Overcoming Challenges of Virtual Scrum Teams: Lessons Learned Through an Action Research Study

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Abstract. After the COVID-19 breakout, agile teams found themselves in situations that "pure agilists" and textbooks on agile methods had preferred to ignore. Whereas agile mindsets helped them to quickly shift to remote work, mere virtualization of agile practices often proved insufficient, and several challenges emerged. This paper reports on an Action Research project carried out in Lufthansa Systems Poland with the aim of (1) revisiting their ad-hoc actions to adapt to remote work; and (2) elaborating systematic solutions to maintain efficiency in such a setting. With our assistance, the participating teams found measures to mitigate issues posed by the new work environment. They devised an inter-team communication model to improve the effectiveness of information exchange that had declined in the absence of spontaneous, face-to-face communication. Moreover, they employed several other mitigation strategies, including working at least one day per week in the office, keeping webcams on during online meetings, and recapping meetings at the end of a session. Our study largely supports previous findings indicating that Scrum can be effectively applied beyond its comfort zone but also suggests that for adaptations to be successful and comprehensive, they should be developed in a structured manner.

Keywords: Remote work · Method tailoring · Agile Software development · Adaptation · Teamwork · Collaboration

1 Introduction

When COVID-19 swept over the world, many businesses were suddenly disrupted and forced to make rapid changes to the workplace and work processes [1–3]. During these turbulent times, organizational agility not only proved to be useful but also often made the difference between success and failure. Not surprisingly, software houses and IT departments, which had already adopted agile methods, coped quickly with the pandemic situation by virtualizing agile practices, digitizing agile artifacts, and sending their employees to work from home [3–8]. Nevertheless, as team collocation is one of

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the pillars of agile software development [9], an ad-hoc transition to a remote environment challenged the well-established approach to delivering product increments. Indeed, many of the collaborative practices that used to depend on face-to-face communication were rapidly disrupted [10, 11] in the new reality, even though remote communication itself was to some extent commonly practiced before the pandemic [8, 12]. As a consequence, a short-term drop in performance occurred immediately after the transition to a remote environment [3, 13].

The phenomenon of the initial drop in performance is evidenced by the results of three surveys conducted during the first months of the COVID-19 pandemic. In April 2020, Ralph et al. surveyed software developers who switched from working in an office to working from home because of COVID-19 [14]. Based on 2225 responses that met the inclusion criteria, the authors concluded that perceived productivity declined. Another survey study conducted in Germany almost during the same time period and mainly focused on managers and project management experts (with a total of 171 responses) found a small perceived loss in productivity after switching to remote work [15]. The decreased productivity due to the pandemic was also reported by Butt et al., who surveyed over 250 software developers, team leaders, and project managers between April and June 2020 [1].

As agile methods provide no guidelines for remote work, agile teams needed time to come up with in-house solutions. Indeed, recent studies show that the performance of agile teams has not permanently decreased [2, 4, 13]. Nonetheless, despite a significant body of literature that focuses on switching to remote work and the resulting impacts on agile teams (for review, see [6, 7]), only a few studies have examined how agile teams may overcome the new challenges [14, 16, 17]. Furthermore, the mitigation strategies and adjustments are quite diverse, suggesting that they depend on many factors and the individual situation of the team (e.g., effects due to the maturity of the agile process in use) [6]. Therefore, the agile community is responsible for elaborating and reporting context-specific strategies and best practices for remote agile teams. In light of this need, we report on an Action Research project carried out in Lufthansa Systems Poland (1) to revisit their ad-hoc adaptations to remote work; and (2) to elaborate systematic long-lasting solutions for maintaining efficiency in such settings. To guide our work, we raised the following research questions:

RQ1: How did Scrum teams adapt their practices and processes due to the ad-hoc shift to remote work?
RQ2: What are the advantages of remote work for Scrum team members?
RQ3: What new challenges are faced by virtual Scrum teams and their members?
RQ4: How can these challenges be mitigated?

The main contribution of our research is twofold: (1) developing mitigation strategies for Scrum teams to tackle challenges posed by remote working; and (2) enhancing knowledge regarding agile software development in the post-COVID-19 era.

