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Master

Generative AI utilization: How developers utilize Generative AI

Investigating how developers can improve their work by utilizing the power of generative AI

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Preface

This thesis has been conducted as part of the master's program Information Systems at University of Agder by students Jaran Faret and Stig Hagum.

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Abstract

After the deployment of generative AI, many organizations have been quick to find a way to implement it into their work processes in the hope that it will increase efficiency. There are however challenges that come with generative AI, and it is important that organizations attempting to adapt generative AI are aware of the challenges and the opportunities, to prevent common issues and increase efficiency. This study attempts to answer the research problem *"how do software developers utilize generative AI?"* to establish the most effective use cases, how to ensure quality and how users get motivated into using it.

This is a qualitative study where we have conducted semi-structured interviews with employees in consultant companies with technical knowledge, like developers, because they have a more natural curiosity towards new technology and can in turn provide better insights that other non-technical professions can provide. After analyzing the data from the interviews, we were able to identify some key factors that managers should consider when implementing generative AI themselves.

We have identified how important it is with knowledge work, as intrinsic motivation is the main driving factor for generative AI utilization, and the more an employee knows about the possibilities of generative AI, the more they are willing to use it.
We identified two categories of use modes, explore, and accelerate, which depending on the use case, has different requirements for accuracy. Accelerate mode is when users use generative AI to complete simple, but time-consuming tasks. In these cases, it is very important that there are security measures in place to ensure that the work being completed is correct and according to company standards. In explore mode, generative AI is used for inspiration and discussions, and nothing it creates is used directly, and therefore the accuracy is not as important.

Too many rules and regulations with generative AI decreases employee's motivation and increases the time spent on the task. Because of legal and privacy issues, developers can share very little of the code base with generative AI, and without that contextual understanding, generative AI provides subpar answers. A solution to this is integrated large language models that are trained on company data and do not share this data. Solutions like these have a much better contextual understanding of the project and remove the ability for the users to commit mistakes.

The findings in this thesis suggest more research into specific types of large language models, as well as studying these principles on other professions, to establish how they affect employees from less technical professions.

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1. Introduction

Generative AI is a relatively new form for AI that can create something completely new, in audio, text or image format. This has resulted in many organizations trying to implement it and getting their employees to use it. Because of the versatility of generative AI, its interface being designed like a chatbot, it is difficult to know which methods are the most efficient. Several people are worried that AI and especially generative AI will replace them and take over their job, and employees can be demotivated and not want to use generative AI (Sætra, 2023). Along with this, there are also issues regarding utilizations of generative AI. Teachers are experiencing an increase in students cheating on their homework and are struggling to distinguish between students' work and a language model (Jalil et al., 2023). People using generative AI for menial tasks have experienced a phenomenon called 'hallucinations', meaning the chatbot invents information with no sources to back it up (Susarla et al., 2023). Despite these faults, many people are using generative AI religiously, and organizations are quick to try and implement large language models into their own working processes for economic gain (Bera et al., 2023). Because of the immaturity of this technology, there has not been a lot of research and experience in how organizations can implement generative AI in a mature, responsible way (Akbarighatar et al., 2023). This thesis explores early adapters of generative AI and establishes a set of common principles that organizations that want to implement these technologies must consider before initiating a GAI implementation process.

1.1 Motivation for the study

Generative AI has since its release to the public been a hot topic for companies that want to save money on processes and want to increase the productivity of their workers (Retkowsky et al., 2024). At the same time, generative AI has also created discussions about to which degree humans can be replaced by machines, and what happens if people lose their jobs because of a machine (Susarla et al., 2023). Our own lives have been affected by generative AI, having the power to summarize academic articles, and creating a completely unique picture to fit in a presentation. There are of course issues that need to be considered when using generative AI, as many papers have pointed out (Michel-Villarreal et al., 2023). So much so that certain terminology have been utilized to refer to the use of Artificial intelligence that is human centric and understandable for a human, respectively RAI (Responsible AI) (Akbarighatar et al., 2023), and XAI (explainable AI) (Bauer et al., 2023). Generative AI can create text outputs indistinguishable from a human, and has the potential to increase efficiency for several employees. Multiple papers have been published that highlights the need for more research into how to use generative AI in the most beneficial and responsible way possible (Banafa, 2023), like translating code (Acher et al., 2023), bug fixing (Sobania et al., 2023) and even to act as a scrum leader (Bera et al., 2023). Not only because this is a new highly relevant technology that is relevant for most professions, but also because it is so versatile and can be used in so many ways. Because of this versatility, proper testing and research is needed to ensure an implementation that focuses on a human centric experience, and an increase in efficiency and gain (Susarla et al., 2023). Human Centric means developing something with the human end user in mind from the beginning, and Human Centric AI means to develop artificial intelligence not with the AI capabilities in mind, but the human requirements (Capel & Brereton, 2023).

Over the years as technology has evolved exponentially, organizations are quick to study and figure out a way for them to make money on this technology. Digital transformation is a concept that has been studied many times before, and every time a new technology enters the market, studies are being conducted on how to implement this and use it (von Rosing & Etzel, 2020). Although there have been

countless studies on digital transformation and implementation of a new technology, we aim to establish what methods are unique for generative AI, and how the digital transformation approach will differ.

1.2 Research questions

In this study we attempt to fill the research gaps identified by an extensive literature review. The goal with this study is to gain clarity and insight into how employees perceive generative AI and what steps organizations can take to successfully implement and adapt generative AI into their own processes. Through an extensive literature review, three factors were identified that alter the value drawn from using generative AI in the workplace.

RQ1: "How is generative AI utilized by developers in their work?"
When researching this question, we aim to establish a method for utilization that can be implemented and used by other organizations. Given that technical professions like developers and data analysts have a better foundation for understanding a technical tool like generative AI, they are more likely to be reflective of their work and have better insights into these use cases and can give more in depth answers than other professions. Knowing how these professions are utilizing generative AI, managers can work against

RQ2: "How are developers motivated and enabled to use GAI". The second factor we identified was motivation. Research seems to suggest that the more interested and motivated an employee is in generative AI, the more efficient they are at utilizing the tool. With this question we aim to establish how organizations can motivate and enable their employees to use generative AI efficiently. By researching organizations with altering approaches to implementation, we could identify how these altering approaches are perceived from the employees, and measure their individual success based on the response from the employees.

RQ3: "How can users of generative AI maintain and increase the quality of responses?" Quality in this context refers only to it fulfilling the requirements set by the customer. Studies have shown several examples of how generative AI can deliver faulty answers, and employees who are not aware of this can cause some severe challenges in their workplace. With this question we aim to establish how aware users are when utilizing generative AI and establish how users can quality control the responses and ensure ethical use.

1.3 Research Approach

Based on a collection of respected methods of research, we have conducted a qualitative study based on semi-structured interviews. We are using a interpretivism as a paradigm for conducting this research (Goldkuhl, 2012), with the aim at establishing information that is explicitly useful in an implementation context, while also being acknowledged as valuable for the informational value it provers in an academic context (Chua, 1986; Goldkuhl, 2012; Oates, 2005). We have conducted semi structured interviews with multiple actors and users of generative AI. The interview guide was developed through the research gaps we identified in the literature review, with a strong focus on theoretical guidelines on evaluating computer systems and human relations (Kaplan & Maxwell, 2005). For the interviewees, we collected a collection of senior and junior consultants in technical professions like software development and data analysis. Through the literature review we have identified that technical companies are more interested in implementing generative AI into their processes, than less technical companies. Also, the employees in

these companies are also more curious about these technologies. Because of this we decided to interview employees in consultant companies, to get the most amount of insight. The interviews were transcribed, and then coded using Nvivo, where valuable individual statements were categorized into similar themes that can be referred to in the analysis part (Byrne, 2022).

1.4 Structure of thesis

This report is segmented into a total of seven main chapters. Each of these chapters are segmented into smaller sub-chapters, depending on relativity.

Introduction: The first chapter introduces the reader to the thesis. This chapter explains the problem statement and the research questions, as well as briefly introducing the research approach and analysis.

Research background: The second chapter covers the literature review. This chapter will show the process of selecting relevant research articles and explain how each article will be relevant for this study.

Research Method: Chapter three explains the methodology we used for gathering empirical data, as well as explaining the reason for choosing the interview candidates we did, and the interview guide.

Results: This chapter explains what information we find out in the interviews, and how we coded and structured the transcribed interviews.

Discussion: In the fifth chapter we explain how the results relate to the information we gathered from the literature review and preliminary work.

Conclusion: The final written chapter explains the conclusion for the thesis.

2. Research background

Generative AI has not been publicly available for that long, and it has not been many studies conducted on how to utilize GAI for different tasks. This chapter explains the background research that we base our studies on. This thesis explores how generative AI changes the work processes of IT consultants and software developers. The aim is to establish guidelines for implementing generative AI into other professions and fields. The reason for choosing this profession was because developers and coders tend to have a greater technical knowledge and curiosity for new technologies, and thus could offer up more insights during our interviews. There are also more articles being conducted on these technical fields in general. Human Centered AI is a term that is used to describe how development, deployment and implementation of AI must happen with the human end user in mind (Bingley et al., 2023), and this study aims to establish how organizations can have a human centered approach to generative AI when implementing the technology into their everyday tasks.

2.1 Literature review

Currently, the academic landscape of empirical studies done on generative AI is thin, much because the technology has only been available for just over a year. Just between September and the time of this writing, we have seen a large increase in academic studies and reports about different use cases of generative AI. This section of the report will explore the current state of academic literature on generative AI and its various use cases. We will also present research gaps in the literature and use them to justify the direction of this report.

2.1.1 Method

The goal for this section of the report is to gain a better understanding of the topic we are researching, and to identify research gaps. Identifying gaps in the literature will justify the direction of the report. The research gaps identified here will be the motivation for asking the research questions we explained earlier in the report. To conduct this review, we used a combination of theory from three different articles and divided the process into three distinct phases: planning, conducting and findings. (Kitchenham, 2004; Kitchenham & Charters, 2007; Watson & Webster, 2020). The first phase of this process is planning the review, planning the parameters, and establishing a direction to take this study. The second phase is to execute the planned review, and in the final phase we will present the findings.

2.1.2 Planning

The planning phase is the phase where examine the current state of academic articles and identifies relevant articles. This is also the part of the report where the research questions are being developed (Kitchenham, 2004). We initiated this process by conducting a broad study on multiple journals and articles, to gain an understanding of relevant literature. After gaining better understanding of the relevant topics, we identified some research gaps, which helped us properly define the research questions. We also identified certain key concepts that could be included in the literature search, such as keywords and search strings. A research gap we identified right away, that could challenge the search for more relevant articles, was a clear lack of common terminologies for the different concepts in this field. This poses a challenge with finding search queries because it requires us to be critical already with the queries. Not only is there a general lack of case studies on this topic, but to find the best ones, the query had to be adjusted to accommodate every synonymous word with generative AI that we could find.

