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Best practices for work from home: A qualitative survey in open source and distributed software development

Katharina Müller [a],*, Nikolay Harutyunyan [a], Dirk Riehle [a], Christian Koch [b]

[a] Friedrich-Alexander-University, Erlangen, Germany
[b] Georg Simon Ohm University of Applied Sciences, Nuremberg, Germany

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ABSTRACT

Due to the COVID-19 pandemic that broke out in 2020, companies switched to working from home on a large scale. Now, in 2025, many employees are working from home entirely or are only in the office irregularly. This has created a new working environment for many software professionals that resembles both the distributed software development (DSD) and open source software development (OSS) models. While working from home or a hybrid work environment is relatively new for many organizations (about 5 years), the challenges in DSD and OSS development have already been widely researched. Our research question focuses on best practices derived from OSS and DSD that solve the current challenges of working from home. We conducted a qualitative survey and interviewed fifteen individuals who have experience with DSD or OSS development. In this paper, we present fourteen proposed best practices for remote communication, collaboration, management, and tooling. Using the context–problem–solution pattern, we go beyond presenting high-level practices and suggest actionable details. The results of the study provide insights into this topic with high industry relevance. At the same time, the study contributes to existing academic research on working from home and the consequences of the COVID-19 pandemic.

1. Introduction

Distributed software development (DSD) is a topic of broad interest, both in academia and among practitioners. Since March 2020, we have observed a special form of DSD as the switch to remote work in many cases was unplanned and without time for preparation. Now, in 2025, we are faced with a new working environment in many traditional companies, where the focus changed from working on site to working from home (Ford et al. [1], de Souza Santos and Ralph [2]). At the same time, part of the staff returned to the offices. Thus, more and more companies are providing a hybrid collaboration model in which some employees work from home while others work on premises. The collaboration model is expected to remain permanently. This form of working in turn brings new challenges (Chou et al. [3], Neumann et al. [4]).

This paper presents best practices from the areas of open source software (OSS) and DSD that address the current challenges faced by software professionals. Our study is based on existing research on the current challenges software developers face when working from home and in a hybrid environment. In addition, we conducted our own study (Müller et al. [5]) to gather insights from more than 100 software professionals who had to switch to remote work abruptly and without preparation due to the COVID-19 pandemic. The study focused on identifying the main challenges these professionals experienced in their new working environment. In our previous study (Müller et al. [5]), we identified challenges of working from home in the following categories: communication, collaboration, management, and tooling.

In terms of communication, the lack of personal contact, technical communication problems and finding the right balance between synchronous and asynchronous communication were seen as the biggest challenges. In terms of collaboration, dependence on colleagues and the feeling of always having to be available were cited as the biggest challenges. In the management category, a slower decision-making process and planning problems were categorized as challenges. The biggest challenge in using tools was to find suitable tools that support collaboration and knowledge transfer. We also found that employees working in a competitive team were significantly less satisfied with the work from home situation.

For some challenges, known best practices from OSS and DSD can be adapted. For others, new best practices need to be developed as they differ from the challenges we know from distributed collaboration

* Corresponding author.
E-mail addresses: katharina.katmue.mueller@fau.de (K. Müller), nikolay.harutyunyan@fau.de (N. Harutyunyan), dirk@riehle.org (D. Riehle), christian.koch@th-nuernberg.de (C. Koch).

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between multiple locations of an organization (as often addressed in previous DSD research) or from individual employees working from home (which has been the common case in studies on working from home). In this work, we identify existing research and interview experts in the field of OSS development and DSD who have experienced working from home to gather proposed best practices for key current challenges in software development. The broad research question we asked was:

> **RQ:** What are open source and distributed software development best practices for management, collaboration, communication, and tooling that meet the current challenges of employees in the software industry due to the changing ways of working caused by the COVID-19 pandemic?

To answer the research question, we conducted a qualitative survey according to Jansen et al. [6], which included fifteen expert interviews. We used the context–problem–solution pattern after Harutyunyan et al. [7] to go beyond high-level representation and suggest actionable details for practice in the areas of communication, collaboration, management, and tooling.