2 Method and Setting

The study followed the canonical action research (AR) within the field of software engineering [18, 19]. It stretched over a six-month period, during which two AR cycles were run. Each AR cycle had the following phases: Diagnosing, Action Planning, Action Taking, Evaluating, and Specifying Learning. Table 1 shows how data was collected in the different phases of AR cycles. The research process itself was hosted at Lufthansa Systems Poland – a subsidiary founded in 1998 in Gdansk, Poland. Two teams namely *Covid-DI* and *Group App* participated in the study. Their composition is summarized in Table 2. Although both teams belonged to the same branch (i.e., the Digital Delivery Lab), where solutions supporting the Lufthansa Group's digital infrastructure were developed, they did not collaborate with each other. However, they used the same tools to create test flight numbers and communicated with the team responsible for cloud infrastructure and the Continuous Integration and Delivery (CI/CD) process. They also used Scrum both before and after the transition to remote working.

Table 1. Data collection techniques.

AR phase	Objective	Technique	Data source
Diagnosing	Preliminary identification of existing issues	Non-structured interview	Team members
	Confirming the issues identified	Online survey	
Action Taking	Inspecting implemented interventions	Participatory observation	Researcher
Evaluating	Assessing the interventions	Online survey	Team members
	Discussing intervention performance and collecting recommendations	Focus group	

The *Covid-DI* team has developed a system that provides automation of the process of verifying documents that are required for a flight. The system features microservices and an internal web application. It receives a passenger's data along with all the documents provided by the passenger through a web application[1] developed by another team. After entering personal data and ticket number, the passenger is presented with a list of possible combinations of documents to be sent to receive a positive verification.

The *GroupApp* team rolls out a mobile app for SWISS, Austrian, and Brussels Airlines (a single application with three visual overlays in accordance with the expectations of the individual carriers belonging to the Lufthansa Group[2]). The application stores flight information and enables an end user to review one's trip details. It is a personal

[1] Available at: https://www.lufthansa.com/ge/en/online-check-in.

[2] A version customized for Austrian Airlines is available at: https://www.austrian.com/us/en/austrian-app.

assistant that offers a real-time display of relevant travel information and keeps travelers up to date with flight notifications. The app's functionality covers mobile check-in, changing or reserving a seat, and handling boarding passes.

Table 2. Professionals taking part in the study.

Covid-DI	GroupApp
1 × Team Leader	1 × Team Leader
1 × Product Owner	1 × Product Owner
1 × Scrum Master	1 × Scrum Master
5 × Backend Developer	4 x Backend Developer
1 × Frontend Developer	1 × Frontend Developer
1 × Junior Test Engineer	1 × Test Engineer
1 × Business Analyst	1 × Business Analyst
1 × System Architect	1 × System Architect
	1 × UX/UI Designer

3 Findings

3.1 The First Action Research Cycle

Per *Diagnosing*, we determined that Microsoft Teams had been established as the primary videoconferencing platform after the transition to remote work. Usually, the Scrum Master shared his screen presenting the Scrum board with the project backlog, current user story, or tasks to be discussed at Daily Meetings or during Backlog Refinement. Retrospectives were conducted using Timbo and TeamRetro tools for the *Covid-DI* and the *Group App* teams, respectively. Sprint planning was achieved through the use of screen sharing, and the PlanITPoker tool, which supports collective estimation with Planning Poker [20, 21], was used for task estimation. Given its visualization-oriented capabilities, both teams also introduced the online Miro whiteboard to facilitate various types of meetings, brainstorming, discussions, etc.

As the *Covid-DI* team is concerned, a few significant changes were reported by the Scrum Master compared to Scrum practices implemented in the on-site office environment. Daily Scrum meetings became more static. Everyone presented their progress without much thought to any discussion or exchange of information (which was an indispensable part when hosting those in the office). Therefore, at the end of each meeting, there was a moment to discuss ongoing problems, if any. Although, probably due to the lack of visible feedback from the other team members, there was usually silence – which was rare at office meetings. Another significant change was the introduction of two additional meetings. A non-mandatory Open Session meeting was to be held 3 times a week (Monday, Wednesday, and Friday) for the development team and collaborating teams or individuals. The meeting was created due to the need to pass information between teams. The second meeting set up in the remote environment was Operation Weekly – a

meeting between developers and individual DevOps team members to discuss resource and infrastructure issues. The regularity of Sprint Review meetings also deteriorated relative to the on-site environment. In the remote mode, the meeting used to take place every two to three sprints, and over time this regularity has diminished to an occasional occurrence. In contrast, at the office Sprint Review was held every sprint, and it was seldom canceled – only if a particular sprint did not produce any presentable Increment. In the *GroupApp* project, the only change was to hold Sprint Review every second iteration to save the development team's time.

