function to identify and promote effective working practices. This understanding will benefit both remote teams and hybrid teams adopting a remote-work mindset [43]. One specific aspect to investigate is how remote teams collaborate effectively, as it is known collaboration (including communication and coordination) can be challenging in a distributed work environment due to the distances (geographic, temporal, socio-cultural) involved [44] leading to delays in work products in comparison to co-located teams [45]. Collaboration is a broad topic [46] so within this SLR, we focus solely on meetings as meetings are vital to team success [47]. Specifically, this SLR aims to identify what research has been undertaken on meetings involving remote software teams and to summarize this research to benefit practitioners and researchers interested in this topic.

2.2. Related Literature Reviews

To the best of the authors' knowledge, no existing literature reviews focus solely on meetings within the context of software teams, let alone meetings in remote software teams. However, there are three literature reviews focused on meetings that cut across industries and professions. Two consider meetings from research within the meeting science domain [48, 49]. Geographic distribution is not a concern for either of these two papers. The third SLR [50] covers only hybrid meetings researched in the Computer Supported Co-operative Work (CSCW) and Human-Computer Interaction (HCI) fields. These three SLRs do not consider meeting dynamics due to the distribution of attendees.

The 2018 literature review by Mroz et al. [48] provides an overview of the meeting science literature drawn from 200 articles published in the preceding decade. The paper provides practical advice to ensure good meetings with the advice grounded in meeting science research. As meeting science [15] examines what happens before, during, and after the meeting, the good practices are categorized into these three distinct areas. For example, before the meeting occurs, the organizers need to consider the meeting length, attendees, technology to use, goals, and outcomes for the meeting. During the meeting, attendee responsibilities include avoiding perceived bad behavior such as complaining or dominating communication. In contrast, leader responsibilities encompass following the agenda, avoiding distractions and multi-tasking, and actively encouraging everyone to participate. After the meeting, meeting minutes and action items should be sent out promptly, and feedback should be sought on the effectiveness of the meeting. The paper ends with three suggestions for the future of meeting science. The first is to extensively use audio

and video recordings of meetings to better analyze behaviors in situ rather than reported behaviors. Understanding behaviors could lead to identification of interventions to improve the effectiveness of the meeting. The second is to examine the role of technology in meetings for both meeting purposes and other purposes. The third is for the identification of different theories. Arguably, researchers in the CSCW and the HCI fields have pursued the first two suggestions in recent years through research such as the role of multi-tasking in remote meetings [51] and the parallel use of chat in video conferences [52].

The more recent review by Allen et al. [49] summarizes the latest meeting science research by undertaking a systematic literature review on meeting research in psychology and management sciences. This review identifies five critical features of meetings: Leading, Interacting, Managing Time, Engaging, and Relating. Like Mroz [48], the paper provides suggestions for practitioners on improving their meetings based on evidence from meeting research. For example, amongst the advice offered, leaders should participate and consider the meeting modality likely to achieve the meeting objectives. Within interacting, pre-meeting talk is recommended, and counterproductive meeting behavior should be limited. Organizers should consider managing time by limiting the meeting load on attendees. Meetings should be engaging to ensure the meeting purpose is relevant to attendees. Meetings often facilitate colleague relationship-building, and the relating theme recognizes this. Cheerful humor can help but can make others feel excluded if not careful. Amongst recommended future research was examining how technology such as Group Support Systems and Communication technology can support all of the five identified meeting-related themes, especially considering that the future of work is expected to involve hybrid teams [53]. An additional focus area was to examine the mismatch between a leader's optimistic view of the meeting and the attendees' view. This aspect should be explored as research has shown that, for virtual and hybrid meetings, one critical factor related to a successful meeting outcome is the motivation and engagement of attendees [54].

Notably, while these two reviews from the meeting science literature have findings that are relevant to the research goals of this paper (e.g., practices for improving the effectiveness of meetings), neither takes into account the impact that remoteness of attendees has on the meeting effectiveness. This is the research gap we address through this SLR.

Neumayr et al. [50] provide a systematic literature review that considers meetings in the broader hybrid collaboration and meetings (HCM) area within the CSCW and HCI fields. The paper defines hybrid collaboration as collaborative practices involving co-located and remote collaboration with synchronous and asynchronous work phases. Hybrid meetings refer to video or audio-based meetings among co-located and remote participants. As the scope is limited to HCM, fully remote meetings are expressly excluded from the results. Moreover, only publications within the ACM Digital Library were considered. Among the 67 papers identified as relevant to HCM, the authors noted that most papers focused on workplace settings. Less than a quarter are based on ethnography/field research, with over half based on experiments. Twelve of the 67 identified papers related to hybrid meetings, with most meeting research conducted in laboratories. Each identified paper was presented within a taxonomy to indicate the size of the group investigated in the paper, the number of locations/sites in which the group was dispersed, and whether the paper discussed asynchronous work and synchronous work or both. This taxonomy was presented as one of the main outcomes within the paper because terms such as hybrid, virtual, distributed, dispersed, and remote are used inconsistently across the HCI and CSCW domains, leading to difficulties in finding papers relevant to a particular team construct and challenges in understanding the exact team constructs discussed in a research paper. The authors request that researchers be more explicit about the distributed team's structure and locations and any localized sub-groups that form when presenting research featuring distributed/hybrid/virtual teams. Amongst the future research recommendations is a call to focus research on hybrid meetings within the workplace, given the expected rise in hybrid working in the post COVID-19 world. Moreover, hybrid teams have different working dynamics than fully co-located or fully remote teams; they should also be investigated further. While this review has some relevance to our research goals in that it identifies software tools used to facilitate hybrid meetings and so applicable also to remote teams, it does not consider meetings where all participants are remote or consider factors relevant to our research such as good practices for effective remote meetings. Additionally, it only uses the ACM Digital Library so thus excludes software engineering related papers published in alternative libraries such as Scopus. In contrast, this SLR will use a wider set of data sources to focus exclusively on papers related to software teams.

In summary, while these three reviews address some of the research goals for this paper, including best practices on how to conduct effective meetings and the use of tools, they are not grounded in the context of remote meetings involving software teams. We therefore believe our paper makes a unique contribution to existing literature on meetings by focusing exclusively on meetings involving fully remote software teams.

3. Study Design

This study follows Kitchenham's [12] guidelines for undertaking a systematic literature review. We first planned the literature review by identifying the need for a review (Section 2), articulating the research questions (Section 3.1) and authoring a research protocol. We subsequently conducted the review by identifying the data sources (Section 3.2), selection criteria (Section 3.3), and selecting the primary studies (Section 3.4). Finally, we undertook quality assessment (Section 3.5) and data extraction (Section 3.6) steps on the primary studies before analyzing the data and presenting the results (Sections 4 and 5).

3.1. Research Questions

This research focuses on synchronous online meetings involving fully remote software development teams. To help our goal of achieving a comprehensive understanding of the experiences of such meetings, we identified the following four research questions:

- **RQ1:***What are the perceived benefits to meeting remotely?* Understanding the benefits of remote meetings helps assess their value for software teams. Do these meetings facilitate better team coordination, communication, and collaboration compared to traditional methods, or are there specific areas where they excel?
- **RQ2:** *What challenges have teams encountered in remote meetings?* Identifying problems with remote meetings allows us to explore potential drawbacks. Are there technical challenges hindering communication? Do these meetings lead to reduced team engagement or a lack of focus?
- **RQ3:** *What practices do teams employ to improve the effectiveness of remote meetings?* Exploring best practices provides actionable insights for teams. What strategies have other remote software teams implemented to improve the effectiveness of their online meetings?
- **RQ4:** *What is the role of tools in supporting and facilitating remote meetings?* Understanding the role of tools helps determine their impact on meeting effectiveness. Do different online tools, such as video conferencing or collaborative platforms, influence team engagement and overall meeting outcomes?

3.2. Sources

Three databases were used to identify relevant studies: IEEE Xplore, ACM Digital Library, and Scopus. These databases were selected because these three databases index publications from well-regarded software engineering conferences and journals such as the International Conference on Software Engineering (ICSE), ACM Transactions on Software Engineering and Methodology (TOSEM), and the Information and Software Journal (ISJ) as well as more human-centered research focused venues such as the ACM Conference on Computer-Supported Co-Operative Work (CSCW) and ACM CHI Conference on Human Factors in Computing Systems (CHI).

To include as many relevant studies as possible, we used several keywords and their synonyms in our search string. Firstly, we used "software engineering OR software development" to limit the scope of the results to those pertinent to software engineering. Secondly, we used "meeting or remote work or videoconference" to identify papers potentially relevant to meetings. Videoconference was used as a synonym for meeting, as the term videoconference implies an online meeting. Thirdly, we used "remote or hybrid or virtual or distributed" to identify the dispersion mode of the software team. We purposefully used multiple terms to identify research potentially related to remote teams as researchers are inconsistent in how they describe a team's dispersion model [50]. Using multiple terms helped us identify papers that used the term virtual to describe a remote team, for example. Table 1 summarizes the search string used for each in-scope database.

The results from each database were saved in a Google Sheet and stored securely on a shared drive. For each result, the title, keywords, authors, abstract, year of publication, and URL to the paper were captured inside the Google Sheet.

#	Database	Search String	Date Query Executed	#Results
1	IEEE Xplore	(“software development” OR “software engineering”) AND (“meeting” OR “remote work” OR “videoconference”) AND (“remote” OR “hybrid” OR “virtual” OR “distributed”)	2 May 2022	336
2	ACM DL	[[Abstract: “software development”] OR [Abstract: “software engineering”]] AND [[Abstract: “meeting”] OR [Abstract: “remote work”] OR [Abstract: “videoconference”]] AND [[Abstract: “remote”] OR [Abstract: “hybrid”] OR [Abstract: “virtual”] OR [Abstract: “distributed”]]	5 May 2022	36
3	Scopus	(“software development” OR “software engineering”) AND (“meeting” OR “remote work” OR “videoconference”) AND (“remote” OR “hybrid” OR “virtual” OR “distributed”)	5 May 2022	413

Table 1. Data sources

3.3. Selection Criteria

To determine which of the search results should be included in the study, we used the following inclusion and exclusion criteria.

Inclusion criteria

- Entire article written in English.
- Published after Jan 1st, 2000. Since remote work practices became more widespread in the mid-2000s, we focused on literature published after January 1st, 2000, to capture the most relevant research in the then emerhging and now evolving field.
- Paper must be related to remote software teams and meetings.
- Paper must discuss meetings and at least one of the topics of interest: remote meeting benefits, meeting practices, problems experienced, or tools used to support the meeting.
- The type of team observed in the paper is a fully remote team.

Exclusion criteria

- The type of team observed in the paper is not fully remote, e.g., some people are co-located in one location, others are either in single or multiple different locations or everyone is co-located.
- The topic is collaborative work rather than meetings, e.g., pair programming.
- The study focuses on professional software development teams, excluding studies solely involving students in academic settings (e.g., university courses).
- Paper is unavailable online.
- Format of the paper is not PDF.
- The paper is a conference abstract.
- Duplicate papers.

We included studies from various academic sources, such as peer-reviewed journals, conference proceedings, and workshops. We excluded systematic reviews and mapping studies to avoid redundancy and focus on primary research studies.

3.4. Review Execution

Once we completed the initial search, we undertook a two-step review process and snowballing to determine the final set of papers to include in the study. The initial query resulted in the identification of 785 search results in total across the three databases: IEEE Xplore, ACM Digital Library, and Scopus. Subsequently, the first two researchers reviewed the results to determine which papers should be included in this systematic literature review based on the inclusion and exclusion criteria. A two-stage process was followed to identify the initial shortlist of papers potentially in the scope of the review:

- First Review: in the first filter, the abstract of each paper was reviewed to determine whether it should be considered further. In the IEEE Xplore database, a total of 336 articles were reviewed, out of which 26 papers were accepted, and 311 articles were rejected. In the ACM Digital Library (ACM DL), 36 papers were assessed, with 10 papers being accepted, and 26 papers being rejected. Moving on to the Scopus database, 413 articles were reviewed, and 163 papers were accepted, leaving 250 papers rejected. Overall, across all three databases, the final number of accepted papers was 199, while 586 papers were rejected.
- Second Review: in the second filter, subsequently, the full paper was briefly read to consider whether it should be considered further. Duplicates and inaccessible papers were removed at this stage, also. See Figure 1 for details on the numbers accepted and rejected for each database.

Each researcher reviewed approximately half of the papers at each stage. In some cases, it was not immediately apparent whether the paper should be included. In these cases, a discussion took place between the two researchers to decide whether to include the paper or reject the paper. In the case of uncertainty in Stage 1, it was accepted, and the decision was re-considered in the second stage, when the paper would be read in more detail.

Three difficulties faced in these two stages of the review process were determining: (i) whether the teams discussed in the paper were fully remote or instead some form of hybrid team, (ii) whether meetings were covered in the paper, and (iii) whether the meeting attendees were software teams or more general information workers. The abstract was often ambiguous both with regard to the team structure and the types of communication or coordination covered in the research. The nature of the work performed by a team or organization under study in a paper was sometimes not mentioned, so it was not always clear if the research was in the context of a software team. We, therefore, decided to err on the side of caution and carry such papers forward into the second stage for a more detailed review of the paper's content. Even when reading the paper's full content, it was sometimes difficult to determine the type of team structure within a paper, and discussion was required between the two reviewers to determine if a paper was discussing a fully remote software team.

Database	Papers	Accepted	Rejected
IEEE Xplore	26	4	22
ACM DL	10	3	7
Scopus	163	12	151
Total	**199**	**19**	**180**

Figure 1. Results of Second Review

This two-stage process resulted in 19 shortlisted papers to consider for this SLR.

After applying the snowballing technique, we were left with 32 studies. Following a quality assessment process (detailed below), two studies were excluded, resulting in a final set of 30 studies for review. Table A.7 contains the complete list of the included studies.

Despite the increased interest in remote work driven by the recent COVID-19 pandemic, the number of selected studies is low. This perhaps reflects the lack of studies on meetings within software development more generally, an observation supported through a search of the IEEE Computer Society Digital Library (a subset of IEEE Xplore containing venues such as ICSE and TSE) that found only 30 papers related to meetings and software teams published between 2000 and 2022.

3.5. Quality Assessment

As recommended by Kitchenham [12], we assessed the quality of each shortlisted study. The goal of this quality assessment was to help interpret the findings of each selected paper. We purposefully used the quality assessment outlined in [55] as this is a popular quality assessment tool commonly used in SLRs [56]. The eleven quality assessment criteria are grouped under four categories:

- Reporting: Relates to the quality of the reporting of a study's rationale, aims, and context.
- Rigor: Looks into the rigor of the research methods used in the study.
- Credibility: Examines the credibility of the findings in terms of validity and meaningfulness.
- Relevance: Assesses whether the study is relevant to the academic community and/or industry practitioners.

Each study was scored against each of the criteria with either a 1 when it met the criteria or a 0 when it did not. This led to each paper receiving a total score of between 0 and 11 inclusive. The specific criteria in each category are listed in the supplementary material. The results are available in the supplementary material. We decided to exclude two papers that had low total scores (<= 3). These two papers were opinion papers. This left 30 papers for the final set of papers and listed in Table A.7 within the Appendix.

The first two authors independently undertook the quality review. Each researcher separately scored the papers within a Google Sheet. The two researchers then reviewed the results. No differences were found. The quality assessment for each of the 30 papers is shown in the Appendix in Table A.8.

In analyzing the quality assessment results, we noted that none of the studies met QA6. This is possibly due to the nature of the studies included in the final set, as they did not run experiments requiring control groups. Additionally, the majority of papers did not score against QA9. The authors of these papers did not discuss their relationship with the study participants, so it is unclear if this relationship could have affected the results. Particularly, in some cases (e.g., [S5], [S23]), the authors and participants worked for the same company, so it was unclear what the exact relationship was. We would have expected some discussion in such cases.

Generally, the papers scored highly on the quality assessment, with 19 of the final 30 papers scoring 9 or above out of the possible 11.

Category	**#Item**	**Assessment Criteria**
Reporting	QA1	Is the paper based on research (or is it a "lessons learned" report based on an expert opinion?)
	QA2	Is there a clear statement of the research aims?
	QA3	Is there an adequate description of the context in which the research was carried out?
Rigor	QA4	Was the research design appropriate to address the aims of the research?
	QA5	Was the recruitment strategy appropriate to the aims of the research?
	QA6	Was there a control group with which to compare treatments?
	QA7	Was the data collected in a way that addressed the research issue?
	QA8	Was the data analysis sufficiently rigorous?
Credibility	QA9	Has the relationship between researcher and participants been adequately considered?
	QA10	Is there a clear statement of the findings?
Relevance	QA11	Is the study of value for research or practice?