During this process, three main concepts were identified as factors that decide the value from using generative AI to complete work processes. The first concept we identified was the use case. The way

people use generative AI can affect the results they get from using it. We have identified examples of this where teachers uses generative AI as a work relief (Hashem et al., 2024), and hospitals using it to cut down on time spent in front of a computer, to be able to spend more time with patients (Santandreu-Calonge et al., 2023). Depending on how the employee chooses to utilize the tool, it may increase the benefits gained from it.

The next concept we identified was motivation. Research suggest that employee motivation changes the way they interact with conversational AI, and the more motivated a person is, they more they understand the tool, and the more they understand it, the more they trust it (Gkinko & Elbanna, 2023b). One study identifies four categories of generative AI users, and it seems that the ones who gain the most from its use case are the ones who are the most motivated (Gkinko & Elbanna, 2023a).

The last concept we identified by searching was responsibility. Using generative AI has shown to have issues and can create faulty answers (Susarla et al., 2023). Responsibility covers ethical principles that users must consider and be aware of when using the tool. This can be wrong answers generated by the chatbot hallucinating, customer or company data being shared with the bot, ensuring that the generated answers fulfill company criteria etc. (Banafa, 2023). Research suggests that user understanding, and trust are factors that affect how efficient and responsible the generated work is.

With these main concepts in mind, we developed this model that also highlights other concepts that are relevant for this study. These three concepts are umbrella terms for other important concepts uncovered by the literature review.

Main Concepts	**Related Concepts**
Use case	Efficiency, productivity, time saving, inspiration, pair-programming, programming, code review, testing,
Motivation	Enablers, understanding, ease of use, facilitating, training
Quality	Ethics, security, quality, personal information, intellectual property, customer demands

Table 1: Main Concepts and Related Concepts

2.1.3. Conducting

After planning the literature review, we initiated the process of conducting the review. As mentioned in the preliminary work, the searching process required multiple different iterations, including all the different terminologies. We used Scopus to look for articles, as the database provides relevant and peer reviewed articles that we can easily ensure are relevant for this study (*Scopus*). The database also provides intuitive ways to identify articles, by showcasing relevant metadata in a way that is both user friendly and informative. Scopus also allows for data exporting to useful citation tools like EndNote, a functionality utilized during this process. In digital databases, it is possible to create a query that uses an either-or logic, by using the keyword ‘OR’. We used the keyword to combine the different terminologies we found and create one combined search query. With this initial string, we did one search for generative AI and work environments in general, to get an overview of the consensus of generative AI at work, both from the perspective of managers and lower-level employees. Then we did a search focusing on the synonyms of ‘coding’, finding articles researching how technical professions like programmers or data analysts are utilizing generative AI for their benefit.

String Query
TITLE-ABS-KEY ("generative AI" OR “generative artificial intelligence” OR GAI OR ChatGPT) AND (“workplace” OR “work process” OR employee OR work) AND (LIMIT-TO (LANGUAGE, “English”)
TITLE-ABS-KEY ("generative AI" OR “generative artificial intelligence” OR GAI OR ChatGPT) AND (“Software development” OR development OR “programming” OR coding”) AND (LIMIT-TO (LANGUAGE, “English”)

Table 2: Search Queries

Generative AI is a relatively new phenomenon for the public. Because of this, we did not have to limit the search by year, since every article covering this research topic will be from 2022 or later. However, articles from 2023 and 2024 will have a better academic foundation to conduct its research on. With the queries we used, we have arrived at a total of 141 articles. 50 of these articles are related to software development and are a result of the second search string we created. From here we excluded most of the articles based on criteria we decided. The following model explains the criteria we set.

Criterias	
Peer reviewed	A peer reviewed article has been proofread by other academics making the data more reliable.
Found in Scopus	Being identified in databases like Scopus further validifies its value.
Written in English	To keep the language of the literature consistent, we will only be using articles that are written in English.
Related to the concepts	The articles must be related to the concepts identified in the chapter ‘Planning’.
Written in 2021 or later	Because generative AI is a new technology, the articles needed to be written after the release of generative AI for public use. There were some simple versions of generative AI that was released before ChatGPT 3.5, in November 2022, and therefore we allowed some articles from 2021, depending on relativity in related concepts and criteria.
Must be empirical	The main articles we use must be empirical studies, meaning the article must work with data gathered for that specific study.

Table 3: Inclusion Criteria

We chose not to include criteria like number of citations, because several articles were posted just within the last few months, and thus would naturally not have many other articles citing it.

Figure 1: Exclusion Process

Along with these must-have criteria, the exclusion was done in a six step process from a similar literature review (Danielsen et al., 2022). In this process we go through every article and exclude the ones we deem irrelevant or not relevant enough. This process is done iteratively, where each iteration we explore each article deeper. The first step is to filter the articles according to the criteria we set, while also removing any duplicates or articles with vital information missing, like author or publicist. While only 9 articles were removed in this step, all remaining articles now were following criteria and were each unique. The next step was to read the titles and remove articles based on the relevancy of the titles. This process was then repeated for the abstract and then for the whole article. At the end of this process, we were left with a total of 20 highly relevant articles for this thesis.

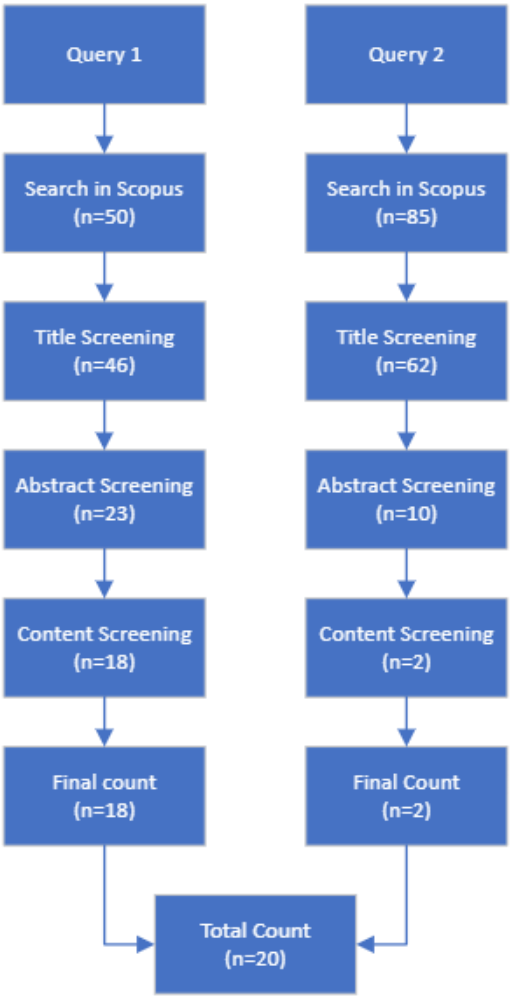

Figure 2: Exclusion Process 2

2.1.4. Results

The following table shows the final articles that we were left with after conducting a thorough literature review. Among these articles are a mix of studies on generative AI. Some of these are gathered from last semester's literature review, while some are new. Most of them are about software engineering and how to utilize generative AI efficiently and ethically in their profession. Others are about specific methods of utilizing generative AI, or how employees in general respond to having generative AI implemented. These articles give insight into the current state of generative AI research, and in which direction we want to take this thesis. The articles mention several factors that we identified as being crucial for succeeding with generative AI implementation. There is the time factor, ensuring that utilizing generative AI either reduces the time it takes to complete a task, or increases the number of tasks being performed in the same amount of time (Bale et al., 2023). These articles often mention a method or strategy for utilizing generative AI (Wuisang et al., 2023). Then there is the quality aspect, or how to ensure that the work being done fulfills the criteria set by the company or customer. The studies often highlight how important it is to remain knowledgeable around the generative AI, and to always be aware that the GAI can create faulty answers (Ding et al., 2022).

The final factor for successful implementation is motivation and enablers. Several articles research how generative AI effects employees, and how to motivate them into using it (Brachten et al., 2021). The following table shows the final articles that, through an extensive literature review, were identified to be the most relevant for this thesis.

Title	**Author(s)/publication year**	**Outlet**
On Programming Variability with Large Language Model-based Assistant	(Acher et al., 2023)	International Systems and Software Line Conference
Generative AI for reengineering Variants into software product lines: An experience report	(Acher & Martinez, 2023)	Association for Computing Machinery
ChatGPT in software development: Methods and Cross-Domain applications	(Bale et al., 2023)	International Journal of Intelligent Systems
On the use of ChatGPT to support Agile Software Development	(Bera et al., 2023)	International Workshop on Agile Methods for Information Systems
The use of Generative AI in the domain of human creations – a case for co-evolution?	(Böhm & Schedlberger, 2023)	International Conference on Socio-Technical Perspective in Information Systems
DesignAID: Using Generative AI and Semantic Diversity for Design Inspiration	(Cai et al., 2023)	Association for Computing Machinery

On the Use of GPT-4 for Creating Goal Models: An Exploratory Study	(Chen et al., 2023)	International Requirements Engineering Conference Workshops
Assessing the Readability of ChatGPT Code Snippet Recommendations: A Comparative Study	(Dantas et al., 2023)	Association for Computing Machinery
Too many rules or zero rules for the ChatGPT?	(De Minico, 2023)	BioLaw Journal
Generative AI for Software Practitioners	(Ebert & Louridas, 2023)	IEEE Software
An Evaluation of the Effectiveness of OpenAI's ChatGPT for Automated Python Program Bug Fixing using QuixBugs	(Wuisang et al., 2023)	International Seminar on Application for Technology of Information and Communication
Better Together? An Evaluation of AI-Supported Code Translation	(Weisz et al., 2022)	International Conference on Intelligent User Interfaces
Pre-made Empowering Artificial Intelligence and ChatGPT: The Growing Importance of Human AI-Experts	(Virvou & Tsihrintzis, 2023)	International Conference on Information Intelligence, Systems and Applications
Investigating Explainability of Generative AI for Code through Scenario-based Design	(Sun et al., 2022)	International Conference on Intelligent User Interfaces.
Generative AI: Here to stay, but for good?	(Sætra, 2023)	Technology in Society
The acceptance of chatbots in an enterprise context – A survey study	(Brachten et al., 2021)	International Journal of Information Management
Exploring tensions in Responsible AI in practice. An interview study on AI practices in and for Swedish public organizations	(Figueras, 2022)	Scandinavian Journal of Information Systems

Opening up ChatGPT: Tracking openness, transparency, and accountability in instruction-tuned text generators	(Liesenfeld et al., 2023)	Association of Computing Machinery
Brainstorming Will Never Be the Same Again—A Human Group Supported by Artificial Intelligence	(Lavrič & Škraba, 2023)	Machine Learning and Knowledge.
Managing a ChatGPT-empowered workforce: Understanding its affordances and side effects	(Retkowsky et al., 2024)	Business Horizons

Table 4: Final Articles:

A concept matrix is a table used in several important literature reviews and is something we alto utilize in this thesis. The models explain the most important concepts and themes for the research area, and highlights which articles are relevant for that concept (Watson & Webster, 2020). This way we can rank the articles from most relevant to least relevant, and more easily identify each article. The concept matrix is separated into three categories, representing the three categories we have identified for successful implementation of generative AI. These categories are again separated into sub-categories to be able to be more specific with the categorization. 'Use case' is the first category we identified, and it encompasses the different ways for employees to utilize generative AI. There are multiple ways of using this, depending on the task that is to be performed. The effect an employee gains from using generative AI may also change, from either decreasing the time it takes to complete the task, to increasing the quality of the work.