A survey fueled by prior non-structured interviews revealed both positive and negative feedback regarding Scrum performance in a remote environment (Table 3). The main conclusions are as follows: (1) working from home hinders both communication between teams and ad-hoc communication between team members; (2) teams' commitment is lower in a remote environment; (3) it becomes increasingly difficult to integrate a new employee into a virtual team; and (4) being physically together in the open space office favors the development of innovative solutions.

Table 3. Selected qualitative feedback – the first AR cycle.

Setting fit	— *"Remote: to pursue tasks. On-site: for creative work"* [System Architect] — *"Working on-site is better when a project requires a lot of creativity and innovation. Such a setting helps create more team involvement which is necessary when there are a lot of unknowns. For more delivery-oriented projects or when there are fewer unknowns and it's easy to plan the work, the remote setting is convenient as the tools currently available make managing work easy"* [Developer] — *"On-site is better for coming up with something out-of-the-book; remote is better for earning more from the project"* [Developer] — *"Both methods of conducting Scrum have their advantages and disadvantages. A lot depends on the project, its complexity, and the people involved. When a project is developed by people from multiple locations, remote work gains more advantages. In the case of a project developed by a team in a single location, physical collocation can have a number of advantages. Of course, we must also take into account individual characteristics of team members: some simply work better in the office, others remotely"* [Developer]
Communication and maintaining focus	— *"When working remotely during meetings, I am able to prepare lunch or do some exercises – albeit it is much harder for interpersonal contact"* [Developer] — *"Certainly, the role of the Scrum master in terms of the 'soft' part is made more difficult, because people – as a rule – prefer not to turn the cameras on. Muting the microphone makes team members less willing to speak up; and even often by the time they manage to turn on the microphone, the meeting has already moved on to another topic. Without seeing the body language of others, it is difficult to determine what a given member would prefer, how they feel, and what they actually think about a topic. Meetings cease to be relaxed and become more focused on the work and the task. This is nice at first, but in the long run, it erodes morale, and with that also the quality of work/creativity. Bringing in new members is especially challenging. Established staff may not see that much of a difference, while it is extraordinarily difficult for newcomers to get acquainted with a project and feel like they are a part of the team"* [Scrum Master]

(*continued*)

Table 3. (*continued*)

Communication and maintaining focus (cont.)	— *"I see such a benefit in remote work that I can attend a meeting and do something else in parallel. Normally that would not be welcome. Remotely, what the eyes do not see… Being co-located in the same office facilitates communication outside of the process. You turn around in your chair, shout that something is not working, and a discussion is swiftly established"* [Developer] —*"Working in the office I have always spent half a day at meetings, and the time was often wasted. Now, as the meeting moderately concerns me, I can do a task, at the same time knowing what is being said there"* [Developer] —*"On-site office environment: you want to do something, but someone asks if you are going out for coffee. So the job rests. But during that coffee, there may be an 'unplanned' exchange of ideas and something interesting comes up. It is a toss-up. If I were developing any sort of app of my own, I would definitely prefer the core team to have direct contact. I myself somewhat nostalgically remember those ad-hoc meetings, when you would gather with the team in a small cubicle: people armed only with their brains and crayons to draw on the board – and we would work out an issue. The best part of the job, as far as I am concerned, is gone now. I also get the impression that we used to try to analyze an issue in-depth, consider various possibilities, and finally choose the optimal solution. And now there is a 'put it into production ASAP' policy in place"* [System Architect] — *"On-site office environment: the team gets together and comes up with a solution. Everyone then knows why it was done that way. Remotely: a person comes up with a solution and presents it ostensibly for review. And the reviewer is actually busy with something else (he/she has one's tasks on the board) and most often just pats it down because it is also inappropriate to say 'do it completely differently'. So maybe it is that the transition to remote has simply intensified this"* [Developer]
Perceived efficiency	— *"I have a somewhat similar feeling that it is easier to stick to the schedule and efficiency of meetings when Scrumming remotely"* [Developer] — *"I have said again and again that there are too many meetings and that people are invited who should not/do not want to be there. In fact, it is not an on-site/remote Scrum problem, but if you cannot change this (and you simply cannot), it is easier to cope with remotely (for me). In addition, all folks are by the computer. I can write to someone and quickly find out from a given person about what and how. Also, it depends on the person/project /team. I would gain nothing being on-site except the stress of being stuck in traffic"* [Developer] — *"It seems to me that working on-site makes less sense than working from home. My main point is that better organization of work in remote mode is absolutely necessary, so introducing such a mode significantly improves work, communication, and team engagement. What I have not quite witnessed at the office, where it was more perceived (at least from my observation) as redundancy of meetings… Because we communicate all the time anyway"* [Business Analyst] — *"I did not have a chance to work in an office environment, but in general I am sure I am more efficient remotely (the fact is that I have decent working conditions at home). In the office, there are a lot of distractions and I am just able to get more done working remotely"* [Developer]