Table 2. Quality Assessment Criteria (from [55])

3.6. Data Extraction

We firstly extracted common metadata for each selected study. This consisted of:

- Paper Name
- Paper Authors
- Date of publication
- Publication venue

Subsequently, following the recommendations in Petersen [57], we classified each paper using topic-independent (e.g., Publication Venue) and topic-dependent (e.g., Type of Meeting) classifications. As we are unaware of any previous classification scheme used in SLRs related to meetings, we defined our own classification scheme based on our research questions and examination of the selected studies. Table 3 summarizes the scheme used. The values for the topic dependent classifications were determined by the first two researchers through reading the final set of papers, identifying a number of distinct values and subsequently discussing and agreeing on the final values.

Each paper was read in its entirety to determine the most appropriate classification. The classifications were stored in the same Google Sheet as the selected set of studies. The first two researchers performed the classification independently. They then met and resolved any differences to determine the final classification.

Classification	**Potential Values**
Topic-independent classification	
Publication Venue	Journal, Conference, Workshop
Research Type	Evaluation research, Solution proposal, Validation research, Philosophical paper, Opinion paper, Experience paper
Research Method	Evaluation Research (Industrial Case Study, Controlled experiment with practitioners, Practitioner targeted survey, Action research, Ethnography), Validation Research (Simulation as an empirical method, laboratory experiments, Prototyping)
Topic dependent classification	
Research setting	Workplace, Laboratory, Open Source Software Project
Primary paper topic	Meetings, Impact of COVID-19, Productivity, Collaboration
Type of meeting	General, Project meetings, agile ceremonies, agile retrospective, Technical, Design, Ideation, Requirement interviews, Client meetings, Maintenance
Contributions	Meeting experiences, Tool design requirements, Tool use, Recommendations

Table 3. Classification of papers

For the Primary paper topic, we identified four different categorizations since we included papers that covered remote meetings even if remote meetings were not their primary topic. Some papers focused on remote *collaboration* more generally (while including findings related to remote meetings), whereas others were solely focused on *remote meetings*. Other papers were focused on the broader impact of *COVID-19* on software teams (e.g., [S11]) or the *productivity* of individuals or teams (e.g., [S2]), yet still discussed remote meetings.

Some of the papers covered multiple types of meetings in which case we captured all the mentioned types. We categorized the type of meeting as General in cases where the specific type of meeting was not mentioned, but it was implied that it was some kind of general meeting involving the team. We also categorized a paper as covering agile ceremonies when a number of ceremonies were mentioned (e.g., Daily Stand-Ups, Planning meetings) or the paper used the term (or a synonym of) agile ceremony. If a paper only covered one type of agile ceremony, then we categorized its meeting type with the specific agile ceremony. Design was used when the paper explicitly discussed software design or architecture, Maintenance was for meetings where the ongoing maintenance of a piece of software was discussed, while Technical was used for meetings discussing technical aspects of a product such as bugs or technical issues or challenges.

Within the contributions classification, we considered Meeting experiences to capture information about the good or bad of remote meetings, Tool design requirements for when a paper made recommendations on designing tools to support meetings, Tool use for discussing the use of a tool in a reasonable level of detail (as opposed to just naming a tool), and Recommendations on good practices for effective remote meetings. Some papers made multiple contributions which were all captured in the data extraction process.

3.7. Data Analysis

In addition to data extraction, inductive thematic coding [58] was performed on each of the final papers to help determine the specific tools used, benefits, challenges and good practices of remote meetings. The same two researchers who completed the previous steps undertook the coding. Each paper was downloaded from its source database and imported into MaxQDA [59] prior to coding. One researcher coded all the papers, in the process producing a codebook. A second researcher reviewed the coding and codebook. Any disagreements were discussed in detail before coming to a consensus on the codes and coding resulting in updates to the coding of the impacted papers. The codes were then placed onto a Google Jamboard and grouped to form an affinity map to determine themes as agreed by the two researchers. The results of this coding process was used to help answer all of the research questions.

3.8. Supplementary Material

The extracted data from the search results are available along with the generated codebook and affinity map. This supplemental data has been provided alongside this manuscript.

4. Results

This section answers the four research questions posed earlier. The answers draw upon the finalized set of 30 papers identified through the process described in Section 3 and listed in Table A.7.

4.1. Overview of Primary Studies

In examining the results of the data extraction process described in Section 3.6, we are able to show summaries about the set of final studies, including trends for numbers published per year, primary topic, type of meeting, research type and method, and research contribution.

4.1.1. Publication per year

Figure 2 shows the papers published by year per publication venue. Conferences are the most popular venue by far. Additionally, most papers have been published since 2020, with only 8 published in the 19 years prior to 2020. The impact of the recent COVID-19 pandemic has likely driven research interest in remote software teams hence the uptick in publications since 2020. For example, papers [S1, S2, S3] were all published after 2020 and relate to remote team work during the COVID-19 pandemic. It is unclear why there has been little research in remote software teams prior to 2020.

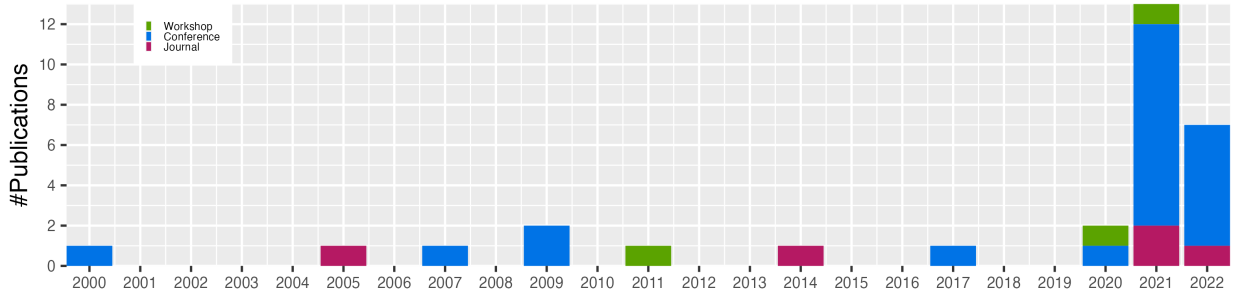

Figure 2. Publication venue by year

4.1.2. Primary topic of paper

The papers included in the research covered various topics. Most studies (13 in total) examined the impact of COVID-19 on different aspects. Similarly, 13 studies focused on remote meetings, highlighting their significance during the pandemic. Additionally, three studies delved into the theme of collaboration, exploring its effects and challenges. Lastly, one study concentrated on productivity research. It is worth noting that both "Meetings" and the "Impact of Covid-19" emerged as the most popular primary topics of study, while other less prevalent issues were related to collaboration and productivity.

4.1.3. Type of meeting

Papers vary by the type of meeting studied, such as a type of agile ceremony (e.g., Daily Standup, Retrospective), more generalized meetings (e.g., Team Meetings), or specific types of meetings, such as Design meetings. As shown in Figure 3, within the finalized set of papers, the most commonly studied remote kind of meeting was General meetings, with 16 studies dedicated to this category. Agile ceremonies followed closely behind, with 9 studies exploring them. However, more specialized meetings, such as design meetings, technical meetings, agile retrospectives, client meetings, and maintenance meetings, received comparatively less attention, with few studies discussing these types of meetings.

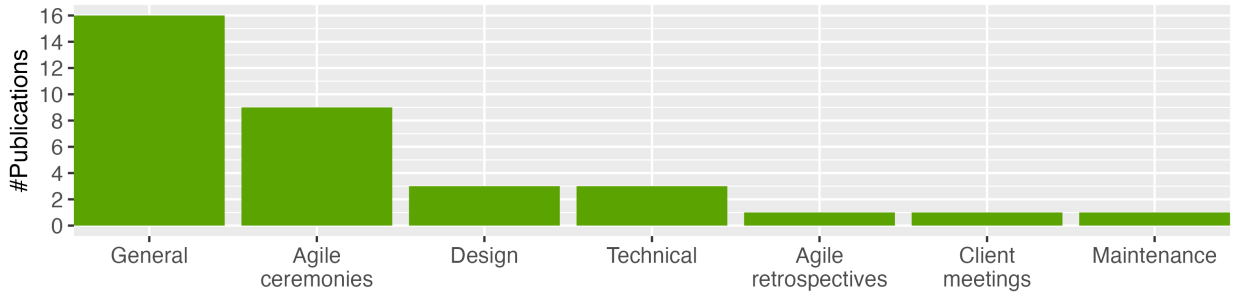

Figure 3. Type of Meeting Studied

For the more specialized types of meeting:

- Three papers ([S6], [S8], [S27]) discussed software design meetings. Two papers considered tool support, whereas the other was more focused on the outcomes of a remote design meeting. In [S27], the use of a novel VR tool accessed via the Oculus Quest headset was used to meet remotely and to help design a technical solution. [S6] observed an in-person design meeting to provide design recommendations for tools to support remote design meetings. Finally, in [S8], a laboratory experiment was conducted to determine the impact of physical distance on design sessions using a design thinking approach.
- Three papers ([S24], [S25], [S26]) discussed technical meetings in the context of open-source projects with a focus on quantitative aspects of the meeting, such as the number of attendees and number of active participants. These papers did not discuss qualitative aspects of meetings, such as challenges and good practices.
- A novel tool to support agile retrospectives was examined in [S9]. The tool was designed to focus on root-cause analysis, a technique sometimes used in agile teams as part of their retrospectives [60].
- Recurring software maintenance meetings were the subject of a case study [S26]. This type of meeting is where the product leads regularly meet with other invitees as necessary to discuss emerging issues and new directions for a product.

4.1.4. Research type and method

The selected papers in this research exhibit a diverse distribution of research types, with the majority falling under Evaluation Research (21 studies). Experience Reports and Validation Research are closely behind, each represented by three studies. Additionally, there are two Opinion papers and one Philosophical study.

Evaluation Research is the most prevalent type, focusing significantly on industry settings. Among the Evaluation Research papers, three studies specifically examined open-source software projects (OSS), while the rest were conducted within an industry context. Experience Reports (represented by pieces [S7], [S18], and [S27]) were centered around industrial projects, providing valuable insights into real-world applications.

Validation research, which contrasts with Evaluation Research by taking place in a laboratory setting rather than an industry environment, comprises only three papers ([S8], [S14], [S15]). This demonstrates that research conducted within an industry setting is the prevailing approach when studying remote meetings.

The two Opinion papers ([S19], [S20]) incorporated literature reviews to substantiate their viewpoints, offering valuable perspectives on the subject matter. On the other hand, the philosophical paper ([S6]) delved into design tools' essential capabilities in supporting distributed design.

Notably, the research excluded papers that focused on meetings held in academic or classroom settings, resulting in a greater emphasis on Evaluation Research, which is more relevant when investigating industry practitioners. In fact, out of the 30 papers, 21 were situated within an industrial setting, with 18 under the Evaluation Research category and the remaining three being Experience Reports.

All the papers selected were original research rather than pure replication studies. However, the goal of the form [S17] was to validate previous research on the impact of COVID-19 on agile software teams, setting it apart from the other studies, which aimed to produce new findings rather than validate existing ones.

The case study is the most popular research method, with 11 studies, closely followed by a survey with 10 studies and then interviews with 3 studies. Prototyping ([S14], [S15]) and experiments ([S8]) were little used.

4.1.5. Research contributions

The research contributions within the selected papers were categorized as follows: Meeting Experiences (13 studies), Recommendations (10 studies), Tool Design Requirements (6 studies), and Tool Use (6 studies). It is important to note that a single paper might present multiple research contributions. For instance, paper [S8] discusses meeting experiences, tool use, and tool design requirements within its study.

Most papers provided insights into meetings' positive or negative aspects, focusing on Meeting Experiences. Following this, many pieces offered valuable recommendations for enhancing remote sessions. However, relatively fewer papers delved into the Use of Tools, which might explain the lower numbers for Tool Design Requirements and Tool Use categories.

4.2. RQ1: What are the perceived benefits to meeting remotely?

33% of the papers (10) discussed the perceived benefits of remote meetings compared to co-located or hybrid meetings. We grouped these benefits into seven categories (Table 4), each ordered according to the most common benefit found in each study.

Some of these benefits arise because of the necessity for all remote meeting attendees to use technology to participate in the remote meeting thus, the technology affords the benefit. For example, participating in parallel chat is only possible when a device is readily available. This may not be the case when meeting in a traditional meeting room due to a lack of equipment or cultural norms dictating laptops and tablets are not to be used. Likewise, it is easier to multitask and potentially more socially acceptable when joining the remote meeting via a laptop or desktop in a private workspace (e.g., at home), as other attendees cannot see other participants' screens.

The use of technology to attend remotely also makes it easier to attend meetings. No travel is required as people can join from their personal workspace. There are no room size limitations that may occur in an office building, so more people can choose to attend. Likewise, it appears more socially acceptable to leave a meeting when it is online [S17].

The selected papers noted that remote meetings feel more effective than co-located meetings. Identified reasons for improved effectiveness included scrum meetings being more factual and goal-oriented [S16], more focused [S28], improved meeting discipline such as note-taking and meeting minutes [S1], and more efficiently run [S20].

Some of the papers noted that reduced time was spent in meetings [S19] due to either a reduction in meetings [S11], [S28] or shorter meeting duration [S28], and this reduced time was considered a benefit in their studies. This was considered a benefit in some papers, although, as noted in [S19], this reduced duration could result in less information exchange between team-members so it could be considered a risk to team effectiveness.

One study also noticed that, as everyone joined remotely, there was more egalitarian information diffusion taking place amongst the participants [S11]. There is no opportunity for side conversations involving people who attend in person before or after the meeting.

One study that considered using a Virtual Reality environment to host the meeting [S27] identified improved ideation due to the immersive and realistic workplace environment in which the meeting was held.

#	Benefit	Description
1	More effective	The meeting has an identified objective, and the conversation stays on point. There is less social talk and a greater focus on the topic under discussion. [S1], [S16], [S20], [S28]
2	Reduced time spent in meetings	Meetings are shorter in length or not as frequent in comparison to in-person meetings. [S1], [S11], [S19], [S28]
3	Easier to attend	Travel is not required to join the meeting so easier for participants to attend. [S17], [S28]
4	Easier to multitask	Participants are able to multitask more effectively when joining a meeting remotely. [S4], [S20]
5	Egalitarian information diffusion	Everyone joins remotely so there is no additional information transferred due to in-person conversations prior or post the meeting. [S11]
6	Support for Parallel chat	As participants join the meeting via a device, it is easier to use parallel chat either directly within the conference software or via a dedicated chat tool. [S23]
7	VR improves ideation	Attending a remote meeting using Virtual Reality headsets improved ideation due to the ability for playfulness (e.g., falling through the air) made possible by VR software. [S27]

Table 4. Benefits of Remote Meetings

4.3. RQ2: What challenges have teams encountered in remote meetings?

Of the papers examined, 46% (14) described problems in remote meetings. In Table 5, these problems were classified into six categories: Technology's Role, Excessive Meetings, Collaboration Effectiveness, Reduced Team Socialization, Unclear Team Social Norms, and Personal Impact. The respective papers extensively discuss and support each category, and each problem is ordered according to the most common problem found in each study.

The technology that is used can undermine remote meetings. On the one hand, undesirable problems in the functioning of the technology, such as network connectivity interruptions, audio or video glitches, and software compatibility issues, can disrupt the flow of communication and impede effective collaboration [S28], [S7], as participants may encounter difficulties joining the meeting or struggle to hear and see others. Such technological issues are found sometimes to generate frustration, diminish engagement, and result in less productive meeting experiences. On the other hand, even if the technology is functioning as desired, it can still introduce distractions during important meetings or ceremonies, diverting participants' attention and hindering meeting effectiveness, for instance, because chat activity distracts people from conversation taking place [S4], [S23]. Participants also may be tempted to multitask or face interruptions from other digital devices, compromising their focus and overall engagement [S13].

Excessive meetings are a common hurdle in organizations caused by interdependent tasks requiring frequent collaboration. This can lead to unproductive and stressful meetings [S2], [S10], disrupt workflow, and hinder productivity [S28]. However, according to Table 4, a potential benefit of remote work is reduced meeting time. Remote meetings may be shorter or less frequent than in-person meetings.