		Use case				Motivation				Responsibility			
		Inspiration	Pair-programming	Programming	Efficiency	Enablers	Facilitation	Training	Ease of use	Quality	Intellectual property	Personal information	Rules and governance
Author(s)	**Year**												
Acher et al.	2023		x	x	x	x	x			x			
Acher & Martinez	2023			x	x	x	x		x	x			x
Bale et al.	2023			x	x			x		x	x	x	x
Bera et al.	2023	x	x	x	x	x	x		x	x			
Böhm & Schedlbergher	2023	x	x	x	x				x	x			
Cai et al.	2023		x	x	x			x	x	x			
Chen et al.	2023	x		x	x			x	x	x			
Dantas et al.	2023		x	x	x				x	x		x	x
De Minico	2023			x	x			x	x	x	x	x	x
Ebert & Louridas	2023	x	x	x	x					x	x	x	x
Wuisang et al.	2023		x	x	x			x	x	x			x
Weisz et al.	2023		x	x	x					x			
Virvou & Tsihrintzis	2023									x			x
Sun et al.	2023			x		x				x			x
Sætra	2023			x			x	x					x
Brachten et al.	2021					x		x	x				
Figueras	2022			x					x				x
Liesenfeld	2023			x	x	x	x			x	x		
Lavrič & Škraba	2023	x		x	x					x			x
Retkowsky	2024	x	x	x	x					x			x

Table 5: Concept Matrix

2.1.5 Findings

The findings chapter will explain the results of the literature review. During the process we identified three factors that have an effect on the implementation and adaptation of generative AI. These factors are again separated into smaller sub-categories. The categories are the ones presented in the concept matrix (Table 5). We identified perceived value, quality assurance, and enablers as factors that affect whether generative AI implementation will succeed or not. In this section we will go through each of these factors and explain the sub-categories as they are presented in the literature. Combining the knowledge identified in the literature review, we gained a broad understanding of the most important factors for implementation. Using this knowledge, we can compare it to the empirical data we collect through the qualitative interview process and use it to validify the conclusion we reach. Through these articles we also aim to identify research gaps that our and other researchers should work towards filling with explicit knowledge.

2.1.5.1 Use cases

The first and mainly the biggest factor we identified through the literature review was how to use it in the most beneficial way possible. This technology, being interactable chatbots, has near infinite methods to approach a task, and some methods can prove to be more or less effective than others. Researchers have looked at ways to increase programming variability using generative AI, establishing that while the chatbot can create multiple variations of an answer with the same code, it cannot be trusted to deliver correct or quality work without supervision (Acher et al., 2023). Other research established how generative AI can be used to 'Semi-automate' reengineering of older code, needing thorough review to counter inaccuracies (Acher & Martinez, 2023). Several articles reach the conclusion that using generative AI in software development can ease the amount of tedious work, like bug fixes (Wuisang et al., 2023), code translation (Weisz et al., 2022), or creating smaller code snippets (Dantas et al., 2023). A case study called 'Generative AI for software practitioners' identifies three tedious tasks in software development where generative AI excels: Automated tagging and categorization, natural language processing, predictive analysis, and testing automation (Ebert & Louridas, 2023). Generative AI can also give inspiration for design and increases creative thinking to make it easier to come up with new solutions for problems despite the initial responses are non-functioning (Cai et al., 2023; Chen et al., 2023).

Other tasks that are a part of the software, like being scrum master, have also been tested on a chatbot, giving it all the information it need along with agile theory, and testing its ability to manage an agile software development team (Bera et al., 2023).

The biggest takeaway when it comes to practical applications for generative AI, is that it is useful for smaller tasks and tedious work, but it can prove challenging to use on larger tasks. Research has shown that the biggest value is drawn from a symbiotic relationship between human and chatbot, where the AI is dependent on the human user for context and conceptualization, while the human is dependent on the AI to complete the work much more efficiently (Weisz et al., 2022).

We found through the literature that there are 2 different used modes for GAI tools, acceleration mode and exploration mode (Böhm & Schedlberger, 2023). Acceleration mode is about autocompleting code, generating code, and in general using GAI as an assistant to delegate tasks to. Exploration mode is about getting inspiration for tasks and how they can be solved like you would with using a sparring partner or rubber duck method.

2.1.5.2 Responsibility

The second factor for succeeding with implementation of generative AI was ensuring responsible utilization. Among the many methods mentioned in the section above, many of these can prove to be less efficient or even harmful than not using it at all. Therefore, knowledge within the use of generative AI is crucial to succeeding with implementation. Based on the literature, the term 'responsibility' can mean multiple things. Firstly, users of generative AI must be aware, and work to prevent common mistakes that the generative AI can make (Liesenfeld et al., 2023). As generative AI is just a complex algorithm, its results can vary with just a small change in the prompting, so adequate prompting skills is important (Acher et al., 2023; Acher & Martinez, 2023). Generative AI has a phenomenon that users have called hallucinating, meaning that it just invents information with no references or source to back it up (Acher et al., 2023). This can create issues when attempting to utilize generative AI to get information, and all facts gathered from generative AI must be fact checked (Acher et al., 2023). Another issue presented from the literature is legal issues. Developers relying heavily on generative AI to help with their coding,

can encounter challenges with the legality of their code block. Because generative AI is trained on publicly available data, companies can end up with sections of code they are unable to get a patent on because the code is heavily inspired by other people's work (Liesenfeld et al., 2023). Because of the risks involved with utilizing generative AI, studies emphasize the importance of knowledge of generative AI (Sun et al., 2022; Weisz et al., 2022).

2.1.5.3 Motivation

Research has shown that motivation is vital for utilizing generative AI. Employees must be aware of the potential benefits gained from using it, and researchers are looking at how to motivate its employees, and whether extrinsic or intrinsic motivation works best (Brachten et al., 2021). Currently we have seen that human users of generative AI must possess knowledge on using the tool to be able to utilize it properly (Acher et al., 2023), and to do that, they need to be motivated to use it. In the literature, they separate between extrinsic and intrinsic motivation, extrinsic motivation being wanting to do something for the reward gained from doing it, while intrinsic motivation is wanting to do something for the sake of doing it (Morris et al., 2022). There are several articles that mention examples of both extrinsic and intrinsic motivation for using generative AI. Extrinsic motivation usually means that completing a task gives the user some sort of reward, or benefit, and there are numerous examples of benefits being gained from utilizing generative AI. Literature claim that intrinsic motivation has a bigger influences on use of generative AI than extrinsic {Brachten, 2021 #51}.

As mentioned in the section about use cases, the most beneficial way to utilize generative AI is for it to complete boring and tedious tasks with human supervision (Acher & Martinez, 2023; Chen et al., 2023), but then it is important to make it easy for employees to use it, and not create unnecessary obstacles and restrictions (De Minico, 2023). Looking at generative AI studies in other fields than developers, articles are more concerned with the potential issues and challenges from using it, than seeing opportunities (Lund et al., 2023), while we identified several studies done in more technical fields like software development testing the abilities of generative AI models to see how they could benefit from it (Ebert & Louridas, 2023). This suggests that more technical fields may have a better understanding of these models and how they function, and the nature of their profession makes them naturally more curious. Research has shown that explainability is also vital for users' understanding and as a result their motivation (Sun et al., 2022), and better understanding increases the efficiency of the tool.

2.1.6. Research gaps

After the introduction of generative AI, we have seen much research being done on the topic of practical applications of the technology. However, most of these are being done on the users of generative AI. This thesis aims to establish how managers can approach the implementation process and which approaches are the most efficient. We identified articles that established the efficiency of generative AI, (Ebert & Louridas, 2023), but they were conducted with controlled experiments. Our goal is to see how efficient these methods are in practice. Research also mentions how important it is for users to 'tinker' with the chatbot, to increase their level of understanding of the tool, and in turn increase the interest in using it (Retkowsky et al., 2024), and for employees to tinker and explore the tool, they need to be motivated. Literature say that intrinsic motivation is important (Brachten et al., 2021), and that extrinsic motivation has a smaller effect on employees. With this study we want to establish if there is anything that management can do to increase the motivation and interest in generative AI for their employees. Though the literature implies that quality control is important for most tasks (Ebert & Louridas, 2023), we want

to explore whether the need for quality control changes depending on what kind of task that being performed.

2.1.7. Implications

This section explains the implications we got from the literature review. The process explores the current academic research conducted on generative AI and how it affects user's workday. By analyzing the literature, we find several factors on how to successfully implement generative AI, and which of these digital transformation factors are unique to generative AI. The biggest implication we found was that the value gained from utilizing generative AI is highly dependent on how you use it, and both users and managers need to know which method of use is the most efficient for that specific task (Ebert & Louridas, 2023). Being context specific is not necessarily unique for generative AI, but with the number of ways this technology can be used to complete tasks, it certainly implies more knowledge and experience is needed.

Another clear implication is that while most large language models are highly impressive and can create human like responses, it is still not capable of conducting most tasks alone without human supervision (Virvou & Tsihrintzis, 2023). Most articles that test the efficiency of generative AI arrive at the conclusion that generative AI can help with tedious and menial tasks, but the human user must supervise its responses and be knowledgeable of not only the task they are supposed to do but also how the AI tool works (Sun et al., 2022). This is also implied not only when it comes to efficiency gains, but also when it comes to quality and responsibility. For a management team to implement generative AI successfully, they must be sure that using it will not affect the quality demands of the company (Virvou & Tsihrintzis, 2023). Therefore, it is important for the managers that their employees are motivated and enabled to work with this tool properly. We also see implied that intrinsic literature is the most effect on employees (Brachten et al., 2021), with literature claiming that personal interest is important for users to properly understand the responsibility that comes with using such a tool.