The article is structured as follows: Section 2 defines key terms and concepts of the article. Section 3 provides an overview of the relevant literature on current best practices in DSD, OSS and working from home due to the changing forms of work triggered by the COVID-19 pandemic. In Section 4 we present our research approach and methodology, including qualitative data collection and analysis. In Section 5 we explain the research results. In Section 6 we discuss the results and limitations of the study, including threats to internal and external validity. Section 7 concludes the paper.

2. Background

The section defines key terms and concepts of the article namely open source and distributed software development as well as work from home.

2.1. Open source software development

OSS is software whose source code is disclosed so that anyone can modify, improve, and redistribute the software under the same license terms. Open source software development describes the collaborative and transparent development of such software by communities or organizations [8,9]. OSS developers work in arbitrary locations and collaborate primarily via the Internet [10].

2.2. Distributed software development

DSD refers to an approach in which team members are spread across different geographical locations, either within the same organization or as a collaboration between different organizations. This allows access to specialized professionals and potential cost advantages, but also presents challenges in communication, coordination, and product quality [11]. In this paper, we use the term DSD to encompass “global”, “distributed”, and “multi-site” software development and define it as "the management, development, and maintenance of software being geographically distributed across the globe" [12]. While we found multiple definitions and nuances between each term, we took this broad notion because our topic was sufficiently and equally distinct from the expressions above.

2.3. Work from home

There are many terms that describe the same phenomenon, such as “home office”, “work from home”, “remote work”, and “telework”, among others. Due to the COVID-19 pandemic and the resulting lockdowns in 2020, working from home has become more relevant and has encompassed entire teams (rather than just individuals). When we write about “work from home” we mean a form of work in which employees perform their duties entirely or predominantly from their private residence, supported by digital tools and communication media [13]. We refer to this phenomenon under investigation as “work from home” throughout the paper. The case examined in this research therefore shows similarities to OSS development (insofar as the entire team works from home) or to the DSD approach (in case some employees are in the office while others work from home).

3. Related work

OSS, DSD and work from home have been studied extensively in the literature, with a focus on challenges and best practices. Before the pandemic, individuals worked from home, but rarely did entire teams. Therefore, work from home literature (written before the pandemic) is not necessarily relevant to our research, which focuses on entire teams, or at least the majority of a team, working from home. Many companies meanwhile have several years of experience with large-scale remote working. However, DSD and OSS development already have decades of experience with distributed work and focus on software development teams, just as we do in our research. Therefore, we emphasize the existing DSD and OSS literature as a basis for our research (next to work from home research conducted during the pandemic of course).

DSD is a topic of great interest in the software engineering community, and several studies have addressed the challenges and effective strategies. A notable work by Espinosa et al. [14] investigated the coordination challenges in large distributed software projects and proposed strategies to mitigate the problems arising from geographic distribution. We propose some industry-inspired best practices that mitigate these issues. The open source model has emerged as a significant paradigm in software development, and research in this area focuses on the practices of collaboration and coordination between distributed teams. A study by Scholtes et al. [15] investigated how coordination and communication patterns influence the productivity of OSS teams and highlighted effective practices for successful collaboration. A TOSEM paper on software developers working from home includes two surveys from 2021 that captured the challenges and self-reported productivity of engineers following the switch to remote working during the pandemic.

Team connectivity was cited as the biggest challenge and, at the same time, one of the most important success factors for distributed work by software teams [16]. In our best practice suggestions, we focus on the issue of teamwork and communication and offer potential improvements for practitioners.

In examining the current state of the literature on this topic, we found that the majority of research is exploratory case studies reporting on challenges, problems and success factors, rather than empirical evaluations of methods, techniques or tools Šmite et al. [17]. In contrast, we focused on the latter and propose practices that include methods and techniques for efficient work from home that can be implemented by practitioners in industry.

