UiA University of Agder

Master

Remote Product Development

The normalization of remote work as a result of COVID-19

and its implications for digital product development practices

HEDDA BJØRNSEN

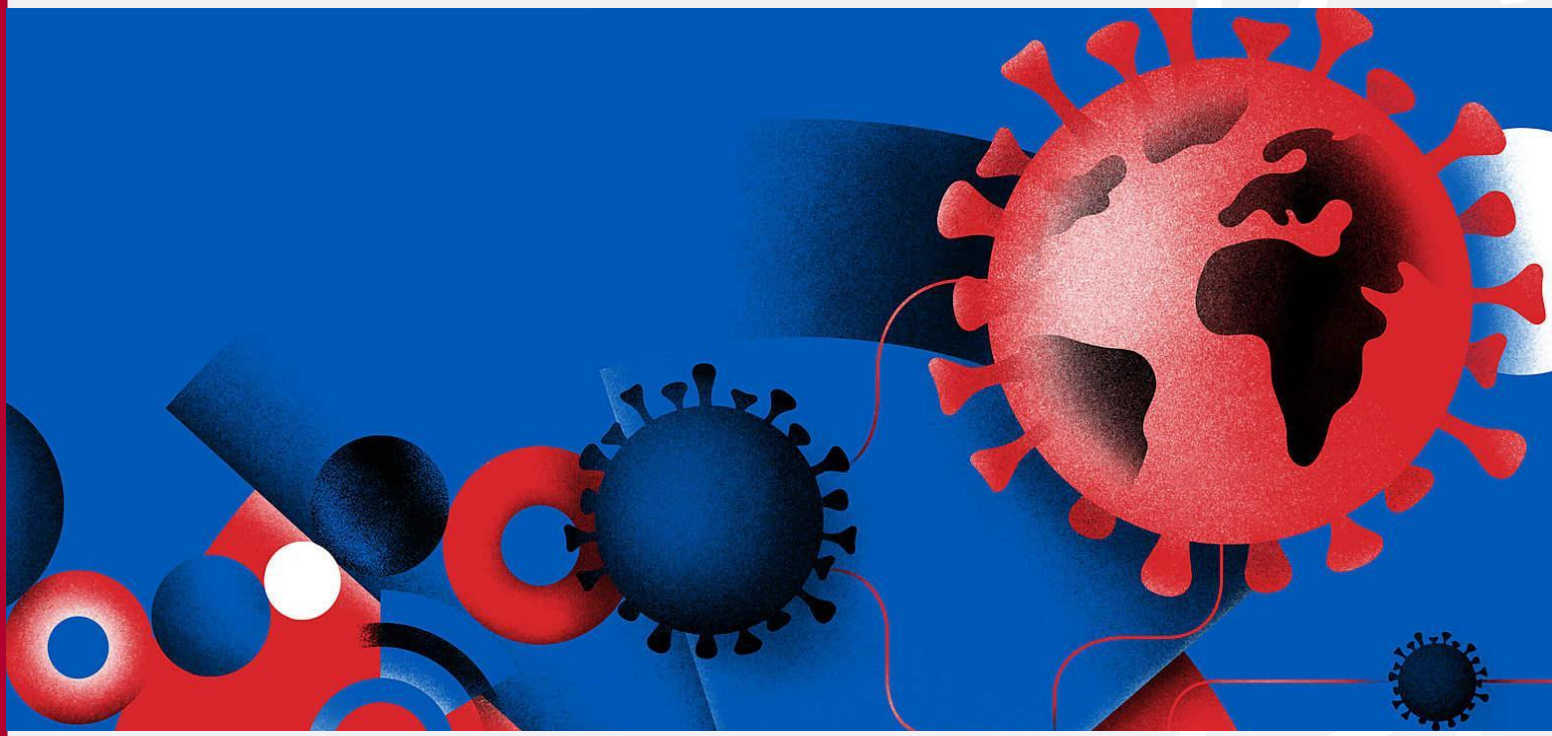

Illustration: Dubravko Tuksar

SUPERVISORS

Stine Øyna & Mette Marie Næser Seldal

University of Agder, 2023

School of Business and Law

Department of Management

Preface

Acknowledgements

I would like to thank my supervisors Stine Øyna for helping me start writing this master thesis, and Mette Marie Næser Seldal for helping me finish and deliver it.

A big thank you also goes out to my family for being a great support system and for encouraging me to keep going. Special thanks to my mother Gunn Bjørnsen and brother Eskil Jakobsen for being excellent academic advisors, my father Rune Jakobsen for pushing me, and grandma Berit Bjørnsen for praising me.

Thank you to my employer, Gaming Innovation Group, for allowing flexible work arrangements, enabling me to do this.

Lastly, thank you to all the informants who participated in the study, as well as Maren Oustad Torve for being a great research partner.

The process

Writing this master thesis is the biggest academic challenge I have ever faced.
In addition, there were some obstacles along the way, delaying the process.
I am proud to finally be able to say that I did it.

I have truly enjoyed and learned a lot from the Shift Entrepreneurship and Innovation master program, and I feel well prepared for whatever challenges the future has in store for me. Thanks again to everyone who helped me get there!

Kristiansand, 01.06.23

Hedda Bjørnsen

Abstract

This master thesis explores the influence of COVID-19 and the shift to remote working on product development, examining the advantages and difficulties associated with this transition. Through a qualitative study, the thesis draws insights from in-depth interviews conducted with 12 employees across 8 different tech companies. These individuals hold key roles in product development and product management, providing their experiences and perspectives on the pre-pandemic, during-pandemic, and post-pandemic product development processes. The study aims to uncover the impact of the pandemic on digital product development practices and the implications of this.

The research question guiding the study is: What impact has COVID-19 had on digital product development? Further, the research question is divided in two:

1. How has the normalization of remote work changed product development practices?
2. What are the benefits and challenges of remote product development?

The findings suggest that the shift to remote work has both advantages and challenges, and the ability of individuals and organizations to navigate these effectively will play a crucial role in the future of post-pandemic work.

Certain phases of product development have been affected by the transition to remote work to a larger extent than others, particularly ideation and concept development. The practices in these phases have gone from being physical and interactive, using post-its and whiteboards, to being conducted via digital conferencing platforms such as Google Meet or Zoom, aided by tools like Mural. The implications of this depend on how the identified challenges are addressed.

Table of contents

Table of Figures

1. Introduction

1.1 Background

In an era where markets are becoming more dynamic, influenced by rapid technological changes, the development of new products and services has become a vital factor in maintaining a company's competitiveness (Wiesböck, Hess & Spanjol, 2020, p. 1). This has led to an increased focus on product development, and there are many researchers within this field striving to uncover the ideal processes and practices.

Developing products, both physical and digital, is a complex process involving different departments within a company. There are several phases required to successfully deliver a new product or service and to profit from it (Ulrich & Uppinger, 2008, p. 3), which can make it a challenging field to navigate.

Technological developments have enabled humans to communicate with one another in ways that were unimaginable just a few decades ago, and digital tools allow teams to work and collaborate from any location or time zone, removing geographical constraints (Wiesböck et al., 2020, p. 6). These tools have been in use by many for several years already, but when the COVID-19 pandemic made its entry, people became dependent on these like never before.

The world as we knew it closed down in 2020 and restrictions were imposed by governments across the globe, making it impossible to meet with others the ways we were used to. In order to stay connected, people had to make use of technological solutions, which made the adoption of digital tools accelerate at a record pace. For those who were not used to using online communication methods this posed great challenges, but the need to keep in touch with people led the majority to adapt and learn. The sudden transition to remote work had a

significant impact on people's physical and mental health as their daily routines were turned upside down. The situation was even more challenging for working parents, as the closure of schools and daycare centers did not only mean homeschooling, but also managing an increasingly chaotic work environment with distractions at home (Xiao, Becerik-Gerber, Lucas, & Roll, 2021, p. 182).

The pandemic ended up lasting longer than expected and companies came to the realization that this was not something they could wait out. Thus, the business community had to restructure and adapt to the new circumstances, which meant that workers who did not represent essential functions in society had to work from home, meeting colleagues via digital platforms like Teams and Zoom instead of at the office. Remote work is not a new phenomenon (Pyöriä, 2011). Some were already used to working this way, but few to this extent.

There has been a common skepticism about employees' ability to work efficiently from home. This was put to the test during the pandemic, and the experiences of working from home varied from person to person. Many enjoyed the flexibility and found that they have been more efficient working remotely since the usual distractions at their workplaces were not present, while others have struggled to concentrate due to other forms of distractions at home.

1.2 Delimitation and research question

The focus in this study is on the development of digital products and services and what impact the pandemic and its normalization of remote working has had on practices within this field, as well as the implications of working remotely. This is not an industry that has been particularly affected by COVID-19 regulations compared to others in regards to digital transformation, since people involved with digital product development were used to working digitally

before the pandemic. Still, these are people who were used to working from an office, meeting face to face and interacting with coworkers on a daily basis. It is therefore interesting to see how the lack of physical interaction with team members and colleagues has changed how they work.

The reason I have chosen product development as the overall theme alongside COVID-19 and remote work is that it is a dynamic field where things constantly change and evolve. Additionally, I have experience working with digital product development, which gives a solid foundation for writing a thesis about the subject and a good understanding of the data collected. The research question guiding the study is: What impact has COVID-19 had on digital product development? Further, the research question is divided in two:

1. How has the normalization of remote work changed product development practices?
2. What are the benefits and challenges of remote product development?

1.3 Research design

To be able to answer the research question, a co-student and I collected data through qualitative semi-structured interviews with employees at technology firms who work with the development of digital products and services. The reason behind selecting a qualitative approach is that we wanted to get in-depth descriptions of remote work experiences.

The data collected consists of interviews with 12 people from 8 different tech companies, and the informants are employees who play key roles in product development processes as developers, product managers or C-level executives. They all shared experiences from working with product development before, during and since the pandemic.

2. Theoretical framework

In this chapter I will describe the theoretical concepts applied in the thesis.
I will also describe the research field and how my study is positioned.

2.1 Traditional product development

In order to define product development, we first need to understand what a product is. As explained by Professor of Entrepreneurship and e-Commerce, Karl T. Ulrich, and Professor of Management Science and Innovation, Steven D. Uppinger, a product is "something sold by an enterprise to its customers" and product development is "the set of activities beginning with the perception of a market opportunity to and ending in the production, sale and delivery of a product" (Ulrich & Eppinger, 2008, p. 2).

"A product development process is the sequence of steps or activities which an enterprise employs to conceive, design and commercialize a product" (Ulrich & Eppinger, 2008, p. 12). It is a complex process which requires collaboration between multiple teams within an organization at various stages (Ulrich & Eppinger, 2008, p. 3), and while there are various methods to approaching this process, the overall set of activities involved in bringing an idea to the market is largely similar among different firms (Durmuşoğlu & Barczak, 2011, p 322).

It usually begins with a planning phase, which is often referred to as *phase zero* because it takes place prior to project approval and the initiation of the actual product development process. The first actual phase of the process is the concept development phase where a need or problem in the market is identified, and then translated into an idea for a new product. Once the idea is developed, the product team conducts research to determine if it is feasible and if there is a demand for it in the market (Ulrich & Eppinger, 2008, p. 13-15).

The second phase is where the product team begins to create a product design, particularly focusing on system-level design. This phase involves defining the product architecture and breaking down the product into subsystems and components. The third phase focuses on detail design which includes the complete specification of the product (Ulrich & Eppinger, 2008, p. 15).

Then there is the testing and refinement phase. This includes prototyping, where the team creates a working model of the product to test its functionality, usability, and performance. The prototype is usually tested both internally and externally with potential customers to gather feedback and identify any potential issues. This feedback is then used to refine and improve the product design until it meets the desired standards (Ulrich & Eppinger, 2008, p. 15).

Finally, the production ramp-up phase is entered. In this phase, the product is created as defined in the previous stage, and sometimes distributed to certain clients to evaluate the final product and identify any remaining shortcomings before the product is officially launched and made available for widespread distribution (Ulrich & Eppinger, 2008, p. 15). Once the product is ready for launch, the marketing team promotes the product (Ulrich & Eppinger, 2008).