3. Methodology

This chapter explains the methodology we used to gather empirical data on this topic. To gather data, we utilized semi structured interviews, based on Michael D. Myers' article about Qualitative Research in Information Systems (Myers, 1997).

Based on the literature review and the preliminary work, we created an interview guide. The interview guide was to be as open as possible, allowing the subjects to talk freely and not follow a rigid structure. This way we could intervene and ask follow-up questions when we felt like there was more to be said about a certain topic. The interview guide is separated into seven very open questions, with several follow-up sub-questions we can ask the subject if we want to know more about what they are talking about. Each interview is recorded and transcribed, and then coded in NVivo based on Gioia's method. The coded interviews are analyzed using a thematic approach (Byrne, 2022).

Based on the background research, this study is designed to answer these questions:

RQ1: "How does software developers use generative AI?"

RQ2: "What motivates software developer's use of GAI and how can management facilitate the use of generative AI?"

RQ3: "How can developers using GAI maintain and increase quality of responses?"

The following chapter will explain the theoretic perspective we use to validify the data, how and why we chose the subjects we did, the interview guide we used, the data collection and analysis, and finally methods we used to validate our data.

3.1 Perspective

There are several ways to categorize and validate the findings we are gathering for studies such as these, but the most common are the three categories proposed by Chua in 1986, positivist, interpretative and critical (Chua, 1986). Interpretivism is a philosophical perspective that aims to provide subjective understanding and contextual insight (Chua, 1986). As we attempt to establish guidelines for implementing generative AI, we believe we will uncover some pieces of information that are different for different people, and what makes them think like that. Interpretivism is a useful perspective when studying topics that are dependent on social perception, something that utilization of generative AI is.

3.2 Research approach

The research topic for this study aims to get the opinion of several active users of generative AI, and for them to explain in detail their thoughts and experiences from using generative AI. To fulfill this, we have chosen to conduct a qualitative approach to the study. Qualitative studies allow researchers to gather details of a certain topic by in depth interviews (Myers, 1997). Qualitative methods are in sharp contrast to quantitative, where the goal is to get as many participants as possible, and often in the form of a survey where the answers are a choice between pre-decided responses (Bloomfield & Fisher, 2019).

A qualitative approach to a study allows for the researchers to ask follow up questions if they feel that the subjects have more to say about the matter (Myers, 1997). It also allows the researchers to gain a more detailed understanding of the phenomenon they are researching, by getting a more personal explanation from the subject (Barrett & Twycross, 2018). Interviews can be categorized into either structured, semi-structured or non-structured interviews. In structured interviews, the questions are all decided before hand and the interviewer make no deviations from this. In semi-structured interviews, the questions are planned, but the interviewer can ask follow-up questions, and in non-structured interviews there are no pre-planned questions, usually only a topic they will have an open conversation about. (Myers, 1997). This report is also a case study, a method of studying a phenomenon and how it is

perceived by those affected. By interviewing users of generative AI, we can get context specific information on the “how” and “why”, we get a more in-depth understanding of how generative AI is perceived among software developers, and managements, along with the challenges of using it, and how to utilize it responsible and efficiently.

The case study has been conducted on software developers and other programmers in large companies that use generative AI in some way in their daily work, with the aim of gaining contextual information on our research topic (Oates, 2005). More specifically, this is an explanatory case study, where the aim is to gain a deeper understanding of a particular phenomenon. We arrived at this decision with inspiration from the research process model (Oates, 2005).

3.3 Interview design

In qualitative research, the most common method of data collection is interview, and that is what we have conducted in this thesis. Based on the previous work we conducted, and based on the research questions, we developed an interview guide. This guide would take the interview in the direction we wanted and ask guided questions that could make the participants talk freely and open about the topic in questions Interviews are also a good method for collecting data that can vary depending on the person being interviewed (Oates, 2005), something that could be the case when it comes to generative AI. The questions in the interview guide are created literature review in mind. The interview guide is designed to be semi-structured, as generative AI is a relatively young technology and thus has not had a lot of research conducted on it. With semi-structured interviews we had the ability to go off the planned interview guide and ask follow-up questions, to gain deeper insight when we felt this was necessary.

The initial interview guide is separated into seven “main” questions. These main questions are written to be as open as possible, to promote as much talking from the subject as possible. If the subject answers in short answers, we have created several more specific “sub-questions” that ask more specific questions. Even some of the sub-questions have their own sub-questions. The aim of interviews is for the interviewee to talk as much and as freely as possible, and for the interviewer to talk as little as possible to not affect the answers too much. The way we designed this interview, we can get more and more specific in the questions the less they speak for themselves. The seven main questions are designed to in some way get an answer to the research questions that we identified earlier in this report.

The first four questions are background questions, asking for consent to record the interview, and asking for their work experience and their understanding of generative AI. We do need verbal confirmation in the recording that we were allowed to record it. The background information is part of the validity process, to establish their perspective and to look at differences between workplace, experience, and personal opinions. Knowing these things may give us deeper insight into the other questions, as well as give reasoning for some of the variable answers.

The fifth main question asks about use cases, and how they utilize generative AI for their work processes. This topic mainly focuses on specific use cases, and the subjects were told to come up with as many examples as possible with as much detail as they could. The sub-questions in this section are about getting as much detail as possible from the subject. The aim for this section is to establish how programmers currently use generative AI in their processes, as well as thoughts and experiences on the efficiency of that method. We also ask if it was easy for the subject to initially understand how to use it, and if they believe using the tool saves them time or not. By asking these questions we can establish how

difference in experience changes the way some subjects use generative AI, and the value they are able to draw from it, in the form of time saved or work completed.

The next main question in the interview guide is how much the user is aware of the quality requirements. We mainly ask about how important it is for the subject to receive quality answers, and how much effort is put into checking the answers. Multiple sources from literature state how important it is that the generated answers are checked by a human, and we want to test if this is common practice. When we ask about quality, we mean that the generated material follows the requirements set by the employer. We also ask if they believe they are knowledgeable enough to use generative AI responsibly. The aim with this question is to se how efficient they believe the tool to be, and how much effort, if any, they put into ensuring high quality

The next two questions are about how their employer, or their customer organization view generative AI. We want to establish whether the subject is encouraged by their employer to use this tool, and whether the employers must follow a set of rules to ensure responsible answers. We ask if they have gotten some training and encouragement and are thus more motivated to use it. The aim of these questions is to establish the degree of control the employer pushes, and what effect this control, or lack thereof, has on the employee.

The final set of questions are about the future, and how the implementation of generative AI will change their working environment. By asking these questions we not only get the subject talking about their experience with generative AI, but we also gain deeper insight by asking control questions like how time efficient they believe it is.

We changed the interview guide slightly to accommodate the students, and not ask them questions about their current workplace, as they are not expected to have a job yet. We are using the students to gain insight into what new employees might expect from their employer in the future when it comes to generative AI.

3.4 Subject Selection

This section presents a table explaining each subject that participated in the interviews, and why they were chosen to participate. The reason we chose to research technical professions was because we wanted the participants to have some technical expertise, as we believed we could receive more detailed and thought-out answers. Technical professions also have better natural understanding of a tool like generative AI and might provide insight that other non-technical professions might not be aware of. The candidates were chosen because of their interest in generative AI and their curiosity for new technologies. E-mails were sent to the management team in some of the biggest consultant companies in the region, asking if they could share with their employees our wish for interviews with people who have personal experience with using generative AI in their work. A total of 11 participants responded with interest to our request, and we planned a time and date for the interviews. By interviewing technical professionals like these we can get insights from the user perspective with technical details. The aim is to gather information on what management teams can do to succeed in the implementation of generative AI, and we believe that these employees can give useful insights. Based on the availability of the subjects, we planned either a digital or a physical interview, prioritizing physical whenever possible, to counter digital delay and ensure a more fluid conversation. After discussing with our supervisor, we decided to contact some students to act as ‘future users’ of generative AI. By interviewing students, we can get insights that long time employees in this field have not thought of, and we can establish what kind of

expectations new employees will have to using generative AI. Three students in the final year of their bachelor's degree in IT and information systems were contacted and we planned a group interview. We believe that students can provide more theoretical perspectives that can be compared to the current practical procedures.

Candidate	Title	Experience (year)
D1	Software engineer	2
D2	Senior application consultant	6
D3	Regional manager	25
D4	Full-stack developer	2
D5	Developer	15
D6	Developer/tech lead	9
D7	Junior software developer	2
D8	Data scientist	2
D9	Data scientist	9
D10	Software developer	2
D11	Senior ServiceNow developer	6
S1	Students	0

Table 6: Candidate List

3.5 Data collection

This section will explain the data collection method. We conducted a total of 12 interviews, with a total of 15 interview subjects. The interview guide we created was made to be semi-structured, and the interviewee could include or exclude certain questions depending on how the interview goes. Based on the literature, we created an interview guide that would cover most of the research topics we identified in the literature review.

A sub section of the participants was chosen because they work in a company that enables and encourages the use of generative AI, are all from the same company. These interviews were conducted on the same day. With the help of the regional manager, we got a list of people who were willing to participate, and planned a day where we visited the office and spent all day interviewing the six participants. According to the company, they are betting a lot of money on AI processes in general, and actively encourages their employees to utilize generative AI whenever they can. The company also has a set of regulations for use that their employees must be aware of, to ensure quality work.

The rest of the participants from other companies were chosen for having similar roles while having different perspectives and experiences of how GAI use is enabled and encouraged. These subjects are still users of generative AI, but their employer has not encouraged them to use it in any way. Their employer may be aware of the phenomenon, but they have not made the decision to start implementing and utilizing it. Therefore, motivation is entirely intrinsic.
These two perspectives give us more insight into challenges encountered when using generative AI, as well as differences in perspectives when it comes to quality and responsibility.

The final interview group were the students, who have little to no work experience, but have certain expectations as to how generative AI will be utilized when they start working. The aim of this interview is to gain more understanding of what future employees expect from their employer, and how companies

can accommodate these.
Common with all interview groups is that they are all employees in technical professions, mainly programmers (or soon to be), and they are all users of generative AI, and thus can talk about their experience with it.

3.6 Data analysis

After each interview has been carefully transcribed, we used a software called NVivo to code each interview. When coding an interview, we categorize each statement into themes based on the research questions (Byrne, 2022; Castleberry & Nolen, 2018). The process was iterative, and we added new categories in this coding process accordingly. The themes we identified from the interview are the foundation of this study, and the findings are presented in chapter four and discussed in chapter 5. The process of iteratively categorizing each statement into themes is a common analysis method called thematic analysis (Braun & Clarke, 2006). This method makes it easier to grasp and understand concepts and ideas from a set of otherwise unstructured data. Because we are using a qualitative approach instead of a quantitative approach, we cannot easily categorize and structure the answers before we get them, making it difficult to identify themes without coding the interviews (Byrne, 2022). The structure of the coding and the findings identified are presented in the next section.