The sudden shift to remote working during the COVID-19 pandemic has sparked interest in the challenges faced by software professionals. A study by Russo et al. [18] examined the impact of remote working on the wellbeing and productivity of software developers and provided insights into effective remote working practices. In particular, the following factors were measured in relation to employee wellbeing: Distraction, noise, lighting, temperature, chair comfort and general ergonomics. As organizations adopt hybrid collaboration models, where some employees work from home while others are in the office, new challenges arise for the effective management of distributed teams. In their systematic literature review on the topic: "Managing Remote Work in Distributed Software Development Teams", Milfont et al. identified 30 issues that managers need to consider when managing remote work in software development, including effective communication and collaboration strategies, trust building, fostering a supportive work culture, and continuous feedback [19]. A study by Park et al. [20] examined the benefits and challenges of hybrid work arrangements and suggested best practices to foster collaboration and communication in such constellations.

Effective communication and collaboration are critical to the success of remote work. In their research, Wang and Haggerty [21] investigated the effects of different types of communication on the performance of remote teams and made recommendations for the selection of suitable communication channels in distributed software development. Cavalcanti et al. [22] also examined communication challenges in remote work, focusing on feedback to remote software development teams.

The COVID-19 pandemic has had a profound impact on the adoption of remote work practices. A study by Neumann et al. [23] investigated the effects of the pandemic on software development teams and their transition to remote work, highlighting the challenges faced and the strategies employed to adapt to the new working environment. The sudden switch to remote work without prior preparation posed significant challenges for software development teams. In their research, Wang et al. [24] examined the difficulties faced by software professionals during the immediate transition to remote work and proposed strategies for addressing the associated challenges. Adzgauskaite et al. [25] also analyzed the success factors for agile software development teams working remotely and revealed that perceived pressure from government, job performance, and team satisfaction are important factors for project success. Hybrid work, a fusion of different work environments that allow employees to work in and outside their offices, was analyzed in a systematic mapping study by Khanna et al. [26]. In this regard, online tools played a key role in supporting hybrid working methods in agile software development.

The adoption of virtual collaboration tools became crucial during the COVID-19 pandemic to facilitate remote work. A study by Nguyen-Duc et al. [27] explored the use of collaboration tools by software development teams and identified their effectiveness in supporting communication and coordination in the remote work context. The systematic literature review by de Andrade et al. [28] recommends best practices for remote meetings in software teams, including the use of tools.

This related literature has contributed valuable insights into the challenges and best practices for distributed software development, open-source collaboration, and remote work. By building upon this existing research, our study aims to identify best practices that address the current challenges faced by software professionals in their current working environments.

4. Research design

4.1. Qualitative survey research

To answer the research question, we conducted a qualitative survey informed by Jansen et al. [6] and based on the results we derived from a former study (Müller et al. [5]). We chose the qualitative survey as our research method because we aimed to analyze the diversity of member characteristics and get deeper insights in the various approaches on how to solve current work-from-home challenges. Thereby, frequencies were less important than the careful analysis of each interview (unlike in traditional quantitative surveys), as one occurrence of the data was potentially as useful as many in understanding the phenomenon. In our previous study (Müller et al. [5]), we conducted a quantitative survey to identify main challenges of entire teams working from home due to the pandemic in 2020. Conducting a quantitative survey had a number of advantages, including a clear evaluation of the figures and finding correlations using mathematical models. After evaluating the quantitative findings, we were left with many follow-up questions not covered by the data. Due to this limitation of a quantitative survey (lots of data but little depth), we decided to add interviews by conducting a qualitative survey in our previous study. We understood that our research focus was on in-depth insights and not on generalized hypothesis statements (Mason et al. [29]). The goal of our current study again is gaining in-depth insights to derive and present a theory of proposed best practices for distributed work. So we used interviews again to gather our data. We plan to evaluate our theory in future work by implementing these practices in a case study company, which will lead to a separate publication. Given the relevance of this topic and novel insights, we present the proposed best practices in this paper, so that others can also apply or validate them.

According to Fink [30] a qualitative sample should represent the diversity of the studied phenomenon (best practices for distributed work) in the context of the target population (work from home software development in our case). According to Jansen et al. [6], researchers should purposely select a diverse sample with the aim to cover all existing relevant varieties of the phenomenon that would lead to theoretical saturation. To build a theory of proposed best practices for distributed work, we took a practice-based approach looking for companies with an advanced understanding and experience in distributed work.