Regarding collaboration effectiveness, teams faced communication challenges during online meetings, particularly in perceiving remote participants' reactions, gestures, and facial expressions [S8], since online participants often struggled to detect and interpret non-verbal cues as they would normally in face-to-face interactions [S1], [S21]. This difficulty posed challenges in accurately interpreting and responding to communication nuances, which in turn led to a reduction in attention and engagement during virtual meetings [S22], [S28] as well as potential breakdowns in shared knowledge and understanding. To compensate, disruptions, parallel conversations, and overlapping speech frequently occurred, further complicating effective meeting communication [S13].

The shift to remote settings also was observed to lead to a reduction in spontaneous interactions, which, in turn, hampered casual conversations that are vital for fostering work relationships, social connections, and career advancement opportunities [S1], [S19], [S29]. The absence of face-to-face interactions makes it challenging to engage in informal chats, impacting the overall dynamics of remote work environments.

Another issue in remote meetings is multitasking, which can be perceived as disrespectful and hinder effective communication. While sometimes such parallel activities are useful (see Section 4.4.1), when participants engage in multiple tasks simultaneously during meetings, it can diminish their focus and engagement and potentially lead to miscommunication and reduced collaboration [S4]. Furthermore, some individuals rely heavily on chat, while others prefer verbal communication. Such mismatching expectations regarding how and when to use chat can create a disjointed experience and hinder effective information sharing [S23].

Finally, the demands of remote meetings—especially when multitasking is involved—can adversely affect well-being and productivity [S4]. Zoom fatigue is real [61] and constantly switching between tasks and dealing with multiple distractions can yet more quickly lead to exhaustion, decreased focus, and heightened risks of burnout [S7].

#	Problem	Description
1	Technology's Role	Technology use can undermine remote meetings through technical issues and distractions. Problems such as network connectivity interruptions, audio/video glitches, and software compatibility disrupt communication. Distractions from chat activity and multitasking also hinder engagement and meeting effectiveness. [S1], [S4], [S7], [S8], [S13], [S19], [S20], [S21], [S22], [S23], [S28]
2	Excessive Meetings	The prevalence of excessive meetings is a pervasive issue, wherein tightly coupled tasks necessitate scheduled meetings, resulting in a high volume of often ineffective and stressful encounters. [S1], [S2], [S3], [S10], [S19], [S20], [S28]
3	Collaboration Effectiveness	The team encountered communication challenges in online meetings, including difficulty perceiving remote individuals' reactions, gestures, and facial expressions, leading to uncertainty regarding shared knowledge and understanding. These issues often resulted in disruptions, parallel conversations, and overlapping speech. [S1], [S8], [S13], [S19], [S21]
4	Reduced Team Socialization	Reduced spontaneous interactions in remote settings hinder casual conversations, impacting work, social life, and career advancement opportunities. [S1], [S19], [S29]
5	Unclear Team Social Norms	Multitasking in remote meetings can be disrespectful and hinder communication. Participants have differing chat usage expectations, causing difficulty finding relevant information. Explicit norms and designated moderators are needed. [S4], [S23]
6	Personal Impact	Multitasking in remote meetings might cause fatigue, affects well-being, and poses risks of burnout and decreased productivity. [S4], [S7]

Table 5. Problems encountered in Remote Meetings

4.4. RQ3: What practices do teams employ to improve the effectiveness of remote meetings?

Our research has identified 11 papers (37% of the total articles surveyed) addressing implementing good practices in remote meetings. These papers offer insights into practical strategies for effectively conducting remote meetings, covering various aspects of the meeting process (pre, during, and post-meetings), as illustrated in Figure 4. They also shed light on the technological, cultural, and social aspects of remote meetings, as depicted in Figure 5.

4.4.1. Meeting Process

Figure 4 provides a visual representation of the meeting process as organized in four phases similar to the phases identified by Mroz et al. [48], highlighting per phase the good practices identified in meeting design, pre-meeting preparations, the conduct of meetings, and post-meeting actions.

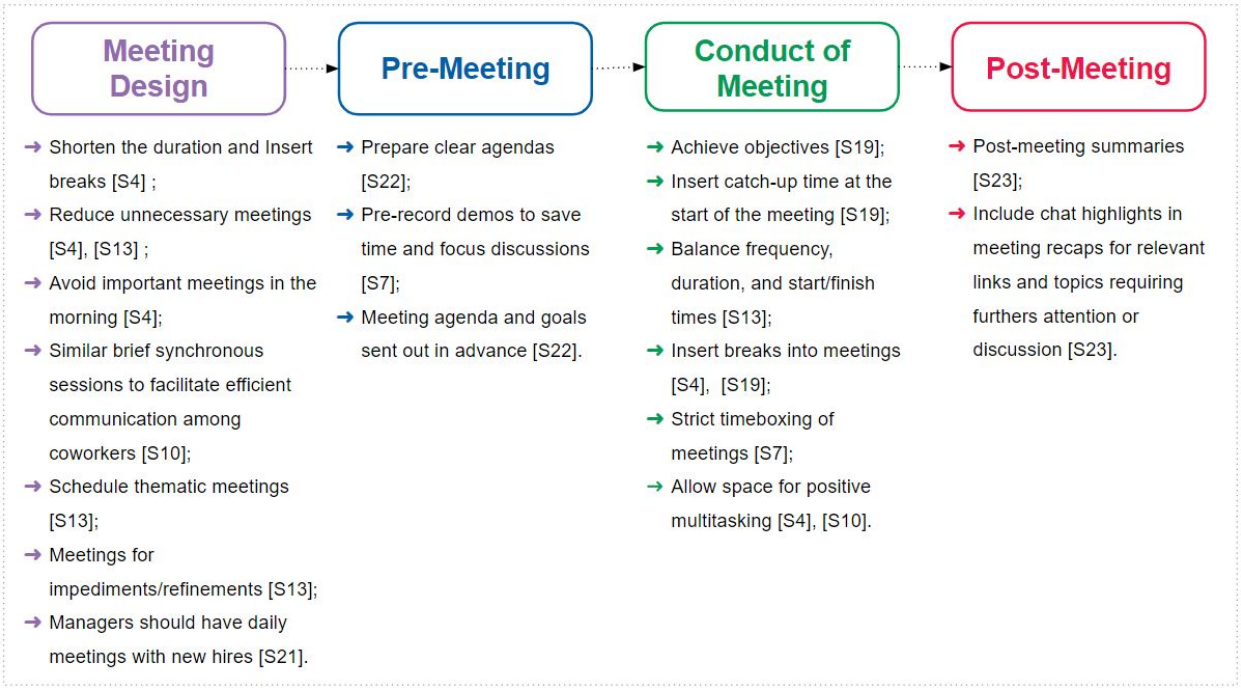

Figure 4. Good Practices: Meeting Process

The studies analyzed in this study highlight the importance of minimizing unnecessary meetings to optimize employees' time management and overall productivity [S4] [S13]. To achieve this, it is recommended to prioritize critical discussions, utilize alternative communication channels (such as email or instant messaging), and consolidate related topics into fewer, more purposeful meetings. Regularly evaluating recurring meetings is also advised to avoid redundancy and promote operational efficiency.

To enhance meeting efficiency, careful consideration should be given to the duration of meetings and the inclusion of breaks to combat meeting fatigue and sustain participant engagement [S4]. For efficient meetings, clear agendas, prioritization of essential topics, adherence to time constraints, and incorporating intermittent breaks. These practices enable participants to maintain focus and mental energy throughout the meeting.

Daily meetings between managers and new hires are crucial in establishing a supportive onboarding process in remote work environments [S21]. These meetings allow managers to clarify expectations, provide guidance, address questions, and build rapport with new team members. By nurturing strong relationships and facilitating integration, managers contribute to successfully assimilating new hires into the remote team [S13].

During remote meetings, several practices can enhance effectiveness and productivity. Aligning discussions and activities with meeting objectives is crucial [S19]. Additionally, incorporating breaks into meetings [S4] [S19] helps

combat meeting fatigue and sustain participant engagement. Allowing for positive multitasking [S4] [S10] acknowledges the reality of remote work environments, where participants may engage in light multitasking during less critical parts of the meeting.

Two critical practices are post-meeting summaries and incorporating chat highlights in meeting recaps [S23]. Post-meeting summaries document key points, decisions, and action items, promoting understanding and accountability and serving as a reference for future follow-ups. Chat highlights in meeting recaps ensure that relevant links and topics requiring further attention or discussion are not overlooked, facilitating continuity and progress beyond the meeting.

4.4.2. Technological, Cultural, and Social Aspects

Figure 5 visually presents the identified practices in remote meetings' Social, Cultural, and Technological Aspects.

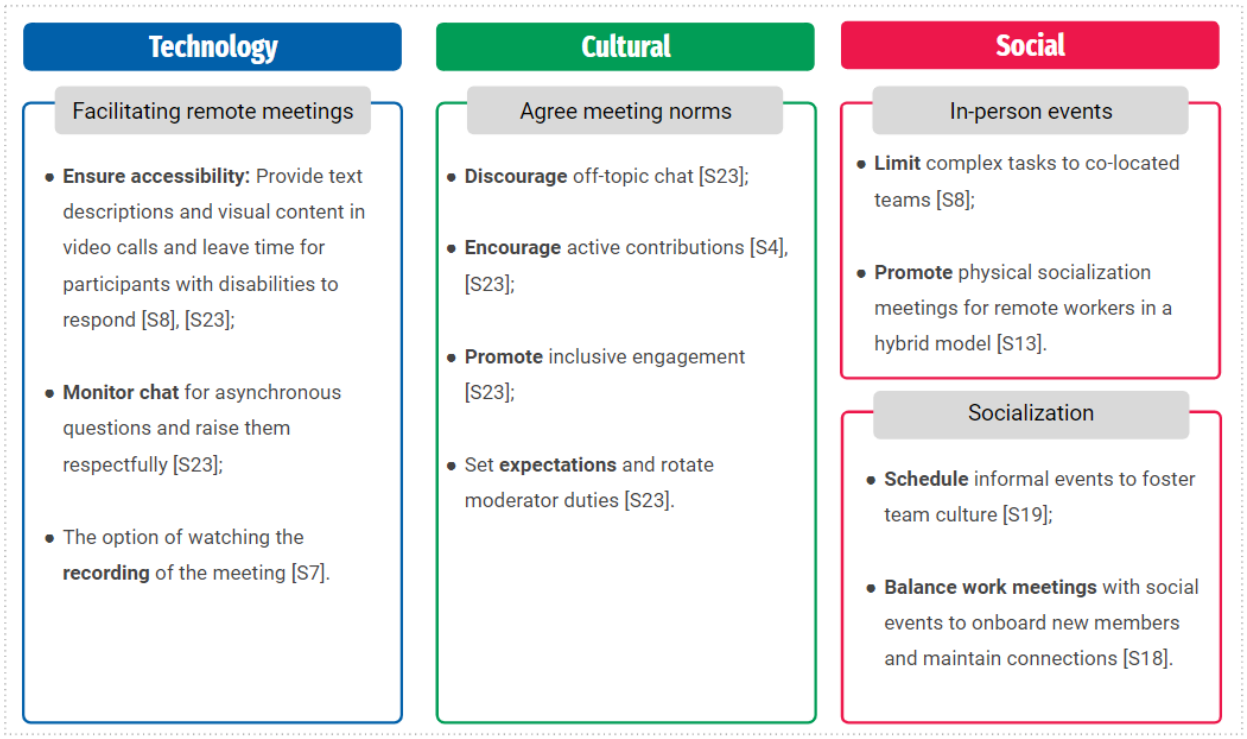

Figure 5. Good Practices: Social, Cultural and Technology Aspect

The significant changes brought by remote work have redefined collaboration and communication for individuals and organizations [62]. As technology advances, examining how technology usage, cultural norms, and socialization interact within the remote work environment becomes crucial [62].

Technology Usage: Ensuring accessibility for all participants is a critical aspect of remote meetings. Two practices that address accessibility concerns are providing text descriptions and visual content during video calls and the availability of recorded meeting sessions.

Providing text descriptions and visual content in video calls is particularly important for accommodating individuals with hearing or visual impairments. By including text descriptions of important visual elements and allowing time for participants with disabilities to respond, remote meetings become more inclusive, ensuring that everyone can actively participate. Studies [S8] and [S23] support the significance of providing equal access to information and opportunities for individuals with diverse communication needs.

To enhance the effectiveness of remote meetings, it is recommended to monitor chat functionalities for asynchronous questions and address them respectfully. As supported by research [S23], this practice allows participants to ask questions or seek clarifications outside the main conversation flow, promoting active engagement and knowledge sharing. By acknowledging and responding to these questions respectfully, remote meeting organizers can foster a

collaborative environment and ensure that participants' queries are addressed, contributing to the overall success of the meeting.

Recorded meeting sessions benefit participants who require additional processing time or have scheduling conflicts. By making recorded sessions available, participants can review the meeting at their own pace and convenience. This accommodates individuals with varying processing speeds and allows those with scheduling conflicts to stay engaged and informed. Research [S7] treats recorded sessions as an effective way to promote equal access and participation in remote meetings.

By implementing these practices, remote meeting organizers can create an inclusive environment where all participants have equal opportunities to contribute and engage. Ensuring accessibility in remote meetings is essential for promoting diversity, equity, and inclusion, supporting the principle that everyone should be able to participate fully in collaborative activities, regardless of their abilities or circumstances.

Cultural Aspects: To facilitate effective remote meetings, some practices can be implemented. Firstly, it is important to discourage off-topic chat during meetings, according to the [S23] study. Off-topic discussions can divert participants' attention and hinder the productivity of the meeting. Setting clear expectations and reminding participants to stay focused on the agenda can minimize off-topic chat, ensuring that the meeting stays on track and objectives are achieved [S23].

Encouraging active contributions from all participants is another practice. Creating a supportive environment where everyone's input is valued makes participants more likely to engage in the meeting actively. This can be achieved by explicitly encouraging individuals to share their thoughts, ideas, and concerns [S4]. Research [S23] suggests that when participants feel their contributions are valued, they are more likely to actively participate and provide meaningful input, leading to more productive discussions and decision-making processes.

Promoting inclusive engagement is important to ensure all participants have equal opportunities to contribute and be heard. This can be achieved by adopting practices that accommodate diverse communication needs and styles. For example, providing alternative participation means, such as allowing participants to contribute via chat or providing designated speaking turns, can help create an inclusive meeting environment [S23]. By considering participants' different preferences and abilities, remote meetings can foster a sense of belonging and ensure that everyone's voice is valued.

Lastly, setting expectations and rotating moderator duties can help create a balanced and participatory meeting environment. By clearly communicating the roles and responsibilities of the moderator and rotating this role among participants, everyone has a chance to lead and facilitate the meeting. This distributes the workload and promotes a sense of ownership and accountability among the participants [S23].

Implementing these practices can contribute to more effective and engaging remote meetings, where participants feel valued, included, and actively contribute to the meeting's objectives. Remote meetings can achieve better outcomes and enhance team collaboration and productivity by fostering a collaborative and inclusive environment.

Social Aspects: As we already mentioned as a negative consequence of remote meetings, remote work raises concerns about potential reductions in social interaction and the sense of community prevalent in traditional in-person work environments. To counter these concerns, two practices were identified: limiting complex tasks to co-located teams [S8] and promoting physical socialization meetings for remote workers in hybrid models [S13]. Assigning complex tasks to co-located teams —or at least teams that are in the same time zone or within a narrow band of time zones— capitalizes on face-to-face collaboration, facilitating seamless coordination. Further, socialization meetings that are in person allow remote workers to foster social connections and strengthen team cohesion. These practices can potentially optimize team dynamics, productivity, and employee satisfaction.

When in-person events are not possible, it is still important to address team socialization. Two practices were identified: scheduling informal events [S19] and striking a balance between work meetings and social events for onboarding and maintaining connections [S18]. Informal events promote camaraderie and bonding among team members, contributing to enhanced team performance. Balancing work and social events is particularly beneficial for onboarding new members and nurturing ongoing connections. Social activities such as virtual team lunches and happy hours facilitate relationship-building and foster a supportive team environment, ultimately strengthening team dynamics, engagement, and performance.

4.5. RQ4: What is the role of tools in supporting and facilitating remote meetings?

Within the 30 papers, 66% (20 papers) mentioned tools. Remarkably, ten papers did not mention any specific tools related to meetings which seems surprising given the necessity of tools to facilitate remote meetings.