The results of the *Diagnosing* phase prompted the research team to prioritize the issue of improving team communication patterns within *Action Planning*. To this end, communication patterns and practices used by the teams at that time were scrutinized. In both cases, communication patterns used were akin to the decentralized Comcon model

(Fig. 1). In the Comcon everyone is free to communicate with the rest of the team [22]. Besides, cross-team information exchange was not governed by any rules; developers contacted professionals from other teams asynchronously. This often led to multiple repetitions of a given piece of information within the surveyed teams and sometimes resulted in repeated queries to people from other teams.

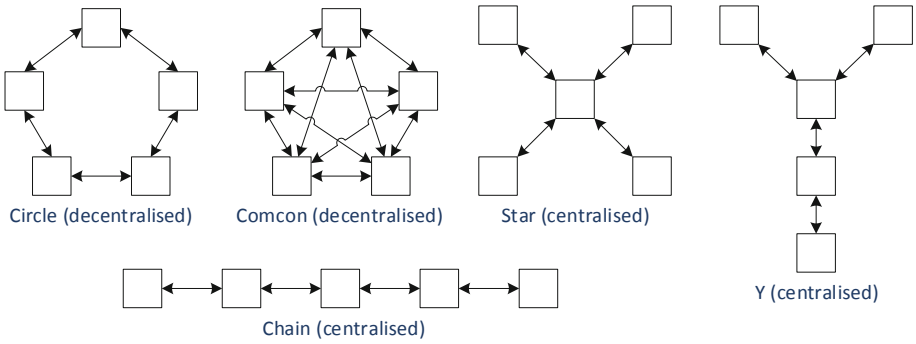

Fig. 1. Team communication models [22].

To address the problem, teams were presented with three centralized models – Star, Y, and Chain (Fig. 1). Upon discussion within the teams, it was agreed that internal communication should remain free-form and become as direct as possible, as typical for the Comcon model. However, cross-team communication should be handled by designated individuals. A developer with the deepest knowledge in every team assumed the role of Service Manager (SM) and was assigned the responsibility of aggregating information from other teams and answering immediately teammates' questions that did not require third-party involvement. Henceforth, other developers were instructed to pass on cross-team inquiries to the SM and avoid contacting collaborating teams on their own. In order to improve decision-making at the cross-team level, it was also decided that SMs would not forward inquiries directly to their counterparts from other teams, but to the Project Manager instead – who was also able to answer some questions at once. If necessary, it was the latter's responsibility to gather information from other teams. Thus, cross-team communication became aligned with the centralized Star model and the overall communication model took on a hybrid form (Fig. 2).

In order to make the process of transferring information between teams more transparent, documentation was proposed, describing who, on which team, is responsible for which specific area, and to whom (if necessary) to direct specific questions. On top of that, each team under study along with collaborating teams was advised to create an extensive Q&A to keep question repetitions in check. To ensure a regular exchange of information between teams, periodic meetings were stipulated for Service and Project Managers. The meetings were designed as optional since there was not always a need to pass information. That said, the calendar placeholder itself ensured that everyone was available at the same time. Finally, separate channels on the MS Teams platform (dedicated to specific areas of the project) were set up. One of those was to be used to communicate internal information regarding merge requests and tasks awaiting review.