For the population of our qualitative survey, we searched for companies that worked in a distributed manner on a regular basis before the COVID-19 pandemic e.g. open source organizations or projects.

To select suitable interviewees, we first created a sampling model. It contains categories towards factors we believe might have an influence on how employees dealing with challenges in remote work: the interviewee's company, the company's unit, sector, industry and size next to the country, role, and experience in DSD/OSS of the interviewee. Our sampling procedure for the companies was directed by recommendations from Open Hub (to find suitable open source organizations or projects) and by our network of industry partners (to find companies experienced in DSD). Open Hub is an online service for cataloging OSS projects, founded by two former Microsoft managers. It compiles statistics on more than 200,000 projects.

In our first sampling iteration we clustered over 50 companies that are either open source companies or companies in which employees used to work distributed before the corona lockdown. We grouped the companies according to the company's unit (organization, project, company), sector (commercial, education, government, non profit), industry and size (large, medium, small).

This yielded seven groups of companies that are identical in the selected categories (unit, sector, industry, and size). We selected two companies from each of these groups and asked for an interview partner from the respective companies. When making our selection, we took into account which companies we were best able to reach based on previous collaborations.

Following the qualitative survey method (Jansen et al. [6]), we wanted to gain in-depth insights from each of the companies and a wide range of interviews relevant to our research topic (Mays and Pope [31]).

The interview protocol was developed by leveraging the challenges of software professionals we identified in our former study (Müller et al. [5]) and aimed to gather approaches on how to mitigate or solve these challenges using best practices of software development teams that have been distributed for years or even for decades.

We validated the interview protocol through a pilot interview with one member of our research group. In some cases, we made minor changes to the interview protocol based on insights gained from previous interviews. At the beginning, for example, we only asked how communication and collaboration are currently handled in the team.

Table 1
Data sources of the qualitative study.

ID	Expert Role	Industry	Size	Country	Expertise
I01	Co-Founder	Software Development	Small	Spain	DSD
I02	Board Member	OSS Foundation	Large	US	OSS
I03	Developer	OSS Foundation	Large	DE	OSS
I04	Developer	Internet Services	Large	CH	DSD
I05	Manager	Software Development	Large	DE	DSD
I06	Developer	Cloud Computing	Large	DE	OSS
I07	Researcher	University (OSS Chair)	Medium	CA	OSS/DSD
I08	Developer	Software Development	Large	CA	DSD
I09	Consultant	Consulting	Medium	AT	OSS/DSD
I10	Manager	Hardware Producer	Small	US	OSS/DSD
I11	Developer	Software Development	Large	DE	DSD
I12	Manager	Hard- & Software	Large	DE	DSD
I13	Developer	Social Media	Medium	US	DSD
I14	Manager	Software Development	Medium	US	DSD
I15	Managing Director	Data Analytics	Small	DE	DSD

After a few interviews, we added the follow-up question of whether the handling had changed over time or remained constant. In this way, we were able to identify trends or certain stages of development within the teams. As the companies adapted more and more to the situation over time, we added the question about additional material, such as rules or official guidelines for working from home.

4.2. Data collection and analysis

In selecting the interview partners, we aimed to identify the individuals who can best explain the phenomenon of interest. In total, we interviewed 15 people from different companies in different countries. Our interview partners were experts in distributed development and included both the management and the development perspective. As an expert, in our context, we define someone who has worked remotely or from home for more than 5 years (before the start of the COVID-19 pandemic) and whose team or majority of the team also works remotely (as is the case in most DSD and OSS projects). Many of the experts are actively involved in OSS projects alongside their main profession (in a company that performs DSD), e.g., the researcher and the consultant we interviewed. In this case, we asked about their experiences with DSD and OSS in our interviews The data we collected is shown in Table 1.

The interviews were conducted remotely via Teams and lasted approximately 45 min. Some were longer, as we wanted to gather as much relevant information as possible and did not interrupt the interviewees when they wanted to elaborate some aspects. We also asked more detailed questions when an aspect seemed new or required explanation. The interviews were conducted by one person. We audio recorded and verbatim transcribed each interview. The transcripts were added to the QDA software (https://qdacity.com/de/) for coding and exploration. We used the thematic analysis according to Braun and Clarke [32] to analyze the data.

