



Unveiling the Spectrum of Hybrid Work in Software Engineering: Research Directions

Maria Paasivaara¹ and Xiaofeng Wang²(✉)

¹ LUT University, Lahti, Finland
maria.paasivaara@lut.fi

² Free University of Bozen Bolzano, Bolzano, Italy
Xiaofeng.Wang@unibz.it

Abstract. Despite the heated debate on whether *hybrid work* would be the new normal in the post-pandemic world, it is an exciting, if not new, research phenomenon for Software Engineering (SE) researchers. Hybrid work has a wide range of dimensions and aspects that need exploration and understanding for modern software companies to truly benefit from it. In this paper, we propose a framework that incorporates multiple perspectives on hybrid work in software engineering. We applied the framework to group a set of research topics collected at the GoHyb (Global and Hybrid Work in Software Engineering) workshop collocated with the XP2023 conference, and extrapolated some new topics based on the framework, to demonstrate various research questions that can be asked on hybrid work in software engineering. We conclude the paper with a remark on the need of more contextual and nuanced understanding of hybrid work in software engineering.

Keywords: Research directions · hybrid work · software engineering

1 Introduction

Hybrid work is here to stay, or is it? With hybrid work, people most often mean different combinations of work at the office and elsewhere, e.g., at home. Currently, it seems to be the future trend of all knowledge work and one of the most debatable topics after the pandemic time. One can hear drastically different voices in the media. Some believe that hybrid work represents the best of working from anywhere and working in the office. There are companies, such as LinkedIn, that take hybrid work seriously and re-design their workplaces for hybrid work, optimizing offices for all use cases and accommodating a more diverse workforce [1]. According to a study by the consulting company McKinsey [3], more than two-thirds of the surveyed employees across North America, Europe, and Australia, prefer the hybrid model and claim that they are likely to change their employers if required to return to full-time office work.

On the other side, some claim that hybrid work combines the worst of office and remote work and would call a hybrid work plan “a compromise”. Google went

as far as “crackdown on office attendance” to urge remote workers to adhere to the hybrid work schedule [5]. Recently, it launched “\$99 a night Hotel Mountain View” to attract remote workers to spend time in offices [4]. Meta’s former director of remote work contended that “*hybrid work is not the future... It’s an ‘illusion of choice’*” [11].

The current hybrid work trend and discussion are concerned with all the knowledge work such as software development that does not require a constant physical presence at the office. It is intriguing to see that software companies such as Google, Meta, and Apple are right at the center of this heated debate since hybrid work was arguably more common in software companies than in most other industries before the pandemic time, and one would expect that hybrid work is seen more positively in these companies. In addition, there is already more than decades of experience and a lot of research literature on global software engineering and virtual software teams and there exist plenty of software tools to support remote work. Thus, we believe that software companies and researchers should lead the discussion and research on hybrid work.

The contrasting opinions and arguments from software companies demonstrate that we are yet to reach a good understanding of hybrid work in software engineering which is an exciting research phenomenon and poses distinct challenges compared to what has been already studied in the global software engineering research field. This in turn represents rich opportunities for SE researchers. Research on hybrid work could highly benefit a large number of companies in the field of software engineering that are currently eagerly looking for solutions for their post-pandemic ways of working. Indeed, Conboy et al. [2] urge the need for future research and a research agenda to guide the research community. This paper is our attempt to start drawing such an agenda.

The remainder of the paper is organized as follows. Section 2 proposes a framework for structuring research topics in hybrid work in software engineering. In Sect. 3, we explain how we populated the framework with the input we collected in a research workshop. The results are presented in Sect. 4. We conclude the paper in Sect. 5.

2 A Conceptual Framework to Study Hybrid Work in Software Engineering

A clear definition of *hybrid work in software engineering* seems a prerequisite for creating a research agenda on this topic. Google defines hybrid work as “*a spectrum of flexible work arrangements in which an employee’s work location and/or hours are not strictly standardized*” [8]. According to this definition, besides the location, the working hours of a hybrid worker might be different than his or her co-workers’.