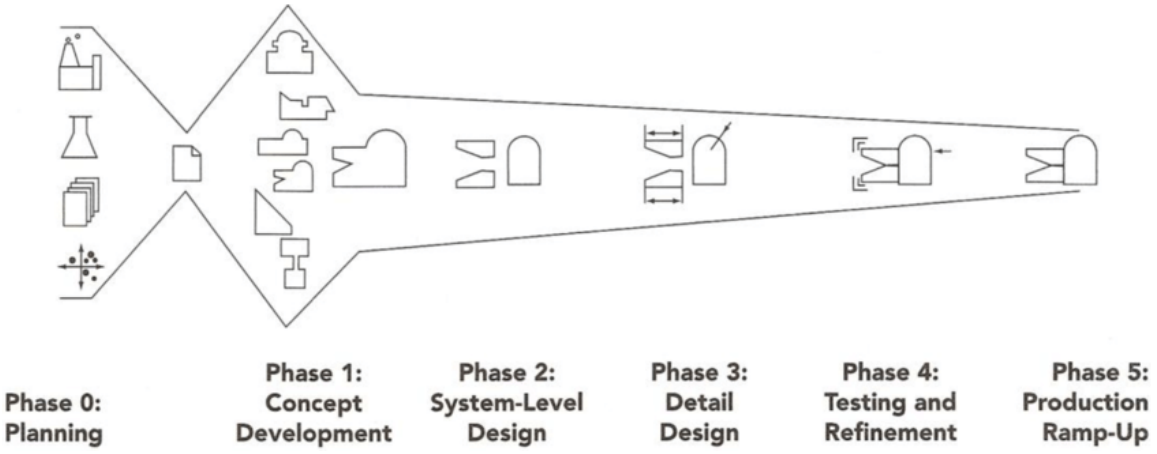

Figure 1. Traditional product development process (Ulrich & Eppinger, 2008).

2.2 Digital product development

Digital products are goods or services that can be transformed into a binary format, enabling their distribution and consumption electronically (Hui & Chau, 2002), or to put it in simpler terms: intangible products and services that are sold and bought online. Examples of digital products and services are digital communication solutions like Zoom, which was commonly used during the pandemic, streaming services like Netflix, or online games, books and courses.

While the product development process for digital products shares similarities with traditional product development, digital and physical product development is usually managed differently. In contrast to physical product development, the digital development process is characterized by a greater level of uncertainty and a reduced emphasis on diversity and materiality. This enables an optimized development process that emphasizes adaptability (Hendler, 2020, p. 745-746).

Digital product development typically involves more iterative and agile processes compared to traditional product development, and the practices within digital product development are described as “short, iterative development cycles with predominantly cross-functional teams, empowered decision-making, one product vision holder, a floating scope, late binding, short up-front planning and several releases per product” (Hendler, 2020, p. 746).

Studies (Henfridsson et al., 2014 & Yoo et al., 2010) have emphasized how the distinctive characteristics of digital technology enable new forms of innovation processes that differ significantly from the analog innovation processes. An important element here is the rapid pace of digital innovation processes facilitated by the adaptability of digital technologies, which can be easily reconfigured (Nylén & Holmström, 2014, p. 59).

Digital product development also relies on different tools and technologies compared to traditional product development. Digital products require expertise in software development and user interface design, whereas physical products require more expertise in engineering, manufacturing, and materials science. In software development there are no direct variable costs such as manufacturing or transportation costs, only the salary you pay the staff (Cooper, 2004).

2.3 Agile software development

As mentioned, product development is a highly researched field with numerous theories. In order to maintain relevance for this thesis I will primarily focus on approaches used by the companies studied. Agile is the most commonly used framework among our informants, and in the next paragraphs I will give an introduction to Agile thinking to provide some background and an understanding of how software developers and product managers work.

Agile is a flexible, collaborative and customer-focused approach to software development. It consists of a set of methods under which requirements and solutions evolve through the collaborative effort of cross-functional teams, and promotes adaptive planning, early delivery, and continual improvement (Varma, 2015, p. 133). Agile software development methods are implemented to enhance the success of software projects, and this methodology fosters teamwork, accountability, and face-to-face communication within the development process. Business stakeholders and developers must collaborate to align the product with customer requirements (Singhto & Phakdee, 2016).

The main principles of Agile development are described in the “Agile Manifesto”, created by a group of leading practitioners of alternate software methods:

MANIFESTO FOR AGILE SOFTWARE DEVELOPMENT

We are uncovering better ways of developing software by doing it and helping others do it.

Through this work we have come to value:

Individuals and interactions *over processes and tools*

Working software *over comprehensive documentation*

Customer collaboration *over contract negotiation*

Responding to change *over following a plan*

That is, while there is value in the items on the right, we value the items on the left more.

Kent Beck	*James Grenning*	*Robert C. Martin*
Mike Beedle	*Jim Highsmith*	*Steve Mellor*
Arie van Bennekum	*Andrew Hunt*	*Ken Schwaber*
Alistair Cockburn	*Ron Jeffries*	*Jeff Sutherland*
Ward Cunningham	*Jon Kern*	*Dave Thomas*
Martin Fowler	*Brian Marick*	

(Varma, 2015, p. 18)

In addition to the four main values, the Agile Manifesto has twelve principles:

1. *Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.*
2. *Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.*
3. *Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.*
4. *Business people and developers must work together daily throughout the project.*
5. *Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.*
6. *The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.*

7. *Working software is the primary measure of progress.*
8. *Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.*
9. *Continuous attention to technical excellence and good design enhances agility.*
10. *Simplicity--the art of maximizing the amount of work not done--is essential.*
11. *The best architectures, requirements, and designs emerge from self-organizing teams.*
12. *At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.*

    (Beck et al., 2001)

Since the Agile Manifesto emerged in early 2001, Agile methods have gained significant prominence due to their ability to address the inefficiencies of traditional software development approaches in rapidly evolving environments. There are numerous methods that fall under the Agile umbrella, and these differ in techniques. However, these methods have much in common, such as short iterative life cycles, quick and frequent feedback from customers, and constant learning (Wang, Conboy & Cawley, 2012).

As the above theories emphasize, the processes for digital product development and Agile software development are very different from traditional product development due to the different natures of physical and digital products. Rather than a linear process, the process for digital products and services are viewed more as a life cycle, as the development of most digital products does not have a clear finish line. Once a product is released, it goes into a continuous loop of refinement and improvement, as illustrated below (Misra & Singh, 2013).

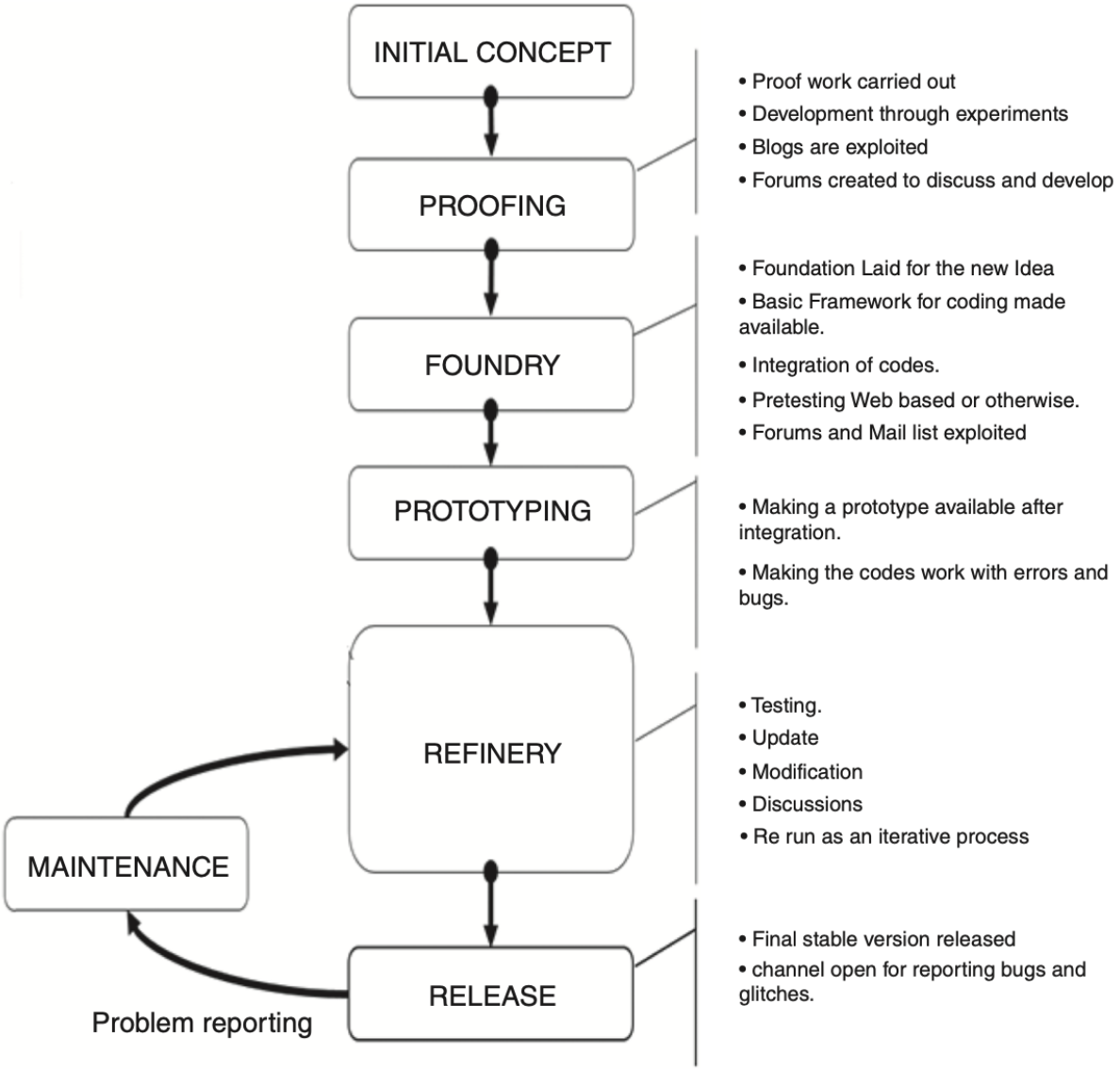

Figure 2. Agile software development life cycle process (Misra & Singh, 2013).

The three most common methodologies used to implement Agile principles are eXtreme Programming (XP), Scrum, and Kanban. These can be ranked on a spectrum ranging from prescriptive to more adaptive. For instance, eXtreme programming has a rigid set of rules and procedures, enforcing a very structured process, while Kanban at the other end of the scale has a more flexible approach, featuring minimal regulations and guidelines. In the middle we have Scrum, offering a balance (Bibik, 2018, p. 7).

Scrum is the most popular Agile method (Varma, 2015, p. 92), and it incorporates a rapid software development approach that aids and focuses on developing software quickly and efficiently (Singhto & Phakdee, 2016, p. 2). Scrum shares similarities with XP in its use of brief release cycles, known as “sprints”. These are time-boxed iterations usually lasting 1-4 weeks, and at the end of each sprint, a small, usable increment of the product is delivered (Bibik, 2018, p. 11).

The term "product backlog" is commonly used in Scrum. This represents a catalog of all desired features that a product team aims to address over the product's life cycle (Varma, 2015, p. 91). Each sprint consists of the most crucial tasks from the product backlog, mutually agreed upon by the product owner and the development team for completion during the sprint (Varma, 2015, p. 92).

The Scrum framework also consists of specific meetings, often referred to as “ceremonies”. These are crucial parts of the Scrum framework, and include:

- **Sprint planning:** This is a meeting at the start of each sprint where the team decides what they will work on during the sprint. The Product Owner presents the most important items from the product backlog, and the team discusses and agrees on the amount of work they can commit to.
- **Daily Scrum/stand-up:** This is a short, daily meeting where each team member shares what they completed the previous day, what they plan to work on that day, and whether there are any obstacles in their way.
- **Sprint review:** In this meeting, the team presents the work they've completed during the sprint to the Product Owner and any interested stakeholders. It's an opportunity to gather feedback and adjust the product backlog if necessary.

- **Sprint retrospective:** A meeting after the Sprint Review and before the next Sprint Planning, where the team reflects on the previous sprint. They discuss what went well, what didn't, and how they can improve processes.
- **Backlog refinement:** The Product Owner and team get together to review items in the backlog to ensure they are defined and estimated (McKenna, 2016 p. 87-94).

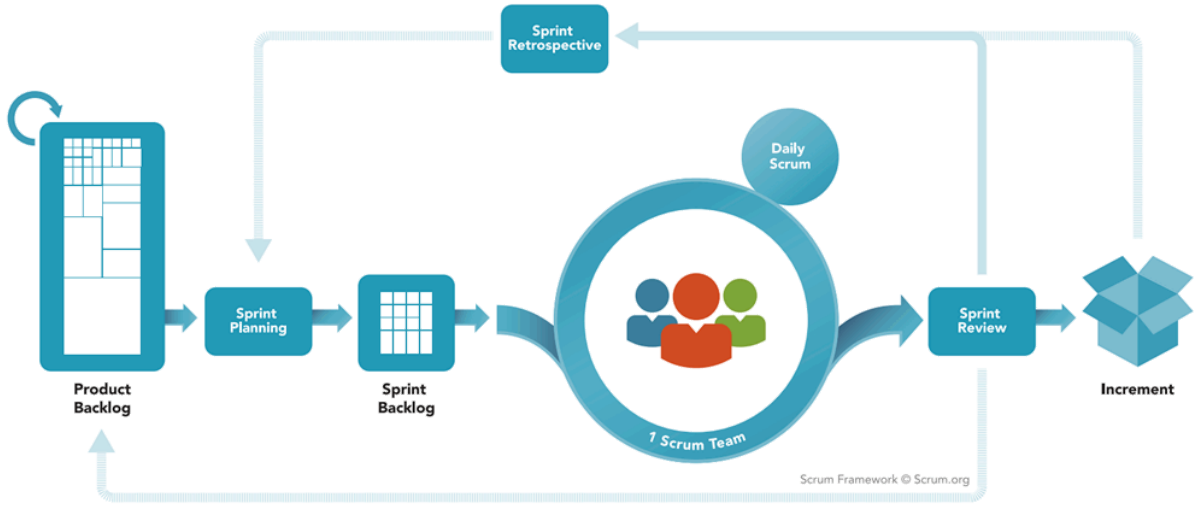

Figure 3. The Scrum framework (Scrum.org, 2020).