After familiarizing ourselves with the data, we created initial codes and themes. The themes included challenges we had identified in our previous research as well as themes we had derived from our current study. As we applied the context–problem–solution pattern for pattern discovery, assessment and validation, we divided the codes accordingly (Harutyunyan et al. [7]). For example, for the theme 'lack of personal contact', we created three codes: 'personal contact - context', 'personal contact - problem' and 'personal contact - solution'. This helped us to understand where a challenge is located (context), why it is a challenge in the first place (problem) and what best practices are used to mitigate the problem (solution).

Here is an example of how we derived a proposed best practice out of the theme (challenge): 'lack of personal contact'. The themes itself were derived from literature and from our previous study (Müller et al. [5]). Quotes like the following described the context of the challenge: "So right now I'm working at my home office. I am alone in front of my computer and I have my three four people in mind that I work with. I think, in the long run my identification with the company, with the team and the goals will diminish''. The problem was stated as follows: "We actually don't have any substitutes to personal contact. I would say that the things that fell through were things that we could not have tackled without personal contact e.g. personal conflicts, personal coaching or to find a common visions or similar topics, these things we dropped and simply did not do them at all''. Of possible solutions such as: "We also now have a weekly meeting, a set time, with no agenda. That's actually this kitchen chat. And that helps tremendously''. or "I find seeing each other helps, of course, but I find, actually, it's more important for me to know where the other person is mentally''. we finally derived the proposed best practice: 'foster personal relationships'.

We developed our theory by performing qualitative data analysis (QDA i.e. "coding") on our interview transcriptions. Using QDA we built our code system. Some codes corresponded to the observed practices, and by way of repeat occurrences and triangulation, we consider them best practices. The overall process, including QDA, of building handbooks of best practices is laid out in Riehle et al. [33].

The code system including the number of codings per code can be found in the appendix.

As a quality assurance measure for our QDA, two co-authors of the paper coded some parts of the data independently, and discussed their results. This helped to adjust and better define the codes in the code system. To ensure theoretical saturation we evaluated the number of new codes and codings per iteration. After several iterations we continued to find evidence for the existing codes (new codings), but no more evidence for new constructs or contradictions (new codes) to our theory in the new data as shown in Fig. 1.

After describing the data collection and approaches used for analyzing the data, in the following, we will explain our results.

5. Results

Our qualitative study resulted in us answering our research question, as well as formulating a set of proposed industry best practices in the form of applicable patterns. We derived 14 common state-of-the-art practices addressing challenges in remote communication, collaboration, management and tooling during our qualitative study. We developed these practices based on the analysis of interviews from

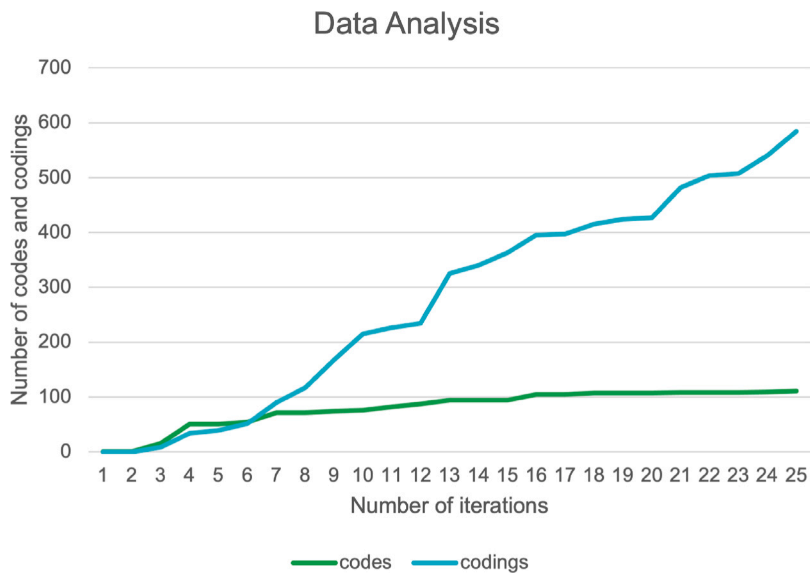

Fig. 1. New codes and codings per iteration until theoretical saturation.