However, as Smite et al. [9] rightly point out, “*the word ‘hybrid’ has become one popular umbrella label attributed to various work-related terms*”, and there is no consensus in SE literature on what exactly *hybrid work* and the related terms mean. This represents one of the central issues to tackle by the researchers. The

desired clarity may be the result of collective research endeavors rather than the starting point. Thus, in this paper, we do not provide a definition but leave that as a future research topic.

It is evident that hybrid work in software engineering is a complex phenomenon, and multiple perspectives are needed in the investigation. We propose a conceptual framework (Fig. 1) with perspectives that can be used to guide the formulation of research questions.

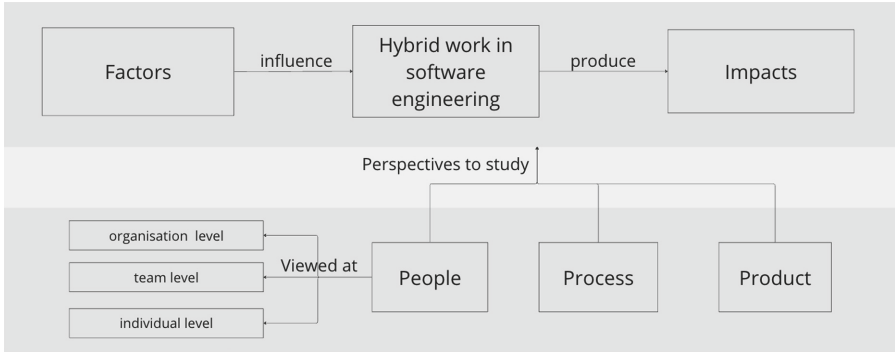


Fig. 1. A conceptual framework for organizing research questions on hybrid work in SE

As shown in Fig. 1, *hybrid work in software engineering* is at the center of the investigation. “Opening this box” means directly researching on how hybrid work is understood and how it is or can be implemented in software companies. Treating it as a “closed-box”, studies can be conducted to either explore what can be the *factors* that influence various policies and implementations of hybrid work or to understand what the *impacts* of hybrid work are in comparison with other formats of work arrangements.

To investigate hybrid work in software engineering, the 3P’s model of software management [6] could be employed. As Reifer [6] argues, for software projects to be successful, *People*, *Process*, and *Product* need to be managed concurrently and conflicts occurring among them be reconciled constantly. Hybrid work, as well as its influencing factors and impacts can be examined along these dimensions. Additionally, the *people* dimension can be further broken down into *individual*, *team*, and *organizational* levels.

3 Research Topics Collection and Organization

3.1 Collecting the Research Topics

We collected research topics on *hybrid work in software engineering* from agile practitioners and researchers through a facilitated workshop session: On June

13th, 2023, we organized a research workshop, *First International Workshop on Global and Hybrid Work in Software Engineering (GoHyb)*¹, collocated with the XP2023 conference² in Amsterdam. This research workshop builds on the Global Software Engineering Conference (ICGSE) and the research and community behind it. The ICGSE conference has been organized yearly since 2000, first as a workshop and from year 2006 onwards as a conference. As hybrid work in software engineering became a new hot topic during the pandemic, we in the global software engineering (GSE) community saw an opportunity to combine the strong research grounds of GSE research and this new industry trend and to organize a workshop on this emerging topic.

In total, 36 persons from around the world gathered in the GoHyb workshop. This half-day face-to-face workshop started with six presentations by practitioners and academics on their practical experiences and research results on hybrid work in software engineering and ended with an interactive session to brainstorm future research topics.

In the interactive session, we used one of the *Liberating Structures* techniques, called *1-2-4-All*³. First, we asked the participants to write individually *future research ideas for hybrid work in software engineering* on sticky notes for a few minutes, then form pairs to discuss, elaborate, and add ideas for five minutes, and finally combine pairs into four-person groups to do the same for ten minutes. In the end, all groups presented their ideas to others: one idea per group, followed by the next group until all new ideas were presented.

