"Do you have time for a quick call?": Exploring Remote and Hybrid Requirements Engineering Practices and Challenges in Industry

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***Abstract*—With the onset of the COVID-19 pandemic and the ensuing shift away from co-located work arrangements towards working from home, practitioners encountered many collaborative and coordination challenges. While companies are slowly moving back towards in-person arrangements, many employers have permanently adopted fully remote and hybrid work modes. However, the work modes are more blurred, as hybrid work makes coordinating the requirements engineering practices that rely on rich interactions more challenging. Therefore, gaining more understanding of RE challenges and practices from practitioners transitioning to the new modes of work is imperative to identify insights that can be useful for organizations shifting to hybrid and remote work. In this paper, we use a mixed-methods approach to gain insights into remote and hybrid requirements engineering practices and challenges in the industry. Through interviews with 12 industry practitioners and a survey with 49 practitioners, we report on 7 adopted practices and 7 challenges encountered in these work arrangements. We found challenges such as organizing co-located tasks, lack of interpersonal connections, keeping everyone in the loop, and engagement barriers, which fall under coordination, communication and collaboration. To offset such challenges, we provide 20 recommendations based on our findings, such as proactive planning and using newer tools that support comprehensive tracking of important knowledge for requirements documentation. Our findings suggest that practitioners are facing challenges in remote and hybrid work arrangements, which they are mitigating with various strategies. Nonetheless, there remains a need for further research, as not all challenges are equally addressed across different work contexts.**

***Index Terms*—Requirements Engineering, Practices, Challenges, Industry**

I. Introduction

The COVID-19 pandemic was a catalyst for a dramatic change in how software organizations conduct work. Many organizations transitioned from traditional co-located offices to remote work arrangements [1], [2]. Recent studies report on new modes of work, and although companies have initiatives to return to the office, some still opt to remain *fully remote* (i.e., no central location and employees work from home or co-working locations) and/or allow *hybrid* work (i.e., employees work remotely from home on some days and in organization's office on other days) [3]. While this phenomenon allowed a greater emphasis on the employees' well-being and sometimes improved levels of productivity [1], also underscoring the long-term potential for employees to work from home [4], it also uncovered challenges for developer coordination and communication [5].

Requirements engineering (RE) comprises a set of practices in software engineering that heavily depend on the quality of communication and collaboration among a multitude of diverse stakeholders [6]. A lack of effective communication of requirements has significant consequences in software projects, including missing or misunderstanding critical requirements, a lack of shared understanding and rework [7], [8], or ultimately failed projects [9]. To make things worse, remote communication significantly exacerbates these problems in distributed projects [6]. Early research that studied software outsourcing where developers worked with remote clients [10] or globally distributed projects where development teams are geographically remote [11] documented major RE challenges as part of larger knowledge management practices (e.g. [12]). They emphasized the importance of achieving a common understanding of requirements or developing trusting relationships essential to effective requirements negotiations [13].

Despite the early studies on distributed development, RE research has largely been focused on co-located settings. The shift to remote and hybrid work creates new challenges for effective RE collaboration, as the modes of work are much more varied, and the opportunities for remote or in-person collaboration are blurred. Moreover, RE is hard to coordinate as companies are still figuring out what works for their employees. Given the current trend towards remote and hybrid arrangements [14], gaining insights into the practices and challenges faced by companies transitioning to hybrid and remote RE work is important for other organizations navigating similar changes as well as to advance research for potential solutions to address current challenges.

To address this gap, our study was motivated by the following research question: ***"What is the current state of requirement engineering practices and challenges in***

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remote and hybrid work arrangements?". Our work aims to answer this research question through a mixed-methods study comprising 12 interviews with industry practitioners and a survey involving 49 professionals. The participants of our study represent a diverse range of backgrounds and a mix of remote and hybrid work settings. This diversity allows us to gather in-depth qualitative insights that apply to a broader audience. We found that practitioners conduct RE practices such as requirements elicitation, interpretation, and negotiation in remote and hybrid settings, mainly through the assistance of newer technologies that facilitate collaborative requirements work. However, our study also shows that several RE practices (e.g., change management) are less practiced in remote and hybrid work. Our empirical study brings the following contributions:

- Empirical insights into newer modes of work that fundamentally challenge effective collaborations in RE, i.e., in remote and hybrid work, including 7 adopted practices of and 5 new affordances of RE,
- Identified 7 RE challenges which fall under the coordination, communication, and collaboration,
- Provide 20 recommendations for mitigating the challenges for RE practices in remote and hybrid settings,
- A discussion of how organizations can leverage technological advancements for hybrid and remote work.

The paper is structured as follows: Section II discusses the background and related work on remote and hybrid work and RE in distributed settings. Section III covers our methodology, which involves mixed-methods research comprising an initial set of interviews, a survey, and follow-up interviews. Sections IV and V present our findings on practices and challenges in remote and hybrid RE, with corresponding recommendations from practitioners. Section VI discusses our study's result interpretations and implications. We then discuss threats to the validity of our research in Section VII and conclude in Section VIII.

II. Background and Related Work

A. Remote and Hybrid Work

Since the pandemic, software engineering has changed in many ways, but one of the most notable changes is the ability for people to choose where they work. A study by de Souza Santos and Ralph [3] describes four different working arrangements that software companies have adopted. *Co-located* team members mainly work together in the same physical location. *Distributed* team members are located in different locations (different cities and countries). *Remote-first* team members primarily work from home offices or co-working areas, with the team possibly having but not relying on a centralized office space. In *hybrid* teams, some members work in a shared office and others remotely on particular days.

Remote work has gained popularity, primarily after companies adopted a work-from-home model during the pandemic [15], and companies have understood the importance of offering flexibility in work location to attract and retain top talent [16]. Shifting to remote work, despite its benefits, such as bringing family members closer and promoting a better work-life balance, has not been without major challenges for software development work. Miller et al. [2] report that remote work impacted the productivity and dynamics within software teams as developers encountered reduced communication and social interactions. Due to these challenges, developers faced difficulties in meeting project milestones. Ford et al. [1] find that working in a remote environment can impact developers' ability to focus due to shared spaces.