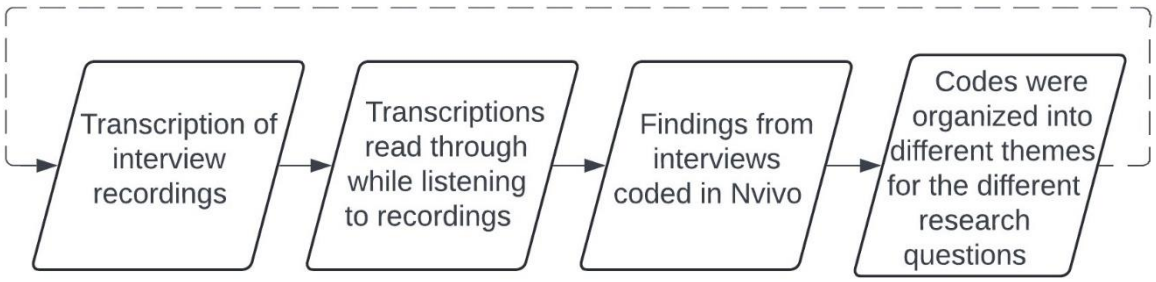

Figure 3: Interview Coding Process

3.7 Ethical considerations.

When conducting a study like this there are several ethical challenges we must consider to ensure academic responsibility (Israel & Hay, 2006). In relation to that we created a contract that informs the subject of what kind of information we are collecting, and for what purpose we are collecting said information. In that contract it is also stated that the participant has the right to retract any personal information that might identify them. As well as stating this in the interviews, and collecting signatures from each candidate, we also verbally informed each subject of this at the beginning of each interview. The ethics were in the back of our heads from the beginning, and we designed the interview guide to not collect any personally identifiable information at all. This related to the subject, their employer or potential customers that were mentioned. Whenever someone mentioned their own or any colleague's name, as well as their employer, we removed it from the transcript so there was no way that any accidental information could be included in the coding. The contract we created is based on a consent form from Sikt, the Norwegian Agency for Shared Services in Education and Research (Sikt, 2024). Because of these considerations we have not asked for any more detailed information than their current

profession. The contract also mentions that at any time, the participants can request insight into how we utilize their data for this project.

4 Findings

In this chapter we present the findings of the data analysis conducted on the interviews (Table 6). We had a total of 11 one-on-one interviews with developers with different levels of experience and place of employment. We also had one interview with a group of 3 students that code and are engaged with developer firms through internships and a bachelor cooperation project. This allowed us to look at potential differences in views between current and future developers. The interviewees are anonymous and will therefore be referred to as D1 to D11 for the developers and S1 for the students. The quotes we reference are only what we deemed the most important parts of what was mentioned related to the research questions. The quotes are also cleaned and translated to English from Norwegian with care to maintaining the original quote's meaning. Full transcripts of the interviews in the original language can be provided if required.

RQ 1-3	**Theme**	**Subtheme**
How developers use GAI	The use areas with efficiency gains for GAI	Efficiency Gains in coding related tasks with GAI
		Efficiency Gains in non-coding related tasks with GAI
	Hinders and enablers for efficiency	Incorrect and low-quality answers
		Barriers to GAI efficiency
		Knowledge of GAI and work area's effect on efficiency of GAI
Enablers and motivators for use	Enablers for use	External sources
		Facilitation of GAI application
		Knowledge of GAI use
	Motivation behind GAI use	Increase efficiency especially in simpler tasks
		Low barrier of entry from new and experienced users
		Sources of motivation
	Hinders related to motivation	Barriers and risks related to using Generative AI
		The quality of GAI is too low
Ensuring quality with GAI	Organization rules and norms	Rule areas for GAI use
		Rules and participants in governance of GAI use
	Quality challenges with use of GAI	Code from GAI is dependent on the user
		Code from GAI can be bad or incorrect
		Time consuming to achieve quality
	The relationship to quality when using GAI	Benefits to quality from GAI
		Maintaining adequate quality with GAI
		Task complexity and type's effect on what quality looks like

Table 7: Findings

4.1 How developers use Generative AI

When asked how the developers use GAI the answers varied between use cases within coding and non-coding areas. The use was also affected by different enablers making use better and hinders or barriers that stopped or altered used cases making it more difficult and less beneficiary. There were also a wide

range of approaches between the participants to using the GAI and creating prompts. The perception on these areas was subjective and the participants had a wide variety of views on the matter with some areas being mentioned at a higher frequency and the participants having more of a common sentiment.

4.1.1 The use areas with efficiency gains for GAI

While there is a wide range of use cases to gain efficiency of GAI for developers, we split the areas into coding and non-coding related elements.

4.1.1.1 Efficiency gains in coding related tasks with GAI

One of the areas that is mentioned within coding benefits is the generation of code to save time and use for inspiration.

One area the developers used GAI was generating code as a starting template that could give inspiration and save time when getting started setting up structures. Generating a template removed the requirement to create everything from scratch and helped with a starting point for structuring the code.

> *"Say that I am going to set up a test for a part of the code, then I can ask it to generate the skeleton of that code. The skeleton for a class I want to test. I can say that it should use a certain testing framework and at the same time I make sure that I have similar tests open with a structure similar to what I want. This way it usually catches necessary libraries and setup that are required. Then I look through it to make sure I have covered the testing scenarios I want and potentially add or remove some things." (D6)*

GAI was also used to autocomplete code the developer was writing by continuously coming up with suggestions to complete what the developer is writing.

> "*For example, as a developer I use ChatGPT and GitHub Copilot. So, I can say that I write only 20% of the code I write each day that is delivered to the customer. Especially the simpler calculations, the simpler algorithms, and the most common code. Such that gets data, or ordinary HTML code. The things that are quite generic.*" (D4)

> "*When you have for example Copilot in as an assistant in Visual Studio Code, you use it without thinking about it, because it gives recommendations all the time. […] But you use it seamlessly. It continuously reads the code and understand what you intend to write before you have written it. So you just click tab and then you have written that code. So, you save those micro moments all the time which makes your working day more efficient.*" (D5)

One area the developers mentioned was using GAI to translate between coding languages, look up information in documentation, ask questions, and complete other information gathering tasks.

> "*I often use it as a support tool. To look up things in a large amount of documentation. That is the best. […] The most efficient is to be capable of understanding heavier documentation quicker.*" (D2)

> "*I often ask questions I otherwise would have asked to google or stack overflow. I can get a simple syntax question about programming languages on what the different things in it does. To be more of a translation from one language to another. PowerShell to C sharp and corrections in format and such.*" (D7)

Multiple of the developers mentioned using different GAI as a rubber duck or someone they could pair code with for inspiration and ideas.

> "*Previously it probably more that you went to for example ChatGPT to ask questions for a problem you have. And then possibly get assistance with solving the problem. But it the same Copilot in Visual Studio does. But it is in some way more available all of the time. And it will try to guess what you are doing before you are done. So, you have in a way always getting hints. Yes, and it's like an assistant, a bit like pair coding with your AI.*" (D1)

> "*But ordinarily I can adjust them by giving feedback too the GAI tool I am using. So, in a way it is like having a rubber duck session with a normal developer.*" (D4)

> "*Other things are can be using the chat part, the chat window and then I can ask for things like a specific API or algorithms for things*" (D6)

Developers mentioned using GAI for smaller, simple and repetitive tasks like file management or creating documentation had high efficiency.

> "*I have told some here about a thing I was going to do, a one off. I was going to extract some unstructured text from a system treat it a bit and make it a Json file. Asked a colleague if this takes long time. Got the answer yes probably hours. Then I used ChatGPT and said I am going to do this and this and split it into four operations. Then the task was done in a few minutes.*" (D3)

> "*You have structures and such that don't have much logic in them but are a bit to write. And it is such, things Copilot generate very efficiently for*" (D6)

> "*In addition we are very aware that we need to document a lot of things. And then we document in DevOps. Which have wikis that are git-versioned. The GPTs are very good at writing mark down format. So, if you only say you want a documentation that is about how to make tea. It creates it in the correct format with the correct structure and everything.*" (D8)

Some types of code like algorithms, functions and scripts can be found, created faster, and sometimes more efficient than normal.

> "*But it is for example, functions, optimization functions. That has saved us. What we have saved most on it our scripts and functions becoming more efficient.*" (D2)

> "*Mainly I use it within scripting. If I need help for debugging or create a script if I am too lazy to write it. […] It helps me with more complicated scripts. Instead of it being more generic. When I was learning JavaScript and such things. I saved a lot of time*" (D11)

> "*Should I use an hour to create an algorithm that has been written maybe thousands of times before. Or can the AI do it in a milli second maybe. So, I make it do it.*" (D4)

4.1.1.2 Efficiency gains in non-coding tasks from GAI

There were multiple areas for GAI use around common tasks developers do outside of development as well. One of the areas that was mentioned multiple times was using GAI to improve and assist when written text in different contexts like creating an offer to a customer, creating manuals, improving language, or writing resumes.

> "*I can use it when writing an offer to a customer. Here I can get support in making it good. I sit with a lot of thoughts in my head and then I can use GAI to write down everything I have and improve the text I have created.*" (D3)

> "I have used it to some to improve texts. For example, user manuals for end-users. And I get help in improving especially the English in it" (D2)

> "I have also used it sometimes to write a resume. You have to update your resume in this job. Yes, to recommendations for slides or e-post where I am going to write text." (D11)

Another area developers used GAI was in creating presentations with illustrations and such.

> "*Then you use it for presentations and get some cool illustrations for PowerPoint-presentations. It helps very much also in getting some life, color, and something fun. Mabe some memes on the presentation. So, it is okay to have GAI in that way.*" (D4)

> "*I think many processes get a lot easier. And with Copilot you can summarize an e-post, an excel document and create a PowerPoint presentation, meeting meting notice and the whole package with almost only a key press and description. And it has also saved a lot of time.*" (D11)

GAI was also used in looking at how things are connected and finding or looking up information.

> "*Yes, to dig a bit into how* things are connected and such. Then you of course have to take it with a grain of salt on what he returns. But it can be a good angle to immerse yourself into something" (D6)

> "*Especially where you sit on a lot of administrative work. Looking at for example, what do I get in holiday money? For all the administrative work where you are searching around to find answers you can instead use a sort of bot on the side of the job just to ask questions about everything that is in the database. I think that can be very positive.*" (S1)

Planning is another area where GAI can help in giving ideas and improve the efficiency of the process.