The other was dedicated to solving technical problems from a programming standpoint. Unlike the former channel which did not have a clearly specified post structure, the latter came with a template with several fields necessary for the inquirer to complete. The fields included the JIRA task number, component, technology, and possible working solutions.

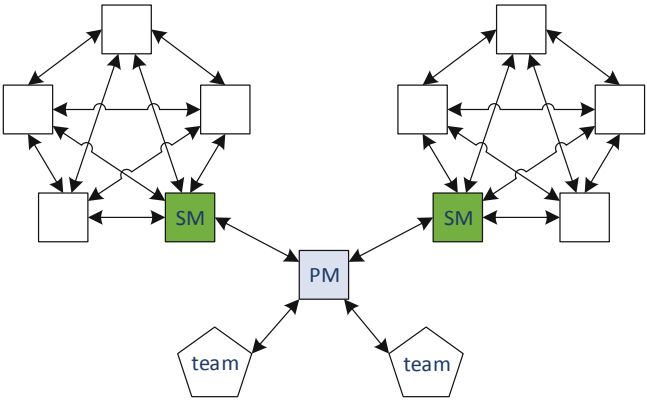

Fig. 2. Hybrid team communication solution.

Regarding the difficulties with integrating new employees, it was proposed to work co-located in the office for one day a week. Such on-site workdays would allow for organizing most of the Scrum ceremonies as face-to-face meetings and taking advantage of effective communication opportunities. Presenting stories to jointly work out solutions, discussing the advantages and disadvantages of a given variant, fostering familiarity between employees, and creating a positive team vibe contribute to the quality of the end product. Teams were not forced to have a predetermined day of the week on which they should come to the office. The decision on the chosen day was still in the hands of the team and resulted from needs at a given time – which allowed the team to maintain its autonomy. Lastly, although *Diagnosing* clearly pointed towards a decrease in team engagement, due to the already broad scope of changes being planned to introduce, it was decided to address this issue in the next AR cycle.

Action Taking spanned across three Sprints. After a total of six weeks, the interventions were assessed. *Evaluating* gathered feedback on the following aspects (Fig. 3):

Q1.1 – Appointing Service Managers to relay information improved communication between teams;
Q1.2 – Setting up optional meetings between Service Managers and the Project Manager improved knowledge sharing between teams;
Q1.3 – Establishing a new, explicit communication model that specifies with whom, in what case to communicate improved communication efficiency;
Q1.4 – Introducing additional channels on the MS Teams platform dedicated to specific areas of the project improved ad-hoc communication.

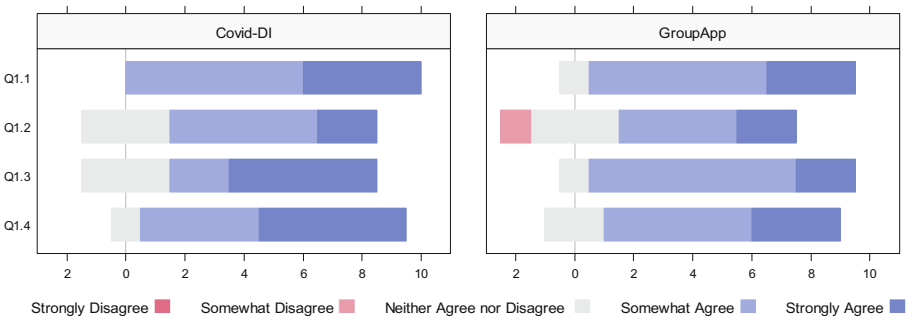

Fig. 3. Aggregated results of the evaluation survey conducted during the first AR cycle.