While many software organizations continue to follow a remote or hybrid working system post-pandemic due to improved work-life balance, flexibility, and autonomy [17], research is yet to crack the code on hybrid work. A 2023 large study reveals the yet-unfulfilled promises of achieving the best of both worlds as envisioned in hybrid work, based on 3,456 responses from individuals working at 28 different companies [17]. The study also explores which practices are best to deal with the tensions reported by many: going to the office when no one is there, being unable to separate work from life, feeling "always on," and experiencing "productivity paranoia" [17]. De Souza Santos and Ralph [18] highlight that remote-first and hybrid software teams encounter challenges in maintaining effective coordination. A related study explored the resilience and transition of software teams into hybrid work [19] but does not explore this transition from the lens of RE.

B. Requirements Engineering in Distributed Settings

Effective communication and coordination are fundamentally at the heart of successful RE and are significantly challenged when project stakeholders do not interact in co-located environments. RE challenges in remote, distributed software development are intricately linked to the human aspects of software engineering and relate to knowledge acquisition and sharing, aligning RE processes and tools, effective communication, and coordination [6]. Damian and Zowghi's [13] pioneering work in 2003 delved into the RE challenges posed by the geographical distribution of stakeholders within a multi-site organization. They identified challenges pertaining to customer culture, business dynamics, establishing trusting working relationships, and developing a common understanding of requirements. Their study focused on a singular project — a case study of a large, multi-site corporation with its global headquarters in the United States and teams dispersed across nine sites worldwide.

A recent multiple case study by Kasauli et al. [20] investigated challenges and practices in RE, specifically emphasizing large-scale agile system development and its practices. In contrast, our study takes a different approach by not focusing on Agile methodologies; instead, it explores a variety of organizations and practices. While other studies have explored the impact of global software development on RE, these investigations focus on specific practices, such as change management [21] or fail to encompass all sub-practices within the RE process, such as risks and safeguards [22]. In the last two decades since 2003, practices have evolved, and in

particular, collaboration tools have been developed to support remote work. For example, Google Docs for documenting requirements and immersive tools that simulate a co-located workplace such as Gather [23]. Each employee receives a virtual avatar in an online virtual space, but each in-app movement mimics the dynamic of an in-office workplace. For example, if employees congregate closely together virtually in the app, they could immediately begin a meeting with screen sharing and other functionalities. Previous literature has found that such apps help build shared understanding in remote teams [8], which is critical for managing non-functional requirements [7]. However, Okpara et al.'s [8] work was conducted on a single case study with a small organization.

While previous works provide insights into conducting RE across different sites, we know little about how organizations handle RE in hybrid and remote work arrangements. Given the importance of practitioners engaging in collaborative RE practices in remote/hybrid settings, it is important to gain insights into the adopted practices and challenges faced by practitioners conducting hybrid and remote RE work.

III. Methodology

We used a mixed-methods research methodology to gain an in-depth understanding of practices, challenges, and practitioner recommendations for RE in remote and hybrid working environments. We started with initial interviews with 4 industry practitioners to acquire preliminary insights. Next, we leveraged the interviews' results to design questions for a survey to develop broader insights and assess whether the findings differed from the interviews. We obtained 58 responses for the survey. Finally, we applied follow-up interviews with eight additional industry practitioners to gain a deeper understanding of insights.

Since practitioners may use differing terminology, we provided the same descriptions for the survey and interviews. We used the terminology of the seven RE practices outlined by Borger et al. [24] and Aurum & Wohlin [25]. *Elicitation:* identification of sources and collection of data. *Interpretation:* structuring requirements, including analyzing the interview transcripts, asking follow-up questions, and writing the specification documents. *Negotiation:* identification of dependencies, resolving inconsistencies, and prioritizing requirements. *Documentation:* defining and documenting requirements and rationales. *Validation/Verification:* checking content and formalities. Testing formalities with templates. *Change management:* managing change requests and versions can be done with or without tools. *Tracing:* collection and assignment of assumptions and decisions. Due to these ethical considerations, we cannot release interview transcripts or survey participants' data as part of our replication package. However, we provide the interview and survey questions, coding scheme, and overview of survey participants' demographics for transparency [26].

A. Interview

1) Initial Interviews: We began our research methodology with initial interviews with four practitioners.

a) Design: For each interview, we followed a base set of questions adhering to the guidelines outlined in the general interview guide [27]. We derived these interview questions from the study of Borger et al. [24] and Aurum & Wohlin [25] regarding each practice of the RE process to guide participants to think about the practices, challenges, and benefits experienced in hybrid or remote work setting.

b) Participant Selection and Procedure: For our initial interviews, we used convenience sampling [28] with personal contacts who work in hybrid or remote environments and have extensive knowledge and experience working with RE. Table I details participants' demographics (i.e., P1-P4), their diverse roles, backgrounds, and company sizes. We conducted semi-structured interviews via Zoom, each lasting approximately 25-45 minutes. Before starting each interview, we introduced the purpose of the research. Per our ethics application, we ensured that each participant was informed that their data was confidential and that each interview was recorded for transcription.

c) Data Analysis: We transcribed the audio verbatim into text and then conducted thematic analysis [29]. Two co-authors applied a combination of open and closed coding on open-ended questions and structured questions, respectively [30]. In total, we derived 33 codes in our coding scheme, including codes like *"negotiation benefit"*. After each coding session, the two co-authors met to resolve disagreements and discuss the codes. Across the interviews, the co-authors achieved inter-rater agreement levels of 0.62, 0.51, 0.80, and 0.79 using Cohen's Kappa, which averaged 0.68 and are considered substantial levels of agreement [31].

2) Follow-Up Interviews: After conducting the initial interviews and surveys, which we describe in the next subsection, we conducted 8 additional follow-up interviews to gain a deeper understanding of the challenges and mitigation strategies adopted by practitioners, as well as the use of tooling and the cultural shift towards hybrid and remote work.

a) Design: The 8 interviews followed the same questions as our initial interviews, with additional focused questions derived from the analysis of the initial interviews and survey responses. An example of such a focused question is *"What tools have you used to resolve communication challenges when conducting elicitation with team members in a remote/hybrid setting?"* [26].

b) Participant Selection and Procedure: Similar to the initial interviews, we used convenience sampling through personal contacts [28] to find 8 additional industry practitioners who work in remote and hybrid environments and have extensive knowledge and experience working with RE. (See P5-P12 in Table I, with diverse backgrounds and working arrangements). Each semi-structured interview lasted approximately 20-50 minutes (38 minutes on average) and was conducted on Zoom. Similar to the initial interviews, we introduced the purpose of our research before starting the interview and ensured the participants that their data was recorded and confidential.