3.2 Organizing the Research Topics

After the workshop, we collected the sticky notes and organized them according to the framework we introduced in Fig. 1. Figure 2 presents the result of applying the framework to identify and organize research topics that can be asked on global and hybrid work in software engineering. In Fig. 2, the green sticky notes contain the input we collected from the GoHyb 2023 workshop participants. After organizing the future research ideas from the workshop using the framework, we extrapolated more research topics to complement the input from the workshop especially from the perspective of agile software development. These topics are shown in the blue sticky notes in Fig. 2.

4 Research Topics on Hybrid Work in Software Engineering

In this section, we elaborate on the research topics presented in Fig. 2, starting from the left, *factors that influence hybrid work*, then moving to *hybrid work in software engineering* and how it could be organized, and finally to the *impacts of hybrid work*.

¹ <https://www.agilealliance.org/xp2023/call-for-submissions/global-and-hybrid-work/>.

² <https://www.agilealliance.org/xp2023/>.

³ <https://www.liberatingstructures.com/1-1-2-4-all/>.

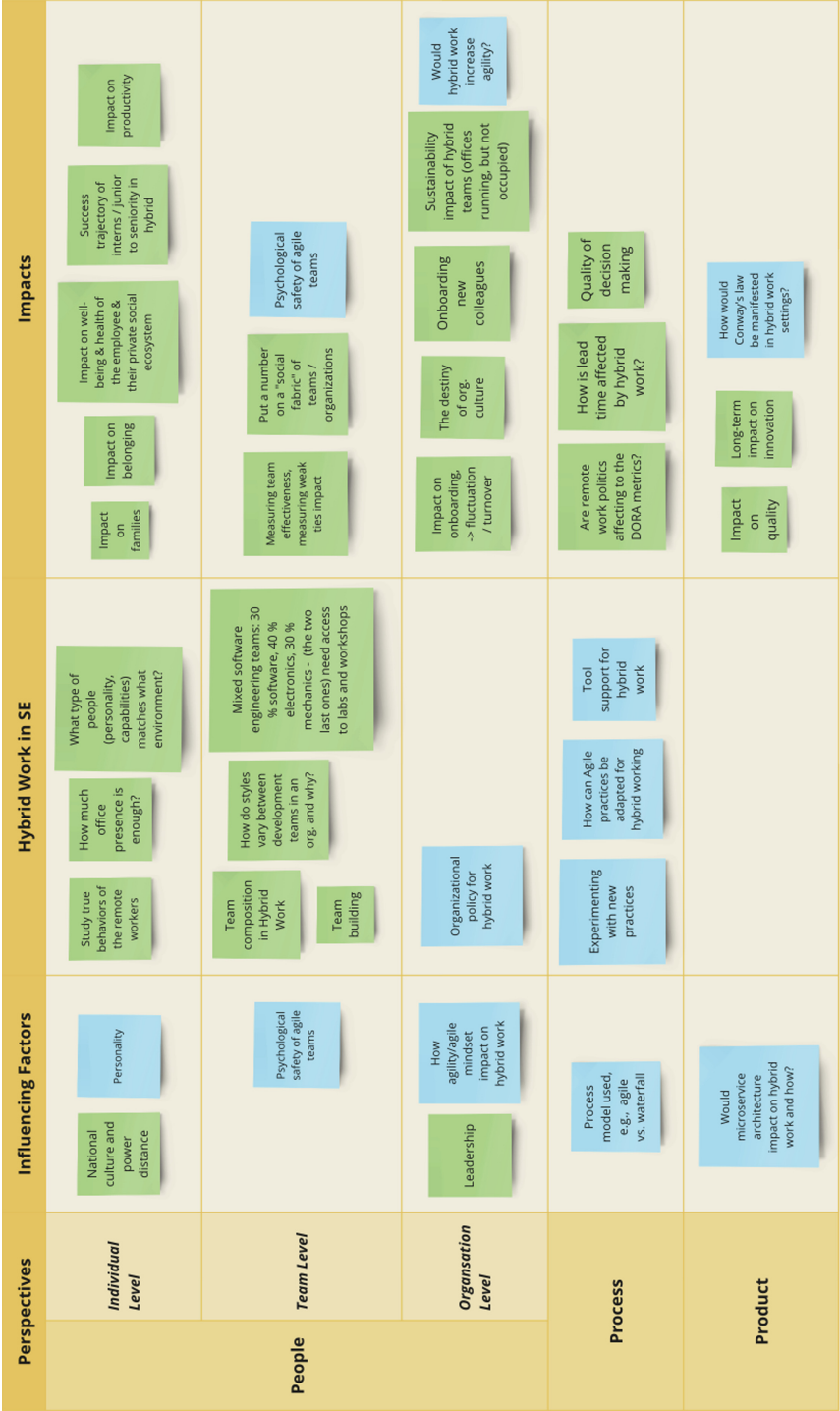


Fig. 2. Illustration of the research topics on hybrid work in software engineering

4.1 Factors that Influence Hybrid Work in Software Engineering

Influencing Factors on hybrid work in software engineering can be examined from people, process, and product perspectives, e.g. whether people or organizations are willing to do hybrid work or whether it fits the product to be developed. As shown by the green post-it notes in the *Influencing Factors* column, we received the least input to this aspect from our workshop participants, however, we added a few topics to give inspiration on what kind of future research ideas this aspect could include. Next, we will elaborate on these.

People Factors. Remote work is not for everyone, and even if it works for a person, it may not be the preferred option all the time. At the *individual level*, understanding what personal factors influence the choice of work mode would be important. *Personality* can be one factor, the *cultural background differentiated by a power distance* could be another one influencing the adoption and implementation of hybrid work.

At the *team level*, how *psychologically safe* the working environment in a team is, may influence how people choose their work mode.

At the *organizational level*, the workshop participants identified *leadership* as an important influencing factor for the effective implementation of hybrid work and raised a question on the *relationship between leadership and hybrid team composition*. When looking at agile software development, an interesting influencing factor might be *how the level of agility or the agile mindset in an organization would influence the hybrid way of working of individual employees and teams*.