> "It is also such that if you create a project plan, or something else you want some ideas for. It's not like any answer is wrong in a way or there being some single kind of correct answer. So, it can be many correct answers." (D8)

> "*It can be during the planning phase of different projects. Theres a lot that can be more efficient with the help of ChatGPT for example. Instead of sitting and slowly move forward you can get ideas in the blink of an eye.*" (S1)

Using tools like Copilot also made transcribing and summarizing meetings more efficient.

> "*Meanwhile for meetings it is things like for example Microsoft Copilot transcribing you meeting or creating a summary of the meeting*" (D1)

One candidate mentioned using GAI to combine and translate events from one calendar to another to manage everything more easily in one place.

> "*An example from recently is yesterday I got every client event translated in my calendar. All the meetings were then duplicated over to my own calendar, so don't have to use 2 at the same time. I don't think I could do it as quickly without Copilot.*" (D5)

4.1.2 Hinders and enablers for efficient use of GAI

Through the interviews we found both hinders and enablers affecting how efficient the use if GAI was for the different developers. The developers appeared to experience the hinders and enablers with some differently.

4.1.2.1 Incorrect and low-quality answers

The way GAI functions have created some issues related to incorrect or bad answers that make using it more inefficient and problematic.

One area that created issues was hallucinations in the GAI answer where the GAI creates a answer that is incorrect.

> "*But it can also come a bit in the way with it comes with alternatives that are not necessarily relevant or even correct. And that it begins to hallucinate, for example.*" (D1)

One candidate mentioned that answers given by GAI can be unpersonal and therefore unusable in some contexts.

> "*I have encountered that things are done unnecessarily difficult also. And that the formulation often become so generic that you easily can see that it is GAI generated. It lacks a bit of personal touch and feel. But you can say I just gave it bad prompts as well.*" (D3)

The function of GAI can also vary between different technologies with older or more niche technologies giving worse results with GAI use.

> "*I work with a bit older technologies that is a part of combinations of different things. So, I experience that it sometimes have no idea. And that the answers is chaotic even though I have specified a context for it.*" (D7)

> "*When I work on new updated and new versions of libraries and diverse other things I can have problems with especially GPT with the free version that it does not follow and is a bit outdated*." (D10)

The answer from GAI can be based on poor quality data making the answer as well.

> "*For example data and that type of things. For a lot of businesses even though AI is very hot. There is a lot of businesses that have a long way to go before. All of them sit on data and information that is useful to put in a GAI model. They might have to go through the classification of documents typically. They might have to straight up have better data quality. Having good enough data quality to get some value at the other end.*" (D6)

> "*With minding the data it sits on, which I feel is the biggest problem. What does it have to base its answer on. This holds it a bit back for me.*" (S1)

4.1.2.2 Barriers to GAI efficiency

When the developers used GAI in their tasks, they came across different areas that had an impact on how efficiently they could use the tools. These areas could require more time to work around or could stop use cases that could have benefits to their efficiency.

One such area was the basic need to spend time to improve the answer from GAI for it to be useful.

> "*You need to prompt a lot. It is a lot of sparring back and forth. You need to ask it multiple questions to get an answer that is good enough and that you can use. So it is a process with ChatGPT until you get what you want.*" (S1)

Another area mentioned is making sure personal data is considered in the way you use GAI tools.

> "*What we need to be very careful with is that we have a lot of sensitive. Especially as a bank we work with a lot of customer data. So that makes it so that we can't use everything with GAI. But we have a line on what we can and can't use it for that is a bit uncertain.*" (D8)

There is also a problem with sharing sensitive data with certain GAI types.

> "*There are things you can't use with GAI like input like sensitive information. If you have a text with very sensitive information whether it is a strategy or an environment-file with API-keys. You can't use ChatGPT to do anything with it.*" (D4)

> "*Privacy is one of the biggest challenges. You need to think about it all the time, so it is going to be very nice to when businesses start to roll out co-pilot internally in the business instead.*" (D2)

The developers also need to see the benefit of using GAI in their tasks for it to have efficiency boosts.

> "*I use it less to generate complete code. Because the quality is at least today not usually good enough. So, you usually want to adjust things. There is also something about that it should understand the code that is generated so that it can build on it in a reasonable way and understand what happens in the whole process. So, you don't accept everything it says and then it has a critical error.*" (D6)

There is also a challenge due to the lack of context from GAI when using it.

> "*For example, you have the part with GitHub copilot. It at least understands where it is. With some documents and things that are open. And files that open around it. While co-pilot for power platform don't quite understand which environment it is inside all of the time. That is because it is completely fresh.*" (D2)

Due to the nature of GAI there can be a requirement for consultants to get permission from the customer for use in their projects.

> "*We need to get written permission from them. To use GAI on the codebase of the customer. In my experience we get permission because it allows us to do more for them. And in a better and more efficient way. As long as you explain that they often say yes.*" (D4)

You also need enough knowledge to use GAI.

> "*But I also think that if you ask him something you know. Like for me with python where I am on the homefield. If I ask him something about another language I don't know that well you need to be careful in the questions you ask. But if you know it from before I think you can be more relaxed. Because you see if something is incorrect.*" (D9)

4.1.2.3 Knowledge of GAI and work area's effect on efficiency of GAI

Through the interviews it became apparent that both knowledge of how to use GAI and knowledge about the area you were using the GAI on could have an impact on efficiency. The perception of the impact appeared to be significantly different based on the person and the context of use.

One area that was mentioned was use and knowledge of documentation on specific GAI tools the developer use, increasing their efficiency.

> *"If I am talking with Midjourney or Dall-E to create images it is a totally different way to create prompts than ChatGPT. So, on Midjourney for example I stick to the documentation. To know what kind of result I want with realistic pictures. To get these special prompt parts that give me correct format on picture size and other things like that."* (D5)

Developers also believed that knowledge of GAI and the work area increases their ability to identify opportunities for use and their capability of applying the GAI tool.

> "*As a technologist you get a much better understanding of how AI functions and how the information it extracts looks. And you will have a much better capability of spotting the opportunities you can use the GAI for. It can't solve everything but as a technologist you might have a better understanding of what it can solve.*" (D1)

> "*Generative AI is so much different things. I have a lot to learn. But the things I have gotten into I am starting to do with an okey efficiency. But the potential of using it more is huge. For example, I have never used GAI to create a presentation and I think there could be a lot to gain there for me*" (D3)

> "*Being a developer helps with using the GAI better. Because it is a kind of development in itself as well. They call it prompt engineering. So, when you know how the system works you have the opportunity to use it better.*" (D4)

In some cases, the developers mentioned there is a difference in result based on the selection of GAI tool. This means knowledge of the different tools can directly affect the result.

> "*...But those that are large and more context dependent and it is a lot of other things that happen in the application, and it gets a problem where you have to take the context of other things it is more problematic. I have some belief that GitHub is better on it because it kind of sits in the code with you. But exactly there ChatGPT struggles more. And you might have to take time in building up a context before you get good answers.*" (D10)

Some developers meant there is a requirement that the user of the GAI tool has the necessary knowledge of the area they use it on for good results.

"*I need to kind of get an understanding myself first for what I want to do and how I want to do it, then I can tell Copilot or the AI how I want it done.*" (D1)

4.2 Enablers and motivators

The second research question was based on the articles that mention the employee's motivation to use generative AI, and how the employer can facilitate proper utilization.

4.2.1 Enablers

Enablers are methods that management have put in place to make it easier for its employees to utilize generative AI. This sub-section will explain the different ways that employers are encouraged or inspired to utilize generative AI in their processes.

4.2.1.1 External sources

"When I started using it, it was mainly colleagues that taught me how to do it" (D2)

Coworkers are a source of motivation and encouragement for some employees.

"We are going to have tremendous investments in AI, especially generative AI as well, to build internal competence." (D3)

Employees may also be motivated to use it by their employer enabling the use for them.

4.2.1.2 Facilitation of GAI application

Facilitation of GAI application is about steps that management can initiate to further facilitate the adaptation and facilitation of generative AI. The subjects in this topic talked about methods for limiting the risk of sharing sensitive data, and how much more beneficial it is to use a large language model that understands the context of the software logic.

"...but then we have the problem of not being able to share it with ChatGPT. That is the benefit with Copilot" (D5)

This subject is talking about certain limitations with using a free open large language model like ChatGPT, instead of a local installed solution like GitHub Copilot. With copilot, the companies can feed it with prompts and training data and be sure that nothing gets leaked since the model is trained in company data and is closed for the organization. More details in the prompt means a better and more reliable answer. This helps motivate the employee into using it more, as we can see that

"...to be able to create your own "GPT" model by taking the pre-trained model and feeding it with your own data and it will be sort of closed for the company. It's something we talk about but then there are a lot of security and blah blah blah, it moves a bit slowly. I think it has a lot of potential [...] for example we have a database that is very messy, and it takes time to understand how things are stored, if we could just feed that data to the model and we could use the model as a database." (D9)

This subject is from one of the companies that does not highly facilitate the use of generative AI, and we can see that they are motivated to use solutions that the employer must implement properly. There are talks about it within the company, but it takes time, much to the subjects frustration.

"...and it reads all the files and understands the context based on the logic" (D5)

This subject state that the large language model they use is good enough to understand what kind of system is being created by looking at the files and understanding the context of the relationships between the different files. This increases the trust in the users and thus makes it easier for the employees to use GAI.

> *"some of us have started using GitHub Copilot, and they seem happy with it. […] Your code sort of acts as a prompt, and you get more accurate and right answers." (D10)*
> *"If I am to use generative AI for development, quality is the most important aspect, sort of. I think it will never get to a point where I 100% trust what is generated but the higher quality and the more context and requirements it manages to understand, the better it is for whatever I want to use it for. (D10)*

Another subject mentions how they are aware of the benefits of a more context specific chatbot, or large language models, that can understand the context based on the logic and variable names. Their employer does not offer any paid large language models services but the subject believes that it would be more beneficial if it could understand more context-specific problems.

> *"Yes, Bing provides sources and references automatically, which creates trust. Also, Copilot in Office may refuse to answer certain questions or requests, and that also gives trust, because you know there is something being filtered there. ChatGPT just makes up something, if it does not know." (D5)*

When talking about trust, this subject mentions how they are more prone to trust the tool if they see that the chatbot refuses to answer something or provides sources for its statements.

4.2.1.3 Knowledge of GAI use

This section covers statements from the interview that talk about the requirement for knowledge on GAI to utilize it efficiently. The consensus here is that it is important for the users to be knowledgeable on how to use generative AI as well as their own profession.