TABLE I: Demographic Information of Interviewees

ID	Company Size	Working Arr.	Role
P1	M	Remote	Architecture Lead
P2	L	Hybrid	Application Designer
P3	XL	Remote	Software Strategy Consultant
P4	S	Hybrid	Business Architect
P5	M	Hybrid	Co-Founder and Principal Product Manager
P6	M	Remote	Director of Delivery and Agile Coach
P7	S	Remote	Co-Founder General Manager
P8	XL	Hybrid	Principal Software Engineer
P9	S	Remote	CTO
P10	S	Hybrid	Software Engineer
P11	L	Hybrid	Director
P12	XL	Remote	Software Engineer

c) Data Analysis: We transcribed each interview verbatim and then conducted a thematic analysis on each transcript. Two co-authors conducted open and closed coding on each transcript. We used the coding scheme derived in the previous stages and created five additional codes, such as *"collaboration challenge"* and *"context switching"* [26]. When we finished each coding session, the authors met to discuss and resolve any lack of shared understanding of the new codes. After the fifth interview, no new codes were found for the final three interviews, indicating that we had reached saturation.

B. Survey

After conducting the initial interviews, and before the follow-up interviews, we collected survey responses from practitioners to gather additional insights about the current state of RE practices in remote and hybrid work.

1) Design: The survey questions covered demographics and RE practices. Questions about RE practices revolve around the seven main practices we asked earlier in our interview. We provided the descriptions of the work modes [19] and RE practices [24] as tooltips in case participants needed clarification. For example, when we prompted participants to choose all applicable challenges that arise from their work context, the options included insights found in the initial interviews and the option to add additional challenges. We performed pre-tests with colleagues to evaluate the order, clarity, and understandability of the survey questions.

2) Participant Selection and Procedure: We first applied convenience sampling [28], where we sent out the survey to 15 personal contacts in the industry. We recruited more participants by sending our survey to 400 practitioners registered to a RE newsletter. Furthermore, we sent out a recruitment post on LinkedIn that resulted in 1900 impressions. In total, we received 58 responses across all the sources, where 35 can be traced back to the direct invitations (i.e., 415) and 23 from the LinkedIn post (i.e., 1900), yielding a response rate of 8.4% from direct invitations.

3) Data Analysis: Upon collecting all the survey responses, we checked each survey to remove responses where participants did not answer anything. Two responses were removed as the participants did not answer any demographic questions. One additional response was removed due to not having any experience working in hybrid or remote environments. Six other responses were removed because they did not answer any of our questions about RE practices. Upon this removal, we were left with 49 responses. For closed-ended questions, we counted the number of responses for each question. For open-ended questions, three of the authors employed open coding [32] on each set of responses and conducted constant comparison. Since each survey question was optional, some interviewees answered some questions and left others blank.

In the following two sections, we describe the themes that emerged from our analysis to address our research question. The results outlined in these sections are derived from either surveys, interviews, or both, as indicated in the respective descriptions.

IV. Practices in Remote and Hybrid Requirements Engineering

In this section, we report on the adopted practices and new affordances or RE in remote and hybrid work arrangements. In total, we found 7 adopted practicesand 5 affordances.

A. Adopted Practices

*1) **Elicitation**:* All 12 interviewees and 46/49 survey participants reported they or their team members were involved in some capacity. Participants described remote *elicitation* as inadequate and occasionally opted for face-to-face meetings to better understand customer requirements. *"We invite them to our office, and have discussions with customers about how they see it, what their expectations are, what they want to achieve." (P2)* P3 highlights the significance of tools in remote elicitation, *"we use more whiteboard tooling and other tool support, surveying tools to be involved in the elicitation process to collect feedback from different people."*

*2) **Interpretation**:* All 12 interviewees and 34/46 survey participants reported engaging in requirements *interpretation*. In remote and hybrid work, interpretation tasks are commonly handled by individual members, often the ones conducting the elicitation process. P4 elaborates, *"generally you either have a meeting for those things, or you fill in the gaps yourself and come with like a set of assumptions that you want to validate."* Virtual whiteboards are used for interpretation tasks, as indicated by P6 *"we use the shape of methodologies, shaping is really where we start in our requirements share, eventually, they get turned into like written requirements. [...] we just use a virtual whiteboard, and it goes into a document."*

*3) **Negotiation**:* 10/12 interviewees and 25/43 survey participants indicated their direct participation or the involvement of their team members. Requirements *negotiation* or prioritization is often conducted through meetings between product managers, product owners, and the client. In remote/hybrid settings, most meetings have transitioned to an online format, requiring additional effort to ensure the task is conducted.

4) ***Documentation****:* For requirements *documentation*, all 12 interviewees and 30/42 survey participants reported that their organization conducted this practice. In remote/hybrid settings, companies heavily rely on tools such as JIRA, Confluence, FellowApp, and Google Workspace for documentation. These tools are regularly used to keep track of the meeting notes, *"If you do a recurring meeting, those meeting notes are stacked on top of each other. So you can easily scroll down the document and see all of the previous meetings notes." (P5)*

5) ***Validation/verification****:* For *validation/verification*, 10/12 interviewees and 23/40 survey participants acknowledged conducting the practice. In the remote context, the requirements are often double-checked, *"we add a lot of personal data analysis on top of whatever elicitation we did to double-check whatever assumption that business gave." (P7)* 6/40 survey participants highlighted that developers are primarily responsible for performing testing, while 5/40 survey participants emphasized an increased commitment to writing good unit tests.

6) ***Change management****: Change management* practices, along with *tracing* had the lowest adoption rates from our participants, with only 8/10 interviewees and 16/39 survey participants admitting to conducting *change management*. *Change management* is often more ad-hoc in nature, without specific formal processes compared to the other RE practices.

7) ***Tracing****:* 8/10 interviewees and 12/37 survey participants indicating they applied *tracing*. *Tracing* is often overlooked both in the literature [33] and in the industry; this observation aligns with our findings. For both practices, our participants highlighted that they lean on tooling. For example, for tracing: *"within the Jira, we have the comments specify what was implemented and where and how. So within a ticket, there is traceability to the part of the application." (P4)*

B. New Affordances of RE in Remote/Hybrid

1) ***Convenience of initiating virtual calls****:* 26/49 survey participants highlighted the convenience of making shorter and more frequent calls in remote/hybrid work and providing unexpected benefits to requirements *elicitation*, *interpretation*, *negotiation*, *documentation*, and *tracing*. Participants mentioned that getting all relevant stakeholders together for meetings can be easier, as *"less time is lost for traveling" (Survey)*. Our participants appreciate the ability to quickly call someone when needed, as highlighted by P5, *"you could just be like, Hey, do you have time for a quick call?"*

2) ***Improved meeting organization****:* 7/49 survey participants mentioned the convenience of having well-planned meetings during *elicitation* and *interpretation*. The interactions are well-organized and purposefully structured to compensate for the lack of face-to-face engagement. In addition, it is easier to align with everyone in the remote context since information is being written down instead of simply verbalized.