2.4 Lean software development

Lean is another approach used in product development and its principles have significantly influenced the development of Agile methodologies. Lean focuses on eliminating waste from the system and to deliver products more quickly and cost-effectively, while Agile is about responding to changes faster (Varma, 2015). There is a lot of overlap between Lean and Agile, however Lean concepts come from Lean manufacturing and have been adopted to fit software development, whereas the Agile manifesto was created specifically for software development (Bibik, 2018, p. 13). The main principles in Lean software development are to:

- **Eliminate waste:** Remove anything that doesn't add value to the customer. An example of this is unnecessary functionality.

- **Build quality:** Prevent defects by ensuring that quality is built into the software from the start, rather than finding and fixing them.
- **Create knowledge:** Highlights the importance of learning in a project.
- **Defer commitment:** Delay decision-making as much as possible until you have the maximum amount of information. This allows more flexibility.
- **Deliver fast:** Reducing the cycle time of development so that the software is delivered quickly and feedback can be received faster.
- **Respect people:** Lean thinking respects every individual's talent and encourages everyone to contribute ideas for improving the work process.
- **Optimize the whole:** Looking beyond individual tasks or team goals, and considering how everyone contributes to the final product and its value. (Janes & Succi, 2014, p.131)

To summarize, Lean thinking fosters a mindset that empowers organizations to "specify value, line up value-creating actions in the best sequence, conduct these activities without interruption whenever someone requests them, and perform them more and more effectively" (Wang et al., 2012, p. 1288).

2.5 Remote working

Remote working is defined as "the practice of an employee working at their home, or in some other place that is not an organization's usual place of business" (Cambridge Dictionary, 2023). The concept of remote work, or "telework", originated during the oil crisis of the early 1970s when American rocket scientist Jack Nilles and his colleagues proposed that substantial savings to the national economy could be achieved by reducing commuting. Initially, it was presumed that increasing traffic issues in major cities could be mitigated by establishing telework centers and promoting work-from-home practices. However, this concept turned out to be impractical (Pyöriä, 2011, p. 388).

Software development later served as a prime example of how virtual workplaces enable individuals to work collaboratively on a single project from different locations. Even if the programming team was dispersed across various locations and face-to-face interactions were limited, they could still collectively contribute their skills to create intangible products like software. Many companies started outsourcing their programming tasks to countries like India, where they could access skilled labor at a lower cost compared to developed countries (Pyöriä, 2011, p. 389).

2.6 Previous research related to remote work and product development

The field of innovation management, which is closely related to product development, has become significantly affected by digitization and digitalization, partly due to the possibilities for remote collaboration digital technologies enable (Orellana, 2017). The practice of remote working and its effects on product development activities has been studied from different perspectives and through different methods, as we will look into in the coming paragraphs.

A survey-based study of 248 small high-tech firms indicated that remote collaboration in practice can prevent knowledge-transfer between team members (Berchicci et al., 2016), while a different one suggests that working from home contributes to increased creative performance (Vega, Anderson & Kaplan, 2015).

The results of another study provide evidence that the use of some IT tools during new product development (NPD) positively affects effectiveness (Durmuşoğlu & Barczak, 2011, p. 326). This is consistent with older research (McDonough, Kahn, & Griffin, 1999) which suggests that highly effective NPD teams use email more extensively compared to teams with lower performance.

In the study, they found that the use of email is indeed associated with enhanced new product quality and market performance. However, their results further suggest that these effects are specifically evident during the development and commercialization phases. As a result, their study emphasizes the importance of early face-to-face interactions in the NPD process to improve both product quality and market performance (Durmuşoğlu & Barczak, 2011, p. 326).

2.7 Previous research related to remote work as a result of COVID-19

The COVID-19 pandemic resulted in what has been called "the largest work-from-home experiment" (Banjo, Yap, Murphy & Chan, 2020). Governments and businesses worldwide suddenly had to implement remote working practices to maintain operational continuity due to lockdown measures (Moglia, Hopkins & Bardoel, 2021, p. 2). Workers were encouraged to work from home full time, and this redefined the traditional view of working from home, which had previously only been used for certain types of work on occasion, or due to special circumstances (Xiao et al., 2021, p. 181).

The impact of increased remote working due to COVID-19 on performance has also been studied. Some have pointed to increased remote collaboration contributing to better creative performance in line with the pre-pandemic research (Tønnesen, Dhir & Flåten, 2021), and a study published in 2022 found that the increase contributed negatively to knowledge-transfer and necessitated increased efforts to facilitate social interaction by managers (Cecchi et al., 2022).

As a result of COVID-19, the book *Suddenly Virtual: Making Remote Meetings Work* (Reed & Allen, 2021) was written, comparing best practices for meetings before and after the pandemic. Through their research, they identified the following challenges related to virtual meetings:

- **The lack of nonverbal communication:** Peripheral vision and auditory signals allow us to easily perceive cues such as body language in person, but these natural abilities are less effective in a virtual setting.
- **Self-consciousness:** Concerns about our personal surroundings, such as our home, private space, pets or children causing disturbances can make people feel on edge during virtual meetings.
- **The camera makes it feel like a performance:** Bringing a camera into the equation can make meetings feel like a performance, making participants strive for perfection and overthink.
- **The absence of water-cooler catch-ups:** It's difficult to replicate the ad-hoc, informal chats usually had in an office environment digitally. (Reed & Allen, 2021)

2.8 Positioning

The potentially varying effects remote working and online collaboration can have indicates that further research within this field is needed. Although researchers have previously looked into remote working and its impact on effectiveness and performance, there is still a lot to be uncovered, especially considering the enormous digital transformation that happened as a result of the pandemic, which was after most of the previous studies related to remote work were conducted.

I have not been able to find any previous research related to how the widespread adoption of remote work as a result of COVID-19 has impacted the actual practices of product development processes and methods, and that is why my study addresses this topic specifically. In addition, I have looked into how the changed dynamics as a result of using online communication tools have impacted the processes, as this might also affect practices, as well as the benefits and challenges of working remotely in the field of product development.

3. Methodology

In this chapter I will describe the choice of methodological approach, data collection and analysis processes, as well as presenting an overview of the data material. At the end I will also reflect on methodological limitations.

3.1 Research design

Selecting the right research design depends on the situation, what the goal is and the resources available. There are three main approaches to research: qualitative, quantitative and mixed methods. The quantitative method is based on numbers, and the answers you get can give measurable answers. The qualitative method, on the other hand, seeks to understand the human experience, behavior, and perceptions. It involves collecting and analyzing data that is not numerical in nature, such as interviews, observations, and document analysis. Mixed methods research incorporates elements of both (Creswell, 2014, p. 3-4).

It is usually more time-consuming to use a qualitative method as you spend a lot of time interviewing or observing the informants and analyzing the information. By using a quantitative method, you can reach more people in a shorter time, but the data collected is not as thorough (Gripsrud et al., 2010).

Qualitative research design is often used to explore complex phenomena such as social and cultural issues, experiences and attitudes, and it seeks to generate in-depth descriptions of the research topic (Hennink, Hutter, & Bailey, 2020, p.11). I decided to go with this approach to get thorough descriptions of experiences from working remotely during the pandemic and have the possibility for comparisons between pre-pandemic and post-pandemic practices.

According to Kvale & Brinkmann, the research process based on qualitative interviews can be divided into seven phases: 1) choosing the topic and justifying the choice, 2) planning the study and creating the interview guide, 3) conducting the interviews, 4) transcribing, 5) analyzing, 6) verifying and 7) reporting (Kvale & Brinkmann, 2009, p. 118). The descriptions and clarifications of the different phases have been useful as guidance in my research process.

3.2 Data collection method

The data was gathered through semi-structured interviews, which is a data collection method in which the interviewer asks open questions while also using a predetermined set of questions or topics to guide the conversation. In semi-structured interviews, the interviewer has a certain level of flexibility to explore new topics that emerge during the interview while still maintaining a structure to ensure that relevant information is collected (Kvale & Brinkmann, 2009).

There are degrees of openness in semi-structured interviews, and questions are often seen as directions rather than requiring all informants to answer all questions. We encouraged the informants to share their experiences and reflections inspired by the questions. This gives limited possibilities for comparison on some of the themes, but more in-depth insight into each informant's experiences. The interview guide is attached (Appendix 1).

The role of the researcher is central in the production of data in any research process (Thagaard, 2018), both in the planning of the project, the conducting of the interviews and the analysis. This might be a significant factor in this

particular study, as I have been working with digital product development remotely in parallel to writing this thesis. I have been aware that my own work in the same industry as the informants give both advantages and possible challenges, and my previous knowledge in this field is both a strength for understanding the informants, as well as a risk for being biased. I could relate to a lot of the things mentioned during the interviews, however I chose not to include personal insights in the results, as this would have necessitated a different research methodology.

3.3 Participant selection

The selection of companies and informants can be called strategic sampling (Thagaard, 2018). We contacted people that we considered likely to have experience from and knowledge on the topic we wanted to explore. The informants were selected based on their role and function within product development as well as the company they work for. The aim was to cover multiple aspects of the product development process and to identify any differences and similarities between experiences from different companies.

The criteria for selecting companies was that they are technological firms who work with digital products and services. Two thirds of the informants are Norwegian and one third international. Out of the 8 companies in the final selection, 7 have offices in Norway, while one is Maltese. Many of the companies with offices in Norway also have offices abroad. Work environments in this field are often multinational, so I do not see any drawbacks with having one of the companies stand out in this way.

We interviewed 14 employees from 9 different tech companies in total. However I made the decision to exclude two of the interviews from the selection due to one of the informants being mainly involved with the development of physical products, which is outside of the scope of this thesis. The other was excluded because he spent most of the time explaining details irrelevant for the thesis.

The final selection therefore consists of 12 informants from 8 different companies. The companies will be referred to as “Company 1”, “Company 2” etc. to ensure anonymity. The anonymity of companies and informants is important to enable the informants to speak as freely as possible. The below table gives some background information on each company, describes what type of products they develop and their approach to product development:

Company 1	Global company that develops technology and provides services in networking and communication. They follow an Ideation-Exploration-Delivery model. The ideation phase involves the product manager speaking with customers to understand the problem they are trying to solve. The exploration phase involves agreement on the solution scope and technologies to be used. Delivery is the final implementation. They operate in Scrum teams typically consisting of 4-6 individuals.
Company 2	Platform provider delivering cloud-based solutions to iGaming operators. They use an Agile framework, mainly Scrum, given the fast-paced nature of their business. Their products are in continuous development and maintenance. There are six product owners reporting to the head of product, each responsible for 1-2 development teams.

Company 3	TV distributor providing digital TV via antenna, internet, and fiber. They use a feedback loop system where designers gather feedback from customers, which is then used to make updates to the product, followed by more feedback. They work in full-stack teams that cover all technical aspects of product development, including design, backend and frontend development.
Company 4	Web development company with clients ranging from online shops, nonprofits and fundraisers to larger governmental organizations and companies. They have a four-phase process: 1) strategy phase with customer workshops, 2) design phase, 3) development phase with sprint reviews, and 4) product launch and transition into the maintenance phase. They also use a model called User Centered Design Canvas for defining user needs and motives. They structure teams depending on project size, typically including a project manager, UX/UI designer, front-end developer, back-end developer, and a tester.
Company 5	Consulting firm creating digital solutions for a wide range of clients across various industries. They mainly focus on the maintenance and further development of existing products, and work in sprints with regular releases of new features every three weeks. Their teams consist of consultants from different firms and employees from the company to ensure domain knowledge. They have project managers/product owners who manage the tasks according to priority.
Company 6	Video solution provider enabling clients to add videos to websites in a vertical story format. The company's largest clients are involved in sectors such as education, recruitment marketing, online shops and sports.

	They use customer feedback to guide their product development but verify decisions through data. They use a build-measure-learn model and start with an MVP before moving to full-scale commercial solutions. They are organized into a product team, commercial team, and administrative team. The commercial team is further subdivided into direct sales, marketing, customer success, and partner sales.
Company 7	Provider of IT solutions and consulting services to both public and private sector clients. They follow Agile methodology and work with autonomous teams, allowing flexibility in what they are going to create. They have a consulting unit and a counseling unit. The consulting unit is further split into departments like UX, Agile management, project management, architecture, and data science.
Company 8	Technology consulting firm specializing in banking and finance. The company sells tailor-made solutions for customers, including end-user solutions and management systems for bank employees. They use Double Diamond, which is a design process model focusing on gathering experiences and making iterations and adjustments, as a basis for their product development. They also use pair programming to ensure redundancy in knowledge and to foster growth amongst team members. They operate with teams typically consisting of eight people. They also have a management team that works on operational and strategic matters, and a product team that focuses on long-term planning and strategy.