Table 2
Best practices and respective categories.

ID	Category	Proposed Best Practice
BP01	Communication	Foster personal relationships
BP02	Communication	Save certain time slot for answering emails
BP03	Collaboration	Set up mentoring (especially for onboarding)
BP04	Collaboration	Avoid hybrid work (when possible)
BP05	Collaboration	Collaboratively work on decisions
BP06	Collaboration	Parallelize tasks and communicate status
BP07	Management	Manage people oriented
BP08	Management	Foster autonomous decision making
BP09	Management	Establish a tangible mission and vision
BP10	Tooling	Use appropriate and proven tools
BP11	Comm. and Collab.	Foster asynchronous communication
BP12	Comm. and Collab.	Set up meeting rules
BP13	Comm. and Collab.	Communicate availability
BP14	Comm., Collab. and Mgmt.	Distribute information equally

various companies. Table 2 presents the proposed best practices and their respective categories.

Most of these practices are also backed by the literature on the high-level. Using the Context–Problem–Solution patterns we go beyond the high-level presentation of the practices, presenting actionable details.

Together, our proposed practices form a practical handbook for practitioners who want to introduce an efficient work from home setup in their companies. The handbook can be accessed in our public repository. In presenting our findings, we followed a research method we documented and used in our past studies on topics such as open source governance and software supply chain management [33].

In total, we have two proposed best practices in the communication category (BP01 and BP02), four in the collaboration category (BP03–BP06), three for management (BP07–BP09), and one proposed best practice that recommends a range of tools that efficiently support working from home (BP10).

It turned out that meeting in person cannot be substituted by any virtual measure, thus, on a long term perspective it is inevitable to set up meetings in person on a regular basis even if this is only once a year (e.g. conferences, workstations or team onsites) Thus, fostering personal relationships is essential for good remote communication. Save a certain time slot for answering emails also belongs to the proposed practices in the communication category. Mentoring, especially for junior colleagues, is a relevant practice in the category of collaboration. Collaborative decision-making, task parallelization, and status communication are other suggested approaches to avoid bottlenecks or reliance on synchronous communication. Many experts recommended avoiding hybrid working or at least working as if you were at home (i.e., everyone participates in meetings from their own laptop), even if some team members are together in the office, to prevent those working from home from feeling excluded. Manage people oriented and autonomous decision making are recommended practices for managing remote teams. Defining a concrete mission and vision can strengthen the sense of belonging and thus improve loyalty to the team and the company. There are specific tools for communication, collaboration, and documentation that best support working from home. After several years of working from home, these tools are state-of-the-art in most companies. For a complete list of recommended tools, see our handbook on best practices.

There are proposed best practices that cover more than one thematic category e.g. responding to challenges in communication as well as to challenges in collaboration. Examples of such best practices are: Foster asynchronous communication (BP11), Set up meeting rules (BP12) and Communicate availability (BP13). They emphasize the coordination and communication of meetings and availability. The proposed best practice: Distribute information equally (BP14) even covers three thematic categories namely collaboration, communication, and management (view detailed description in our public repository.

6. Discussion

Although most of the practices presented are supported by the literature on the high level, some were more novel or controversial. In this section, we discuss how our results relate to existing studies. In addition, we describe threats to the validity of the study and possible implications for research and practice.

6.1. Relation to existing research results

In our survey, we found that fostering personal relationships helps overcoming communication challenges. Herbsleb and Grinter [34] in their frequently cited paper on challenges in geographically distributed software projects already recommend bringing people who need to communicate together early on. They state that all other means of communication will work better once developers, testers, and managers have some face-to-face time together. This is consistent with the findings of Zaidman and Van Dijk [35], which show that, contrary to previous assumptions, developers nowadays do indeed want social interaction.