3) ***Increased productivity due to focused work****:* 23/49 survey participants indicated the ability to work effectively when focusing on tasks related to *elicitation* and *negotiation*. 11/49 survey participants indicated that they avoided getting involved in an excessive number of meetings. 5/49 survey participants pointed out that the lack of random meetings with colleagues is beneficial as it allows them to maintain their workflow without interruptions.

4) ***Tool support for collaborative work****:* 7/46 survey participants stated that the use of persistent and evolving tools like PowerPoint and Mural helps with collaborative tasks related to *interpretation* and *documentation*. Tools like Jira help *tracing* and managing document decisions and discussions. A survey participant highlighted the advantage of documentation tools, eliminating the need to send documents with multiple versions. 3/46 survey participants mentioned that sharing one's screen with colleagues makes collaboration easier. *"In the remote context, sharing a screen is almost a given, making it somewhat easier to document things immediately."* (Survey)

5) ***Tools keep track of tasks****:* Participants indicated the benefit of having tools to track *documentation*, *change management*, and *tracing*. 5/42 survey participants and 4/12 interview participants pointed out that long conversations are automatically transcribed and documented. In remote/hybrid *change management*, random verbalized content is not lost to obscurity as long as it is documented. *"We internally use Google Workspace. So fundamentally, every document that we collaborate on has built-in change management that works perfectly. [You] see every version and who edited it. " (P5)* Participants also acknowledged that being remote leads to *"people [being] quicker to ensure all requirement discussions are documented"*. The main benefit for *tracing* is the reliance on specialized tools such as Jira, Confluence, Miro, Yogi, Zephyr, and Azure DevOps.

V. Challenges And Recommendations For RE in Remote and Hybrid Settings

We report on the themes that emerged from our analysis. In total, we identify 7 challenges that fall under coordination, communication, and collaboration and provide 20 recommendations to address these challenges. Figure 1 presents an overview of these challenges and recommendations. We adopt the definitions of these areas as outlined by Aranda [34]. *Coordination* consists of sharing and negotiating a common understanding of participants' goals and plans, thereby guiding the organization of communication. *Communication* consists of sharing and developing a common understanding of the participant's status and context, thereby facilitating and enhancing coordination. *Collaboration* refers to the optimal teamwork among individuals or groups of individuals.

A. Coordination Challenges

1) ***Organizing Meetings with Stakeholders****:* 20/49 survey participants and 4/12 interview participants expressed the difficulty in *getting all relevant stakeholders together for a meeting*, which impacted their requirements *elicitation* and *interpretation* tasks. P1 highlights the drawback of remote RE work, *"from an elicitation point of view, you have to remember that we're kind of isolated in a room [when remote], so we're not getting together with the customer and doing it. [...] a*

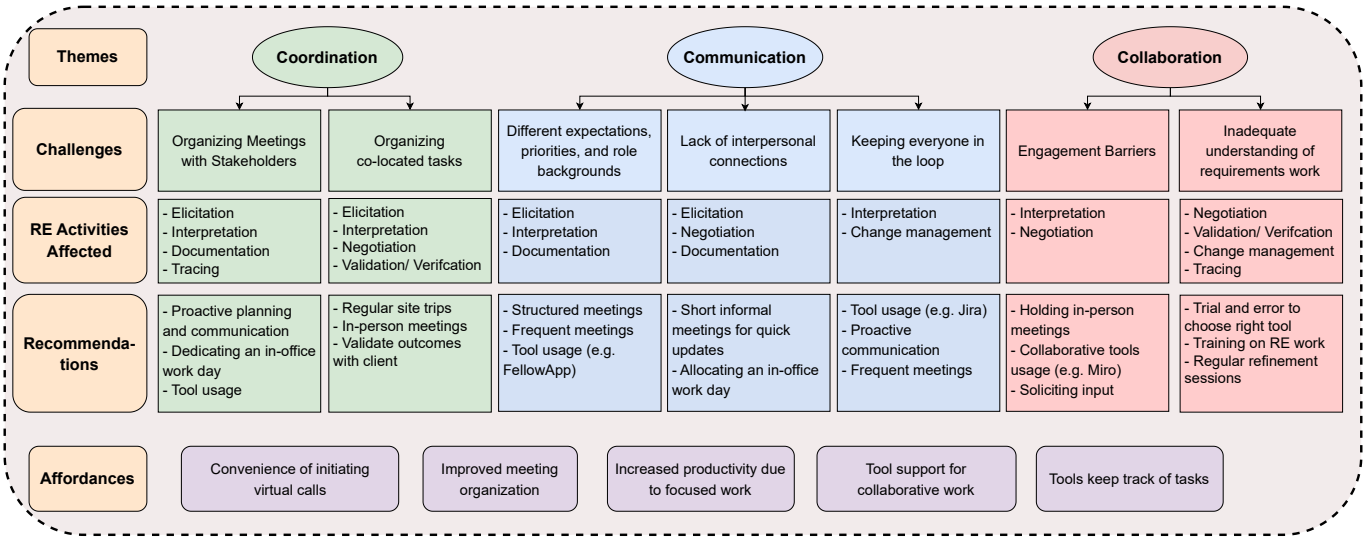

Fig. 1: RE in remote and hybrid models of work: challenges, affordances, and recommendations.

lot of the times it's just that maybe not all the stakeholders are there." The challenge arises due to the varying schedules among the stakeholders. Expressing the difficulty in coordinating meetings with stakeholders, P8 mentions, *"So try to find time and a calendar for an hour for 12 people to talk about this thing, it's going to take you weeks, and sometimes it would take weeks."*