The rationale behind selecting specific tools was generally not described except for the studies that investigated experimental tools. The paper [S27] was an exception, which explained the decision to utilize Google Slides for remote design thinking sessions based on participants' familiarity with presentation software, real-time collaborative editing capabilities, and helpful features like graphical tools for drawing tasks.

Within the final papers, we observed that tools were used to:

- Mediate the remote meeting, i.e., video conferencing.
- Present pertinent information.
- Capture information, e.g., sketches.
- Improve meeting effectiveness or inclusiveness

Overall, the use of commercial and experimental tools highlights the diverse approaches employed to support meetings in remote software development teams.

4.5.1. Mediate the remote meeting

Given the evident reliance on communication tools to facilitate collaboration among remote teams [63], it is unsurprising that most of the papers referenced video conferencing tools for mediating remote meetings. Two papers referred to conference systems without specifying the particular video conference system employed. Table 6 summarizes the video conferencing tools mentioned in the papers.

Two papers discussed the potential use of VR. A paper from 2000 [S15], discussed an attempt to use VR to facilitate a design meeting but found the technology was unstable so had to test a simpler, non work-related activity. A second, more recent paper [S27] presented an industry case study that employed a customized Virtual Reality application and VR headsets to facilitate collaboration among meeting participants within a virtual environment resembling a work site. This immersive environment enhanced participants' sense of collaboration within the simulated work site.

In addition to discussing VR, [S15] considered the use of a commercial tool available at the time of the study (GroupSystems OnLine) for facilitating synchronous meetings. It noted helpful features such as showing the name, photo and number of contributions made by each participant. This latter feature allowed the facilitator to decide when to finish the meeting based on reduced number of contributions. It also considered how the same tool could be used to support asynchronous meetings which it defined as an ongoing meeting (initiated via an initial kick off meeting) to complete a specified task.

In the context of meetings within open-source software projects, three papers ([S24], [S25], [S30]) utilized Internet Relay Chat (IRC), a chat-based tool, for real-time meetings and general project communication. This contrasts with the papers concerning industry settings where chat tools were not mentioned as being the mediation tool in meetings.

Meeting organizers can spend much time organizing remote meetings not only by creating the calendar entry with the details of the meeting dial-in details but also gathering information such as previous meeting minutes and setting up tools to capture the outflow of the meeting. One proposal [S14] is to use a Domain Specific Language (DSL) to automate much of this work. A small example was used to illustrate the premise, but this work does not appear to have made it out of the laboratory.

4.5.2. Present pertinent information

A couple of papers discussed tools to present information to participants. [S26] discussed the use of Confluence to share information within the meeting. Such information is typically prepared beforehand and sometimes even serves as the agenda of the meeting, e.g., as a set of issues that are documented in Confluence and now have to be talked about. Tools also supported cases where some information was prepared but then modified throughout the meeting. Specifically, [S1] noted that the use of digital whiteboards such as Miro and Mural had replaced the use of physical whiteboards, which allowed content to be prepared beforehand and easily shared and updated as a result of the discussion. Sometimes, a skeleton design was prepared, or an agenda was captured on the whiteboard, then

Tool	Papers
Video Conferencing	
Microsoft Teams	[S2], [S4], [S11], [S12], [S16], [S18], [S22], [S23]
Google Meet	[S2]
Skype	[S8]
Zoom	[S27]
WebEx	[S26]
Unspecified	[S5], [S29]
Custom VR platform	[S15], [S27]
GroupSystems OnLine	[S15]
Custom meeting organizational tool	[S14]
Chat	
Internet Relay Chat (IRC)	[S24], [S25], [S30]
Information Presentation and Capture	
Confluence	[S2], [S11], [S26]
Jira	[S26]
Google Slides	[S27]
Miro	[S1], [S11]
Mural	[S1], [S11]
ConceptBoard	[S11]
Customized OctoUML Whiteboard	[S8]
Novel Retrospective Tool	[S9]

Table 6. Tools to Support Meetings

led to discussion and additional content being created. Use of these digital whiteboards was observed to have the additional benefit that all participants can see the digital notes, even after the meeting since the notes automatically persist. Arguably, this leads to a sense of inclusiveness and equality as everyone has access to the same information.

4.5.3. Capture information

While some meetings are mostly presentational to share information with colleagues (as per Section 4.5.2), other meetings are more interactive and require data to be captured. For example, brainstorming generates ideas for later discussion or designers sketching a candidate architecture to be referred to later. Some of the papers discussed the use of tools to capture information pertinent to the meeting. A variety of tools were used in this regard dependent on the need of the meeting, as shown in Table 6.

Meetings often result in the identification of tasks or actions (outflow); [S26] noted the use of Jira to capture the resulting outflow of the meetings under study.

Many commercial tools support concurrent editing by multiple people. This capability within Google Slides was leveraged in [S27] to gather small groups within breakout rooms to contribute to slides, that were then shared out to the broader group for further refinement of the collectively brainstormed ideas. The paper implied the slides were setup in advance with the tasks to complete thus leading to a more effective meeting.

Developers are well known for sketching at a whiteboard [64]. One study [S8] examined the use of physical smartboards running a customized version of OctoUML (an open-source UML diagramming tool) alongside Skype (a video conference tool) to determine whether remote pairs (each person in a different location) solved a design problem as effectively as co-located pairs. The paper concluded the remote pair did less design thinking than the co-located pair. One recommendation was to enhance the video-conference software to focus more on faces and gestures so participants could better understand the body-language of remote colleagues. This observation aligns with some of the technology problems noted in Section 4.3.

Retrospectives are a meeting common to agile teams. [S9] tested the use of a novel tool to facilitate root cause analysis within a retrospective. The tool enabled each participant to enter data concurrently. Google video conferenc-

ing software was used in the meeting so participants could see and hear one another.

4.5.4. Improve meeting effectiveness or inclusiveness

The video conference tool used to mediate remote meetings generates a lot of data about the meeting itself. Video, audio, and textual content (from chats) can all be analyzed automatically using machine learning algorithms to detect, amongst other aspects, who is speaking, how long they speak, emotions (from text, audio, or facial expressions). Such data can be used to provide feedback to the meeting participants in order to improve their individual contributions to meetings. Such an approach was taken in [S22] where a prototype dashboard was designed to provide post-meeting feedback to participants. The data driving the dashboard came from the video, audio, and text contributions of the meeting participants. Design recommendations included providing actionable insights into the meetings and to incorporate multi-modal (video, audio, text) signals to draw conclusions.

Turn-taking is considered helpful to providing an opportunity for all participants to speak [15]. To potentially provide future support for turn-taking to meeting participants, [S12] examined audio data to automatically identify overlapping talk in meetings. While this was very much a prototype, it showed potential in supporting turn-taking leading to more inclusive meetings.

5. Discussion

In this section, we discuss the synergies and novel findings uncovered in this systematic literature review. Additionally, by juxtaposing the final set of papers with other research in software engineering (e.g., AI, accessibility), we identify fruitful areas for future research in remote meetings in software teams.

Overarchingly, our study identified merely 30 papers related to remote meetings and software teams. Within this number, only 13 had meetings as the primary topic of the paper. The remainder of the papers discussed aspects of collaboration more generally, including meetings. Given the known difficulties of communicating over distance [65] and the prevalence of meetings in developers' workdays [66] to help with coordination and collaboration, it seems surprising so few studies have examined meetings in remote software teams. The low number of papers identified in this study aligns with the low number of papers on hybrid meetings (twelve papers) identified by Neumayr et al. [50] when surveying papers related to hybrid collaboration and meetings in the ACM Digital Library. Together, these results show that meetings have not been widely studied in hybrid or remote settings.

5.1. Benefits

Our review identified seven categories of benefits to meeting remotely as noted in Table 4. These are: more effective, reduced time spent in meetings, easier to attend, easier to multitask, egalitarian information diffusion, support for parallel chat, and improved ideation in VR environments.

One notable benefit is that remote meetings are considered more effective ([S1], [S16], [S20], [S28]) than other forms of meeting modes, such as in-person. Reasons for why remote meetings are considered effective include being more goal-oriented [S16], improved meeting discipline such as note-taking and paying attention to producing and sharing meeting minutes [S1], and being more efficient in running the meetings by focusing on the agenda and curbing distractions [S20]. These reasons align with those recommended from meeting science to improve meeting effectiveness [48]. However, the selected studies do not discuss the underlying causes for why remote meetings are perceived to be more effective. It may be that working remotely results in more respect for participants' time due to a desire to minimize Zoom fatigue [61], with organizers more likely to follow recommended meeting good practices, including having an agenda, setting an objective, starting and finishing on time, etc. [48], as well as considering the necessity of having a meeting and the key participants to invite if it is deemed actually necessary. Further research is required to investigate this benefit, especially in comparison to in-person meetings.

We also noted that less time is spent in remote meetings than other forms of meeting modes such as in-person ([S1], [S11], [S19], [S28]) and this is perceived as a benefit. This finding aligns with other research in both software teams [40] and other domains [41]. However, there is a risk that reduced meetings can cause issues in the team's effectiveness as previous research has shown that effective meetings can help a team's productivity and overall organizational success [47]; ideally, fewer meetings means that non-effective meetings are eliminated, but it is possible that meetings that would have led to important progress were not held. Alternatives to meetings, such as using chat tools (e.g.,

Slack, Google Chat) to facilitate asynchronous work [67] may mitigate the risks caused by reduced time spent in meetings. Further work is required to investigate whether a reduction in time spent in meetings causes issues to the team's productivity.

Using technology to facilitate the meeting makes it easier for participants to attend as travel is not required ([S17], [S27]). They can join from wherever; they do not need to be in the office. The commonly used tools to mediate remote video conferences (e.g., MS Teams, Zoom) support parallel chat, which makes it easier for participants to exchange information without disturbing the speaker [S23]. Moreover, joining remotely allows participants to more easily multitask ([S4],[S20]). Although it was not explicitly mentioned in the identified papers, this ability to join from wherever with no limitations on attendance numbers (unlike in offices where room availability and sizing issues can be problematic) allows people to attend even if they are not critical attendees, which can promote group cohesion [68]. Moreover, the ability to multi-task unseen means participants can listen in and gain valuable knowledge while doing other work.

A further benefit is more egalitarian information diffusion as everyone joins remotely [S11]. This could lead to a reduction in the impact of in-group/out-group effects as previous research on distributed teams has noted that remote workers feel at a disadvantage in comparison to their co-located colleagues [69]. Remote meetings can alleviate in-group effects as everyone attends the meeting remotely, and no room-based conversations occur before or after the meeting. However, the possibility for in-group/out-group effects is still present in remote teams due to the prevalence of communication tools, since team members may use chat tools (either work or personal) to communicate privately with one another or with subsets of colleagues.

Finally, improved ideation appears to be a potential benefit of hosting meetings in VR [S27]. As this was the only recent paper we identified that discussed VR and remote meetings, there may be other benefits (and drawbacks) [70]. Investigating the use of VR environments further may be especially relevant to software teams given the collaborative ideation, problem-solving and solution-finding common to many software tasks such as requirement engineering, architecture solution design, or resolving production issues. Perhaps a VR environment is a more effective medium for such creative work than traditional video-conferencing, although it remains to be seen how software specific content such as use cases or UML diagrams can be easily manipulated in VR.

5.2. Problems

Our review identified six categories of problems reported in the included studies (Table 5). These categories are technology's role, excessive meetings, collaboration effectiveness, reduced team socialization, unclear team social norms, and personal impact. Interestingly, two of these categories (excessive meetings, collaboration effectiveness) are in direct contradiction to perceived benefits (reduced time in meetings, more effective). We come back to these contradictions below.

Given the dependence on technology to facilitate remote work, it is perhaps unsurprising that we identified technology problems within our study. Examples of problems included video conference voice quality degradation due to bandwidth problems [S29] and network connectivity issues [S7]. While companies have strived to reduce this problem for their remote workers by supplying headsets or paying for faster internet connections [S18], it is clear technology problems remain and hinder the effectiveness of remote meetings [6] and remote work more broadly [38].

While earlier we noted one benefit of remote meetings is reduced time spent in meetings, we see contradictory evidence that this benefit is not universal, with some studies reporting too many meetings (e.g., [S10], [S20]) or that scrum meetings are taking too long ([S20]). Excessive or long meetings may occur because it is harder to establish common ground [S10] when working remotely. This contradiction is perhaps due to poor meeting design as it is known poor meeting design can cause frustrations for participants attending in-person meetings [23]. It seems that some organizations are better than others regarding meeting design specifically with the number and length of meetings. Whether this is purposeful or just by luck is unclear, as the papers did not explicitly focus on meeting design. It does mean, through, that organizations need to pay attention to meeting design and practices as these can signifcantly impact effectiveness and efficiency. We return to this in Section 5.7.

Distance (geographical, temporal, socio-cultural) has long been recognized as causing challenges in distributed software teams [71], so it is unsurprising to see some of the studies note problems with collaboration effectiveness in remote meetings. These problems can be caused for reasons such as cameras being turned off or cameras only showing a distant face or partial upper body. Hence, meeting participants are unable to interpret body language [S21], people

talking over one another [S13], or distractions caused by multitasking in the meeting [S19]. Technology is known to exacerbate these distances as it is harder to read body language and gauge engagement or sentiment when collaborating via video conference rather than sitting close to colleagues [72, 73]. This observation is in contradiction with the one perceived benefit that remote meetings are more effective. This again perhaps shows that some organizations are better at running meetings than others, thus overcoming the collaboration effectiveness challenges – perhaps due to implementing the identified good practices.

Remote work has a negative personal impact on individuals, such as fatigue [S7] and tiredness caused by multitasking [S4]. The reduction in opportunities for team socialization ([S1], [S19]) can also have a negative personal impact. These problems align with existing literature. Zoom fatigue [74] is familiar to many remote workers and can contribute to the technology and personal impact problems we identified. Likewise, reduced socialization in remote teams has been observed [75] along with poor mental well-being during the recent pandemic [76], both of which can contribute to the personal impact of remote work.

A final major problem identified in our review relates to unclear team social norms, specifically mismatching expectations concerning meeting etiquette. Some studies noted that multitasking could be considered disrespectful [S4]. Others found it is a pervasive practice, though with differing views on the appropriate use of parallel chat in meetings [S23]. Still, positive uses were observed, for instance when participants looked up some information relevant to the ongoing discussion or had a quick parallel chat with a colleague to verify an assumption in a design session. At the same time, the technology also allows participants to engage in unrelated parallel chats with colleagues and exit the meeting more easily. Teams must agree on social norms to reduce the potential conflict caused by mismatching expectations in remote meeting etiquette.

5.3. Good practices

Given the prevalence of and importance of meetings to software teams, it is unsurprising that 11 of the identified papers discussed good practices used to improve the effectiveness of remote meetings. We categorized these good practices as those related to the meeting process itself and those aiming to improve the technological, cultural, and social aspects of the meeting. Figures 4 and 5 summarize the good practices.

In terms of the meeting process, it is not unreasonable to assume that many of the good practices we identified in some studies would help in overcoming certain problems that were identified in other papers. For example:

- Inserting breaks [S4] and reducing unnecessary meetings [S13] will help with reducing the personal impact of meetings ([S4], [S7]).
- Setting up daily meetings with new hires [S21] and inserting catch-up time at the start of the meeting [S19] will help reduce the isolation remote workers can feel and support socialization between team members ([S1], [S19]).
- Meeting effectiveness can be improved through improved meeting design and facilitation. Preparing and communicating clear agenda and goals in advance of the meeting [S22], pre-recording demos [S7], timeboxing meetings [S7], identifying the objectives [S19], and sending out post meeting summaries [S23] all help improve meeting effectiveness ([S1], [S2], [S3], [S10], [S19], [S20], [S29]).
- Having thematic meetings [S13] or meetings focused on a specific topic (e.g., impediments [S13]) can also help with meeting effectiveness as the objectives of the meeting are clear ([S1], [S2], [S3], [S10], [S19], [S20], [S29]).

The identified good practices mentioned above align with many of those identified in the meeting science literature (e.g., [49], [54], [15]). Many of these practices are good practices for both co-located meetings and also remote meetings. For example, ensuring the meeting agenda is sent out in advance or undertaking pre-meeting activities such as soliciting input prior to the meeting are helpful in preparing for an efficient meeting. Other good practices identified across the papers we reviewed are more applicable to remote meetings as they combat some of the problems associated with remote work. For example, it is important to build in opportunities for a social chat either through allowing time at the start of the meeting or designing the work week to incorporate fun social activities such as virtual happy hours [77] in order to ameliorate remote workers who may feel isolated with less opportunity for socialization [75] and, as some have observed, aid meeting effectiveness with small talk [78].