Process Factors. Different process models are used in organizations, e.g., agile, waterfall, or a combination of these. An interesting question could be *whether and how the choice of process model would influence how a hybrid work mode is implemented in a company*.

Product Factors. There is a paucity of topics in this category. We encourage SE researchers who have research interests in software projects to consider potential linkages between their research topics and hybrid work in SE. For example: *Would microservice architecture influence hybrid team composition*, and if yes, how?

4.2 Hybrid Work in Software Engineering

People Perspective. At the *individual level*, we could study the *true behaviors of remote workers*, which can be beneficial to dismiss the fear of management losing control when work is not performed at the office, and to enable the management to better support remote and hybrid workers. A relevant question is: *How much office presence would be considered enough?* This links to another interesting question raised by the participants: *What type of people in terms of*

personality and/or capability match different environments in order to be productive?

At the *team level*, the *team composition in hybrid work* is a central topic to investigate: can we create e.g., guidelines to configure hybrid teams? *How do working styles vary between different hybrid development teams in an organization*, and why? *How can team building happen in hybrid mode?* *How to build high-performing hybrid teams effectively?* Team composition can be an even more complex task to tackle when software development is a part of larger system development. A scenario was described by participants: mixed teams with 30% software, 40% electronics, 30% mechanics people, where the last two groups need access to labs and workshops. How to effectively implement hybrid working with such a team composition?

Even though the workshop participants did not provide any input to the *organizational level*, the other questions they posed point to an important question: *How to define effective organizational policies for hybrid work?* These policies would govern and impact how individuals and teams are allowed and encouraged to work and collaborate, which will be critical when large-scale software development organizations, e.g., several agile teams collaborating on a common product, adopt hybrid work.

Process Perspective. Processes and practices need to be adapted to best support hybrid work. Thus, we could study e.g. *how agile practices can be adapted to hybrid work*. As suggested by Conboy et al. [2], experimentation is important: organizations and teams should *try out what kind of practices work in different hybrid set-ups*, and researchers could collect and report experiences from these experiments. The pandemic already forced us to participate in an experiment: to take into use new tools to support remote work. Many of the tools can support hybrid work as well, and studies on *which tools and how could they best support hybrid work in SE* would be interesting.