Eventually, given both the performance of both teams across the Sprints and the feedback, *Specifying Learning* led to the following conclusions:

1. **Establishing an explicit communication model and appointing Service Managers to relay information facilitate cross-team communication**. The remote environment has almost deprived ad-hoc communication, which was done naturally in the open space office environment (the proverbial "spin on the chair"). By implementing clearly defined communication patterns and identifying the appropriate individuals responsible for gathering and relaying external information, the teams were able to communicate more efficiently. The new approach not only reduced the number of questions that went unanswered for prolonged periods of time but also decreased the number of developers that one had to disturb before reaching the developer who actually knew the answer.
2. **Joint meetings between Service Managers and the Project Manager improve knowledge sharing**. Providing a convenient time for all Service Managers to talk to each other affects the overall awareness of the activities of the collaborating teams and allows immediate decisions to be made on topics affecting their work. In addition, it ensures that key stakeholders will have time to deal with issues affecting other teams, which are very often set aside. A faster and more transparent flow of information also ensures a reduction in possible errors resulting from misunderstandings between teams.
3. **Introducing additional areas for specific types of information improves communication**. One of the problems encountered in the remote environment was information preservation and duplication. Establishing additional channels on the MS Teams platform improved the response rate of teammates on specific issues and ensured that the knowledge transferred was, to some extent, preserved.

3.2 The Second Action Research Cycle

Upon completing the intervention, it was decided that the following two-week sprint should constitute a hiatus between the research cycles. This allowed both teams to unwind from additional workflows (attending focus groups, completing surveys), and to consolidate previously implemented solutions before the next cycle.

Although the discussion regarding Scrum's deficiencies in the remote environment and the extent to which the main issues have been addressed by the already implemented measures proved to be vigorous, members of both teams mostly agreed that the quality of the meetings suffered in the remote environment, while the transparency of the teams' work deteriorated. They supported this *Diagnosis* primarily by pointing out frequent occurrences of silence during meetings ("as if no one knows who is supposed to speak up now"), reduced interactions, and greater variability in the online meeting toolset used (e.g., various applications for conducting retrospectives). The *Covid-DI* team considered Daily Scrum to be the most problematic meeting, whereas the *Group App* team highlighted Sprint Retrospective. However, both teams specifically referenced both of these ceremonies. In addition to the previously mentioned problems, participants also hinted that Sprint Retrospective was getting overlong for them, and they were losing interest in it. Several people felt that "retros were held for the sake of holding them". The aforementioned factors primarily caused a big decline in the amount of information exchange.

Moreover, the majority of participants agreed with the statement that regardless of the ceremony, in the remote environment, they are more likely to miss significant information and have to spend more time inquiring about the issues of specific people even just after the meeting is over. Those with more seniority in the industry and experience working in Scrum noted that the principles of the framework in a remote environment began to deteriorate. They highlighted the increased number of meetings resulting from the need for re-discussions, the failure to keep meetings within time constraints, the resulting necessity to catch up on any suspended meetings, and conducting some ceremonies (e.g. Sprint Retrospective) not in line with the Scrum Guide.

As further scrutiny confirmed an increase in the volume of information provided while decreasing the number of tangible details, one of the measures proposed within *Action Planning* was to keep webcams active during meetings. By observing someone's gestures or facial expressions, others can effectively assess whether a message has been understood and whether the audience agrees with the statement made. On top of that, to enhance the flow of conversations during meetings, individuals working in a quiet environment were expected to keep their microphones on to avoid wasting time unmuting themselves. Oftentimes switching to the application window and hitting the unmute button proved to take up enough time for the speaker to move on to the next topic, resulting in disregarding any concerns from the team. Additionally, it was agreed to allocate the last three minutes of a meeting to a brief summary. At the Daily Scrum, Scrum Master was to recapitulate crucial information that had been given during the meeting and to make sure that everyone had grasped it. During the Sprint Retrospective, both the completed action points and newly established ones were to be recapped at the end.

As for maintaining the principles of Scrum, i.e. transparency and self-organization, it was decided to conduct Q&A-heavy single-day training sessions for both teams on the Scrum framework. The training sessions, which were conducted by the Scrum Masters, followed a uniform agenda consisting of the following: (1) an overview of various project management methods; (2) the Agile Manifesto; (3) the Scrum framework, including its

principles, artifacts, ceremonies, roles, and strengths; (4) Scrum vs. SAFe; and (5) a summary.

Notwithstanding the above, in order to address the issue of the lack of engagement, which was identified in the first cycle but left unresolved, it was decided to introduce workshops to better understand the project and the needs of the teams. The workshops were held on-site, as an opportunity presented itself for the management to get to know people working for a shorter time than the rest. During this time, meetings were held with team leaders to convey the broad vision of the project. Professionals were given an opportunity to express in what direction they would like to develop, what they like about the project, and what is missing. Furthermore, even though it was not evaluated in the first cycle due to a too-short time horizon, the rule of one working day in the office to facilitate the onboarding process of newcomers and the socialization of team members was maintained.