Park et al. [20] in this context recommend providing a metaverse, which is a virtual space that imitates a real office setting. In contrast to complete remote work, working in the metaverse increases the chances of workers bumping into their colleagues, which can lead to social interaction. We found that managing people oriented, foster autonomous decision making and distribute information equally are good practices for managing teams in remote or hybrid settings. This is in line with the findings of Wang et al. [24] who recommend managers to employ a more supportive management style such as communication with subordinates using motivating language, building trust within the distributed team, fostering autonomous decision making and sharing information rather than close monitoring. Also Bany Mohammed et al. [16] highlighted autonomy as a key success factor for software projects. Similarly, Adzgauskaite et al. point out that it is important for managers to pay close attention to people management which includes fostering effective communication, collaboration, and knowledge sharing among team members [25]. This is consistent with the findings of the systematic literature review on the most important aspects of managing global software development teams [19]. Russo et al. [18] agree in principle, but add the constraint that while extended autonomy might be perceived positively by employees with a high need for autonomy, it might be perceived as stressful for those who prefer a more structured setup. According to Franken et al. [36], the managerial strategy needs to be defined for the longer term and give work arrangements adequate time to mature.

In our survey we found that software professionals in a distributed team use and recommend similar tools for communication, collaboration and documentation. For communication preferred tools are Microsoft Teams and Zoom for conferencing; and Slack, Mattermost and Microsoft Outlook as messaging tools. Collaboration is supported by tools like Jira and GitHub; and documentation is often structured in Confluence. Neumann et al. [23] underline that technical infrastructure, especially in software applications for communication, play an essential role. The companies from the multiple case study conducted in their paper also used mainly the tools mentioned above. Additionally, further Microsoft tools like Microsoft Planner and Microsoft Team Foundation Server are used in the analyzed companies and some use messaging applications like Threema and WhatsApp. Furthermore, Neumann et al. [23] recommend avoiding the use of too many different tools and the introduction of clear guidelines about which tools may be used.

6.2. Limitations

Limitations of the study are discussed using the framework developed by Gren [37].

Reliability: To potentially repeat the survey, the interview protocol is enclosed in the appendix. Nevertheless, the degree to which the authors are neutral towards the inquiry and their potential bias effect on the findings, is a potential limitation. Qualitative data research realized by only one researcher has inherent subjectivity and bias. In our case one co-author performed most of the QDA. Even though we followed the research method constructs carefully, there is potential bias associated with method interpretation and application. To address this, another co-author independently coded parts of the data, after which the co-authors reviewed and discussed their codings.

Construct Validity: We identified twenty-three themes and about one hundred codes. In summary, we found more than five hundred coding segments that were analyzed following the qualitative survey research method. The main limitation of this research is that the results were derived on the basis of fifteen interviews and that we had only one respondent per company. Confirmatory future research with a widened coverage can further validate the findings presented in this paper.

Conclusion Validity: To ensure reliable conclusions, we discussed the results internally and compared them to current research. However, the practical evaluation of our results is still pending. We are planning a validation study in our next work.

Internal Validity: There could be other confounding factors that impact the causality between measured constructs. To best possible avoid this, the validation of the possible causal relationships was included in the design of the interviews.

External Validity: The best practices proposed in this paper do not cover the full spectrum of the challenges of working from home, as they were limited by the scope of the interviews conducted. Our theory does not claim to fully cover the topic. Future research could help identify practices that fill the gaps in this study and refine our findings.

6.3. Implications for research and practice

Our implication for the research, which arises primarily from the limitations of our study, is to broaden the coverage by extending the survey to more software experts as well as to more industries. In addition, the evaluation of the proposed best practices is still pending and of great practical value. For practitioners, we recommend implementing the practices presented in chapter 5, bearing in mind that it is unlikely that an intervention will have the same effect on all people, so it is important to consider individual differences when exploring the impact of interventions (Russo et al. [18]). We recommend introducing interventions gradually and obtaining regular feedback on their effectiveness from all affected employees.

7. Conclusion

In this paper, we conducted fifteen interviews with experts in distributed software development. We have proposed fourteen best practices for remote communication, collaboration, management, and tooling. These practices address the challenges that software professionals face in relation to their changing ways of working, which we analyzed in a previous research paper. To answer our research question of which best practices address the current challenges of software professionals due to the changing ways of working, we developed a practice-based theory of state-of-the-art practices that form a handbook of best practices for working from home. We provided an overview of the proposed best practices and categorized them. We also presented eight practice examples in an actionable format of context–problem–solution patterns. In our further research, we will conduct a validation study to test the effectiveness of the proposed best practices.