Technology facilitates remote work and can both benefit the collaboration within meetings or hinder it. One good practice is to ensure meetings are accessible and inclusive so all participants can contribute. The tools themselves can support this partially by automatically generating transcripts which may be beneficial to those who are deaf or hard of hearing. Accessibility can also be supported by the meeting participants during the meeting by ensuring there are text descriptions provided for visual content [S23], leave time for participants with disabilities to respond [S23], and making use of chat and monitor chat for asynchronous questions [S23] since some people are more comfortable raising questions via chat than voice [79]. Recording the meeting benefits participants who require additional response time or have scheduling conflicts, allowing them to engage with the meeting content at their convenience. The presence of technology also increases the richness of data available for use post the meeting. Meeting minutes can, and should, incorporate highlights from the parallel chat and the results of verbal discussions [S23].

Cultural norms and values influence individuals' and teams' interaction, decision-making, and work approaches [80]. One way to encourage the discussion about differences in behaviors due to culture is to agree on meeting norms as part of the broader norms common to many software teams [81]. Among the meeting norms identified as good practices in our review are discouraging off-topic chat and setting expectations for use of chat [S23], encouraging active contributions from all participants [S4], and setting expectations for the moderator role [S23]. Agreeing on such meeting norms directly addresses the problem we identified of unclear team social norms.

Remote work raises concerns about potential reductions in social interaction and the sense of community prevalent in traditional in-person work environments. Recognizing the significance of socialization in remote work settings and identifying alternative strategies to promote social connections are vital for maintaining team cohesion and employee well-being [82]. Indeed, reduced team socialization was highlighted as a problem earlier in this review which can be mitigated by scheduling informal remote events to foster team culture [S19]. Interestingly, although our study focused on remote teams, some of the papers noted the importance of holding in-person socialization events where possible [S13]. This aligns with previous research that has discussed the role of periodic face-to-face meetings in building trust and rapport in distributed teams [83]. Getting the team together periodically could also be beneficial for more complex tasks requiring short-periods of intense focus such as quarterly release planning meetings.

While the identified good practices help to overcome many of the problems we noted with remote meetings, they do not completely overcome some of the collaboration effectiveness problems noted, such as difficulty in reading body language over video conferencing, overlapping speech, and interruptions. The latter two problems can be helped through effective in-meeting facilitation [15], including explicit turn-taking or automatic detection of speech overlaps with tools [S12]. The former problem is a known issue with video conferencing and while there have been steps to overcome this through automated sentiment analysis of participants [S22] or automatically detecting when someone is distracted [84], the inability to read body language over video conference appears to remain a problem for remote meetings.

5.4. Tools

In considering the question of the role of tools in remote meetings, we note that the final set of papers discussed tool use in four ways: mediating the meeting, presenting pertinent information, capturing meeting information, and improving meeting effectiveness or inclusion.

We note that only 20 of the 30 selected papers discussed tools. The majority of the papers that contained references to tools mentioned the tool used to mediate the meeting (e.g., a video conference tool) mostly in passing. Only a few papers focused specifically on tool usage in remote meetings. [S8] considered remote designing via a smartboard, [S9] examined a novel tool to support retrospectives, [S15] explored tools to aid facilitation, while [S22] and [S12] used audio, video, and text data generated from meetings to identify potential ways to improve the effectiveness and inclusiveness of meetings. It is surprising that so few papers focus on tool usage given that remote software teams are highly dependent on tools for communication and co-ordination.

In terms of software tools used for mediation, the papers listed a diverse set of commercial tools (Table 6). This diversity aligns with previous research examining the tool preferences of remote teams [85]. One potential improvement to the video-conferencing software used to mediate the meeting was recommended by [S8] for better support for understanding gestures and body language, leading to improved communication between participants. This issue and suggestion aligns with research examining attention levels in video conferences [86].

Only two studies ([S1], [S26]) discussed the presentation of information to meeting participants. This low number could perhaps reflect the fact screen-sharing features within video conferencing software used to mediate a meeting

is a standard feature and so not particularly noteworthy when discussing meetings. At the same time, precisely how a team might use Jira remotely to triage bugs together or how it may interact around the dashboards of its continuous integration/continuous deployment tools to help it diagnose a problem may well have implications for interfaces of those tools that are more specialized to meeting, and especially remote meeting, settings.

Meetings may require the capture and sharing of information from participants for immediate discussion or as input into a task. Many of the commercial document editor tools widely adopted by organizations support concurrent editing, and this ability benefited the design meetings in [S27]. Concurrent editing gives meeting organizers a choice for one person to be the scribe and screen-share as needed (while others may also view the content on their own screens) or for all participants to access the tool independently and make their changes. Such a choice likely depends on the collaborative task (e.g., explicit brainstorming of potential new features versus working on refining a specific requirement), but the meeting literature is silent on the relationship between context and chosen approach thus far.

We note there is some evidence that tools used in the pre-planning stage of a meeting can aid in the effectiveness of the meeting, for example, by setting templates or tasks for participants to complete [S27] ahead of the meeting. This use of tools could be considered a good practice for remote meetings. There may be other uses of tools that can be used in the pre-planning stages of meetings to aid the meeting. Further research is required.

It is also noteworthy that the use of collaborative tools such as digital whiteboards can aid with inclusiveness as everyone is able to see the same information and contribute [S1] (except, as noted earlier, participants with visual impairments, for whom it is important that additional effort is put into fully incorporating them into the meeting and discussions). This is not the case if a traditional physical whiteboard is used in a meeting room and only the participants in that room can easily see the content and contribute to the content.

Microsoft researchers authored five of the studies identified in our study. Although the specific topic of each paper was different, the studies appear aligned in that they consider ways in which the Microsoft Teams software could support more effective meetings. Two of the papers examined individuals' meeting behavior, such as multitasking [S4] and use of parallel chat [S23], to identify design recommendations for how tools could better support these behaviors and also to identify ways in which meeting design and the running of the meeting could incorporate such behaviors positively. Two papers used data (audio, written, video) generated within the meeting itself to automatically examine participants' behavior, including overlapping talk [S12] or the level of engagement and sentiment shown by participants [S22]. Understanding the actual behavior could enable the tools to provide behavioral feedback to participants via a dashboard [S22] to help improve behaviors and thus meet effectiveness. Similarly, [S5] developed a prototype to allow participants to provide post-meeting feedback on the effectiveness of the meeting. Other researchers have investigated similar themes, such as using additional tools to provide back-channel chat support to meetings [87] or automatically detecting the type of conversation taking place in the meeting [88]. Commercial tools for supporting meetings such as otter.ai[1] already make use of Artificial Intelligence (AI) to generate live transcripts and meeting summaries. Such meeting tools will likely to continue to evolve to provide beneficial feedback to users, resulting in more effective meetings.

5.5. Future work

Fully remote software teams are likely to continue for the foreseeable future even as some companies require teams to relocate back to the office (e.g., Apple [89]) for some or all of the time. Meetings are necessary and commonplace so many organizations and teams are keen to ensure meetings are as effective as possible. We, therefore, feel it is beneficial to continue to study remote teams to better understand how tools and processes can support effective meetings. Findings from studying remote teams will also help research into distributed teams more generally.

Based on our observations in this paper, there are a number of areas where we feel further research is beneficial. These areas are detailed below.

Specific types of meetings: There are many different types of meetings held by software teams for many different purposes, including the commonplace agile ceremonies as well as architecture and design meetings, requirement elicitation meetings, and more. Yet, we only identified eight papers where the paper studied a single type of meeting in a remote setting. It would be helpful to perform detailed studies on different types of remote meetings to better

[1] https://otter.ai/

understand participants' behaviors, processes that take place, and the role of tools in facilitating the meeting conversation. For example, by studying a single type of meeting, [S26] noted that novel tooling could help better support the meeting. This recommendation is aligned with Mroz [48], who calls for studies of meeting recordings to better understand behaviors.

Tool support for remote meetings: We observed that, while some papers listed the tools used in a meeting, there were few papers that discussed the role of a specific tool and how it supported the meeting. As an example of the latter, [S9] focused on how a novel tool could support root-cause analysis. We believe there is value in better understanding not only how novel tools can support meetings but also how widely adopted video-conferencing tools or artifact management tools (such as digital whiteboards) are used in a commercial environment. This detailed understanding can help in making more effective use of the existing tools or creating new tools with a narrow feature set. Such new tools may want to consider supporting specific types of meetings (e.g., project kickoff meetings) or activities within meetings (e.g., decision making).

The role of AI: Some of the papers identified in this study made use of machine learning to determine who was speaking ([S4, S22]) or sentiment analysis [S22] to determine the sentiment of a meeting participant. This usage was towards the goal of improving the quality of the meeting by providing feedback during or after the meeting. ML or AI techniques could be explored further to improve the overall meeting experience. For example, AI could identify when a discussion is meandering or heading off-topic and prompt the participants to adjust the direction of the discussion. It might also be possible to make use of the latest generation of Large Language Models (LLMs) and their chat-based interface (e.g., ChatGPT, Google Gemini) to auto-summarize the key outputs of the meeting. Alongside the technical work, the ethical use of AI and privacy concerns of meeting participants will need to be considered [S22].

Meetings within Virtual Reality: Many companies are developing workplace products that leverage Virtual Reality (VR) to bring colleagues together. For example, both Meta Horizon Workrooms [90] and Microsoft Mesh [91] are specifically designed for workplace use. This is in addition to other more generalized Virtual Reality platforms such as Mozilla Hubs [92] or commercial technologies that can aid the development of VR applications (e.g., Unity [93]). Yet, this study only found two papers that explicitly discussed meetings involving remote teams and VR. As VR becomes more widely adopted by teams in industry, it would be helpful to better understand the benefits (and downsides) of hosting meetings involving remote teams in a VR environment. Some research has examined the use of VR for meetings in open-plan offices [94]. Such research could be extended to better understand the experiences of remote teams meeting in VR.

Accessibility: Our research identified three papers ([S7], [S8], [S23]) that discussed the accessibility of remote meetings for software teams. The concept of accessibility in this context refers to using technology and specific meeting practices to make the meetings more inclusive for disabled participants. However, we note that accessibility of remote meetings was not the primary focus of these papers. There is an opportunity to fully examine the accessibility needs of all participants further to better understand how tooling and practices can help provide an inclusive environment. Such research could contribute to the wider body of knowledge on accessibility of collaborative tools. [95], for instance, examines the accessibility of collaborative writing tools and [96] discusses the telework experiences of people with disabilities.

Evolving hybrid meetings: Many companies are promoting hybrid work, resulting in different configurations of hybrid working [97]. It is unclear how meeting practices will evolve to ensure that some of the identified benefits identified for remote meetings will be maintained. For example, we identified egalitarian information diffusion as a positive of remote meetings yet existing research has recognized the negative effects of in-group/out-group behaviors [69] that occur in hybrid meetings. Additionally, accepted social norms for remote meetings (e.g., leaving meetings early) may not be acceptable in hybrid settings. It also appears that digital collaborative tools (rather than physical whiteboards) should be used for hybrid meetings so remote participants can contribute just as easily as the co-located participants. Finally, it may be that some types of meetings are more effective when the participants are co-located whereas others can be just as effective when participants are remote (e.g., retrospectives [98]). Further study is required to determine how the good practices identified in this paper can persist in different hybrid working models and also whether some types of meetings and tasks are better performed in a co-located setting.

5.6. Implications for practitioners

With remote work here to stay, we recommend that remote teams use the identified set of good practices as a helpful set of practices they can draw upon to improve the effectiveness of their meetings. One way to do so is to

identify challenges particular to their meetings and review the good practices described in Section 4.4 to see if one or more of them could overcome them. Section 5.3 contains some examples where we noted challenges and practices – these can act as a starting point for teams. Adopting practices based on a team's specific needs is more likely to succeed than recommending that every team adopt all the practices identified in the paper. Teams work in varying contexts (e.g., organizational culture, industry, existing work practices), so some practices may not be applicable or practical. Only teams will know what is likely to be helpful in their context.

5.7. Overall takeaways

In reviewing the discussion points earlier in this section, there are a few notable overarching observations to make about remote meetings and software teams.

Firstly, there has been little research directly on remote meetings in the context of software teams. Our review identified 30 papers of which only 13 had meetings as their primary topic. This seems a surprisingly low number of studies given the prevalence and importance of meetings to software teams. Specific meetings have been studied much more extensively (e.g., agile meetings [29, 99], software design meetings at the whiteboard [100, 101]), but the majority of these studies concern co-located meetings, rather than remote meetings. We advocate that the remote equivalents receive similar scrutiny by the research community.

Despite the relatively low number of papers, the included set of studies contain sufficient information to identify a broad range of benefits of, problems with, and good practices of meetings involving remote software teams. Some of the findings are somewhat contradictory, especially with regards to meeting effectiveness. There is some evidence that a benefit of remote meetings is improved effectiveness, while there is also evidence that a problem with remote meetings is they are ineffective due to poor collaboration. The cause of this discrepancy could be due to some teams adopting meeting good practices such as those applicable irrespective of meeting mode (e.g., goal focused, use of an agenda, timely meeting minutes) as well as those more helpful for remote meetings (e.g., using technology to support inclusivity, more frequent breaks, inserting catch-up time at the start of the meeting). It appears there is more work to be done to raise awareness of good meeting practices in remote software teams to ensure meeting effectiveness can be improved.

Many of the good practices identified in this study align with those in the meeting science literature and are known to help alleviate the majority of the identified problems, though applying them will likely not completely eliminate them. One problem that appears to have received little attention was collaboration effectiveness being hindered by inability to read body language. Although a known problem in the HCI and CSCW literature, with prototype solutions to address it (e.g., [102], [103]), such solutions have not made it into practice yet. Nonetheless, our study identified a number of tool oriented papers that are looking to address this through the automated use of meeting data (audio, written, video) to determine ways in which video conferencing software could improve meeting effectiveness. More of this research is necessary to overcome this fundamental limitation of remoteness.

Arguably many of the identified good practices are applicable to remote information workers more generally. This perhaps reflects the lack of studies identified that focus on software engineering specific meetings unique to software teams. Such specific meetings include architecture and software design, bug triage, sprint planning, feature identification, outage reviews, and more. Many of these meetings are highly technical, collaborative, and require access to much data, knowledge, and expertise to be effective. Studying these type of meetings unique to software teams may identify additional good practices more specific to software teams as well as novel tools or tool enhancements, as exemplified by the recent study on hybrid daily scrum meetings [104] and a recent study on software maintenance meetings [S26].

6. Limitations and Threats to Validity

This section contains limitations of the research and threats to the validity of our findings.

6.1. Limitations

One limitation with our results is that, as outlined by Neumayr [50], the terms used to describe different team structures such as hybrid, distributed, remote, and so on are used inconsistently by different researchers. This leads to inconsistent keywords and terminology used inside abstracts. This inconsistency could lead to omissions in the

search results within the three databases we targeted. For example, [105] is about remote review meetings yet it did not appear in our initial search results as the keywords or abstract do not refer to remote software teams. We have tried to minimize this issue by undertaking snowballing of the initial set of selected papers.

In this paper, we identified a set of good practices for improving meeting effectiveness. A major limitation of any set of good practices is that they are heavily dependent on culture and organizational context. What may work for one organization may not work for another. Additionally, teams need to consider the needs and preferences of individuals as, for example, not everyone is comfortable with always-on cameras [96, 106] and so this good practice may not be helpful. Teams should be prepared to experiment and adapt good practices when using them in their own organization.

This SLR focuses on remote software teams. It is likely that the outlined results are relevant also to hybrid teams (e.g. where some of the team is co-located and one or more participants are remote). However, there will likely be additional papers relevant for hybrid teams which are not included in this SLR. The results may also be relevant to teams of remote information workers more generally as our findings match those reported in other studies such as those from meeting science and information work.

6.2. Threats to Validity

Following the guidance in Zhou [107], we have identified a number of threats to validity which we document here.

Construct Validity: This type of validity refers to whether the correct operational measures have been identified for the concept under study. As this study is a systematic literature review, we have followed guidance [12, 57] in how best to undertake a SLR within software engineering. In particular, as detailed in Section 3, we defined a research protocol with a set of keywords to search for, and decided to use three well known research databases (ACM DL, IEEE xPlore, Scopus) supplemented with snowballing to help identify relevant papers. This research protocol was reviewed, discussed, and agreed upon amongst the first three researchers. Moreover, an initial pilot of the search queries used in the three databases was also executed by one of the researchers to ensure it returned papers identified as relevant to the study.