After another three Sprints of the *Action Taking* phase, the *Evaluating* phase took place to determine whether the following actions had the desired effects (Fig. 4):

Q2.1 – Running workshops to discuss the project and the needs of the team increased team engagement;
Q2.2 – Having the team co-located in the office once a week accelerated the integration of newcomers;
Q2.3 – Creating a meeting summary facilitated retention of key aspects;
Q2.4 – turning on cameras and microphones during meetings improved signaling of concerns and understanding of the information provided;
Q2.5 – Conducting Scrum training improved adherence to the established principles of the framework.

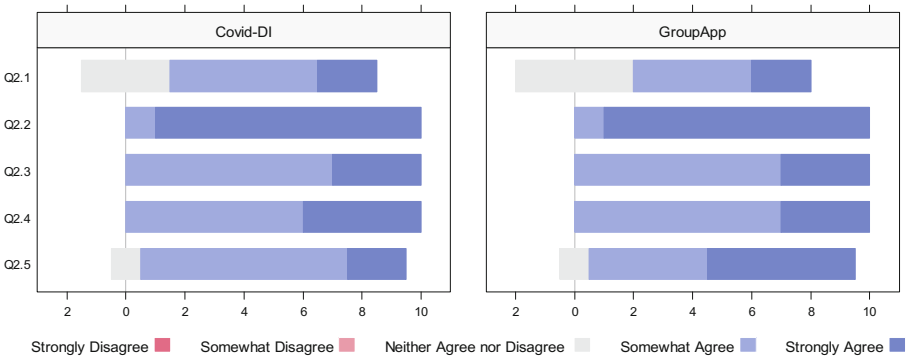

Fig. 4. Aggregated results of the evaluation survey conducted during the second AR cycle.

The feedback was overwhelmingly positive. Thus, *Specifying Learning* phase completed the intervention with the following lessons learned:

1. **The way online meetings are conducted affects the effectiveness of communication**. Keeping webcams switched on allows for more natural and nuanced communication by enabling team members to observe each other's reactions and body

language. This can enhance engagement, build trust, and foster a smoother exchange of information. In addition, the introduction of a brief summary at the end of meetings facilitates better recollection, which, in turn, leads to greater awareness among team members of the issues at hand.

2. **A better understanding of Scrum enhances the team's ability to collaborate effectively.** A remote environment exposes dysfunctions within a team. Fixing the Scrum process requires a comprehensive knowledge of the framework, which can be obtained by participating in training sessions.
3. **Workshops that discuss the project vision and the team's needs have a positive impact on team commitment**. Such workshops provide a shared understanding of the project and its context, foster team bonding, and encourage openness among individuals.
4. **Requiring workers to come to the office one day per week constitutes a healthy compromise that balances work flexibility, employee integration, and collaboration quality through in-person sessions.** This practice not only enables most Scrum ceremonies to be organized on-site but also fosters spontaneous conversations. During such conversations, employees occasionally tend to move away from work-related topics, which promotes the growth of social connections.
5. **Not all members of an agile team necessarily have an agile mindset.** Typically, some developers are hesitant to exchange information or share knowledge, and this attitude may persist regardless of the working environment. In fact, our prior research [23] in an on-site environment revealed the same findings. However, in a remote setting, this reluctance can further exacerbate communication and collaboration challenges with these individuals.

4 Discussion

4.1 How Did Scrum Teams Adapt Their Practices and Processes Due to the Ad-Hoc Shift to Remote Work?

Numerous studies have reported that to transition to remote work, agile teams implemented virtualization of work using software tools [2, 5, 6, 8, 15]. Video conferencing platforms such as Microsoft Teams and Zoom have enabled Scrum meetings to be conducted remotely, while online whiteboard-based collaboration tools like Miro and Mural have facilitated collaboration. It is not surprising that the ad-hoc shift to remote work in the participating teams looked quite similar. Additionally, our teams have introduced dedicated tools that incorporate collaborative games (proven successful in face-to-face meetings [9, 23–25]) for effective Sprint Retrospective and Sprint Planning. Interestingly, this approach stood out, as Neumann & Bogdanov [6] found in their SLR that other teams relied solely on the chat functionality within video conferencing tools and, consequently, lost the playful nature of their meetings. Additionally, one of our teams implemented new types of meetings to coordinate work with collaborating teams.