Further, I have categorized each informant based on their role and function as this is an interesting factor and might say something about which phases or activities have been more affected by the transition to remote work than others.

The three categories are developers, product managers and C-level executives, and the below table provides information about each informant and their role.

Developer 1	Developer who started working at Company 3 in August 2019. His main responsibility is Android development for both mobile and TV platforms, but he also assists with other platforms like Chromecast and web. His role involves troubleshooting, data collection, and analyzing logs, with a primary focus on front-end logic within apps. Just a month before the pandemic hit, he began working on a project aimed at combining teams that were working on different apps into a single product team.
Developer 2	Android developer who started in their role at Company 3 in June 2018. Her duties involve implementing new features as well as enhancing existing ones. She works extensively with Android apps on various devices such as mobiles, tablets, and TVs. A typical part of her job involves working with navigation, ensuring users are correctly redirected to the appropriate pages within the apps.
Developer 3	Developer who has been working at Company 5 since 2020, bringing with her six years of IT-development experience from her previous employment at a similar consultant company. The developers at Company 5 have some discretion in choosing the industries or companies they wish to work with and each project typically lasts about two years. She is currently working with an electricity company, ensuring their IT systems function properly to deliver electricity.
Developer 4	Senior consultant and developer at Company 5 who joined the company in September 2020. She is currently working as a back end developer for a company in the recycling machine industry and her work involves maintaining the backend solution consistent across environments. She works on an app that allows users to track their recycling habits and the money they can withdraw or donate. Currently,

	she is working on a solution that will allow people to recycle bottles in stores that do not have a recycling machine.
Product Manager 1	Product owner who started working at Company 1 in 2018. She is responsible for coordinating with five Scrum teams, each consisting of 4-6 members. Altogether, she oversees the work of 25 developers and 3 UX-designers. Her main task involves developing new features for a video conference system. While the physical component of the product is a significant part of the development process, her focus lies predominantly on the software aspect of the same product.
Product Manager 2	Product owner who began their role at Company 2 in January 2020, spending only a few months in-office before transitioning to remote work. Her primary responsibilities revolve around API integrations and improvements for an online casino platform. She manages two Scrum teams, with their work being organized into sprints.
Product Manager 3	Head of Product at Company 2, where he has worked for the past five years. His department is focused on enhancing the casino platform, specifically with respect to supporting regulated markets and integrating game providers and payment providers. He manages a team of nine product owners who all report directly to him, and oversees the development on the platform.
Product Manager 4	Project Manager at Company 4 since June 2019. She has a long-standing career in project management, although her previous experience was in the oil industry. Her responsibilities span the entire life cycle of digital products, from sales outreach and preparing offers, through to implementation and addressing operational needs post-launch.
C-level 1	CEO of Company 4. He leads the company in building digital solutions and strategies with their clients, which involves

	setting KPIs, defining long-term goals and ambitions, as well as designing user experiences (UX) and user interfaces (UI). Following the delivery of a product, the company continues to provide maintenance, support, and further development services. Their core business is a combination of design, development, and strategy. The strategy component involves significant business and concept development.
C-level 2	CEO and co-founder of Company 6. His role involves ensuring that the established processes, ranging from administrative to commercial and technical tasks, are adhered to. He is also responsible for strategic planning, ensuring the investors, board, and employees are aware of the company's plans and have the necessary resources, including staff and capital, to execute them.
C-level 3	CTO of Company 7. He has been with the company since April 1986, making him a long-standing employee who has experienced the company's growth and evolution first-hand.
C-level 4	CTO of Company 8, specializing in banking and finance. He has been with the company since it was founded in 2003. Their work is focused around tailor-made solutions for customers, which include end-user solutions and case management solutions used by bank employees. The solutions they develop are both web-based and mobile apps, catering to a wide range of client needs in the digital space.

3.4 Conduction of interviews

The interviews were conducted by my co-student and I during the spring of 2022. The informants were informed with an information letter, and signed a declaration of consent prior to the interview (Appendix 2). We first introduced ourselves and the purpose of the study, as well as underlining that anonymity would be ensured. We also got their consent for audio recording the interview.

We then asked the informants open questions based on the interview guide, while allowing the conversation to flow naturally. We asked follow-up questions when the participant mentioned an interesting topic. The interviews typically lasted from 45 minutes to one hour. Most interviews were conducted digitally due to distance, but one of the companies where we interviewed two of the informants allowed us to visit their office and have the interview there. This gave a very different interview experience in a positive way, which is an interesting result related to this study by itself. The context was much more dynamic and one of the informants explained their processes by drawing on the whiteboard.

The disadvantage of conducting most of the interviews digitally is that we lost a lot of the non-verbal communication in the interview process, but I believe this has not impacted the data material to a large extent. In fact, it might have been beneficial to the study as these communication methods are an important part of what is being examined. Most interviews had the form of an informal talk. One of us interviewed while the other listened, took notes and was responsible for the audio recording. The interviews were later transcribed word for word.

3.5 The analysis

The transcribed interviews constituted the 'raw' basis for my data material. From there, I inserted each informant's statements into tables with specific themes assigned to them, which gave an overview of the statements. The themes were based on the questions from the interview guide and helped structure what each informant had said about a certain topic into one section. I marked the most relevant sections, and processed the material further by highlighting the parts best illuminating my research questions. This categorization was based on the interview guide and also included some new categories that came from the

content of the interviews. This more elaborated 'coding' resulted in a more and more focused matrix that constituted the basis for my interpretation of patterns in the material. This is the process of analytic cycles (Hennink et al., 2020, p. 6).

In the analysis it is important to be aware that people normally have a tendency to present themselves in a positive manner. There is often a difference between what people say they do and what they actually do (Holy & Stuchlik, 1983). In my experience working with the data material however, I felt that our informants were open and transparent while sharing their experiences.

3.6 Validity, reliability and methodological limitations

Validity is about relevance and whether the research method and results are valid for the research questions asked, and whether what was intended to be measured has been measured (Kvale & Brinkman, 2009, p. 250). The interview guide was well worked through and seemed to work well in the interviews.

My opinion is that the data material illuminates the research questions to a satisfactory extent. However, I consider the possibility to generalize as limited based on the relatively low number of respondents compared to those usually achieved through standardized questionnaires. Still, some patterns found may be transferable to remote product development in general. Other limitations may be not having the research question set in stone before conducting the interviews as well as my limited research experience and potential bias.

Reliability concerns measurement tools. With qualitative research methods one always has to question if interviews can be trusted as a measurement 'tool' and

the data material stemming from them. With this approach, there are no numbers that can be double checked or research processes that can be repeated, as in quantitative research (Lecompte & Goetz, 1982). However, I believe that the informants to a high degree answered in an honest and sincere way, and the recording and transcribing of interviews increases the reliability.

"Attaining absolute validity and reliability is an impossible goal for any research model. Nevertheless, investigators may approach these objectives by conscientious balancing of the various factors enhancing credibility within the context of their particular research problems and goals" (Lecompte & Goetz, 1982, p. 55). In assessing the methodological approach I have chosen, I believe it has generally produced material that is both trustworthy to a high degree and relevant to answer the research questions.

4. Results

The data gathered provided an abundance of information related to how the companies adapted and how individuals experienced working with product development from home during the pandemic. To give a structured overview, I have split the results into different themes and tables.

The first section focuses on the topics that are interesting to look at from a company point of view, while the second part goes more in-depth into each informant's experiences. After each table I will present a summary highlighting the main findings from each topic.

4.1 Company impact and adaptation

The below table shows key findings related to the pandemic's impact on each company and how they handled the transition to remote work:

Company 1	Handled the shift seamlessly due to their existing home video systems. The company managed to maintain their normal operations, with the hardware team occasionally visiting the office for equipment needs. The main challenge was user testing, as their typical office solution users were no longer in the office. They saw an increase in market demand for hybrid solutions and good video solutions, leading to the development of new products, tailored for home offices. The company also had to restructure office spaces to cater to the new usage patterns. Onboarding and product development became a challenge due to travel restrictions and the need for remote coordination.
Company 2	Found remote work beneficial for reducing interruptions, allowing them to adhere strictly to the planned sprints. However, the lack of in-person meetings and new hires were significant drawbacks. They observed new jurisdictional requirements due to the pandemic, impacting the delivery of existing projects. While the transition to remote work wasn't a big challenge, new processes and structures were implemented. The lack of in-person interaction was a noted change.
Company 3	Had to adapt their methods from physical to digital. They initially lacked the infrastructure for remote work, but quickly adapted without halting any ongoing projects. The company was able to launch three products within a month after swiftly transitioning to remote work. However, the lack of a long-term plan was a challenge.

	The development of the new app was successful due to the increased focus from remote work. However, some meetings were deprioritized and challenges were faced in conducting in-depth discussions digitally.
Company 4	Was already equipped for remote work, having experience with international colleagues. However, the transition still posed challenges, such as difficulty concentrating for analytical work and issues with initial outreach sales. They emphasized that while production could be carried out from home, innovation thrived better in person. The company had to adapt to specific agenda meetings and saw delays in decision-making processes.
Company 5	Employees faced challenges in team integration and the blurring of work and personal life. The company adapted by providing equipment for better working conditions at home. They experienced a major impact on their work methodology, as they had to adapt from physical whiteboards to digital tools for their sprint planning.
Company 6	Had to completely alter their sales process, shifting from a physical to a digital approach. This posed challenges but also allowed them to target foreign markets. However, they saw a positive effect externally, with a 10% growth during the pandemic due to increased recognition of personalized video communication. Internally, the company culture was affected, but the team adapted well to online tools.
Company 7	Ensured a safe workspace for those with less optimal home environments. The firm had already established a crisis team and managed to adapt their systems for remote work, providing additional tech equipment when needed. They faced challenges in establishing initial customer contacts and making connections to new environments and customers. Despite cultural and habitual differences, no negative consequences were reported.

Company 8	Already had the technology to work remotely but faced challenges with the lack of informal meeting places and increased scheduling of meetings. They found the idea-generating phase and estimation processes to be more challenging remotely, with in-person discussions preferred for deciding on technical solutions. Internally, the company culture was affected, but the team adapted well to online tools.

Most companies managed to maintain operations, with some even experiencing growth or launching new products during this time. However, they faced common difficulties such as the lack of in-person meetings, the challenge of integrating new hires, and the difficulty of balancing work and personal life.

Several companies also found that certain activities, such as innovation, idea generation, and complex discussions were more challenging in a remote setting. On a positive note, some companies discovered unexpected benefits like fewer interruptions, greater focus, and the potential for targeting new markets. They found innovative ways to adapt their work processes, systems, and tools to accommodate the new remote work setup.

4.2 Digital tools

The companies used a variety of digital tools to facilitate product development activities during the pandemic:

Company 1	*Jira* for task management and a digital whiteboard function on their self-developed devices. They also started utilizing a tool called *Mural* during the pandemic, replacing post-its.
Company 2	*Jira* and for task tracking and *Confluence for* documentation. For meetings, they first used *Zoom* and later moved to *Google*

	Meet. They also used *Mural* for more interactive collaboration.
Company 3	*Google Meet* and *Slack* for communication, and *Miro* as a digital whiteboard. They also used *Favro*, a tool that replaces post-its.
Company 4	*Figma* and *Adobe* for design purposes and *Microsoft Teams* for communication.
Company 5	*Miro* as a digital whiteboard and *StoryPlan* for task management.
Company 6	*Trello* for project management, *Google Meet* for video conferencing, *Asana* for task management, and a digital tool for contract signing.
Company 7	*Slack* for team communication.
Company 8	*Atlassian* ecosystem to make their products available to clients and *Vimeo* for video conferencing.

Some of these tools were already in use before COVID-19, but our informants depended on these to a much greater extent when working from home. Miro and Mural had not been used by our informants pre-pandemic and the implementation of these were a direct result of remote work, as they were in need of a digital tool to replace physical post-its and whiteboards.

In this next section, we will take a closer look at each informant's experience of working from home. However, in order to understand how COVID-19 and remote work impacted product development practices, we first need to understand what their practices were like *before* the pandemic.