CRediT authorship contribution statement

Katharina Müller: Writing – review & editing, Writing – original draft, Formal analysis. **Nikolay Harutyunyan:** Writing – review & editing, Writing – original draft. **Dirk Riehle:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Christian Koch:** Writing – review & editing.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT in order to improve and rephrase written paragraphs. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Declaration of competing interest

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

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Appendix A. Appendices

A.1 Interview protocol

1	Which company are you working for and what are they doing? What's your role in the project/organization?
2	Do you work entirely distributed?/If yes, since when?/Did your or your teams working mode change because of COVID-19?
3	Did your work mode change (towards more remote work) over time? Why (main reasons)? How?
4	How does your "usual" working day look like? (Do you and your team work during core hours?)
5	What are the most important best practices when working distributed in your experience? (Follow up question: Examples? How did you discover these practices?)
6	How do you cope with missing personal contact?
7	Do you have any (virtual) events so that people get in contact?
8	Did this change after the first Corona Lockdown?
9	How is the decision-making process organized in a remote work setting? Is it more democratic or are decisions made by the boss/by the organization?
10	Who is in charge of strategic decisions and how are they made?
11	Who is in charge of planning (upcoming features, roadmap...)?
12	Did the decision-making process change after the first Corona Lockdown?
13	How do you communicate with your team members?
14	How do you prevent unequal distribution of information?
15	Did communication change after the first Corona Lockdown?
16	How do you collaborate within the team? Do you have fixed processes (e.g. agile development, kanban...)?
17	How do you ensure that people don't depend on experts (bottle necks) for doing their work?
18	Which tools are you using and for what (in the context of remote work)?
19	Did your tools change after the first Corona Lockdown?
20	Are you satisfied with your actual working situation?
21	What could be better?
22	Does your company provide any supplementary material (guidelines, best practices for remote work)?

A.2 Codesystem

Field	Code	Counts
best practices		
	distribution of information	2
	good infrastructure	2
	more documentation	3
	management and organization	2
	office at home	4
	manage your own time	3
	appropriate training	1
	approach people positively	2
	dress properly	1
	build a personal relationship	2
	asynchronous communication	2
	using appropriate tools	2
	no hybrid work	1
	go out	1
	vision and mission	1
	good communication	5
others		
	job satisfaction	16
	agile collaboration	10

Field	Category	Code	Counts
communication			
	unequal distributed information		
		context	10
		problem	5
		solution	25
	lack of personal contact		
		context	28
		problem	36
		solution	65
	synchronous communication		
		context	7
		problem	7
		solution	15
	many emails		
		context	1
		problem	3
		solution	4
	many meetings		
		context	8
		problem	12
		solution	15
collaboration			
	being available at certain core hours		
		context	8
		problem	6
		solution	5
	onboarding		
		context	1
		problem	1
		solution	1
	hybrid work		
		context	4
		problem	3
		solution	8
	strategic collaboration		
		context	1
		problem	4
		solution	4
	depending on experts		
		context	2
		problem	3
		solution	16

Field	Category	Code	Counts
management			
	management		
		context	9
		problem	10
		solution	17
	missing work–life-balance		
		context	10
		problem	10
		solution	10
	decision making		
		context	10
		problem	8
		solution	38
	lack of identification with company/vision/goals		
		context	
		problem	2
		solution	9
	missing team spirit		
		context	1
		problem	0
		solution	0
tooling			
	finding the right tools		
		context	26
		problem	6
		solution	16

Field	Category	Code	Counts
personal challenges			
	missing day structure		
		context	6
		problem	3
		solution	8
	inappropriate environment		
		context	0
		problem	2
		solution	3
	distractions		
		context	3
		problem	6
		solution	1
	bad modes of behavior		
		context	1
		problem	1
		solution	1

The numbers in the "Counts" column indicate how often the context, problem, or a solution for the respective challenge of working from home was mentioned in the interviews.

Data availability

Data will be made available on request.

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