Internal Validity: This refers to the confidence in the research results and that there is a causal relationship from the papers identified to the results. We have tried to ensure that the selected studies are a valid sample of all the related literature through following a rigorous systematic literature review process as described in Section 3. Moreover, the involvement of two researchers in the analysis, data quality review, and classification of the selected studies should minimize bias and potential subjectivity issues. As described in Section 3, we did have difficulties ascertaining whether a paper referred to a remote team or not as the team construct was not always explicitly stated in a paper. This could cause issues in the incorrect inclusion or exclusion of a paper. In cases where it was unclear, we discussed the specific paper amongst the two researchers. One caveat for the tools shown in Table 6 is that the data should not be used to determine the popularity of a tool based on the number of papers that reference a particular tool. The set of papers included in the scope of this study is insufficient to make such inferences and is not the purpose of this study.

External Validity: This refers to the applicability of the results to the domain under study. In this case the domain is remote software teams and the exact phenomenon being researched is meetings. We tried to minimize this threat by only considering research for which the papers returned by the databases (ACM DL, IEEE xPlore, Scopus) and search engines (Google Scholar for snowballing) were accessible. As we excluded papers published before 2000, there is a risk we are missing papers related to our research topic. However, we believe this risk is minimal given some of the earliest research related to distributed teams, such as the classic Distance Matters paper by Olson and Olson [65] was published in 2000.

Conclusion Validity: This threat refers to the repeatability of our results. We expect that the detailed research method described in Section 3 would aid other researchers in reproducing our results notwithstanding the risk that search results executed on different dates may result in different results. There is a risk that individual researcher subjectivity could be introduced in classifying the topics of the paper. We have tried to minimize this by two researchers independently classifying the papers. Finally, we have removed any ambiguity by what a Remote Team is by defining it in Section 1.1. We also note that we solely searched inside databases indexing research literature and did not consider grey literature aimed towards practitioners, such as books (e.g., [43, 108], blog posts (e.g., [109]), videos (e.g., [110]), or white papers (e.g., [53]). There is a risk that non peer-reviewed findings described by practitioners may differ from the results described here. Future research could extend this SLR by undertaking a Multivocal Literature Review to include grey literature alongside published (peer reviewed) literature as outlined by [111].

7. Conclusion

Remote software teams are a common way of working for many organizations. Like other forms of dispersed working, remote teams are reliant on meetings to help communicate and collaborate. Yet little is known about meetings in this remote context. In this first systematic literature review on remote meetings in software teams, several benefits, challenges, and good practices are revealed. Some of these findings align with previous research on meetings generally while others are specific to remote settings. We found that the number of studies explicitly focusing on meetings in remote teams probably should be higher, indicating a gap in the literature. Moreover, further study is required on meetings unique to software teams (e.g., technical discussions, architectural solution design, requirement elicitation).

As technology advances, meeting tools are expected to evolve, incorporating machine learning and artificial intelligence (AI) techniques to provide valuable feedback and improve meeting effectiveness. While video conference tools are critical for remote meetings, more research must also be performed on other collaboration tools that are used by participants to support the activities in the meetings. Tools that help facilitate meetings, tools that create more effective records of meeting outcomes, and tools that help participants quickly find information that helps them conduct the meetings effectively could all be improved, particularly with an eye toward the unique aspects of software engineering activities, such as their often focusing on expanding existing systems or addressing problems with such systems.

Remote meetings are perceived to be more effective compared to in-person meetings, possibly due to increased respect for participants' time and adherence to good practices. Remote meetings also offer greater flexibility and convenience, allowing participants to join from anywhere and multitask. Zoom fatigue, reduced socialization, and distance's negative impact on collaboration persist. Mismatched meeting etiquette expectations was identified as a problem unique to remote meetings. Corroborating meeting science research, poor meeting design was also noted as a problem.

More broadly, good practices for remote meetings closely align with those commonly observed in in-person meetings. However, certain practices are specifically tailored to address the unique challenges of remote work, such as fostering opportunities for social interaction and establishing clear guidelines for technology usage during meetings. It is essential to acknowledge that the effectiveness of these practices can vary depending on the organizational culture and context in which they are implemented. We therefore recommend that practitioners review the good practices detailed in this paper and experiment with them to determine what works in their teams and organization.

For future work, we recommend further research in several areas. First, we suggest conducting detailed studies on the types of meetings specific to software teams to understand the processes and tooling required for effective remote meetings involving software teams. Second, studying the role of specific tools, both novel and commonly used, in supporting remote meetings is an important step towards designing new and improved tools. Third, we suggest investigating the potential of machine learning and artificial intelligence techniques to enhance the meeting experience. Fourth, exploring the benefits of using virtual reality (VR) for remote meetings, especially those requiring creativity, as VR technologies become more widely adopted. Fifth, it is important to consider the accessibility of remote meetings for software teams to ensure inclusivity. Finally, we advocate examining how meeting practices will evolve in hybrid work arrangements and identifying the types of meetings most effective in co-located versus remote settings.

In conclusion, this research provides valuable insights into remote meetings in software teams, highlighting the benefits, challenges, and good practices. It also identifies areas for future research to enhance the effectiveness of remote meetings and support the evolving needs of software teams in the changing work landscape. It thus contributes to the wider literature on meetings in general.

8. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

9. Acknowledgments

This material is based upon work supported by the National Science Foundation under grant CCF-2210812. Rafael Prikladnicki is partially funded by Fapergs and CNPq, Brazil.

Appendix A. Additional Information

The final set of studies included in this review is detailed in Table A.7

ID.	Study
[S1]	Ågren, P., Knoph, E., Berntsson Svensson, R., 2022. Agile software development one year into the COVID-19 pandemic. Empir Software Eng 27, 121. https://doi.org/10.1007/s10664-022-10176-9
[S2]	Bezerra, C.I.M., de Souza Filho, J.C., Coutinho, E.F., Gama, A., Ferreira, A.L., de Andrade, G.L., Feitosa, C.E., 2020. How Human and Organizational Factors Influence Software Teams Productivity in COVID-19 Pandemic: A Brazilian Survey, in: Proceedings of the 34th Brazilian Symposium on Software Engineering, SBES '20. Association for Computing Machinery, New York, NY, USA, pp. 606–615. https://doi.org/10.1145/3422392.3422417
[S3]	Butt, S.A., Misra, S., Anjum, M.W., Hassan, S.A., 2021. Agile Project Development Issues During COVID-19, in: Przybyłek, A., Miler, J., Poth, A., Riel, A. (Eds.), Lean and Agile Software Development, Lecture Notes in Business Information Processing. Springer International Publishing, Cham, pp. 59–70. https://doi.org/10.1007/978-3-030-67084-9 4
[S4]	H. Cao, C.-J. Lee, S. Iqbal, M. Czerwinski, P.N.Y. Wong, S. Rintel, B. Hecht, J. Teevan, L. Yang, Large Scale Analysis of Multitasking Behavior During Remote Meetings, in: Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems, ACM, Yokohama Japan, 2021: pp. 1–13. https://doi.org/10.1145/3411764.3445243
[S5]	Cutler, R., Hosseinkashi, Y., Pool, J., Filipi, S., Aichner, R., Tu, Y., Gehrke, J., 2021. Meeting Effectiveness and Inclusiveness in Remote Collaboration. Proc. ACM Hum.-Comput. Interact. 5, 173:1-173:29. https://doi.org/10.1145/3449247
[S6]	Dekel, U., 2005. Supporting distributed software design meetings: what can we learn from co-located meetings? SIGSOFT Softw. Eng. Notes 30, 1–7. https://doi.org/10.1145/1082983.1083109
[S7]	Griffin, L., 2021. Implementing Lean Principles in Scrum to Adapt to Remote Work in a Covid-19 Impacted Software Team, in: Przybyłek, A., Miler, J., Poth, A., Riel, A. (Eds.), Lean and Agile Software Development, Lecture Notes in Business Information Processing. Springer International Publishing, Cham, pp. 177–184. https://doi.org/10.1007/978-3-030-67084-9 11
[S8]	Jolak, R., Wortman, A., Liebel, G., Umuhoza, E., Chaudron, M.R.V., 2019. The Design Thinking Of Co-Located vs. Distributed Software Developers: Distance Strikes Again, in: 2019 ACM/IEEE 14th International Conference on Global Software Engineering (ICGSE). Presented at the 2019 ACM/IEEE 14th International Conference on Global Software Engineering (ICGSE), IEEE, Montreal, QC, Canada. https://doi.org/10.1145/3372787.3390438
[S9]	Lehtinen, T.O.A., Virtanen, R., Viljanen, J.O., M¨antyl¨a, M.V., Lassenius, C., 2014. A tool supporting root cause analysis for synchronous retrospectives in distributed software teams. Information and Software Technology 56, 408–437. https://doi.org/10.1016/j.infsof.2014.01.004
[S10]	Machado, L.S., Caldeira, C., Gattermann Perin, M., de Souza, C.R.B., 2021. Gendered Experiences of Software Engineers During the COVID-19 Crisis. IEEE Software 38, 38–44. https://doi.org/10.1109/MS.2020.3040135
[S11]	Marek, K.,Wi´nska, E., Dabrowski,W., 2021. The State of Agile Software Development Teams During the Covid-19 Pandemic, in: Przybyłek, A., Miler, J., Poth, A., Riel, A. (Eds.), Lean and Agile Software Development, Lecture Notes in Business Information Processing. Springer International Publishing, Cham, pp. 24–39. https://doi.org/10.1007/978-3-030-67084-9 2

ID.	Study
[S12]	Margariti, E., Rintel, S., Murphy, B., Sellen, A., 2022. Automated mapping of competitive and collaborative overlapping talk in video meetings., in: CHI Conference on Human Factors in Computing Systems Extended Abstracts. Presented at the CHI '22: CHI Conference on Human Factors in Computing Systems, ACM, New Orleans LA USA, pp. 1–8. https://doi.org/10.1145/3491101.3519612
[S13]	Matos, J., Franc¸a, C., 2022. Pandemic agility: towards a theory on adapting to working from home, in: Proceedings of the 15th International Conference on Cooperative and Human Aspects of Software Engineering. Presented at the ICSE '22: 44th International Conference on Software Engineering, ACM, Pittsburgh Pennsylvania, pp. 66–75. https://doi.org/10.1145/3528579.3529184
[S14]	Mayr-Dorn, C., Laaber, C., 2017. A Domain-Specific Language for Coordinating Collaboration, in: 2017 43rd Euromicro Conference on Software Engineering and Advanced Applications (SEAA). Presented at the 2017 43rd Euromicro Conference on Software Engineering and Advanced Applications (SEAA), pp. 57–60. https://doi.org/10.1109/SEAA.2017.33
[S15]	McQuaid, M.J., Briggs, R.O., Gillman, D., Hauck, R., Lin, C., Mittleman, D.D., Nunamaker, J.F., Ramsey, M., Romano, N., 2000. Tools for distributed facilitation, in: Proceedings of the 33rd Annual Hawaii International Conference on System Sciences. Presented at the Proceedings of the 33rd Annual Hawaii International Conference on System Sciences, p. 10 pp.-. https://doi.org/10.1109/HICSS.2000.926626
[S16]	Neumann, M., Bogdanov, Y., Lier, M., Baumann, L., 2021. The Sars-Cov-2 Pandemic and Agile Methodologies in Software Development: A Multiple Case Study in Germany, in: Przybyłek, A., Miler, J., Poth, A., Riel, A. (Eds.), Lean and Agile Software Development, Lecture Notes in Business Information Processing. Springer International Publishing, Cham, pp. 40–58. https://doi.org/10.1007/978-3-030-67084-9_3
[S17]	Neumann, M., Bogdanov, Y., Sager, S., 2022. The Covid 19 Pandemic and its Effects on Agile Software Development, in: 2022 The 5th International Conference on Software Engineering and Information Management (ICSIM), ICSIM 2022. Association for Computing Machinery, New York, NY, USA, pp. 51–60. https://doi.org/10.1145/3520084.3520093
[S18]	NicCanna, C., Razzak. M.A., Noll, J., Beecham, S., Globally Distributed Development during COVID- 19, in: 2021 IEEE/ACM 8th International Workshop on Software Engineering Research and Industrial Practice (SER&IP), 2021: pp. 18–25. https://doi.org/10.1109/SER-IP52554.2021.00010
[S19]	Nolan, A., White, R., Soomro, M., Dopamu, B.C., Yilmaz, M., Solan, D., Clarke, P., 2021. To Work from Home (WFH) or Not to Work from Home? Lessons Learned by Software Engineers During the COVID- 19 Pandemic, in: Yilmaz, M., Clarke, P., Messnarz, R., Reiner, M. (Eds.), Systems, Software and Services Process Improvement, Communications, in: Computer and Information Science. Springer International Publishing, Cham, pp. 14–33. https://doi.org/10.1007/978-3-030-85521-5_2
[S20]	Ozkan, N., Erdil, O., G¨ok, M.S¸ ., 2022. Agile Teams Working from Home During the Covid-19 Pandemic: A Literature Review on New Advantages and Challenges, in: Przybyłek, A., Jarzebowicz, A., Lukovi´c, I., Ng, Y.Y. (Eds.), Lean and Agile Software Development, Lecture Notes, in: Business Information Processing. Springer International Publishing, Cham, pp. 38–60. ttps://doi.org/10.1007/978-3-030-94238-03
[S21]	Rodeghero, P., Zimmermann, T., Houck, B., Ford, D., Please Turn Your Cameras on: Remote Onboarding of Software Developers During a Pandemic, in: 2021 IEEE/ACM 43rd International Conference on Software Engineering: Software Engineering in Practice (ICSE-SEIP), 2021: pp. 41–50. https://doi.org/10.1109/ICSE-SEIP52600.2021.00013
[S22]	Samrose, S., McDuff, D., Sim, R., Suh, J., Rowan, K., Hernandez, J., Rintel, S., Moynihan, K., Czerwinski, M., MeetingCoach: An Intelligent Dashboard for Supporting Effective & Inclusive Meetings, in: Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems, ACM, Yokohama Japan, 2021: pp. 1–13. https://doi.org/10.1145/3411764.3445615

ID.	Study
[S23]	Sarkar, A., Rintel, S., Borowiec, D., Bergmann, R., Gillett, S., Bragg, D., Baym, N., Sellen, A., 2021. The promise and peril of parallel chat in video meetings for work, in: Extended Abstracts of the 2021 CHI Conference on Human Factors, in: Computing Systems, CHI EA '21. Association for Computing Machinery, Yokohama, Japan, p. 8. https://doi.org/10.1145/3411763.3451793
[S24]	Shihab, E., Jiang, Z.M., Hassan, A.E., On the use of Internet Relay Chat (IRC) meetings by developers of the GNOME GTK+ project, in: 2009 6th IEEE International Working Conference on Mining Software Repositories, 2009: pp. 107–110. https://doi.org/10.1109/MSR.2009.5069488
[S25]	Shihab, E., Jiang, Z.M., Hassan, A.E., 2009. Studying the use of developer IRC meetings in open source projects, in: 2009 IEEE International Conference on Software Maintenance. Presented at the 2009 IEEE International Conference on Software Maintenance, pp. 147–156. https://doi.org/10.1109/ICSM.2009.5306333
[S26]	Soria, A.M., van der Hoek, A., Burge, J., 2022. Recurring distributed software maintenance meetings: toward an initial understanding, in: Proceedings of the 15th International Conference on Cooperative and Human Aspects of Software Engineering, CHASE '22. Association for Computing Machinery, New York, NY, USA, pp. 21–25. https://doi.org/10.1145/3528579.3529179
[S27]	Taylor, S., Hoang, T., Aranda, G., Mulvany, G.T., Greuter, S., 2021. Immersive Collaborative VR Application Design: A Case Study of Agile Virtual Design Over Distance, in: International Journal of Gaming and Computer-Mediated Simulations (IJGCMS) 13, 14–27. https://doi.org/10.4018/IJGCMS.291538
[S28]	Topp, J., Hille, J.H., Neumann, M., M¨otefindt, D., 2022. How a 4-Day Work Week and Remote Work Affect Agile Software Development Teams, in: Przybyłek, A., Jarzebowicz, A., Lukovi´c, I., Ng, Y.Y. (Eds.), Lean and Agile Software Development, Lecture Notes in Business Information Processing. Springer International Publishing, Cham, pp. 61–77. https://doi.org/10.1007/978-3-030-94238-0 4
[S29]	Tremaine, M. M., Milewski, A., Egan, R., Zhang, S. (2007). A tale of two teams: success and failure in virtual team meetings, in: Usability and Internationalization. HCI and Culture: Second International Conference on Usability and Internationalization, UI-HCII 2007, Held as Part of HCI International 2007, Beijing, China, July 22-27, 2007, Proceedings, Part I 2 (pp. 442-451). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-540-73287-73
[S30]	Yu, L., Ramaswamy, S., Mishra, A., Mishra, D., 2011. Communications in Global Software Development: An Empirical Study Using GTK+ OSS Repository, in: Meersman, R., Dillon, T., Herrero, P. (Eds.), On the Move to Meaningful Internet Systems: OTM 2011 Workshops, Lecture Notes in Computer Science. Springer, Berlin, Heidelberg, pp. 218–227. https://doi.org/10.1007/978-3-642-25126-9 32

Table A.7: Selected Studies

The individual quality assessments of each selected paper are shown in Table A.8.