4.3 Pre-pandemic practices

A typical workday in the lives of our informants before the pandemic:

Developer 1	All meetings were in-person at the office, including stand-ups

	and weekly task prioritization. Working from home was occasional, and due to commuting or personal issues. They utilized whiteboards and post-its for brainstorming, and Slack for communication.
Developer 2	She went to the office every day, though remote work was possible in certain cases. She enjoyed frequent office gatherings including celebrations with cake and knowledge sharing sessions.
Developer 3	Where she was working before the pandemic, she worked exclusively at the office in a social setting. Remote work was possible, but required approval. They used physical tools like post-its and whiteboards for organization.
Developer 4	Coding and code reviews were digital before the pandemic, but she had to commute to the office daily. Sprint planning involved physical activities like *Planning Poker* and Before retrospectives they would have a physical workout as a team to warm up. Remote work required approval and was viewed with skepticism.
Product manager 1	Before the pandemic, she primarily worked from the office, but had the opportunity to work from home on special occasions.
Product manager 2	Her workday consisted of physical team meetings such as daily scrums, sprint reviews, retrospectives, and roadmap work. Working from the office often led to interruptions from colleagues. They had multiple teams in their office, and spontaneous discussions disrupted the development process.
Product manager 3	A typical workday included office visits, and Slack and email checks. They held product team sync-ups three times a week, daily sprint-related meetings, sprint planning, jurisdictional and customer need discussions, and brainstorming sessions. Remote work was rare as he values office interactions.
Product manager 4	She and her colleagues worked closely at the office, frequently exchanging ideas and engaging in internal and external meetings. She had regular in-person meetings to update clients on projects.

C-level 1	He traveled often to meet with existing and potential clients. Primarily operated from the office.
C-level 2	Worked both from the office and remotely, and had developers based abroad. Physical meetings and traveling were frequent.
C-level 3	They occasionally worked from home before the pandemic, but there was no institutionalized arrangement for it.
C-level 4	Teams were usually co-located and benefited from physical collaboration. Remote work was a rarity, reserved for exceptional circumstances. Their work included physical meetings, client breakfast meetings, general assemblies, and annual client events.

Developers generally had to commute to the office daily and only occasionally had the opportunity to work from home, usually due to commuting issues or special circumstances. Office meetings, including stand-ups and weekly task prioritization, were a common feature. Physical tools such as whiteboards and post-its were widely used for brainstorming and organization.

Product Managers also predominantly worked from the office, with the opportunity for remote work available on special occasions. Their workday typically consisted of physical team meetings, including daily scrums, sprint reviews, retrospectives, and roadmap work. Interruptions from spontaneous discussions and multiple teams within the office were a notable issue.

C-level executives varied in their work practices. Some traveled frequently for client meetings but most of them primarily worked from the office. While some worked remotely on occasion, remote work was generally not institutionalized and was often reserved for special circumstances. Physical meetings, client events, and general assemblies were common practices.

4.4 During-pandemic practices

How work arrangements and activities changed during the pandemic:

Developer 1	They didn't have all the necessary infrastructure to work from home in the beginning, but after 2-3 days it was sorted. They did not have to stop any ongoing projects, it was business as usual.
Developer 2	Despite being thrown into remote work, her team managed to launch three new products within a month of working from home. The company gave employees regular updates and provided necessary equipment for home offices. During the pandemic events like the full day conference they usually had once a month turned into one-hour meetings every two weeks. They tried to have full-day meetings digitally, but it didn't work out well.
Developer 3	She started at the company during the pandemic, which was difficult. It was her first time working in the electricity industry and she had a lot to learn, but the threshold for asking questions was high due to all communication being online. They used Teams to communicate and Miro to replace the post-its and whiteboard.
Developer 4	The transition to remote work was slow and stressful due to initial lack of VPN-access. Walking her dogs in the mornings and afternoons helped her separate work and personal time. They found a digital solution for Planning Poker and replaced the physical warm-up before retrospectives with digital board games.
Product manager 1	The team transitioned easily to remote work because they were accustomed to using virtual video systems. They kept their processes the same, with a virtual "window" for each team. This was a constant meeting where team members could jump in and out any time.
Product manager 2	Working from home, they were better at keeping the sprints "sacred" for the teams, with less interruptions, because they would plan according to the calendar and raise questions during planned meetings rather than asking ad hoc. She missed face-to-face interaction and seeing colleagues.

Product manager 3	Transitioning from physical to digital planning was initially challenging, but was managed using tools like Mural. In the beginning it was cool and exciting, but eventually it became depressing working from home all the time. He was alone, ate by his desk, started working early and finished late. It was difficult to switch off, but eventually he found a good routine.
Product manager 4	Despite having the necessary technology for remote work, the transition was challenging. Sales suffered initially, and balancing work and homeschooling became a struggle. Analytical work was more difficult from home because it requires a lot of concentration, and at home there were too many distractions.
C-level 1	Transition to remote work was relatively smooth as they were already used to working with international colleagues online. They went to the office sometimes even though it was not allowed.
C-level 2	He had to come up with a new sales process. It went from being very physical to digital. This was one of the biggest barriers to overcome, but it also gave them the opportunity to use the same model to target foreign countries without a physical presence.
C-level 3	Wellbeing was the main challenge, because people enjoy meeting in person. The transition to remote work went well for most employees, however younger people had challenges creating a productive work environment at home. For this reason they kept their office open with strict limitations.
C-level 4	The company was well-prepared technologically for remote work. However, the lack of informal, face-to-face interactions led to an increase in scheduled meetings. Instead of stopping by a colleague's desk to get clarification on something in two minutes, you had to schedule a meeting, so whole days were fully booked with meetings. Conducting job interviews and integrating new employees were challenging.

Despite initial difficulties setting up remote work infrastructures, all developers adjusted well, and ongoing projects were maintained. Developer 2's team even launched three new products within a month of transitioning to remote work.

Developer 3 had a challenging start due to joining the company during the pandemic and navigating a new industry virtually. Developer 4's transition was slow due to VPN-access issues, but found ways to maintain work-life balance and translate work practices to digital forms.

Product managers also adapted well to virtual working systems, with Product Manager 1's team creating a virtual "window" for constant communication. Work routines became more organized, and sprints were kept more “sacred” due to fewer interruptions (Product Manager 2). However, the lack of physical interaction and the monotony of working from home were challenging for many, with some finding it hard to switch off from work (Product Manager 3 and 4).

Most C-level executives found the transition to remote work smooth, particularly because of previous experiences with online communication (C-level 1). They noted major changes in sales processes moving from physical to digital, creating opportunities for targeting foreign markets (C-level 2). However, they also recognized the challenge in maintaining employee wellbeing and productivity, especially for younger employees without conducive work environments at home (C-level 3). The transition resulted in more scheduled meetings, replacing informal, face-to-face interactions and making certain processes like recruitment and integration more challenging (C-level 4).

4.5 Productivity during the pandemic

How efficiency and work quality was affected as a result of working from home:

Developer 1	Experienced an increase in productivity due to less interruption. Had to work efficiently to balance work and family commitments.

Developer 2	Managed to maintain her efficiency working from home although she did not enjoy the new circumstances. The productivity went up because they were transparent when they needed help and it was easier to ask for help, because of the common understanding that people were going through a hard time with the new circumstances. However, some worked non-stop and skipped lunch because they lost track of time.
Developer 3	Productivity increased due to fewer interruptions, less time wasted on commuting to the office and between meeting rooms, and the ability to focus more effectively at home. Snoozing notifications kept out noise, and allowed her to get in “the zone”.
Developer 4	Initially, productivity sky-rocketed due to the motivation to prove they could deliver under difficult circumstances. However, this pace was not sustainable, and productivity levels returned to normal as employees grew tired. On average throughout the pandemic she has been as efficient as before. There are distractions at home related to practical things, but also at the office as you might run into someone and have a longer lunch.
Product manager 1	Productivity was similar to before the pandemic. She was more focused at home due to fewer disturbances, but questioned the quality of solutions developed during the pandemic due to the importance of good communication in product development.
Product manager 2	Experienced a dip in productivity due to initial lack of motivation, but learned to leverage the situation to improve productivity and motivation by working from different locations and spending time with family.
Product manager 3	Performance was good, although he thinks it would have been interesting to compare productivity at home versus at the office.
Product manager 4	Working from home she could easily get distracted by the washing machine for example. There is something about

	going to the office and focusing on only that, so she believes that people have higher efficiency at the office than at home.
C-level 1	Noticed an efficiency increase during the pandemic, but was unsure if it was due to the pandemic or the business' growth.
C-level 2	He was more efficient working from home than at the office where he has people knocking on his door every five minutes.
C-level 3	Believes that virtual work has led to higher productivity because of the ability to concentrate regardless of the location.
C-level 4	Some employees expressed that they were able to work more efficiently from home because they could work by themselves without having to coordinate with others. However, as soon as coordination was required, you needed to schedule a meeting which takes up a lot of time.

Several developers reported increased productivity due to reduced interruptions and increased focus that came with working remotely. The absence of office-related distractions, less time spent commuting, and more efficient time management played crucial roles in this. One developer experienced an initial surge in productivity, possibly due to the desire to prove efficiency under difficult circumstances, but found that this was not sustainable in the long run.

Product managers generally maintained or improved productivity levels, but some found that the quality of their work could have been impacted due to communication challenges in remote work. One product manager experienced an initial dip in productivity due to the sudden change but found ways to adapt.

C-levels shared mixed views on remote working productivity. While some observed higher efficiency due to the ability to concentrate without inter-

ruptions, others thought it led to more efficient individual tasks but posed challenges when coordination was required. There was also uncertainty related to whether the increased productivity was a direct result of remote work or coincidental business growth.

4.6 Online collaboration

Experiences from communicating and collaborating online during the pandemic:

Developer 1	They went from daily stand-ups to weekly syncs, and some other meetings came up. Developers are usually very introverted, so most of them thought it was great. After people returned to the office they realized that it's not enough to have one camera set up in the meeting room. When they have meetings where someone is joining remotely, everyone connects from their individual screens even if they are sitting in the actual meeting room, so that everyone can see each other's faces instead of having just one camera far away.
Developer 2	Despite the shift to remote work, their strong team dynamics ensured that communication remained effective. Integrating new team members also went well.
Developer 3	The loss of body language and the spontaneity of in-person conversations was felt, leading to more structured and less dynamic interactions. Talking to a screen versus talking to a person are two very different things, and online it often happens that two people start talking at the same time. Virtual meetings are usually limited to the specific context, so you don't get the same type of small talk as you would in person. At the office, something that seems like a small thing can have a big impact, and new ideas can spark over a cup of coffee. She finds it easier to talk to people when sitting at the office. All you need to do there is look up from your computer and ask. Working from home she would send a message and ask if they have time for a 2 minute call.

	Usually they do, but she would only send that message to the people she is comfortable with. She suggests that this could have affected the quality of solutions developed, although remote work went well overall.
Developer 4	Their small team size facilitated effective remote communication, though there were instances of delayed responses to queries. The communication between product owner and developers was impacted because all of the communication was moved online. Even now that they can go back to the office, they still send any important information via Teams or Slack to make sure the person that needs the information receives it. Nowadays you don't know where people are, so you don't even bother checking if they are at the office or not. She believes it will stay this way.
Product manager 1	Despite a successful transition to remote work, the lack of casual, ad-hoc conversations was missed. She noticed that certain teams, particularly those who enjoy pair programming, adjusted well and remained effective in their communications. Working from home, you don't start a conversation unless you have a specific question. However, they did take measures trying to facilitate more ad-hoc conversations by having the virtual "window" which they also used for informal chats.
Product manager 2	In the beginning it was a challenge keeping the communication flowing. At the office you can't ignore others and they can't ignore you. However, when everyone is sitting at home, this is possible. It took a few months before the communication flowed more easily, and then it was good.
Product manager 3	They were lucky to have found the right tools for collaborating online although it was unusual having online meetings in the beginning. People had their cameras off and were afraid to talk.
Product manager 4	While online communication tools were effective, they couldn't replace the experience of in-person interaction.

	Therefore physical meetings, particularly for initial client interactions and clarification sessions, are still preferred. She believes a project is more deeply rooted in everyone after a physical clarification meeting or workshop. At workshops, there is a natural dynamic around the table, whereas on Teams you need to raise your hand and wait your turn to say something. A positive outcome was the strengthening of relationships with international colleagues. They became tighter because the whole world was going through the same thing, and they had something in common even though they were far away and part of different cultures. They got to know each other on a personal level by having children at home screaming in the background and became closer colleagues, maybe even long term.
C-level 1	Although collaborating online went well, the value of sitting around the lunch table together should not be underestimated.
C-level 2	Collaborating online went well. There were no major challenges and few misunderstandings. However, the personal touch was lost, showing visitors around the office for example. You feel like you owe the person more when they are visiting in person versus having a digital meeting. You get a sense of trust and desire to please the other person when meeting physically. Casual office conversations were missed, especially talking by the coffee machine. Sometimes new ideas are discovered over small chats like that. They became more efficient and clarified things over Teams or Slack without having to set up meetings for every clarification. However, the dynamic has changed since returning to the office as only half of the employees join meetings in person and the others attend remotely.
C-level 3	Having prior experience of communicating online with colleagues based abroad made the transition smoother. It is however important to have some physical meetings,

	especially in the beginning of a partnership or at critical points in a project. A challenge has been that the best technological input is usually given by talking to people in person, and there have been fewer arenas to meet. At the same time, the inbox is overflowing with webinar invitations, but it's difficult prioritizing, because it often loses context when you are invited to a lot of different things and there is no limit to how many things you can attend digitally.
C-level 4	An important factor here is how long you have worked together and how confident you are with each other. If you have a long-standing relationship, the transition to working from home was probably easier than for those who were new and didn't know each other that well. You lose the ability to use body language to express that you disagree with something being said, which makes it difficult when faced with challenging tasks or projects.