Product Perspective. Our workshop participants did not provide any input to this category. Indeed, it is not clear how hybrid work could be studied from a product perspective, or whether this perspective is relevant. It would be interesting to see some future research filling this void.

4.3 Impact of Hybrid Work

Impact on People. At the *individual level*, there are concerns on what would be the *impact of hybrid work on workers' productivity*. SE literature on the productivity of software professionals during the pandemic shows contrasting evidence: some studies show that productivity was not impacted, some show an increase, while others show a decrease in productivity (as reviewed in [10]). However, the long-term tendency and consequences are yet to be seen. The workshop participants raised a concern: *How could young people build their careers and succeed in moving from intern/junior positions to seniority in a hybrid setting?*

Apart from these professional concerns, *physical and psychological health and social well-being of hybrid workers and impact on their families* are prominent concerns that could be investigated further.

The workshop participants posed several questions on the impact of hybrid work at the *team level*. Similar to individual productivity, *team effectiveness* in hybrid settings could be monitored and measured. The participants were concerned about hybrid workers losing connection to others in the organization, especially losing the weak ties, and therefore suggested studying the impact on *weak ties* and on the ‘*social fabric*’ of *teams and organizations*. Additionally, when connecting hybrid work with agile software development, it would be interesting to study how various aspects of agile teams are affected by hybrid settings. Several studies (e.g., [12]) have investigated how the psychological safety of agile teams was affected when they conducted online agile meetings. Similar studies could be conducted in hybrid settings.

At the *organizational level*, one prominent concern is *how a hybrid setting would impact the onboarding of new employees*, which became more challenging during the pandemic time [7]. This is linked to the *turnover of personnel*, as people who are not onboarded properly might leave. Sustainability aspects were brought up as well: *What would happen to offices not occupied? What are the sustainability impacts of these unused resources? How could offices be re-furnished to better fit hybrid work?* The workshop participants also wondered *what would be the destiny of organizational cultures* under the influence of hybrid working. We added a related question: *Would hybrid working have an impact on the agility of an organization?* If yes, how?

Impact on Process. The workshop participants wondered whether remote work politics affect the speed of development (lead time) and the DORA (DevOps Research and Assessment) metrics⁴. A better understanding of hybrid work may also impact on the decision making process, as the input from the participants indicates: *How does hybrid work affect the decision making quality?* Answering such questions can facilitate fact-based decision-making in the context of hybrid work.

Impact on Product. Some workshop participants were concerned with the *quality of software produced by hybrid teams*. Conway’s Law⁵ states that “*any organization that designs a system (defined broadly) will produce a design whose structure is a copy of the organization’s communication structure.*” This could mean that the new communication structures in hybrid work settings would affect the product structure. It would be interesting to study *whether Conway’s law holds also in hybrid work* and we can ask: *How would Conway’s law be manifested in hybrid work settings?* The workshop participants also wondered *what would happen to the software product innovation in the long run*. What would

⁴ <https://dora.dev/>.

⁵ https://en.wikipedia.org/wiki/Conway%27s_law.

happen when there are less serendipitous conversations and informal face-to-face communication among co-workers? How should companies support innovation in a hybrid work environment?

5 Final Remarks

The advent of hybrid working at the global scale challenged profoundly our understanding of where, when, and how work can be performed. We did not intend to provide an exhaustive list of research questions on hybrid work in SE. Instead, the collected inputs are exemplar questions serving as an “*enticer*” to tease out more research questions that are worth investigating. The classification of topics/questions under a specific dimension/perspective is not definitive either. Some topics or questions can fit into multiple categories, depending on how they are approached. There are already conducted or ongoing studies covering some of the topics listed in this paper. A systematic analysis of SE literature, or even involving literature on hybrid work in other research fields, could provide a more informed understanding of the landscape of this research area and reveal knowledge gaps to guide future research.