Different locations and time zones notably impacts requirements *elicitation*, *interpretation*, and *tracing* practices. When some colleagues are remote and in multiple locations, *"there's just no reasonable overlap of time." (P5)* Furthermore, remote colleagues face the challenge of not having the opportunity to sit side by side and collaboratively conduct the *tracing* process. 9/12 interviewees also reported having time constraints to conduct certain tasks, as described by P4 *"you sort of have to make due with like a 2-3 hour workshop setting with some screen sharing and maybe some whiteboarding and search through online tools."*

The challenge of coordinating meetings with stakeholders leads to *difficulties in collecting necessary feedback* as highlighted by 8/42 survey participants, which is crucial for *documentation* practices. Failure to receive feedback on time can have consequences for the company, as described by P8, *"[Stakeholders] don't give us feedback at the right time, and three months later, we're done. We launch it and you said [it] doesn't meet your expectations. [We're agile], we can add that, what if we need to add [three] weeks of timeline that's not on us, you are accountable as a stakeholder."*

Recommendations: Participants recommended proactive planning and using tools like Slack, Zoom or Teams to connect with stakeholders on a regular basis. Additionally, participants suggested dedicating an in-office day for hybrid work modes to conduct collaborative work, reflecting the need for a proactive culture to maintain effective communication and stakeholder involvement. 3/12 interview participants emphasized the importance of pre-meeting preparations, *"a successful requirements elicitation starts with good preparation by a manager/scrum master (i.e., what items will be discussed) and a knowledgeable product owner who can answer (tough) questions on the fly. (Survey)"* Furthermore, P5's organization ensures that everyone (in different time zones) can meet remotely on calls at a reasonable time so that no one is considered a second-class citizen on a call and everyone receives the same experience.

To address the feedback issue, participants suggested having the product owner review the documentation and having one central location to store the documentation. Participants recommend following up rigorously with stakeholders, such as through repeated email reminders if no response is received after a few days. Moreover, P8 suggested educating the stakeholders on timely feedback, *"educating stakeholders in terms of you don't just give your opinion, when you want to give your opinion, you're part of the team and you're part of the process. And there are expectations that you show up to these meetings and the ceremonies."*

2) ***Organizing co-located tasks****:* We found that 15/46 survey participants highlighted their struggles of *getting stakeholders involved* in meetings, which are imperative for holding requirements *interpretation* and *negotiation* sessions. The participants reported that while it is easy to facilitate participation from stakeholders in physically co-located settings, it is not the same for remote tasks. Describing the *interpretation* challenge in a remote setting, one survey participant elaborated, *"For me a big challenge is detecting the overall involvement [in online meetings]. It seems easier to see if people are on the same page when you're physically together."*

Similarly, we found interview participants discussing their challenge with conducting some requirements *elicitation* and *validation/verification* practices in remote settings. P4 highlights the importance of understanding the physical location where the software will be used, *"You do not really see the physical environment that your application will be used in.*

It's also harder to talk to people that are not directly within the project team on the customer side and also to like for testing purposes and search, which would generally be wider audience than those that you do a project with." In addition, prior to the pandemic and mass mobilization into remote work, many development teams relied on *locally conducting final acceptance tests* with the end client stakeholders, especially for industries involving software and hardware integration. However, since the shift to remote work, organizing these *validation/verification* practices has become significantly more challenging. This may still be a problem even in hybrid settings, depending on how often employees are available for co-located tasks. This is not only a logistical issue, considering the need to arrange for physical presence, but also a quality assurance concern, as the final acceptance test is a critical component in ensuring that the deliverables meet client requirements and industry standards.

Recommendations: Many of our participants emphasized the continued necessity for regular trips to the sites and conducting in-person meetings. For instance, P7 explains that they would drive across borders to reach satellite offices for in-person meetings. One suggestion for *validation/verification* is checking the completeness of a work item in a refinement session with a product owner or business analyst to confirm the content of a work item. *"Separate [groups] not/less involved with the requirements process make the final acceptation. [Adds] extra level of verification where not only the product owner and the team need to be on the same page, but [PO] and [business] group have same level of agreement."* (Survey) This approach ensures that any discrepancies or misunderstandings are addressed early in the process. In addition, *"validate algorithmic outcomes from client data together with the client and (debugging) problems in the learning models using subject-matter experts." (Survey)* This collaborative approach facilitates a more thorough validation process.

B. Communication

1) ***Different expectations, priorities, and role backgrounds****:* Working in a remote setting often results in *task delay* when team members have different responsibilities and priorities. Particularly, 11/12 interview participants noted that requirement *elicitation* can be difficult when individuals are preoccupied with other commitments, which are not properly communicated to other team members. P12 describes in remote RE, *"it takes longer to make decisions, and it takes longer to get people to sign off on things."* Furthermore, 9/12 interview participants expressed the increased difficulty of reaching individuals beyond the core project team in the remote work setting. *"there's this necessary business communication step, where you need to communicate priority changes, and you need to communicate prioritization, like logic." (P5)*

The different roles and priorities often result in a *lack of shared understanding*, particularly in *interpretation* and *documentation* practices. *Interpretation* is predominantly conducted by individual members in remote settings as outlined in Section IV. In remote contexts, stakeholders often face challenges of differing understanding of the requirements and terminology, as indicated by 13/46 survey participants. P3 describes the difficulty with shared understanding due to the varying roles, *"logistics guys have a different [expectation] than a hardcore software developer. They come up with a different idea and it is sometimes difficult to keep the things together. We have big product that have a breakdown from a high level overall product setup. The interpretation of what was meant on the highest level will deviate."* The findings further indicated that 15/46 survey participants faced a lack of shared understanding in remote settings, emphasizing the importance of ensuring that all stakeholders have a clear and consistent interpretation of the requirements. This challenge is further exacerbated as *elicitation* and *documentation* tasks are often conducted by different people (8/49 surveyees). P3 elaborates, *"it's important to understand that elicitation, documentation and presentation is not always done by the same team of people. There is an overlap, but not everyone is involved in all steps. So this already brings challenges and way how to interpret information that are given from the documents. And sometimes it feels like discovering the requirements new by reading the documents."* These problems result in lackluster communication in ensuring clarity and consistency in the *interpretation* of requirements.

Recommendations: Participants suggested creating a structured approach to meetings, distributed feedback loops, and preemptive pulling of potential requirements. These actions can help ensure that all voices are heard and that the diverse expectations and priorities are adequately considered and integrated into the project's requirements. More frequent meetings to update the current state of interpretations and the idea of purposely over-communicating were also suggested. Agreements with stakeholders can be double-checked, especially those concerning fundamental aspects like priorities.