	Reporting			Rigor					Credibility		Relevance	
ID.	**QA1**	**QA2**	**QA3**	**QA4**	**QA5**	**QA6**	**QA7**	**QA8**	**QA9**	**QA10**	**QA11**	**Total**
[S1]	1	1	1	1	1	0	1	1	0	1	1	9
[S2]	1	1	1	1	1	0	1	1	0	1	1	9
[S3]	1	1	1	1	1	0	1	1	0	1	0	8
[S4]	1	1	1	1	1	0	1	1	0	1	1	9
[S5]	1	1	1	1	1	0	1	1	0	1	1	9
[S6]	1	1	1	1	1	0	0	0	0	1	1	7
[S7]	0	1	1	0	0	0	0	0	0	1	1	4
[S8]	1	1	1	1	1	0	1	1	0	1	1	9
[S9]	1	1	1	1	1	0	1	1	0	1	1	9
[S10]	1	1	1	1	1	0	1	1	0	1	1	9
[S11]	1	1	1	1	1	0	1	0	0	1	0	7
[S12]	1	1	1	1	1	0	1	1	0	1	1	9
[S13]	1	1	1	1	1	0	1	1	0	1	1	9
[S14]	0	1	1	0	0	0	0	0	0	1	1	4
[S15]	0	1	1	1	0	0	0	0	0	1	1	5
[S16]	1	1	1	1	1	0	1	1	0	1	1	9
[S17]	1	1	1	1	1	0	1	1	0	1	1	9
[S18]	1	1	1	1	1	0	0	0	0	1	1	7
[S19]	1	1	1	1	1	0	0	0	0	1	1	7
[S20]	1	1	1	1	1	0	1	1	0	1	1	9
[S21]	1	1	1	1	1	0	1	1	1	1	1	10
[S22]	1	1	1	1	1	0	1	1	0	1	1	9
[S23]	1	1	1	1	1	0	1	1	0	1	1	9
[S24]	1	1	1	1	1	0	1	1	0	1	0	8
[S25]	1	1	1	1	1	0	1	1	0	1	1	9
[S26]	1	1	1	1	1	0	1	1	0	1	1	9
[S27]	0	1	1	1	1	0	1	1	0	1	1	9
[S28]	1	1	1	1	1	0	1	1	1	1	1	10
[S29]	1	1	1	1	0	0	0	0	0	1	1	6
[S30]	1	1	1	1	0	0	1	1	0	1	0	7

Table A.8. Quality Assessment of Selected Studies

References

[1] S. G. Dastidar, S. Chatterjee, Distributed software development: Experience and recommendation, in: 2013 3rd International Workshop on Collaborative Teaching of Globally Distributed Software Development (CTGDSD), IEEE, 2013, pp. 11–14.

[2] E. Brynjolfsson, J. J. Horton, A. Ozimek, D. Rock, G. Sharma, H.-Y. TuYe, Covid-19 and remote work: An early look at us data, Tech. rep., National Bureau of Economic Research (2020).

[3] A. Powell, G. Piccoli, B. Ives, Virtual teams: a review of current literature and directions for future research, ACM SIGMIS Database: the DATABASE for Advances in Information Systems 35 (1) (2004) 6–36. doi:10.1145/968464.968467.
URL `https://doi.org/10.1145/968464.968467`

[4] A. Nolan, R. White, M. Soomro, B. C. Dopamu, M. Yilmaz, D. Solan, P. Clarke, To work from home (wfh) or not to work from home? lessons learned by software engineers during the covid-19 pandemic, in: European Conference on Software Process Improvement, Springer, 2021, pp. 14–33.

[5] M. Tanner, M. Naidoo, The use of tools affordances to support communication and collaboration during covid-19 remote work, in: 27th Annual Americas Conference on Information Systems, AMCIS 2021, 2021.

[6] K. A. Karl, J. V. Peluchette, N. Aghakhani, Virtual work meetings during the covid-19 pandemic: The good, bad, and ugly, Small Group Research 53 (3) (2022) 343–365.

[7] B. Evans, The zoom revolution: 10 eye-popping stats from tech's new superstar, Cloud Wars (2020).

[8] P. Peters, Google's meet teleconferencing service now adding about 3 million users per day, The Verge (2020).

[9] D. Thorp-Lancaster, Microsoft teams hits 75 million daily active users, up from 44 million in march, Windows Central (2020).

[10] W. Standaert, S. Muylle, A. Basu, How shall we meet? understanding the importance of meeting mode capabilities for different meeting objectives, Information & Management 58 (1) (2021) 103393.

[11] B. A. Aseniero, M. Constantinides, S. Joglekar, K. Zhou, D. Quercia, Meetcues: Supporting online meetings experience, in: 2020 IEEE Visualization Conference (VIS), IEEE, 2020, pp. 236–240.
[12] B. Kitchenham, Guidelines for performing Systematic Literature Reviews in Software Engineering, Tech. rep., Keele University and University of Durham (2007).
URL https://www.elsevier.com/__data/promis_misc/525444systematicreviewsguide.pdf
[13] J. Kniel, A. Comi, Riding the Same Wavelength: Designers' Perceptions of Shared Understanding in Remote Teams, SAGE Open 11 (3) (2021) 21582440211040129, publisher: SAGE Publications. doi:10.1177/21582440211040129.
URL https://doi.org/10.1177/21582440211040129
[14] T. Neumayr, H.-C. Jetter, M. Augstein, J. Friedl, T. Luger, Domino: A Descriptive Framework for Hybrid Collaboration and Coupling Styles in Partially Distributed Teams, Proceedings of the ACM on Human-Computer Interaction 2 (CSCW) (2018) 128:1–128:24. doi:10.1145/3274397.
URL https://doi.org/10.1145/3274397
[15] J. A. Allen, N. Lehmann-Willenbrock, S. Rogelberg, The Cambridge Handbook of Meeting Science, 1st Edition, Cambridge University Press, New York, NY, USA, 2015.
[16] J. A. Allen, N. Lehmann-Willenbrock, S. J. Sands, Meetings as a positive boost? how and when meeting satisfaction impacts employee empowerment, Journal of Business Research 69 (10) (2016) 4340–4347. doi:https://doi.org/10.1016/j.jbusres.2016.04.011.
URL https://www.sciencedirect.com/science/article/pii/S014829631630131X
[17] A. L. Meinecke, J. A. Allen, N. Lehmann-Willenbrock, Managing meetings in organizations, Emerald Publishing Limited, 2020.
[18] J. E. Mroz, M. Yoerger, J. A. Allen, Leadership in workplace meetings: The intersection of leadership styles and follower gender, Journal of Leadership & Organizational Studies 25 (3) (2018) 309–322.
[19] J. Sutherland, K. Schwaber, Home | Scrum Guides (2022).
URL https://scrumguides.org/index.html
[20] V. Stray, Planned and unplanned meetings in large-scale projects, in: Proceedings of the 19th International Conference on Agile Software Development: Companion, XP '18, Association for Computing Machinery, New York, NY, USA, 2018, pp. 1–5. doi:10.1145/3234152.3234178.
URL https://doi.org/10.1145/3234152.3234178
[21] A. Brodsky, M. Tolliver, No, Remote Employees Aren't Becoming Less Engaged, Harvard Business Review (Dec. 2022).
URL https://hbr.org/2022/12/no-remote-employees-arent-becoming-less-engaged
[22] B. J. da Silva Estácio, R. Prikladnicki, Distributed pair programming: A systematic literature review, Information and Software Technology 63 (2015) 1–10. doi:https://doi.org/10.1016/j.infsof.2015.02.011.
URL https://www.sciencedirect.com/science/article/pii/S0950584915000476
[23] S. G. Rogelberg, D. J. Leach, P. B. Warr, J. L. Burnfield, " not another meeting!" are meeting time demands related to employee well-being?, Journal of Applied Psychology 91 (1) (2006) 83.
[24] L. A. LeBlanc, M. R. Nosik, Planning and leading effective meetings, Behavior analysis in practice 12 (3) (2019) 696–708.
[25] J. A. A. Nale Lehmann-Willenbrock, S. Kauffeld, A sequential analysis of procedural meeting communication: How teams facilitate their meetings, Journal of Applied Communication Research 41 (4) (2013) 365–388. arXiv:https://doi.org/10.1080/00909882.2013.844847, doi:10.1080/00909882.2013.844847.
URL https://doi.org/10.1080/00909882.2013.844847
[26] F. Calefato, D. Damian, F. Lanubile, Computer-mediated communication to support distributed requirements elicitations and negotiations tasks, Empirical Software Engineering 17 (2011) 640–674. doi:10.1007/s10664-011-9179-3.
[27] N. Mangano, T. D. LaToza, M. Petre, A. van der Hoek, Supporting informal design with interactive whiteboards, in: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI '14, Association for Computing Machinery, New York, NY, USA, 2014, pp. 331–340. doi:10.1145/2556288.2557411.
URL https://doi.org/10.1145/2556288.2557411
[28] E. Whitworth, R. Biddle, The social nature of agile teams, in: Agile 2007 (AGILE 2007), IEEE, 2007, pp. 26–36.
[29] V. G. Stray, Y. Lindsjørn, D. I. Sjøberg, Obstacles to Efficient Daily Meetings in Agile Development Projects: A Case Study, in: 2013 ACM / IEEE International Symposium on Empirical Software Engineering and Measurement, 2013, pp. 95–102, iSSN: 1949-3789. doi:10.1109/ESEM.2013.30.
[30] T. O. A. Lehtinen, R. Virtanen, J. O. Viljanen, M. V. Mäntylä, C. Lassenius, A tool supporting root cause analysis for synchronous retrospectives in distributed software teams, Information and Software Technology 56 (4) (2014) 408–437. doi:10.1016/j.infsof.2014.01.004.
URL https://www.sciencedirect.com/science/article/pii/S0950584914000159
[31] M. Paasivaara, C. Lassenius, V. T. Heikkilä, Inter-team coordination in large-scale globally distributed scrum: do scrum-of-scrums really work?, in: Proceedings of the ACM-IEEE international symposium on Empirical software engineering and measurement, ESEM '12, Association for Computing Machinery, New York, NY, USA, 2012, pp. 235–238. doi:10.1145/2372251.2372294.
URL https://doi.org/10.1145/2372251.2372294
[32] E. Hutchins, Cognition in the Wild, MIT press, 1995.
[33] A. R. Dennis, R. M. Fuller, J. S. Valacich, Media, tasks, and communication processes: A theory of media synchronicity, MIS quarterly (2008) 575–600.
[34] H. Sharp, R. Giuffrida, G. Melnik, Information Flow within a Dispersed Agile Team: A Distributed Cognition Perspective, in: C. Wohlin (Ed.), Agile Processes in Software Engineering and Extreme Programming, Lecture Notes in Business Information Processing, Springer, Berlin, Heidelberg, 2012, pp. 62–76. doi:10.1007/978-3-642-30350-0_5.
[35] M. Korkala, F. Maurer, Waste identification as the means for improving communication in globally distributed agile software development, Journal of Systems and Software 95 (2014) 122–140. doi:10.1016/j.jss.2014.03.080.
URL https://www.sciencedirect.com/science/article/pii/S0164121214001009
[36] D. Smite, A. Tkalich, N. B. Moe, E. Papatheocharous, E. Klotins, M. P. Buvik, Changes in perceived productivity of software engineers

during COVID-19 pandemic: The voice of evidence, Journal of Systems and Software 186 (2022) 111197. doi:10.1016/j.jss.2021.111197.
URL https://www.sciencedirect.com/science/article/pii/S0164121221002715

[37] C. Miller, P. Rodeghero, M.-A. Storey, D. Ford, T. Zimmermann, "How Was Your Weekend?" Software Development Teams Working From Home During COVID-19, in: 2021 IEEE/ACM 43rd International Conference on Software Engineering (ICSE), IEEE, Virtual, 2021, pp. 624–636, iSSN: 1558-1225. doi:10.1109/ICSE43902.2021.00064.

[38] D. Ford, M.-A. Storey, T. Zimmermann, C. Bird, S. Jaffe, C. Maddila, J. L. Butler, B. Houck, N. Nagappan, A Tale of Two Cities: Software Developers Working from Home during the COVID-19 Pandemic, ACM Transactions on Software Engineering and Methodology 31 (2) (2021) 27:1–27:37. doi:10.1145/3487567.
URL https://doi.org/10.1145/3487567

[39] D. Russo, P. H. P. Hanel, S. Altnickel, N. van Berkel, Predictors of well-being and productivity among software professionals during the COVID-19 pandemic – a longitudinal study, Empirical Software Engineering 26 (4) (2021) 62. doi:10.1007/s10664-021-09945-9.
URL https://doi.org/10.1007/s10664-021-09945-9

[40] D. Šmite, N. B. Moe, E. Klotins, J. Gonzalez-Huerta, From forced Working-From-Home to voluntary working-from-anywhere: Two revolutions in telework, Journal of Systems and Software 195 (2023) 111509. doi:10.1016/j.jss.2022.111509.
URL https://www.sciencedirect.com/science/article/pii/S0164121222001856

[41] E. DeFilippis, S. M. Impink, M. Singell, J. T. Polzer, R. Sadun, The impact of COVID-19 on digital communication patterns, Humanities and Social Sciences Communications 9 (1) (2022) 1–11, number: 1 Publisher: Palgrave. doi:10.1057/s41599-022-01190-9.
URL https://www.nature.com/articles/s41599-022-01190-9

[42] Airbnb's design for employees to live and work anywhere (Apr. 2022).
URL https://news.airbnb.com/airbnbs-design-to-live-and-work-anywhere/

[43] J. Stanier, Effective Remote Work, 1st Edition, Pragmatic Bookshelf, 2022, iSBN: 9781680509229.

[44] H. Holmstrom, E. O. Conchuir, P. J. Agerfalk, B. Fitzgerald, Global Software Development Challenges: A Case Study on Temporal, Geographical and Socio-Cultural Distance, in: 2006 IEEE International Conference on Global Software Engineering (ICGSE'06), 2006, pp. 3–11, iSSN: 2329-6313. doi:10.1109/ICGSE.2006.261210.

[45] J. Herbsleb, A. Mockus, T. Finholt, R. Grinter, An empirical study of global software development: distance and speed, in: Proceedings of the 23rd International Conference on Software Engineering. ICSE 2001, IEEE, Toronto, Ontario, Canada, 2001, pp. 81–90, iSSN: 0270-5257. doi:10.1109/ICSE.2001.919083.

[46] I. Mistrík, J. Grundy, A. van der Hoek, J. Whitehead, Collaborative Software Engineering: Challenges and Prospects, Springer Berlin Heidelberg, Berlin, Heidelberg, 2010, pp. 389–403. doi:10.1007/978-3-642-10294-3_19.
URL https://doi.org/10.1007/978-3-642-10294-3_19

[47] S. Kauffeld, N. Lehmann-Willenbrock, Meetings matter: Effects of team meetings on team and organizational success, Small group research 43 (2) (2012) 130–158.