4.2 What are the Advantages of Remote Work for Scrum Team Members?

Several advantages of remote work were highlighted by the participants of our study, which can be categorized into two main groups: increased flexibility and improved productivity. In fact, the latter may be an outcome of the former, as greater flexibility results

in happier developers, and empirical evidence from previous studies has shown that happy developers are more productive [26]. With a work-from-home policy, software engineers enjoy greater control over their work schedule, resulting in higher job satisfaction and a better work-life balance. Accordingly, the majority of them would like to continue working remotely, which indicates an improvement in their well-being. Moreover, remote work enables them to be more productive by reducing distractions and interruptions while enhancing their ability to focus on the tasks at hand. Furthermore, remote work saves time that would otherwise be spent on commuting. These findings are in line with the results of several previous studies [3–5, 15, 27], some of which even suggest that employees can no longer imagine switching to pure co-located work [15]. Nonetheless, some authors have emphasized the negative aspects associated with remote work. Ralph et al. found that the pandemic had a negative effect on developers' well-being and productivity [14], while Butt et al. reported that the investigated team members experienced increased mental and physical stress [1]. Additionally, Griffin [17] described the challenge of household distractions for agile team members working from home. Finally, it was suggested that the work-life balance was disrupted by even more blurred boundaries between work and life [7].

4.3 What New Challenges are Faced by Virtual Scrum Teams and Their Members?

Despite the availability of various tools to support both synchronous and asynchronous communication, the absence of face-to-face interaction introduced a lot of inefficiency to the exchange of information and required the investigated teams to put extra effort into collaboration. Additionally, many participants in our study noticed that remote work hindered creativity since team members became less interconnected. Furthermore, without regular in-person interactions, both teams experienced a significant decrease in social exchange, which resulted in a reduced sense of team cohesion. These observations are consistent with the results of several previous studies [5–7, 16, 28]. Another challenge that arose in a remote environment was the onboarding process of new team members. This challenge encompassed both the need to assimilate newcomers into the team dynamic, as well as to ensure their understanding of established processes, practices, and tools. Prior studies [3, 5, 6, 29] also observed this challenge. Finally, in both participating teams the transparency of the team's work deteriorated, requiring special actions to restore it. This finding contradicts previous studies [2, 3, 5], which reported that the overall transparency increased as a result of the digitization of artifacts and the increased use of digital chat channels.

5 Conclusions

The COVID-19 pandemic revealed that many preconceptions about remote work were misplaced. What is more, even though the pandemic is behind us, there is a global desire to retain the flexibility of remote work. Our research confirms the numerous benefits of remote work that have been identified in previous studies. Working from home allows for increased employee comfort and greater personalization of one's work environment,

creating opportunities to better align personal and professional needs. Moreover, working remotely eliminates the time and expense associated with daily commuting to a physical office. Nevertheless, the ad-hoc switch to remote work also presented challenges for agile teams, such as a lack of proper communication and reduced team cohesion. In this work, we report on an Action Research project in Lufthansa Systems Poland, where we worked with two Scrum teams to systematically address challenges posed by the remote environment. Our collaboration resulted in the following solutions:

- establishing an explicit communication model between collaborating teams;
- setting up optional meetings for representatives of collaborating teams and the Project Manager;
- introducing one on-site workday per week;
- summarizing meetings at the end of the session;
- keeping webcams on during online meetings;
- establishing additional channels on the MS Teams platform to maintain knowledge;
- organizing occasional workshops to discuss the project vision and the team's needs.

Our research not only demonstrates once again that Scrum is agile itself and thus can be applied outside of its traditional boundaries (previously Scrum has its proved flexibility in adapting to large-scale projects [30–33]) but also shows that Scrum in an online environment does not lose its benefits.

The study has two main limitations. Firstly, the evaluation of the implemented solutions was done subjectively. Secondly, there is a potential bias among study participants. Employees who already hold the belief of working exclusively remotely may not have viewed on-site meetings positively and could have disregarded their positive aspects.

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