Most informants had positive experiences with online collaboration, appreciating the convenience and reduced need for in-person meetings. Some even saw improvements in team dynamics and communication, especially in teams that were well-established before the pandemic. However, there was an overall consensus that in-person interactions were missed, particularly the casual, ad-hoc conversations and the ability to communicate non-verbally.

Developers found that online meetings required adjustments, like connecting individually from their screens even when in the same room, to ensure everyone's faces could be seen (Developer 1). They also noted the loss of dynamic interactions due to the absence of body language and the difficulty of spontaneous conversations. Despite these challenges, most developers managed to adjust well to the new circumstances. Particularly those that engaged in pair programming stayed effective in their communication.

Product managers observed that ad-hoc conversations were harder to initiate in a remote setting. The use of virtual windows for informal chats was one strategy adopted to facilitate more casual conversations. At the C-level, the success of online collaboration was recognized, but the value of in-person interactions was also emphasized. Casual office conversations and the personal touch of showing visitors around the office were missed. They also noted that it is easier to build trust and establish long-term relationships through in-person interactions.

Some mentioned that having previous experience with online communication made the transition smoother, and all agreed that while online collaboration tools are effective, they cannot fully replace in-person interactions. However, the shared experience of remote work also strengthened bonds with international colleagues, who faced the same challenges.

4.7 Innovation, ideation and creative processes

This table highlights how online collaboration impacted creative processes. The developers are not mentioned here as they did not have much to report due to the nature of their work being more technical.

Product Manager 1	Everything they do is innovation in one way or another. She believes it is easier to innovate on the software side, because you can try and fail more quickly and adjust/change direction. COVID-19 gave them new problems to solve, and the focus shifted from developing products for big meeting rooms to home offices. They worked on virtual backgrounds and noise cancellation because people often have more noise around them when working from home.
Product Manager 2	Feels her room for innovation is limited due to the technical and regulatory nature of their work. However, they strive to find opportunities for innovation within those constraints.

Product Manager 4	There is a different dynamic in the creative processes online versus offline. When sitting together, they would throw out ideas, draw on the whiteboard and bounce back and forth. They did not manage to replicate this spontaneous idea-sharing online. At home you are isolated, so you work on something longer before you check with your colleagues what they think about it. Due to this she had to be more independent in the creative processes during the pandemic. It's easier to get quick clarifications when sitting together at the office.
C-level 2	Innovation is closely intertwined with their product development. They listen to their clients' wishes and also try to be ahead of trends. However, they don't have a concrete process for innovation – they already have so much they know they should develop anyway, so they are working their way through the backlog by confirming if there is a real need for it.
C-level 3	Most of their innovation occurs within the context of client projects, where the aim is to create flexible, future-oriented solutions. They rely on the cross-pollination of competencies and connections, including academic networks, for generating creative ideas.
C-level 4	They distinguish between core innovation (focused on testing, experimenting, and improving existing solutions) and transformative innovation (more exploratory and involving clients at early stages). When experimenting with potentially transformative ideas, they aim to keep costs low until the viability of the product is confirmed.

Product Manager 1 sees constant innovation as part of their role, adapting quickly to new challenges, such as those brought by the COVID-19 pandemic. Product Manager 2, however, feels innovation is constrained by technical and regulatory requirements, though they still attempt to innovate within these parameters. Product Manager 4 sees the shift from office to remote work as limiting spontaneous idea-sharing, requiring more independent ideation.

The C-level informants see innovation as an inherent part of product development, often driven by client needs and market trends. C-level 3, for instance, relies on various networks for idea generation and cross-pollination. C-level 4 differentiates between core and transformative innovation, focusing on improving existing solutions and exploring new, potentially transformative ideas. He also stresses the importance of managing costs during the early stages of transformative innovation. Phases such as ideation and concept development seem to be the phases least fit for remote work, as these heavily depend on human interaction and back-and-forth idea-sharing.

4.8 Post-pandemic practices

Practices that persist as a result of working from home during COVID-19:

Developer 1	Moved to Denmark and works remotely due to the flexibility offered post-pandemic. He believes productivity doesn't require office presence and appreciates the company's understanding of individual needs. There are more physical meetings again, but remote participation is supported.
Developer 2	Her team is now "remote first" with several members working from different locations. She personally prefers working from the office because she sees the benefits of organic small talk and in-person collaboration. She appreciates more flexible working hours, but misses aspects of pre-pandemic office culture, such as Friday waffles.
Developer 3	Has adopted a hybrid approach to work, with Mondays and Fridays at home and the rest of the week in the office. There is an increased acceptance of remote work at her company, and they have continued to use digital tools like Miro, despite her personal preference for physical post-its.
Developer 4	Working from home has become the new normal, but the team meets at the office sometimes although this requires planning beforehand. They can work from home or from the office whenever they want.

Product manager 1	Appreciates the improved work-life balance remote work has facilitated, but prefers to have the clear end to the workday she gets by working from the office. She works less now than when she worked from home, but still she occasionally works from the company cabin. She sees in-person meetings as beneficial and tries to get her team together in person at least once a week.
Product manager 2	She values the company's flexibility in allowing work from home, which was particularly useful during her pregnancy as it allowed her to work more than she would have been able to if she had to come into the office. She also mentioned that the reduced office attendance has allowed the company to rent out part of their office space.
Product manager 3	Prefers working from the office now that it is possible again, though the option to work from home sometimes is useful.
Product manager 4	Working from the office most days because she doesn't like working from home. The company is back to normal, but there are less face-to-face client meetings and visits now.
C-level 1	Works from home more than he did before the pandemic, but he is also at the office more than before the pandemic because traveling is not as frequent anymore.
C-level 2	They have kept a flexible approach for most employees, although they prefer having people come into the office. Many meetings that would have been physical before the pandemic are now held digitally instead, which saves them a lot of time. He estimates the amount of physical meetings and travels has been cut in half compared to pre-pandemic.
C-level 3	Tries to maintain physical meetings as much as possible, but finds it easier to follow everything that's happening digitally. The managerial challenge is observing and identifying problems and coming up with the best solution. People are different and have different needs, and they want everyone to continue delivering good service and revenues. They will continue allowing employees to work from home.
C-level 4	Finds relief in returning to the office and reintroducing physical meetings. The company has slowly resumed travel for client interactions and operates a hybrid model.

Developers and product managers have generally embraced the flexibility offered by remote work, also post-pandemic. Some have chosen to relocate or adopt hybrid working models, blending office presence with remote work. There is an appreciation for flexible working conditions and digital tools. However, some employees expressed a preference for office-based work due to its structured workday and opportunities for organic collaboration.

C-level executives have been balancing the benefits of flexibility with the need for office presence. Some found a hybrid model effective, reducing physical meetings and travel, thereby saving time and resources. They acknowledged the challenges in maintaining productivity and employee welfare in a remote or hybrid setup and emphasized the importance of meeting individual needs.

Across all roles, the option to work remotely has been seen as a positive change, although there's recognition for the unique benefits of in-person interaction. The ongoing challenge is to balance these benefits with the flexibility and efficiency gained from remote work, leading many companies to adopt a hybrid work model post-pandemic. The dynamic of meetings has changed, with a mix of in-person and remote attendees. There are concerns about the lack of personal contact potentially affecting the quality of discussions.

4.9 Positive outcomes

Positive effects of the standardization of remote work as a result of COVID-19.

Developer 1	Values the flexibility offered by remote work, especially as a parent of small children. He also states that the reduced stress from commuting has made him a happier person and led to a positive change in his family life.

Developer 2	She thinks it's great that people organize their day as they want. As an example, you can go skiing in the middle of the day, and finish the rest of the work later. It also enables her to visit her family more often.
Developer 3	Diversity. People are hired across borders. The ability to connect remotely if you aren't able to attend a presentation or meeting physically is also great. Remote work in general gives more flexibility.
Developer 4	The freedom to choose where to work from. She likes having the flexibility to work from home when she wants and believes it's positive that people have learned that one can be just as efficient and deliver projects from home. It has also impacted the environment positively by reducing commutes.
Product manager 1	Finds it exciting to work at her company due to the rise of video conferencing. She believes the pandemic has highlighted the environmental benefits of virtual meetings.
Product manager 2	If it wasn't for the possibility of working from home, she never would have been able to keep working up until one month before she was due to give birth.
Product manager 3	Enjoys the flexibility of hybrid work, saving commute time, and attending to personal errands when needed. He also appreciates the option to connect from anywhere and the reduced travel time.
Product manager 4	There has been a quantum leap in digitalization, which is good for their business. More people see the value of digital solutions, and they also expect more from them now compared to before the pandemic. They should be seamless and intuitive, and systems should talk together.
C-level 1	Working remotely disciplines us in a way, because we don't spend as much time talking about the weather. Working remotely with product development specifically is also good in the sense that you can't make a vague order. It forces people to define the scope more in detail. The pandemic accelerated change that organically would have taken much longer. Many have now understood the

	value of having a well-functioning digital system and the potential that lies there, which is positive for their business.
C-level 2	The pandemic normalized hiring people remotely, which has been a good way for them to expand their team of developers. Personally he also values the increased focus and time for personal tasks when working from home.
C-level 3	The main positive effect is that the skepticism of remote collaboration has been broken down to an unimaginable extent compared to how things were before the pandemic.
C-level 4	More flexibility when establishing teams, because they can now put people across locations together in the same team. They also saved a lot of money not traveling, as they used to travel between their offices.

Multiple informants highlighted that the pandemic has accelerated positive changes in digitalization that would have otherwise taken longer, including increased flexibility, cost savings, more focus on digital solutions, and the breaking down of geographical barriers.

Most seemed to value the flexibility of remote work as this allowed for a better work-life balance. With remote work there are opportunities to enjoy hobbies during the day and visit family more frequently. The freedom to choose the workplace and the increase in job opportunities due to decreased geographical limitations were also mentioned as a positive outcome.

Some noticed discipline among remote employees due to a more focused conversation, skipping small talk. This forced individuals to be more detailed in their tasks, leading to higher productivity. They also recognized the potential and value of well-functioning digital systems, which were emphasized during the pandemic. Furthermore, remote work reduced skepticism about collaboration and saved costs due to less traveling.

4.10 Negative outcomes

Negative effects of the standardization of remote work as a result of COVID-19.

Developer 1	The primary negative effect he felt was the lack of face-to-face interactions with colleagues.
Developer 2	Found working from home challenging, primarily due to the lack of separation between work and personal life. Even though she had a comfortable setup at home and saved on commute time, she felt it difficult to set boundaries, which eventually affected her personal interests. She also found the absence of social interaction difficult.
Developer 3	Increased security risks due to a move towards cloud-based solutions making data available from anywhere, and mental health challenges for those who need daily interactions.
Developer 4	Expressed sadness about the loss of social activities and events, and she believes that the social aspects of work might never return to the pre-pandemic normal.
Product manager 1	Working from home makes it easy to forget what is unique about your workplace because the culture and vibe is not the same. This led some employees to consider their jobs as nothing special and consequently change jobs.
Product manager 4	She felt the negative impact of isolation and the loss of dynamic interactions with people that is common in a physical office environment.
C-level 1	Experienced that communication was less effective in virtual meetings, with some participants feeling unheard or misunderstood, leading to passive-aggressive emails after.

The absence of face-to-face interactions with colleagues was noted as a significant downside by all informants Remote work influenced some employees' mental health as the lack of daily interactions was difficult to cope with.

It was also noted that remote work diminished the unique culture and vibe of the physical workplace, leading some employees to view their jobs as unspecial and consider changing jobs. One of the key issues highlighted was the reduced effectiveness of communication in virtual meetings. Some participants felt un-heard or misunderstood, leading to passive-aggressive emails after meetings.

To summarize the negative effects of remote working due to COVID-19, there are significant challenges related to social interaction, mental health, work-life balance, job satisfaction, and effective communication that these companies need to address in order to maintain a healthy and productive workforce.

5. Discussion

This chapter aims to discuss the main findings in light of previous research and theories, and draw lines between these, where applicable.

5.1 Impact and adaptation

The COVID-19 pandemic saw various tech companies adapt their product development strategies. All informants predominantly operated from physical offices before the pandemic, with remote work being an exception. Physical meetings and brainstorming sessions were the norm, while digital tools like Jira were employed for specific task management. In a way, the COVID-19 pandemic was the ultimate test for companies and individuals to put their Agile capabilities to the test. Agile, as we know, is employed as a method to respond to changing environments fast (Varma, 2015), and the sudden shift to working from home certainly was a change everyone needed to respond to fast. All of the informants succeeded with this, although the circumstances were not ideal.

The informants described various challenges and adaptations resulting from remote work during the pandemic. While some areas, such as task-oriented work was not challenging to do remotely, others, like idea generation and personal interactions were challenging to replicate digitally. This relates to another one of the four main values in Agile, and that is “individuals and interactions over processes and tools” (Varma, 2015). When the quality of the interactions are poor, this could be likely to affect the end-result of the project.