What we hoped to convey with our proposed framework and the illustrative topics is that we do not need sweeping statements with “*a broad brush*” that declare hybrid work as good or bad, as we typically see in the media. What we need are contextual and nuanced understanding of when and how hybrid work could be implemented and could yield benefits. Here is where researchers can play a crucial role and empirical evidence is more valuable than opinions.

It is understandable that the current interest of the industry is to understand the impacts of hybrid work. We expect that, when the impacts are better understood, the interests of both industry and research will shift toward discovering better ways of implementing hybrid work and more proactive actions that will enable hybrid work to produce the desired outcomes.

We wish that more researchers and practitioners would realize that hybrid work is not only about “*where the work is done*” but also about “*how and by whom the work could be done*” in the future. Along this line of thinking, we expect that the meaning of hybrid work in SE and in broader contexts would evolve to embrace richer meanings.

Acknowledgement. We would like to express our sincere gratitude to all the presenters and participants of the GoHyb 2023 workshop for their input, ideas, and discussions. Thank you!

References

1. Britz, L., Norwood, R.: How LinkedIn Redesigned Its HQ for Hybrid Work. Harvard Business Review (2022). <https://hbr.org/2022/10/how-linkedin-redesigned-its-hq-for-hybrid-work>

2. Conboy, K., Moe, N.B., Stray, V., Gundelsby, J.H.: The future of hybrid software development: challenging current assumptions. *IEEE Softw.* **40**(2), 26–33 (2023). <https://doi.org/10.1109/MS.2022.3230449>
3. Dowling, B., Goldstein, D., Park, M., Price, H.: Hybrid work: making it fit with your diversity, equity, and inclusion strategy (2022). <https://www.mckinsey.com/capabilities/people-and-organizational-performance/our-insights/hybrid-work-making-it-fit-with-your-diversity-equity-and-inclusion-strategy>
4. Elias, J.: Google is offering an on-campus hotel ‘special’ to help lure workers back to the office (2023). <https://www.cnbc.com/2023/08/04/google-offers-on-campus-hotel-special-to-lure-workers-back-in.html>
5. Elias, J.: Google to crack down on office attendance, asks remote workers to reconsider (2023). <https://www.cnbc.com/2023/06/08/google-to-crack-down-on-hybrid-work-asks-remote-workers-to-reconsider.html>
6. Reifer, D.J.: The “3 P’s” of software management. In: Reifer, D.J. (ed.) *Software Management*, 7th edn (2006)
7. Rodeghero, P., Zimmermann, T., Houck, B., Ford, D.: Please turn your cameras on: remote onboarding of software developers during a pandemic. In: 2021 IEEE/ACM 43rd International Conference on Software Engineering: Software Engineering in Practice (ICSE-SEIP), pp. 41–50 (2021). <https://doi.org/10.1109/ICSE-SEIP52600.2021.00013>
8. Setty, P.: Insights from our global hybrid work survey (2023). <https://workspace.google.com/blog/future-of-work/insights-from-our-global-hybrid-work-survey>
9. Smite, D., Christensen, E.L., Tell, P., Russo, D.: The future workplace: characterizing the spectrum of hybrid work arrangements for software teams. *IEEE Softw.* **40**(2), 34–41 (2023). <https://doi.org/10.1109/MS.2022.3230289>
10. Smite, D., Tkalic, A., Moe, N.B., Papatheocharous, E., Klotins, E., Buvik, M.P.: Changes in perceived productivity of software engineers during COVID-19 pandemic: the voice of evidence. *J. Syst. Softw.* **186**, 111197 (2022)
11. Thier, J.: Hybrid work is not the future, says Meta’s former director of remote work: it’s an ‘illusion of choice’ (2023). <https://fortune.com/2023/07/20/hybrid-work-problems-annie-dean-meta-atlassian/>
12. Tkalic, A., Šmite, D., Andersen, N.H., Moe, N.B.: What happens to psychological safety when going remote? *IEEE Softw.*, 1–9 (2022). <https://doi.org/10.1109/MS.2022.3225579>

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter’s Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter’s Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