While communication tools such as Slack, Zoom or Teams have shortcomings, organizations can employ these tools to facilitate more transparent communication. A documentation tool like FellowApp, highlighted by P5, may help organizations conduct comprehensive knowledge tracking for real-time note-taking, regardless of whether a meeting is a short one-on-one chat or a large-scale stakeholder gathering.

2) ***Lack of interpersonal connections****: A reduced sense of personal connection* is the result of a lack of informal conversations, which typically occurred during spontaneous meetings with coworkers in the office space. RE practices such as *elicitation*, *negotiation*, and *documentation* are negatively impacted due to this challenge. 22/49 survey participants and all 12 interview participants reported experiencing the scarcity of interpersonal connections in remote and hybrid work, given that most meetings are scheduled to address work-related topics. P12 also points out that interpersonal relationships often expedite the work, *"[in remote work there is a] reduced interpersonal relationship that you can have with your team. When working in person, it's kind of easier to kind of be friends with your team. And sometimes that makes things go*

a bit faster."

Additionally, 6/49 survey participants indicated feeling isolated due to the lack of informal communication, feeling like they were *"spinning their wheels by themselves"*. The absence of interpersonal interactions in the workplace can lead to a sense of isolation and leave employees *feeling stuck*. These RE practices often rely on informal communication to resolve conflicts, align perspectives, and build consensus among stakeholders. Compared to informal *"water cooler talk"*, which promotes interpersonal connections, relying on the use of tools like Slack, Zoom or Teams is less effective for knowledge management.

Recommendations: Participants suggested adding frequent 10-15 minute update sessions and extra layers of checks. Additionally, they suggested proactive planning of informal meetings and the use of communication tools like Slack, Zoom or Teams for short informal chats to maintain personal contact and build connections. Participants also recommended allocating a day for in-office work to help build better connections. Another approach suggested by participants is creating focused work groups dedicated to a single topic for two hours, with scheduled breaks every hour.

3) ***Keeping everyone in the loop****:* In remote settings, the absence of in-person interactions can hinder *the exchange of ideas and feedback*, leading to differing *interpretation* and knowledge about *change management* as indicated by 29/46 surveyees. In addition, P1 describes the difficulty of interpreting requirements remotely, *"When requirement is well understood, it's a lot easier to put something together, whether it's a full [or partial] requirement specification for a particular feature, but if it's not well understood. Then it's probably a lot harder to do it remotely."* Participant P9 echos the notion that it is hard to keep people informed on all levels. For instance, *"COVID was a wake up call for us, because team was mostly co-located. We thought we were being good about keeping them in the loop, but COVID hit, [there] were so many things that they weren't privy to." (P9)* Remote work also prevents colleagues from overhearing important details that could be relevant for their work, *"walking around the halls you are still overhearing things that might catch your attention." (P1)*. In hybrid settings, requirements changes can get overlooked and unnoticed by team members as they are only sometimes in the office. Remote and hybrid work increases the threshold for discussing unclear requirements with team members, leading to more instances where a shared understanding is believed to exist without double-checking.

Participants describe that team members often miss out on important information due to the use of *different communication channels*, which can affect *documentation* and *change management*. Particularly, when remote and hybrid teams use Teams and Slack as primary communication tools, *"details can quickly become lost." "Slack is [a bad] knowledge management tool. I would argue that some aspects of Slack inhibit productivity" (P1)* In essence, if organizations rely solely on tools like Slack for documentation, they quickly encounter difficulties tracking and storing requirements-related knowledge.

Recommendations: To mitigate these challenges, participants pointed out the importance of using tools like Jira to support the organization's digital tracking. P1 suggested, *"you could always get together with somebody and, you know, piece things together. And ensure that you have a shared understanding either through a whiteboard or a virtual whiteboard or something like that."* Proactive communication and more frequent meetings were recommended as strategies to keep the current state updated. Decisions and knowledge need to be documented, tracked, and conveyed to other team members after the conversations. Ensuring that video and textual recordings are kept track of and notes are well documented in team chats and distributed to pertinent stakeholders can prevent valuable information from getting lost. Holding in-person meetings for critical issues or adopting a hybrid model where one project member is on-site can also help bridge communication gaps that often arise in fully remote settings.

C. Collaboration

1) ***Engagement Barriers****:* During *interpretation* and *negotiation*, it is imperative that stakeholders have a shared and accurate understanding of the project's requirements. However, 21/49 surveyees and 3/12 interview participants described the *passive role that stakeholders exhibit* when meeting remotely or in a hybrid setting. P2 describes that *"If you're often the only one dialed in [on a video call], then, you're more of a spectator, and you really have to make an effort to intervene."*

P11 describes how their *interpretation* and *negotiation* practices are negatively impacted by poor engagement from stakeholders who pretend like they are not present at the session. *"Depends on your team culture. We partner a lot with [partner], they send 29 people to a call, whom have their cameras off and none of whom participate, because they don't want to be the one to tell you what's actually happening. That's an anti pattern." (P11)* They highlight that this challenge places greater emphasis on the need for a strong team culture.

Similarly, employees in charge of asynchronous requirements work show a lack of engagement, inhibiting team collaboration because teammates who depend on them for negotiation and interpretation are adversely affected. This might lead to missing vital issues that a more active stakeholder would have raised. P11 describes *"I would just work in a public teams channel. Because I think the best way to have an open culture is that to your point, everyone can see you. It's like overhearing conversations in the office."*

An additional engagement barrier is the difference between whiteboarding in the office and at home for *interpretation* tasks. *"The lack of being able to get together and whiteboard things. Like we can't kind of do it remotely" (P1)*. Similarly, the participants pointed out differing expectations between roles and the challenge of getting everyone together to do things on whiteboards. When teams operated in a physical location, they used whiteboards to conduct interpretation sessions that actively involved employees. Such a session would facilitate informal discussion, as P11 mentioned that

they would later pull someone aside and say *"what you said was interesting. Can we dig into that deeper?"*. However, facilitating such sessions is more difficult in remote settings, often leading to reduced engagement and involvement from team members.

Recommendations: To address engagement issues, some participants suggested holding in-person meetings to solve critical issues or implementing a hybrid model where project members can be on-site. Embracing collaborative tools like shared digital whiteboards (e.g., Miro) can help bridge the physical gap. These tools can facilitate more interactive meetings, ensuring that even remote participants can actively contribute. Additionally, it can be helpful to solicit input from all meeting participants and seek their individual interpretations to assess alignment with objective reality.