[48] J. E. Mroz, J. A. Allen, D. C. Verhoeven, M. L. Shuffler, Do We Really Need Another Meeting? The Science of Workplace Meetings, Current Directions in Psychological Science 27 (6) (2018) 484–491, publisher: SAGE Publications Inc. doi:10.1177/0963721418776307.
URL https://doi.org/10.1177/0963721418776307

[49] J. A. Allen, N. Lehmann-Willenbrock, The key features of workplace meetings: Conceptualizing the why, how, and what of meetings at work, Organizational Psychology Review (2022) 20413866221129231Publisher: SAGE Publications. doi:10.1177/20413866221129231.
URL https://doi.org/10.1177/20413866221129231

[50] T. Neumayr, B. Saatci, S. Rintel, C. N. Klokmose, M. Augstein, What was Hybrid? A Systematic Review of Hybrid Collaboration and Meetings Research, arXiv:2111.06172 [cs]ArXiv: 2111.06172 (Nov. 2021).
URL http://arxiv.org/abs/2111.06172

[51] H. Cao, C.-J. Lee, S. Iqbal, M. Czerwinski, P. N. Y. Wong, S. Rintel, B. Hecht, J. Teevan, L. Yang, Large Scale Analysis of Multitasking Behavior During Remote Meetings, in: Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems, ACM, Yokohama Japan, 2021, pp. 1–13. doi:10.1145/3411764.3445243.
URL https://dl.acm.org/doi/10.1145/3411764.3445243

[52] A. Sarkar, S. Rintel, D. Borowiec, R. Bergmann, S. Gillett, D. Bragg, N. Baym, A. Sellen, The promise and peril of parallel chat in video meetings for work, in: Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems, CHI EA '21, Association for Computing Machinery, Yokohama, Japan, 2021, p. 8. doi:10.1145/3411763.3451793.
URL https://dl.acm.org/doi/10.1145/3411763.3451793

[53] J. Teevan, N. Baym, J. Butler, B. Hecht, S. Jaffe, K. Nowak, A. Sellen, L. Yang, Microsoft New Future Of Work 2022 (2022).
URL https://aka.ms/nfw2022

[54] K. M. Reed, J. A. Allen, Suddenly virtual: Making remote meetings work, John Wiley & Sons, 2021.

[55] T. Dybå, T. Dingsøyr, Strength of evidence in systematic reviews in software engineering, in: Proceedings of the Second ACM-IEEE international symposium on Empirical software engineering and measurement, ESEM '08, Association for Computing Machinery, New York, NY, USA, 2008, pp. 178–187. doi:10.1145/1414004.1414034.
URL https://doi.org/10.1145/1414004.1414034

[56] Y. Zhou, H. Zhang, X. Huang, S. Yang, M. A. Babar, H. Tang, Quality assessment of systematic reviews in software engineering: a tertiary study, in: Proceedings of the 19th International Conference on Evaluation and Assessment in Software Engineering, EASE '15, Association for Computing Machinery, New York, NY, USA, 2015, pp. 1–14. doi:10.1145/2745802.2745815.
URL https://doi.org/10.1145/2745802.2745815

[57] K. Petersen, S. Vakkalanka, L. Kuzniarz, Guidelines for conducting systematic mapping studies in software engineering: An update, Information and Software Technology 64 (2015) 1–18. doi:10.1016/j.infsof.2015.03.007.

[58] J. Saldana, The Coding Manual For Qualitative Researchers, 4th Edition, SAGE Publications, London, 2021.

[59] MAXQDA | All-In-One Qualitative & Mixed Methods Data Analysis Tool (2021).
URL https://www.maxqda.com/

[60] T. O. Lehtinen, M. V. Mäntylä, J. Itkonen, J. Vanhanen, Diagrams or structural lists in software project retrospectives–an experimental comparison, Journal of Systems and Software 103 (2015) 17–35.
[61] J. N. Bailenson, Nonverbal Overload: A Theoretical Argument for the Causes of Zoom Fatigue, Technology, Mind, and Behavior 2 (1) (Feb. 2021). doi:10.1037/tmb0000030.
URL https://tmb.apaopen.org/pub/nonverbal-overload/release/2
[62] C. Athanasiadou, G. Theriou, Telework: systematic literature review and future research agenda, Heliyon 7 (10) (2021) e08165.
[63] V. Jackson, A. van der Hoek, R. Prikladnicki, C. Ebert, Collaboration tools for developers, IEEE Software 39 (2) (2022) 7–15. doi:10.1109/MS.2021.3132137.
[64] M. Cherubini, G. Venolia, R. DeLine, A. J. Ko, Let's go to the whiteboard: how and why software developers use drawings, in: Proceedings of the SIGCHI conference on Human factors in computing systems, 2007, pp. 557–566.
[65] G. M. Olson, J. S. Olson, Distance Matters, Human–Computer Interaction 15 (2-3) (2000) 139–178. doi:10.1207/S15327051HCI1523_4.
[66] A. N. Meyer, L. E. Barton, G. C. Murphy, T. Zimmermann, T. Fritz, The Work Life of Developers: Activities, Switches and Perceived Productivity, IEEE Transactions on Software Engineering 43 (12) (2017) 1178–1193. doi:10.1109/TSE.2017.2656886.
URL http://ieeexplore.ieee.org/document/7829407/
[67] V. Stray, N. B. Moe, M. Noroozi, Slack me if you can! using enterprise social networking tools in virtual agile teams, in: 2019 ACM/IEEE 14th International Conference on Global Software Engineering (ICGSE), IEEE, 2019, pp. 111–121.
[68] B. Mullen, C. Copper, The relation between group cohesiveness and performance: An integration., Psychological bulletin 115 (2) (1994) 210.
[69] N. Bos, N. S. Shami, J. S. Olson, A. Cheshin, N. Nan, In-group/out-group effects in distributed teams: An experimental simulation, in: Proceedings of the 2004 ACM Conference on Computer Supported Cooperative Work, CSCW '04, Association for Computing Machinery, New York, NY, USA, 2004, p. 429–436. doi:10.1145/1031607.1031679.
URL https://doi.org/10.1145/1031607.1031679
[70] N. Fereydooni, B. N. Walker, Virtual reality as a remote workspace platform: Opportunities and challenges, aBOUT THE AUTHOR/S Nadia Fereydooni Georgia Institute of Technology Atlanta, USA nadia.fereydooni@gatech.edu Nadia Fereydooni is a Human-Centered Computing doctoral student at Georgia Institute of Technology. She earned her Bachelors degree in Computer Engineering from University of New Hampshire. Her research focuses on the use of Virtual Reality in automated vehicles to provide rich, immersive experiences while maintaining passengers' trust and safety.. https://nadiafereydooni.weebly.com/ Bruce N. Walker Georgia Institute of Technology Atlanta, USA bruce.walker@psych.gatech.edu Bruce N. Walker is a Professor at Georgia Tech, in the Schools of Psychology and Interactive Computing. His Sonification Lab studies the human-computer interaction (HCI) issues in non-traditional interfaces, ranging from mobile devices, to cockpits and vehicle displays, to multimodal interfaces in education and in complex task environments. Particular research interests include sonification and auditory displays. (Aug. 2020).
URL https://www.microsoft.com/en-us/research/publication/virtual-reality-as-a-remote-workspace-platform-opportunities-and-challenges/
[71] H. Holmstrom, E. O. Conchuir, P. J. Agerfalk, B. Fitzgerald, Global software development challenges: A case study on temporal, geographical and socio-cultural distance, in: 2006 IEEE International Conference on Global Software Engineering (ICGSE'06), 2006, pp. 3–11. doi:10.1109/ICGSE.2006.261210.
[72] S. Luebstorf, J. A. Allen, E. Eden, W. S. Kramer, R. Reiter-Palmon, N. Lehmann-Willenbrock, Digging into "zoom fatigue": A qualitative exploration of remote work challenges and virtual meeting stressors, Merits 3 (1) (2023) 151–166.
[73] S. Morrison-Smith, J. Ruiz, Challenges and barriers in virtual teams: a literature review, SN Applied Sciences 2 (6) (2020) 1096. doi:10.1007/s42452-020-2801-5.
URL https://doi.org/10.1007/s42452-020-2801-5
[74] R. Riedl, On the stress potential of videoconferencing: definition and root causes of Zoom fatigue, Electronic Markets 32 (1) (2022) 153–177. doi:10.1007/s12525-021-00501-3.
URL https://doi.org/10.1007/s12525-021-00501-3
[75] C. Miller, P. Rodeghero, M.-A. Storey, D. Ford, T. Zimmermann, "how was your weekend?" software development teams working from home during covid-19, in: 2021 IEEE/ACM 43rd International Conference on Software Engineering (ICSE), 2021, pp. 624–636. doi:10.1109/ICSE43902.2021.00064.
[76] P. Ralph, S. Baltes, G. Adisaputri, R. Torkar, V. Kovalenko, M. Kalinowski, N. Novielli, S. Yoo, X. Devroey, X. Tan, et al., Pandemic programming: How covid-19 affects software developers and how their organizations can help, Empirical software engineering 25 (2020) 4927–4961.
[77] D. L. Reyes, M. Luna, E. Salas, Challenges for team leaders transitioning from face-to-face to virtual teams, Organizational Dynamics 50 (2) (2021) 100785.
[78] M. Yoerger, J. A. Allen, J. Crowe, The impact of premeeting talk on group performance, Small Group Research 49 (2) (2018) 226–258.
[79] M. Das, J. Tang, K. E. Ringland, A. M. Piper, Towards accessible remote work: Understanding work-from-home practices of neurodivergent professionals, Proceedings of the ACM on Human-Computer Interaction 5 (CSCW1) (2021) 1–30.
[80] K. Rogers, The effects of remote work on organizational culture: Examining the effects of external social support to mitigate social isolation within organizations, Master's Thesis, University of Tennessee, 2022. (2022).
[81] V. Stray, T. E. Fægri, N. B. Moe, Exploring norms in agile software teams, in: Product-Focused Software Process Improvement: 17th International Conference, PROFES 2016, Trondheim, Norway, November 22-24, 2016, Proceedings 17, Springer, 2016, pp. 458–467.
[82] L. Errichiello, T. Pianese, The role of organizational support in effective remote work implementation in the post-covid era, in: Handbook of research on remote work and worker well-being in the post-COVID-19 era, IGI Global, 2021, pp. 221–242.
[83] J. Kotlarsky, I. Oshri, Social ties, knowledge sharing and successful collaboration in globally distributed system development projects, European Journal of Information Systems 14 (2005) 37–48.
[84] D. Avrahami, E. van Everdingen, J. Marlow, Supporting multitasking in video conferencing using gaze tracking and on-screen activity detection, in: Proceedings of the 21st International Conference on Intelligent User Interfaces, 2016, pp. 130–134.

[85] V. Jackson, A. van der Hoek, R. Prikladnicki, Collaboration tool choices and use in remote software teams: Emerging results from an ongoing study, in: Proceedings of the 15th International Conference on Cooperative and Human Aspects of Software Engineering, CHASE '22, Association for Computing Machinery, New York, NY, USA, 2022, p. 76–80. doi:10.1145/3528579.3529171.
URL https://doi.org/10.1145/3528579.3529171
[86] A. Kuzminykh, S. Rintel, Classification of functional attention in video meetings, in: Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems, 2020, pp. 1–13.
[87] B. Adriel Aseniero, M. Constantinides, S. Joglekar, K. Zhou, D. Quercia, Meetcues: Supporting online meetings experience, in: 2020 IEEE Visualization Conference (VIS), 2020, pp. 236–240. doi:10.1109/VIS47514.2020.00054.
[88] K. Zhou, M. Constantinides, L. M. Aiello, S. Joglekar, D. Quercia, The role of different types of conversations for meeting success, IEEE Pervasive Computing 20 (4) (2021) 35–42. doi:10.1109/MPRV.2021.3115879.
[89] Apple tries to bring workers back to the office—again (2023).
URL https://fortune.com/2022/08/15/apple-return-to-office-policy-remote-hybrid-work/
[90] Horizon Workrooms Virtual Office & Meetings | Meta for Work (2023).
URL https://forwork.meta.com/horizon-workrooms/
[91] Introducing Microsoft Mesh | Here can be anywhere. (2023).
URL https://www.microsoft.com/en-us/mesh
[92] Hubs - Private, virtual 3D worlds in your browser (2023).
URL https://hubs.mozilla.com/
[93] U. Technologies, Build VR experiences with Unity (2023).
URL https://unity.com/solutions/vr
[94] A. Ruvimova, J. Kim, T. Fritz, M. Hancock, D. C. Shepherd, "transport me away": Fostering flow in open offices through virtual reality, in: Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems, CHI '20, Association for Computing Machinery, New York, NY, USA, 2020, p. 1–14. doi:10.1145/3313831.3376724.
URL https://doi.org/10.1145/3313831.3376724
[95] M. Das, D. Gergle, A. M. Piper, "it doesn't win you friends": Understanding accessibility in collaborative writing for people with vision impairments, Proc. ACM Hum.-Comput. Interact. 3 (CSCW) (nov 2019). doi:10.1145/3359293.
URL https://doi.org/10.1145/3359293
[96] J. Tang, Understanding the telework experience of people with disabilities, Proc. ACM Hum.-Comput. Interact. 5 (CSCW1) (apr 2021). doi:10.1145/3449104.
URL https://doi.org/10.1145/3449104
[97] D. Smite, E. L. Christensen, P. Tell, D. Russo, The future workplace: Characterizing the spectrum of hybrid work arrangements for software teams, IEEE Software 40 (2) (2023) 34–41. doi:10.1109/MS.2022.3230289.
[98] T. Sporsem, N. B. Moe, Coordination strategies when working from anywhere: a case study of two agile teams, in: Agile Processes in Software Engineering and Extreme Programming: 23rd International Conference on Agile Software Development, XP 2022, Copenhagen, Denmark, June 13–17, 2022, Proceedings, Springer, 2022, pp. 52–61.
[99] Y. Ghanam, X. Wang, F. Maurer, Utilizing digital tabletops in collocated agile planning meetings, in: Agile 2008 Conference, IEEE, 2008, pp. 51–62.
[100] N. Mangano, T. D. LaToza, M. Petre, A. van der Hoek, How software designers interact with sketches at the whiteboard, IEEE Transactions on Software Engineering 41 (2) (2014) 135–156.
[101] J. Rooksby, N. Ikeya, Collaboration in formative design: Working together at a whiteboard, IEEE software 29 (1) (2011) 56–60.
[102] M. Poel, R. Poppe, A. Nijholt, Meeting behavior detection in smart environments: Nonverbal cues that help to obtain natural interaction, in: 2008 8th IEEE International Conference on Automatic Face & Gesture Recognition, IEEE, 2008, pp. 1–6.
[103] P. Kar, S. Chattopadhyay, S. Chakraborty, Bifurcating cognitive attention from visual concentration: Utilizing cooperative audiovisual sensing for demarcating inattentive online meeting participants, Proceedings of the ACM on Human-Computer Interaction 6 (CSCW2) (2022) 1–34.
[104] S. Buyukguzel, R. Mitchell, Progressivity in hybrid meetings: Daily scrum as an enabling constraint for a multi-locational software development team, Computer Supported Cooperative Work (CSCW) (2023) 1–34.
[105] Akman, C. Turhan, T. Hacaloglu, Utilization of Online Collaborative Tools in Software Engineering: An Empirical Study on Review Meetings, in: 2021 6th International Conference on Computer Science and Engineering (UBMK), 2021, pp. 654–659, iSSN: 2521-1641. doi:10.1109/UBMK52708.2021.9558995.
[106] K. M. Shockley, A. S. Gabriel, D. Robertson, C. C. Rosen, N. Chawla, M. L. Ganster, M. E. Ezerins, The fatiguing effects of camera use in virtual meetings: A within-person field experiment., Journal of Applied Psychology 106 (8) (2021) 1137.
[107] X. Zhou, Y. Jin, H. Zhang, S. Li, X. Huang, A Map of Threats to Validity of Systematic Literature Reviews in Software Engineering, in: 2016 23rd Asia-Pacific Software Engineering Conference (APSEC), 2016, pp. 153–160, iSSN: 1530-1362. doi:10.1109/APSEC.2016.031.
[108] J. Fried, D. Heinemeier Hansson, Remote: Office Not Required, 1st Edition, Currency, 2013.
[109] B. Stallings, Hidden Habits Killing Your Remote Team's Ability to Collaborate Effectively (Sep. 2022).
URL https://www.infoq.com/articles/hidden-habits-killing-collaboration/
[110] H. Knieberg, Are distributed teams the new normal? Slides from my Agile Turkey talk. (Nov. 2022).
URL https://blog.crisp.se/2022/11/24/henrikkniberg/are-distributed-teams-the-new-normal-slides
[111] V. Garousi, M. Felderer, M. V. Mäntylä, Guidelines for including grey literature and conducting multivocal literature reviews in software engineering, Information and Software Technology 106 (2019) 101–121. doi:10.1016/j.infsof.2018.09.006.