The use of video communication tools and online collaboration platforms became essential for maintaining work processes and productivity. This was not something revolutionary to our informants, as most of them already had experience using digital communication tools from time to time due to their work being digital by nature and many of them having colleagues based abroad. However, none had previously utilized these communication methods to the extent the pandemic required them to.

Based on the previous research done by both McDonough, Kahn, & Griffin (1999) and Durmuşoğlu & Barczak (2011), one might think that the more IT tools applied, the better the performance will be, however in the case of the COVID-19 pandemic, the physical human aspect was taken completely out of the equation, and based on our informants’ responses this was not optimal, especially when creativity and collaboration was required.

Many reported an increase in workload, blurred lines between work and personal time, along with issues maintaining team cohesion. However, they also found benefits in flexible work hours, reduced commuting, and the potential for international collaborations. In these findings we can draw lines to both Agile and Lean thinking. Reducing the need to commute to an office eliminates waste,

as is a key principle in Lean (Janes & Succi, 2014), and allowing flexible work arrangements is consistent with principle number 5 in Agile: *Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.* (Beck et al., 2001)

5.2 Productivity

The study's results indicate that productivity during the pandemic varied among developers, product managers and C-levels, and it is evident that working from home impacted people differently. Most individuals managed to maintain or improve productivity levels, but some challenges were also experienced. The ability to adapt to the new environment played a significant role in the transition.

Many informants reported similar or increased levels of productivity when working from home due to fewer distractions and interruptions that are often present in a traditional office environment. However, concerns were raised about the quality of work produced during this period, with some expressing that the lack of face-to-face communication might have impacted the development and decision-making process. This corresponds with Agile principle number 6: *The most efficient and effective method of conveying information to and within a development team is face-to-face conversation* (Beck et al., 2001).

Some noted that digital communication platforms helped maintain efficiency and productivity, which supports the theories of McDonough et al. (1999) and Durmuşoğlu & Barczak (2011). Several informants pointed out an initial drop in productivity due to the sudden change and lack of motivation, but highlighted that adapting to the new circumstances, like working from different locations and spending time with family, helped restore and even improve their productivity. However, it was acknowledged that more meetings were necessary.

5.3 Online collaboration

The transition to remote work brought several changes in the way product teams communicated and collaborated. For most informants, the lack of casual, ad-hoc conversations in a physical office setting was one of the main challenges, as these often sparked ideas and promoted better team dynamics. Despite these challenges, the use of digital tools helped maintain overall good communication and workflow, such as *StoryPlan* for providing a digital solution for Planning Poker, which was done with physical cards before the pandemic, or *Miro* and *Mural* for simulating whiteboards and post-its.

Previous research has suggested that remote collaboration can prevent knowledge-transfer between team members (Berchicci et al., 2016). The results from my study indicate the same in some cases, for instance when there is no existing relation between the parties collaborating online. For those who do have an existing relation, on the other hand, especially developers involved with pair programming, this does not seem to be the case.

Different teams and individuals had varying experiences based on their work styles and personalities. According to some informants, developers are known for being introverted. However most developers interviewed expressed a clear preference towards in-person communication. Product managers and C-levels also stressed the importance of having in-person meetings for initial client interactions and clarification sessions, which is consistent with Durmuşoğlu and Barczak's (2011) research suggesting that early face-to-face interactions in the NPD process is important to improve product quality and market performance.

Product Manager 4 reported a strengthening of relationships with international colleagues due to shared experiences during the pandemic. The transition also resulted in a shift towards more structured and less dynamic interactions, which could have potential implications on the quality of solutions developed.

5.4 Creative processes

The shift to remote work during the pandemic seemed to impact the dynamics of creative processes, with some finding new opportunities for innovation and others experiencing challenges in maintaining the same level of interactive brainstorming as in-person environments. This shift led to more independent creative processes, which may have pros and cons depending on the specific task or project. This could indicate that previous research pointing to better creative performance through telework on an individual level has merit (Vega et al., 2015). However, the varying experiences between study participants does point to potential differences between personality types.

5.5 Post-pandemic practices

As offices have reopened, a hybrid model has emerged, with employees split between in-person and remote work. This shift has led to changes in meeting setups to better include remote attendees and a recognition of the continuing importance of physical meetings at key points in the development process.

The hybrid work model gives employees the flexibility to work remotely or from the office, leading to a rise in remote work. This has opened up possibilities for employees to relocate or adjust their schedules to fit their personal needs. However, there is a broad consensus on the value of occasional in-person meetings to foster better collaboration and communication. Again, this reinforces Agile principles 5 and 6 (Beck et al., 2001).

Many appreciate the flexibility of remote work. Some prefer it for personal reasons, while others believe it improves work-life balance. However, many employees also prefer being in the office, associating it with more structured work hours and a more distinct end to the workday. For those working remotely, digital tools have been efficient, but physical tools and face-to-face interactions are still preferred for workshops and retrospectives.

5.6 Comparison between pre-pandemic and post-pandemic practices

To visualize the changed practices that have emerged in product development as a result of the normalization of remote work during the COVID-19 pandemic, I have illustrated the practices used both pre-pandemic and post-pandemic, based on the Scrum framework:

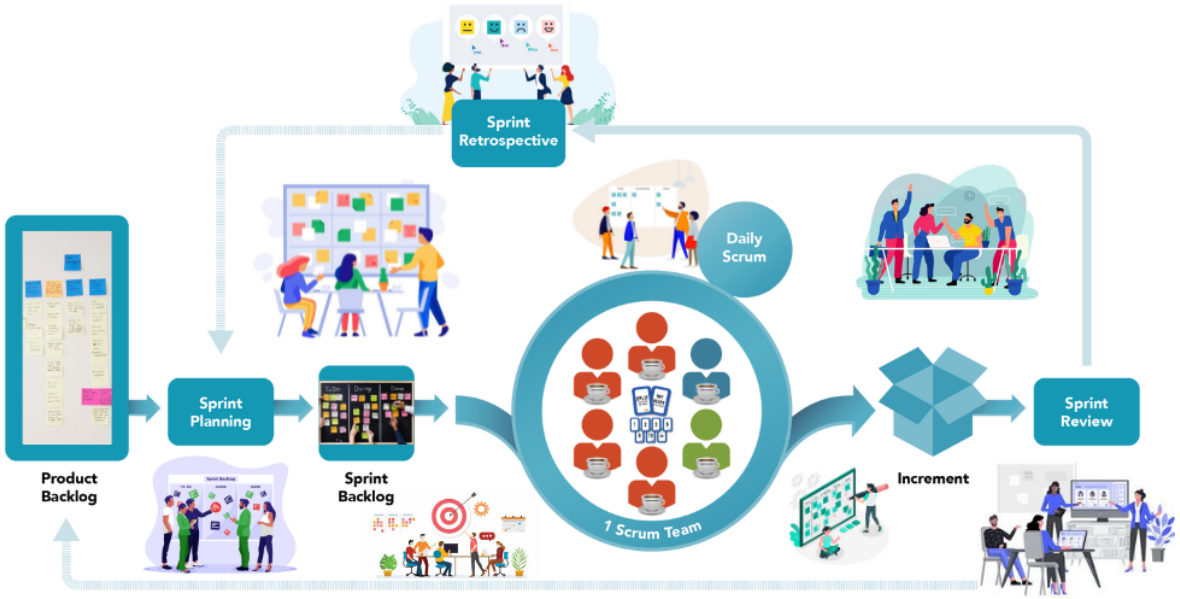

Figure 4. Pre-pandemic product development practices (Bjørnsen, 2023), based on the Scrum framework (Scrum.org, 2020).

Before the pandemic, the office was a dynamic and fun place to be. Our informants would get together with their team daily and bounce ideas off each other over a cup of coffee, lunch or in one of the many Scrum ceremonies. Meetings usually took place around a whiteboard and post-its were commonly used to visualize the tasks in the product and sprint backlogs. They would use physical Planning Poker cards when estimating these tasks. Teams celebrated their successes together when reaching important milestones by for example sharing a cake, and after work get-togethers were also frequent among some.

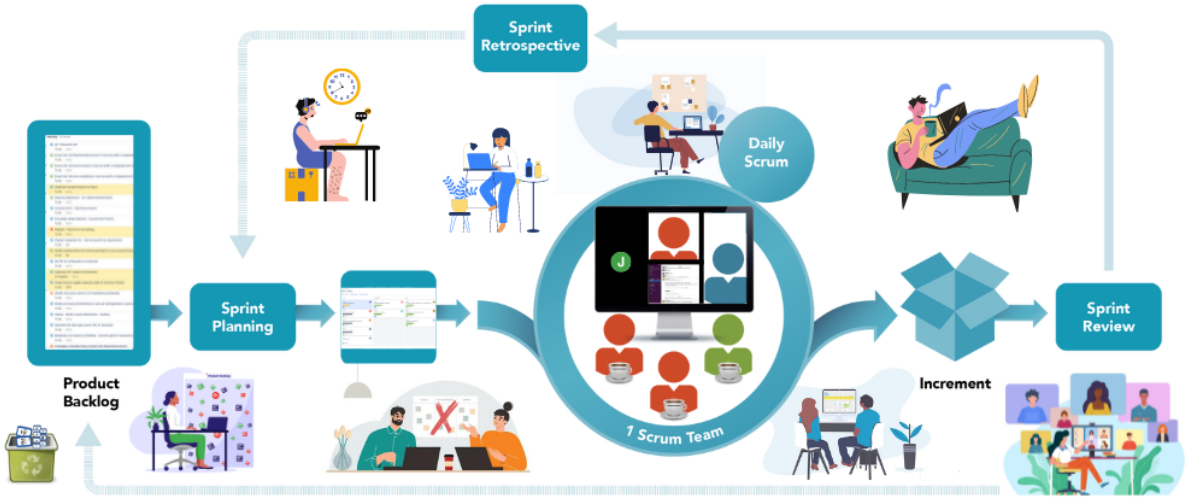

Figure 5. Post-pandemic product development practices (Bjørnsen, 2023), based on the Scrum framework (Scrum.org, 2020).

Since the pandemic, product developers seem to have become comfortable with the digital tools they had to adapt to when the world as we knew it closed down. Tools like Miro and Mural have replaced post-its and whiteboards to a significant extent, and Planning Poker cards have been thrown in the bin and replaced by digital solutions like StoryPlan.

All companies represented in the study have transitioned into a hybrid workplace approach, allowing employees to work from anywhere. This means reduced in-person attendance in meetings, with some teams even embracing “remote-first” thinking. Many reported that the lack of face-to-face meetings has been challenging, particularly in product development phases requiring complex problem-solving or decision-making.

5.7 Benefits of remote work and product development

Our informants saw several positive outcomes of the shift towards remote work:

- **Improved work-life balance and flexibility:** Across all roles, the ability to work from anywhere at any time was appreciated. The flexibility allowed employees to organize their day as they pleased, fulfilling personal needs and professional duties simultaneously.
- **Reduced commute and travel:** With remote work, commuting became less of a concern, and freed up more time for productive activities or personal errands. Additionally, business travel reduced significantly, leading to cost savings and environmental benefits.
- **Acceleration of digital transformation:** The pandemic expedited the shift towards digital solutions, which increased the demand for businesses in the digital space.
- **Geographic diversity and collaboration:** Hiring employees across borders has been normalized, expanding teams and promoting diversity.
- **Increased efficiency and discipline:** Remote work necessitated more discipline in communication and increased efficiency in certain areas.

5.8 Challenges related to remote work and product development

As a result of the shift towards remote work during the pandemic, several challenges were also identified by employees and executives:

- **Loss of company culture and affiliation:** Some employees felt that the unique vibe and culture of their workplace were lost in the remote work setting. This led to feelings of detachment and, in some cases, caused individuals to change jobs.
- **Lack of face-to-face interaction:** The absence of daily physical interaction with colleagues was a significant drawback for many. This absence of social interaction led to feelings of isolation and negatively affected the dynamics usually experienced in a physical workspace.
- **Blurring work-life boundaries:** The lack of physical separation between work and personal life caused some employees to struggle with establishing boundaries. This issue was particularly prominent for those who had their work and personal activities in the same space.
- **Ineffective communication:** In virtual meetings, some found it challenging to effectively express their feelings or concerns, leading to misunderstandings or passive-aggressive behaviors. The lack of in-person meetings was perceived as a barrier to open communication.
- **Mental health challenges:** Remote work created mental health challenges for some, especially those who need daily interaction with others. The issue of maintaining mental health while working remotely was mentioned as a significant concern.
- **Loss of social activities and events:** The cancellation of social activities and events during the pandemic was another negative outcome. The realization that people could survive without these social activities was seen as unfortunate and a loss to workplace culture.

6. Conclusion

The COVID-19 pandemic has had a significant impact on society, and the main consequence product developers faced was having to transition to remote working. This required workers to adapt to new technology, communication methods, and work practices to stay productive while working from home.

Although studies conducted long before the pandemic had already indicated that software development can be done efficiently from anywhere, the actual development is just one aspect of the product development process. My study indicates that phases requiring complex problem solving and ideation are not as successful when solely based on online collaboration.