2) ***Inadequate understanding of requirements work****:* Though participants mentioned leveraging tools for various benefits, we found that 7/49 surveyees nonetheless reported the overall challenges of not clearly defining requirements tasks and tools to support these tasks. Software organizations have an abundance of tools readily available, but they sometimes struggle to discern the differences between them and choose the correct tool for their use case. For *negotiation*, *change management*, and *tracing* practices, participants described difficulties when they chose the wrong tools to help track changes, manage approvals, and ensure all stakeholders were informed about the latest project updates. In *negotiation* specifically, team members are required to communicate with stakeholders using tools to resolve inconsistencies before prioritizing requirements. Participants specified that this could be the result of an unwillingness, fear, or lack of motivation to modernize and automate and the fact that a holistic view within the organization may sometimes not be possible.

Regarding the tooling, participants discussed that ineffective screen sharing inhibits discussions in remote and hybrid settings, negatively impacting *tracing*. This contradicts prior sections and practices, where some participants found screen sharing beneficial. The selection of a useful screen-sharing and collaborative tool ultimately plays a significant role in the effectiveness of collaborative work.

Similarly, when requirements-related tasks are not clearly defined, challenges arise for *validation/verification*. For instance, our survey participants detailed difficulties that arose when Jira tickets lacked clarity. Generally, Jira tickets are expected to encompass all the necessary information for task execution, but when it is unclear, the individual assigned to the task must address these uncertainties. This lack of clarity can lead to uncertainties where an individual may not conduct sufficient validation, relying too heavily on end-to-end validation or customer reports. Ensuring that requirements tasks are properly clarified can lead to more time-consuming work for individuals to check. As one survey participant explained *"Checks take more work if things get missed because discrepancies don't get discussed as they arise."*

Recommendations: To mitigate the challenges, participants described that trial and error can help them choose the right tool for the tasks. P5 mentions after using a particular tool, *"for our team just didn't land"*. Furthermore, training on RE work and tools can be provided so that team members are well-versed in using them and that tools are integrated into the workflows effectively. Regular refinement sessions were suggested to help improve the clarity of requirements-related tasks. These sessions serve as a basis for stakeholders to discuss, clarify, and refine the tasks, ensuring that everyone involved has a clear and shared understanding of the requirements. It was also recommended to encourage open communication channels within digital collaboration tools like Teams and instruct colleagues to stay in touch and discuss any ambiguities or questions as they arise. This approach emphasizes the importance of continuous communication and collaboration in ensuring that tasks related to requirements are clearly defined and effectively communicated and understood by all stakeholders.

VI. Discussion

Prior works [11], [13], [21], [22] provided extensive reporting on the challenges of conducting RE in multi-site work arrangements. However, the pandemic has led to a shift in the work arrangements of software organizations. Many workplaces have transitioned to fully remote and, more recently, to hybrid working arrangements. However, little is known about the challenges related to RE practices that companies have encountered during this transition and the strategies they have employed to address these challenges. In this study, we report the current state of RE practices and challenges in remote and hybrid settings through in-depth responses from 12 semi-structured interviews and insights from a broader base of industry practitioners (49 survey responses). Two main takeaways emerged that enhance our understanding of the challenges and opportunities for RE in the new modes of work, which we discuss in the following subsections.

A. "Coordinating" Hybrid Work Arrangements to Align with RE Collaboration Needs

One of the main findings of this study is the importance of coordinating the RE practices for hybrid work. Recent work investigating hybrid work has found it to be a positive balance for handling professional isolation and feelings of envy in employees between in-person and fully remote arrangements [35]. Hybrid work is gaining popularity as a working arrangement [36], placing greater importance on effective RE in hybrid.

Coordination is also important for (entirely) remote work, but hybrid organizations must fully leverage in-person days for requirements practices. Research has documented the collaboration challenges and significant implications to requirements work and the project overall when the stakeholders are distributed [11], [13], [21], [22]. Recent research studying working from home [37], [38] has also found profound issues when employees choose their work-from-home days. Not coordinating in-office days has led to endless problems scheduling meetings for remote and in-office employees and diversity risks facing those who work remotely more often.

In our study, too, many participants repeatedly highlighted the risk of miscommunication or poorly orchestrating meetings involving various requirements practices when some colleagues meet in person and others meet online.

In these instances, *"the virtual attendee is always a second class citizen, if anyone else is in person, virtual is a second class citizen just hands down" (P6)* who miss out on contextual information and have natural engagement barriers. Our participants emphasized the importance of in-person gathering for *elicitation*, *negotiation* and *interpretation*, *"where there's like roadmapping conversation, or this whole like planning thing where we went all [to have the meetup]." (P6)* With hybrid modes of work, however, organizations can identify and prioritize the critical practices that require effective communication and interpersonal interaction for on-site meetings in a way that maximizes everyone's engagement.

Our participants suggested the importance of scheduling their in-office day so that relevant people are at the office together on the same day. Several interviewees describe their experiences as: *"We try to coordinate [our in-office] days. That's the whole point. And one of the points coming in is to coordinate with others." (P10) "All of the local staff is in [local office], we try to all be in the office on Tuesdays." (P11)*

Similarly, requirements *negotiation* or *interpretation* sessions benefit greatly from in-person meetings for hybrid teams. One of our participants described their experiences driving for long distances to be physically in various satellite offices to be part of their *negotiation* and *interpretation* meetings. This required extra effort, but they explained that being in person with the rest of the team allows for better observations and asking immediate questions.

B. Technological Advances to Support Remote and Hybrid RE

Our findings strongly suggest that similar to other software development practices, RE practices have also been adapted in remote work by using the opportunities afforded by Zoom, Teams, and other video conferencing tools for conducting formal and informal meetings. Technology has significantly advanced over the last 20 years since challenges in conducting RE work in distributed settings were initially reported (when basic teleconferencing tools were used [13]). Organizations are now equipped with more powerful tools to navigate development practices, including RE.

Our findings indicate modern software such as Zoom, Teams, Miro, Mural, Slack, Gather, FellowApp, and Confluence significantly supported remote work during the pandemic. Tools such as Slack, Jira, and Git help automate the *coordination* of RE practices such as *change management* and *tracing* of requirements. Moreover, *communication* tools facilitate formal and informal meetings, essential for requirements *elicitation, interpretation*, and *negotiation*. Describing the effortless "one click functionality" of Zoom, industry experts coined it as "black magic" [39]. Additionally, *collaborative* tools like Miro and Mural help mitigate knowledge management challenges and improve requirements *documentation*.