> *"Now we're working towards Azure-certifications on AI, […] so we learn how we can as efficiently as possible utilize it." (D1)*

> *"We are encouraging our employees to use it. We are also financing certifications for GitHub Copilot, as well as certifications and courses on Ai in general. We have quantifiable measurements on how many employees are taking certifications in all departments." (D3)*

These subjects are from the same organization and explain how their employer finance certifications in Azure AI and try to get their employees to use it correctly and efficiently.

> *"Management does not encourage us to use generative AI, if we got more courses and lessons and encouragement from management, I think more employees would use it more." (D7)*

This subject explains how they are not getting enough motivation from their employer, and they think that more encouragement from their employer would make more employees use it.

> *"I think that if generative AI gets developed into being more integrated into systems and requires less knowledge to utilize it, people will automatically use it more without needing to know that it is AI that is doing the work, like Microsoft Copilot.*

In the future, when generative AI is being implemented as an assistant, this subject believes that more people will get the benefits from using it, without needing to know that it is AI that is doing the work.

> *"...I will probably need to read more about how to properly use GitHub Copilot in Visual Studio because there are a lot of tips and tricks one should be aware of to use it as efficiently as possible. But her in (company name) we get a pretty good introduction on how to use it." (D1)*

> *"I think the courses and this encouragement have helped some employees get a little bit better so that they are even more efficient." (D5)*

These four subjects are from the same company, and they explain how important they believe that knowledge on Generative AI is. They are experiencing an increase in efficiency with what they have learned already through courses and other reading.

> *"It's an art form, to write good prompts, and I could probably be a bit better on that front than I am currently. (D7)*

This statement highlight how important it is to be knowledgeable about using generative AI, and how they probably could spend more time learning about it. This subject's employer does not encourage their employees to use GAI.

> *"It's a double-edged sword, because it's pretty fun to use generative AI, and figuring out how to increase efficiency myself, and you want to get good results, but in the beginning it takes time to learn how to be efficient with it. I also notice with coding that if you don't know how to code before-hand, and try to get GAI to code, you usually don't get what you wanted." (D8)*

> *"It's easy to be a bit sloppy on that part. That's why it is important to have some knowledge of the things you're doing. You're always keeping in the back of your mind that it can hallucinate if you're using it to read and learn for example. If I'm ever in doubt, I usually like to put ChatGPT up against Bing Chat, to compare the answers." (D8)*

While this subject also talks about how important it is to be knowledgeable in GAI to use if efficiently, they also state that the user must be knowledgeable in their own profession as well. Meaning you can't just replace any profession with a person skilled in generative AI and expect the same outcome.

> *"you get more out of it (GenAI) than people who don't understand it. I feel there are many people I talk to that I feel don't understand how to use it, and as a result receive bad answers." (D9)*

> *"For people who don't understand it, it can cause problems, for example it may give wrong answers, even if the developers are trying to make it more open about its limitations, I still think it can cause problems." (D11)*

> *"You need some experience. To get the best answers, you need to have experience on how to use it, and to know that you are getting the best answers, you need to know what you must ask about." (S1)*

The students agree that it is important to know both how to use generative AI, and the field you are working in.

> *"It took me a long time to get to the understanding that I have today, but there was never any high intensity course on it." (D1)*

> *"People need to spend time to figure out the limitations and that it is not always beneficial to run the code that is generated for example." (D5)*

> *"…testing and failing in the beginning, and reading about it, and it becomes better and better, so it is a relatively easy low threshold tool to use, as long as you are aware of the implications and use it the right way." (D6)*

These subjects claim that it takes some initial time to properly understand how to utilize generative AI in the most efficient way.

> *"You get more out of it (GAI) than someone who does not understand it as much. I feel like there are many who haven't understood how to use it, or why even bother, because they feel it gives bad answers." (D9)*

The subjects suggest a slow buildup over time to gain the experience needed to utilize generative AI efficiently and properly. It is a steep learning curve.

> *"I never ask for a whole solution when asking for code solutions I ask for fractions of solutions. I know what I want, I just don't want to write it myself. It does not take much time because I understand the code and I don't need to test it. […] But I tried using it for something I haven't done before, so I had to use the whole code. In that case I had to iterate it multiple times before the code worked, I think it would have been faster to write it from scratch. […] I absolutely believe that it is easier for us with technical professions to use it efficiently. I have proposed to share my ChatGPT-account with my better half but they are not interested at all. I think that professions that does not understand it as much will not get as streamlined efficiency than us." (D5)*

> *"I feel that as a developer I often have a clear understanding of what sort of logic I need and the architecture and all that, so it is easier for me to judge if the code I get from generative AI is good enough or not. But say you are relatively new to your job, and you ask GPT for something that seems to work, but it could have been done in a much simpler way" (D6)*

These are examples of statements where our technical practitioners claim that it is easier for them to understand and utilize generative AI efficiently, compared to other non-technical professions.

4.2.2 Motivation behind use of GAI

In this section we list examples of motivators that our subjects claim increased their interest in generative AI.

4.2.2.1 Increase efficiency especially in simpler tasks

In this section we explore how our subjects experience using generative AI for smaller and simpler tasks.

> *"It is very good at creating a foundation of what you are creating." (D1)*

> *"It is fine with me if it delivers pseudo-code, if I can understand what it is trying to convey. […] I would never use a whole project created by ChatGPT, and sort of use it as inspiration. Therefore, it is not as important for me that the code that is writes is runnable." (D7)*

Some developers say that they use generative AI as more of a brainstorming partner, and thus they do not need code that works, they only need to understand what logic the model is trying to convey.

> *"I feel like I save a lot of time when I for example am using a programming language that I have never used before, I can write it in a language I do know and have gen AI translate it for me." (D7)*

Generative AI seems to work effectively when translating from one programming language to another .

> *"And then I use it for presentations, to get cool illustrations for my power points. It is fun to have some fancy illustrations or memes, and generative AI is great for that." (D4)*

Generative AI can be fun too.

> *"Recently I had a task that I was told would take hours, days even. It was a simple but time-consuming task, and I experimented with trying to get ChatGPT to do it. That was the whole task done in minutes. […] I do get some 'a-ha' moments, when I realize how much potential this technology has when it comes to simplifying my work processes." (D3)*

Generative AI seems to be more efficient the simpler the task, and our subjects get motivated by it being able to reduce the amount of boring and tedious tasks. It also has a clear time saving benefit according to our subjects.

4.2.2.2 Low barrier of entry for new and experienced users.

> *"That was very easy, it was just a quick registration, and I was done. It did not take me a long time at all to understand how to use it." (D3)*

> *"It can process natural language, so you can basically explain something very badly and it might actually understand it." (D5)*

Generative AI can be easy to understand for both skilled and unexperienced users. It is, however, easier to understand if you have technical expertise.

> *"ChatGPT has gotten really good at explaining, if I ask it coding questions it will provide me with a good explanation." (D5)*

Some instances of generative AI can explain its answers, making it easier to communicate with it, especially with code snippets.

> *"I use it often because I am lazy and don't want to Google. Instead, I may spend a few minutes asking the AI, instead of maybe asking a senior developer. I use it as a first solution to figure out a problem."*

Because generative AI is so easy to use, employees are more likely to use it before trying anything else. Also, by asking the GAI, workers don't need to disturb their coworkers.

4.2.2.3 Sources of motivation

In this section we mention some examples of our subjects talking about where they get their motivation from for utilizing generative AI.

> *"This workplace, they really want you to explore the possibilities of generative AI, understand its range and potential. They want to be able to offer it to customers. I do feel like a push to get certified to minimum an introduction course on generative AI." (D2)*

Encouragement from management has helped the employees of this organization to utilize it more and better.

> *"Using generative AI as a tool when you don't have experience in that field I think is unwise. In that case I would rather use it as a teacher, making it create assignments for me that I could solve by myself." (D9)*

According to this subject, using generative AI to solve a problem that you yourself don't know how to solve is not a smart way to use it. In that case, it is better to use it to make it learn the solution to you instead of just delivering a bad solution.

> *"It is very important to pay attention to the newest technologies, unless it will quickly become irrelevant. Because we are now experienced in GAI, we can offer AI services to our customers. (D4)*

Especially consultant companies must pay attention to new technology to be able to keep up with the ever-evolving market, unless they want to become obsolete in the eyes of their customers.

> *"In the beginning it was personal interest, we did not use in in projects until we got permission. […] A technical person will more often be more interested to utilize technologies than for example a nurse." (D1)*

Our subjects claim that it was initially their own interest in technologies like these that made them utilize this in the first place. People who work in technical professions tend to be more interested in these kinds of technologies.

> *"It has so much knowledge if you give it the right prompt. I have just two years of experience, but ChatGPT has the knowledge of the entire internet. That inspires me to use it in the right way so I can get the best possible answers." (D3)*

Because generative AI is based on the entire internet, this subject is aware of the possibilities of this technology. This inspires them to learn how to write good prompts so that he can utilize its full potential.

4.2.3. Hinders related to motivation.

In this section we provide some examples of risks and challenges related to an employees interest in using generative AI for their work processes.

4.2.3.1 Barriers and Risks to using generative AI

> *"I can understand the skepticism, because people are always talking about how we so easily get dependent on something. If the whole workforce were to become dependent on generative AI to create good code, and then the prices were increased, it would become very difficult to abolish." (D10)*

Becoming dependent on generative AI can prove challenging, further highlighting how important it is with employees who know both their own profession and is experienced with good prompting.

> *"Recently I did something I am not that used to doing, and then I had to uncritically use the whole code that a generative AI provided, and I had to go back and forth many times before it worked. I think it would have been faster if I just did it myself." (D5)*

This subject state that using generative AI to do something new is not a good idea. When you don't know what the end product might look like, it is difficult to figure out when generative AI has done it correctly.

> *"I think there are no tasks we cannot use generative AI for, but there are certain things we cannot do ever, like sharing customer data with open models like ChatGPT." (D4)*

Because there are many different ways of using generative AI, the users must be careful of not using a method that is sharing personal data into the model. This requires knowledge to avoid.

> *"Its like, today I think its great, tomorrow I might think its crap, its based on my perception of the last task I used it for." (D10)*

This users perception of generative AI is somewhat affected by the previous time they used it. If it delivered good responses, the user will more likely use it more, but if it gave a bad response, they might not use it again at once.

> *"I noticed that after using it for very simple things, these skills just disappeared out of grasp." (D9)*

Using generative AI for simpler things may cause the user to over time do it less efficiently without generative AI because they are missing out on "training".

> *"Sometimes it is just straight up irritating to use. Sometimes it just so much better to talk to a real human compared to generative AI." (D1)*

In certain situations it is just preferrable to converse with real people instead of a chatbot.'