There has been a shift in working hours, with employees adapting their work schedules to fit their daily routines. Despite this, some aspects of office culture remain important to most, and meeting in person from time to time is valued. In the hybrid model, companies have made efforts to include remote employees in meetings with the help of technology, and a trend of less frequent but more purposeful physical meetings is also observed.

In conclusion, the shift to remote work demanded innovation and flexibility, and resulted in new practices used in product development, as described throughout the thesis. Luckily for our informants, this was similar to what they do on a daily basis. They had to apply their Agile mindset and adjust to the changed circumstances. There are both benefits and challenges related to working remotely with product development, and the effectiveness of remote work is individual and context-dependent, highlighting the need for flexible work arrangements that cater to different needs and working styles. This is something all companies interviewed have incorporated and all of the informants expect this to last.

References

- Banjo, S. Yap, L. Murphy, C. Chan, V. (2020). *Coronavirus Forces World's Largest Work-From-Home Experiment*. Bloomberg. https://www.bloomberg.com/news/articles/2020-02-02/coronavirus-forces-world-s-largest-work-from-home-experiment#xj4y7vzkg
- Beck, K., Beedle, M., Bennekum, A. V., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B., Martin, R. C., Mellor, S., Schwaber, K., Sutherland, J., & Thomas, D. (2001). *Agile Manifesto.* http://agilemanifesto.org
- Berchicci, L. et al. (2016). Remote collaboration and innovative performance: the moderating role of R&D intensity. *Industrial and Corporate Change,* 25 (3), 429 – 446. https://doi.org/10.1093/icc/dtv031
- Bibik, I. (2018). *How to Kill the Scrum Monster? Quick Start to Agile Scrum Methodology and the Scrum Master Role.* Apress. https://link.springer.com/book/10.1007/978-1-4842-3691-8
- Cambridge Dictionary. (2023). *Remote Working*. https://dictionary.cambridge.org/dictionary/english/remote-working
- Cecchi, M. A. et al. (2022). How COVID-19 impacted the tacit knowledge and social interaction of global NPD teams. *Research-Technology Management,* 65 (2), 41-52. https://www.tandfonline.com/doi/full/10.1080/08956308.2022.2020566
- Cooper, A. (2004). *The Inmates Are Running the Asylum: Why High-Tech Products Drive Us Crazy and How to Restore the Sanity.* Sams Publishing.
- Creswell, J. (2014). *Research design.* (4th Edition). SAGE.
- Durmuşoğlu, S. & Barczak, G. (2011). The use of information technology tools in new product development phases: Analysis of effects on new product innovativeness, quality, and market performance. *Industrial*

Marketing Management, 40 (2), 321-330. Elsevier. https://doi.org/10.1016/j.indmarman.2010.08.009

- Gripsrud, G., Olsson, U. & Silkoset, R. (2010). *Metode og dataanalyse.* Kristiansand: Høyskoleforlaget AS – Norwegian Academic Press.
- Hendler, S. (2020). Exploring coordination practices in digital–physical product development. *Journal of Manufacturing Technology Management.* Emerald Insight. https://www.emerald.com/insight/content/doi/10.1108/JMTM-06-2019-0229/full/pdf
- Henfridsson, O., Mathiassen, L., & Svahn, F. (2014). Managing technological change in the digital age: The role of architectural frames. *Journal of Information Technology*, 29(1), 27-43.
- Hennink, M., Hutter, I. & Bailey, A. (2020). *Qualitative research methods.* 2nd Edition. SAGE.
- Holy, L. & Stuchlik, M. (1983). *Actions, norms and representations. Foundations of Anthropological Inquiry.* Cambridge University Press.
- Hui, K. & Chau, P. (2002). Classifying Digital Products. *Communications of the ACM,* 45 (6), 73-79. https://dl.acm.org/doi/fullHtml/10.1145/508448.508451?casa_token=fova6PHk5MoAAAAA:OUl4jqvRcpmClB6dzOy6vX9ixATyI65kxSTb9RQ1baiPljAfd6P2DQk57JOSwVopQqvtTre35ifJrw
- Janes, A. Succi, G. (2014). *Lean Software Development in Action.* Springer.
- Kvale, S. & Brinkmann, S. (2009). *Det kvalitative forskningsintervju.* Gyldendal Akademisk.
- Lecompte, M. & Goetz, J. (1982). Reliability and Validity in Ethnographic Research. *Review of Educational Research,* 52 (1), 31-60.

- McDonough, Edward F., III, Kahn, Kenneth B., & Griffin, Abbie (1999). Managing communication in global product development teams. *IEEE Transactions on Engineering Management*, 46 (4), 375−386.
- McKenna, D. (2016). *The Art of Scrum: How Scrum Masters Bind Dev Teams and Unleash Agility.* CA Press.
- Misra, S. Singh, V. (2013). Conceptualizing open agile software development life cycle (OASDLC) model. https://www.emerald.com/insight/content/doi/10.1108/IJQRM-08-2013-0127/full/pdf
- Moglia, M. Hopkins, J. Bardoel, A. (2021). *Telework, Hybrid Work and the United Nation's Sustainable Development Goals: Towards Policy Coherence.* MDPI.
- Nylén & Holmström, (2014). *Digital innovation strategy: A framework for diagnosing and improving digital product and service innovation.* Elsevier.
- Orellana, S. (2017). Digitalizing Collaboration. *Research-Technology Management*, 60 (5), 12-14. https://www.tandfonline.com/doi/pdf/10.1080/08956308.2017.1348125
- Pyöriä, P. (2011). Managing telework: risks, fears and rules. *Management Research Review*, 34 (4), 386-399. Emerald Group Publishing Limited.
- Reed, K. Allen, J. (2021). *Suddenly Virtual: Making Remote Meetings Work.* John Wiley & Sons, Inc. Hoboken, New Jersey.
- Singhto, W. & Phakdee, N. (2016). *Adopting a Combination of Scrum and Waterfall Methodologies in Developing Tailor-made SaaS Products for Thai Service and Manufacturing SMEs.* DOI: 10.1109/ICSEC.2016.7859882
- Thagaard, T. (2018). *Systematikk og innlevelse – en innføring i kvalitative metoder.* Vigmostad & Bjørke AS.

- Tønnessen, Ø., Dhir, A. & Flåten, B. T. (2021). Digital knowledge sharing and creative performance: Work from home during the COVID-19 pandemic. *Technological Forecasting and Social Change.* Elsevier. https://doi.org/10.1016/j.techfore.2021.120866
- Ulrich, K., T. & Eppinger, S.D. (2008). *Product Design and Development.* 4th Edition. McGraw-Hill, New York
- Varma, T. (2015). *Agile Product Development: How to Design Innovative Products That Create Customer Value.* Apress.
- Vega, R.P., Anderson, A.J. Kaplan. S.A. (2015). A Within-Person Examination of the Effects of Telework. *Journal of Business and Psychology*, 30 (2), 313-323. https://www.jstor.org/stable/24634513
- Wang, X., Conboy, K., & Cawley, O. (2012). "Leagile" software development: An experience report analysis of the application of lean approaches in agile software development. *The Journal of Systems and Software,* 85 (6), 1287–1299. Elsevier.
- Wiesböck, F., Hess, T., & Spanjol, J. (2020). The dual role of IT capabilities in the development of digital products and services. *Information & Management*, 57 (8). Elsevier.
- Xiao, Y., Becerik-Gerber, B. Lucas, G. Roll, S. C. (2021). Impacts of Working From Home During COVID-19 Pandemic on Physical and Mental Well-Being of Office Workstation Users. *Journal of Occupational and Environmental Medicine*, 63 (3), 181-190. *DOI:* 10.1097/JOM.0000000000002097
- Yoo, Y., Lyytinen, K. J., Boland, R. J., Jr., & Berente, N. (2010). *The next wave of digital innovation: Opportunities and challenges. A report on the research workshop 'digital challenges in innovation research.* http:// papers.ssrn.com/sol3/papers.cfm?abstract_id=1622170

Appendices

Appendix 1. Interview guide

Introduction

- How long have you worked here?
- What is your position in the company?
- Can you tell us about what you do?

Product development

- What types of products/services do you develop?
- How is the product development structured where you work?
- Do you work with innovation?
- Have you launched any new products since the pandemic started?
- How has the pandemic affected your creative processes?
- Have you had to put any projects on hold because of the pandemic?

Remote working

- What was a typical workday like for you before the pandemic?
- Did you ever work from home before the pandemic?
- Were any phases of the product development particularly affected?
- Are there any phases that haven't been affected by the changes at all?
- Was the company ready for digital work when the pandemic started?
- How has the communication outside the product team been?
- How have you kept track of each other's work?
- Should something have been done differently?

The COVID-19 pandemic

- How was everyday work during the pandemic?
- What has it been like to collaborate online?
- How is your relationship with your colleagues now compared to what it was like before the pandemic?
- Has the dynamic changed?
- How has your efficiency been during the pandemic?
- How has the communication flow been between team members?
- How has your motivation been?
- How has this affected your work?
- Do you miss anything from before the pandemic?
- How has the relationship between leader and team changed?
- Have any special measures been taken to maintain team/company spirit?

Post-pandemic

- How is everyday work now?
- Has the pandemic led to investments in IT solutions for remote work?
- Are there any activities that have been moved permanently online?
- Have you discovered new job positions due to the changes?
- Which changes do you think will be permanent?
- What barriers have you encountered? What has been most difficult?
- Do you see any positive effects of the pandemic?
- What negative effects do you see?
- Do you have anything more to add?

Appendix 2. Declaration of consent

Would you like to participate in the research project:

What impact has working remotely during Covid-19 had for product development?

We hereby ask you to participate in a research project where the purpose is to find out how remote working has changed product development practices in companies. In this letter, we provide you with information about the project and what participation will mean for you.

Purpose

This study is carried out in relation to a master's thesis in Shift entrepreneurship and technology / innovation at the University of Agder. The study aims to investigate how working remotely has affected product development during the Covid-19 pandemic, and how it has transformed and shaped existing and new product development practices. The research question to be analyzed is:
"What impact has working remotely during Covid-19 had for product development?".

The purpose of the information is to prepare a well-argued thesis that can benefit those who work with product development within technology and digital development.

Who is responsible for the research project?

The School of Business and Law at the University of Agder, Department of Strategy and Management is responsible for the project.

Why are you asked to participate?

You work in a company that conducts product development and/or you have valuable knowledge on the topic. You are either the leader or part of a product development team, and we want to hear about your experiences from the pandemic in relation to your work as well as other insights you may have on the topic.

What does it mean for you to participate?

If you choose to participate in the project, you will participate in a 45-minute interview. There will be one person conducting the interview and one person taking notes at the same time as audio recordings will be made. These are later transcribed and anonymised.

The interview will include questions about what it has been like to work with product development before, during and after the pandemic.

It is voluntary to participate

It is voluntary to participate in the project. If you choose to participate, you can withdraw your consent at any time without giving any reason. All your personal information will then be deleted. It will not have any negative consequences for you if you do not want to participate or later choose to withdraw. The project will not affect your relationship with your workplace.

Your privacy - how we store and use your information

We will only use the information about you for the purposes we have described in this article. We treat the information confidentially and in accordance with privacy regulations.

- The only people who will have access to this data are the project group and supervisor at the School of Business and Law at the University of Agder, Department of Strategy and Management.
- Names and contact information will be replaced with a code and stored separately from other data on a secure server.
- With consent, you might be recognized in a publication through a quote or statement relevant to the research.

What happens to your information at the end of the research project?
The information is anonymised once the project is completed / the assignment has been approved, which according to the plan is 1st June 2022. The data material will be deleted.

Your rights
As long as you can be identified in the data material, you have the right to:
- access the personal information registered about you and to receive a copy,
- have personal information about you corrected,
- have personal information about you deleted, and
- to send a complaint to the Data Inspectorate about the processing of your personal data.

What gives us the right to process personal data about you?
We process information about you based on your consent.
On behalf of the Department of Strategy and Management at the School of Business

and Law at the University of Agder, NSD - Norwegian Center for Research Data has assessed that the processing of personal data in this project is in accordance with the privacy regulations.

Where can I find out more?
If you have questions about the study or want to exercise your rights, please contact:

- Maren Oustad Torve (student) – maren.oustad.torve@uia.no / 41218122
- Hedda Bjørnsen (student) – heddab13@uia.no / 41388182
- Stine Øyna (supervisor) – stine.oyna@uia.no / 38 14 19 88
- Our privacy representative:
  Ina Danielsen (contact person) – personvernombud@uia.no / 45 25 44 01
  If you have questions related to NSD's assessment of the project, you can contact:
- NSD - Norwegian Center for Research Data by email:
  personverntjenester@nsd.no or by phone: 55 58 21 17.

Declaration of consent

I have received and understood information about the project «what impact has working remotely during Covid-19 had for product development?» and agree:

- to participate in interviews
- that the interviewers can provide information about me to the project
- that information about me may be published so that I can be recognized
- that my information will be processed until the project is completed

_____

(Signed by project participant, date)