Throughout our findings, we reported recommendations that emerged from the analysis in our study. Knowledge about the challenges and practices can help practitioners understand which aspects to avoid and what strategies to implement to improve their own RE practices. By leveraging our study's insights, practitioners can proactively develop and adopt better approaches and tools that suit their specific remote and hybrid work. Furthermore, different organizations and their practitioners may encounter one or more of the 3 challenges (coordination, communication, and collaboration) in their remote/hybrid RE work. Depending on their specific problem, practitioners can focus on each aspect and employ our recommendations.

C. Comparison to Related Work

In our study, we found 7 adopted practices and 7 RE challenges related to coordination, communication, and collaboration in hybrid and remote work arrangements. Building upon previous research, we explore if these practices and challenges are also prevalent in other work settings.

Damian and Zowghi [6] examined RE practices in global software development with a case study of a multi-site organization [13]. They identified challenges in the four known problem areas of global software development: (i) cultural diversity, (ii) inadequate communication, (iii) knowledge management, and (iv) time difference. They adopted different RE practices than ours; they do not have practices related to change management and tracing, and include two additional ones: examining the current system and managing uncertainty.

Lopez et al. [22] performed a systematic literature review on the RE process in global software development. They found challenges within seven categories: (i) communication and distance, (ii) knowledge management and awareness, (iii) cultural differences, (iv) management and project coordination, (v) tools, (vi) clients, and (vii) miscellany. Although this study focused on the RE process, only practices related to negotiation, documentation, and management were mentioned.

Yaseen et al. [11] performed a systematic literature review on the RE challenges and barriers in global software development. They have identified 15 RE challenges, where the 7 most prevalent challenges are (i) lack of effective and proper way of communication, (ii) organizational differences (culture/time zone/geographical terminology differences), (iii) lack of collaboration and coordination (iv) lack of knowledge sharing and management, and (v) lack of requirement management, (vi) global project management issues and (vii) trust building. They did not find any practices to overcome these challenges.

Akbar et al. [21] performed a survey study and implemented an analytical hierarchy process to investigate the challenges related to RE change management practices. They found 25 challenging factors, which are categorized under four categories: (i) organizational management, (ii) team, (iii) technology, and (iv) process. They found practices related to validation/verification, change management, and tracing.

While these studies have categorized their challenges differently, we found that our challenges were also present in distributed work arrangements. We believe that the intensity

of these challenges varies depending on the work mode; for instance, coordination challenges are exacerbated in distributed work arrangements compared to hybrid or remote setups. Moreover, these studies only cover a limited number of RE practices. In contrast, our study covers all RE practices, as we intentionally integrated the practices outlined by Borger [24] and Aurum [25] in our interview and survey questions.

D. Implications for Research

The impact of organization size and maturity: Our research presents practices and solutions for addressing remote/hybrid RE challenges. Previous literature showed that larger organizations prioritize mature RE practices [40]. Further empirical studies could examine how organizational size and maturity impact the adoption and refinement of these practices for effective RE practices.

Examining and enhancing existing tools: Practitioners expressed difficulties in selecting suitable tools for RE practices, including tracking changes, managing approvals, and ensuring stakeholders are updated on the latest project developments. Future research could focus on examining and enhancing existing tools to optimize the effectiveness of these practices. The integration of artificial intelligence could provide valuable assistance in optimizing these tools.

VII. Threats to Validity

Despite careful planning of our methodology, there are still several threats to the validity of our results. We present these threats according to the categories by Roller [41]: credibility, analyzability, transparency, and usefulness.

Credibility focuses on the completeness and accuracy of the data. Our study may suffer from sampling bias as we used convenience sampling to reach the interviewees, and we could only survey participants who responded to our calls. In addition, we selected interviewees who are knowledgeable and experienced in working RE and participants who engage in either remote or hybrid work. Since our study's goal is to gain insights into RE practices in remote and hybrid work arrangements, our participant selection criteria fit this goal. We also tried to mitigate potential bias from interviewees and survey participants by informing them in advance that their identities would be anonymized.

Analyzability focuses on the completeness and accuracy of analysis and interpretations. For our study, we used an automated tool to help transcribe each interview transcript into text. We also manually verified the textual content of each transcript to ensure its accuracy. The co-authors followed the thematic analysis steps to analyze the interview transcripts and survey results. Disagreements in coding and interpretation could lead to inconsistencies, but our inter-rater agreement levels indicate substantial levels of agreement.

Transparency focuses on completeness and disclosure in our reporting. For transparency, we provided detailed descriptions of our methodology and used quotes as much as possible. We tried our best to show the connection between the findings and broader themes. As per our ethics and confidentiality agreement, we cannot release interview transcripts or raw survey participants' data. However, we provide the interview and survey questions, coding scheme, and overview of survey participants' demographics for transparency [26].

Usefulness focuses on the practical applicability of our research findings. The rapid evolution of tooling may mean that some of the tools we mentioned will become updated or outdated in the future. However, our study shares insights about how practitioners apply RE in remote and hybrid working arrangements. We recognize that our findings may not apply to every software organization or development team, but we expect similar organizations working in remote and hybrid settings to experience similar challenges and practices.

VIII. Conclusion

In this paper, we present an exploration of the current state of RE practices, such as elicitation and interpretation, in remote and hybrid work contexts. We conducted 12 interviews and gathered 49 survey responses from industry practitioners, resulting in an overview of the practices currently implemented to support these RE practices. Our participants also shed light on new affordances and challenges. Three main areas - namely coordination, communication, and collaboration - were uncovered this way. These areas consist of 7 challenges inhibiting various RE practices and 20 concrete recommendations on how to mitigate these issues. For example, a dedicated in-office workday is recommended for teams working in hybrid settings to mitigate the challenge of organizing meetings with stakeholders or a lack of interpersonal connections. The results of our study support practitioners in recognizing which challenges might apply to their work context. Furthermore, practitioners can implement these recommendations as mitigation strategies for these challenges. Our findings suggest that remote and hybrid work arrangements pose challenges for practitioners, who are addressing them by implementing a greater number of mitigation strategies. However, there is still room for meaningful research efforts since not all challenges are mitigated equally for all work contexts.

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