> *"We need a written permission from our customer to use generative AI in their codebase." (D4)*

Some customers have started requiring permission for them to use generative AI on their code.

4.2.3.2 The quality and security of GAI is too low

This section presents some statements from our subjects talking about how they perceive certain aspects of generative AI as low quality, and what kind of issues that presents.

> *"it feels like it always want to ensure me that he is correct, even though it is not. I guess that's my biggest issue with it, that he is a bit too confident in its answers." (D1)*

Even though generative AI is often wrong, the fact that it presents everything it generates as confidently as it does, creates a bad perception in the users eyes.

> *"when it comes to lets say scripting in D Studio Max, which is its own scripting language, we have had very little success. With other languages, like C++, they are actually pretty good, all of them." (D5)*

> *"I work sometimes with some older technology which is a combination of multiple technologies, and I notice that the chatbot has no clue what I'm doing." (D7)*

There is a difference between what programming languages the generative AI models are trained on, and some models are better at certain programming languages.

> *"I have seen instances where it did it a bit too complicated, and formulating sentences that are too generic"*

The responses from generative AI is pretty obviously written by a large language model.

> *"Today it is a challenge that some of these models have is that it does not completely understand context the same way as humans. They don't have complete overview of the code in the same way we humans do. You may then end up with a lower quality of the code." (D6)*

There might be problems that are easier to solve by knowing the context, but when it doesn't know the full context it may create code that is worse than if it did know the context.

> *"One must consider bias in models when using it for customers. It may have unwanted side effects related to the data it is trained on." (D6)*

Large language models may have the same bias as the data it is trained on, and can create responses based on that bias.

> *"and then you have the issue with it not being bale to share freely with ChatGPT." (D5)*

When users cannot freely share their code with a large language model, they have to consider privacy and create a vague prompt and receive a vague response.

4.3 Ensuring quality with GAI

The stakeholders when GAI was used often had some requirements and concerns that needed to be addressed and fulfilled. These concerns could be both broad and specific for their case. The requirements for GAI output was defined as its capability to uphold the necessary standards set for projects.

4.3.1 Organization rules and norms

When managing GAI use the different businesses appeared to have different approaches and maturity.

4.3.1.1 Rule areas for GAI use

There were some different areas mentioned where it was necessary with rules and considerations for governance. These areas needing specific governance rules appeared to be shared by multiple interview candidate and businesses.

One of the areas mentioned was the concern of copyright where the GAI use something that can be copyrighted at a later date.

> "*We have internal guidelines on how you should use it, with rules that govern what you should use it for and what you shouldn't use it for. And it things like items people have ownership of or privacy concerns.*" (D1)

The candidates mentioned the rules against the use of sensitive data due to the concerns of it ending up being stolen or shared.

> "*There are some things you don't add as part of the input like sensitive data. You can't use that. If you have a text with very sensitive information. It can be strategi or for example an environment-file with API-keys. Then you can't use ChatGPT or these kinds of tools to do something with it.*" (D4)

One of the more specific areas was managing data in a database with GAI. Here the concern was that the data would be altered, lost or otherwise negatively affected by GAI handling it.

> "*It is the security aspect that is the big blocker for it. There are guidelines to make sure the integrity of the data is maintained. That you can trust it, that nothing disappears out where it should not be. This is the foundation for many of the limitations on use.*" (D2)

4.3.1.2 Rules and participants in governance of GAI use

There were differences between the different businesses in how norms and rules were created, communicated, and applied. Some governance of GAI in specific businesses appeared to come more from norms within the business and personal perceptions rather than from actual rules. The sources also had some variety in the perception of how important the rules were.

Some of the participants mentioned that they used discussions with colleagues as a way to decide or communicate how GAI could be used.

> "*I am aware that pretty early there was a creation of awareness internally. At least in my group. About how we needed to limit us with use and such things. And what we can search for. Search for how we should use it. This became a theme early for us. Because we sit with people that work with co-pilot, security, and access control in our development team. So it is a natural theme to take up. We are careful. It can be some leaks here and there. That is one of the larger things we have talked about. But that applies to many places. So it is general security.*" (D2)

There were also some candidates that mentioned internal rules that they knew of for governance of GAI use.

> "*We have internal guidelines for how you should use it. And rules that govern what you are allowed to do and what you are not allowed to do.*" (D1)

The candidates from some businesses with customers had rules where they needed to ask the customer for approval of GAI use in their projects.

> "*For example, if the customer has code, you have to get approval from the customer before to use GAI on that code*" (D1)

In some cases, the decisions for how you could use GAI were left more up to the individual developers.

> "*There is not an as established coding environment here which makes it. There is kind of no one that can follow whether you use it correctly or not. You do not have the procedures because you don't have the established environment. Because I would believe that with a more of a developing environment you would probably have had more established routines, habits and diverse things than one could use to quality check that people don't misuse it. But here it is more relaxed on it. So, you take much responsibility for it yourself.*" (D9)

When there are guidelines from multiple parties in a project the most restrictive guidelines count.

> "*I have both guidelines here where I am a consultant, and I have guidelines from the customer I am with. And it is the most restrictive guidelines that count. But especially when you work for a customer this is important.*" (D2)

In some cases, the rules can be built into the tools stopping unwanted use and leaks from happening.

> "*Shortly summarized. The rules will remain equally strict, but the rules will be worked into the tools so that the user don't need to think as much about it.*" (D2)

4.3.2 Quality challenges with use of GAI

When it comes to quality there is different challenges that makes maintaining the quality high enough more difficult.

4.3.2.1 Code from GAI is dependent on the user

Code generated by GAI is still dependent on how the user interacts with the GAI. This can create issues with quality due to the suboptimal use of GAI.

One area that was mentioned multiple times was with GAI creating code for the developer there were a higher distance between the developer and the code making the developer lose ownership and understanding of the code. And that this potentially could decrease quality.

> "*It can come some negative consequences with implementing GAI. It can also be challenges only as well. It can be that a good number of developers, if they don't have an understanding of what is created and don't go through what is generated then they might lose some ownership of the code and lose some control. That can be a negative. We don't have much of it now but in time it can become a problem.*" (D3)

Another area mentioned was that use of GAI can create worse results than without it.

> "*It is very good for coming up with a foundation for something you then continue working on. It can be both good and bad as you might have come up with a better idea yourself, but if you are a bit stuck it can give you a template you can work from for something.*" (D1)

The developers also mentioned that the different GAI tools have different strengths and abilities meaning they need to select the right GAI tool for the task they are doing if they want the most benefits.

> "*Those that I talk with that have licenses for GitHub Copilot say they often save half an hour a day on coding days. So, there is a lot to gain on it, it has probably a bit with the tool you use*" (D10)

4.3.2.2 Output from GAI can be bad or incorrect

The developers mentioned that the output of the GAI can be too bad to use or even incorrect, creating challenges with unusable results.

The different GAI models also vary in the possibilities of detail control for quality in the answers. This means some GAI models can give incorrect answers instead of saying it doesn't know.

> "*You can set parameters and settings for how it gives you answers. But it is clear that a lot is locked in the model. For example, you can set it to be very critical of the answer it gives. So, each time it gives you an answer it will say this is not necessarily correct.*" (D1)

Another thing that was mentioned was how more niche questions can have more requirement for validation due to a higher level of mistakes from GAI when it has less data to answer based on.

> "*The more special things I ask about the more important it is to verify the content. So go into it. Because I have tested with pretty special code modules. And then seen that it has changed important things*" (D2)

> "*We have had very bad success with Gemini, ChatGPT and Bing when it comes to, for example scripting in D Studio Max which is its own scripting language they obviously don't know. But with other languages like C++ for example for micro controller which is quite heavy and boring to write they are very good.*" (D5)

There was also a potential problem mentioned with GAI creating code based on something with security or copyright problems.

> "*For example, that Copilot has used datasets that are copyrighted or that have security holes that have not been caught by developers. It can be because they don't sit and write and get the hands on.*" (D3)

The GAI tools could also be certain it was correct when it was not.

> *"Instead of talking with the AI that always will say it is correct. But it is not necessarily true. That is my biggest problem. It is a bit too confident in the answers it gives."* (D1)

There could also potentially be biases and problems in the answer that comes from the sources it has used.

> "*I have the same approach as you would have for a newspaper that you know might be angled a bit to the left or right. So, you will think the article that is written there might have two angles. Or wait might not be entirely correct. So ordinary critical thinking is present.*" (D5)

4.3.2.3 Time consuming to achieve quality

One of the challenges with GAI is the time required to achieve the necessary quality with the output.

4.3.3 The relationship to quality when using GAI

When managing the use of GAI, quality challenges and risks coming with it are some of the key points that need to be addressed. Some areas mentioned by the interview participants was rules and norms governing how they used and approached GAI.

4.3.3.1 Benefits to quality from GAI

The developers also mentioned how there were potential benefits for quality from GAI.

One developer used GAI in quality assurance to save time. He used it to help gather information and create tests.

> "*And as I said I use the AI for quality assurance as well. It is like discussing with another human. You ask about for example, the code I get is there any edge cases, so it begins to think about that. Or you ask if it can write some tests for it and then you use these tests to figure out if it's good enough.*" (D4)

It was also mentioned that GAI can be used to find new ways and perspectives when completing tasks that could be better.

> "*For my part I don't think it improves my efficiency in a work day very much. But I believe it instead increases the quality of what I do a bit more. As I said plays ball getting some new perspectives on things.*" (D10)

Using GAI can also help the coders write more standardized code.

> "*It allows me to write better. More standardized. Mabe, it takes aways some of my distinctiveness. But it makes me more efficient.*" (D2)

The use of GAI also frees up time that can be used for things like testing and other tasks increasing quality.

> "*…And because I get some extra time, I can do some brutal testing for all edge cases and such. So, it is like that I do quality assurance.*" (D4)

4.3.3.2 Maintaining adequate quality with GAI

The developers had different approaches to maintaining quality in their work with GAI.

First was one of the areas most mentioned was about a person with the required knowledge always going through the output of the GAI.

> "*You should always quality check what the AI generates for you. If it's about GAI. It should be looked over by a person that has knowledge to look at what the AI produced withing a domain. Whether it is a picture, code, or text. It should be looked over by a person that has the competence to see if this good and that we can use this.*" (D1)

In some cases checking the sources of the GAI when provided can help ensure the quality of the output.

> "*…Yes, you can do that in the Bing chat for example, then you can see the sources it has used. And then it is okey because you can see yourself where it has gotten it from. But I would always check the source anyway.*" (D1)

Some GAI tools like copilot have functions that improve quality of the output by using what you already made to base its solutions on.

> "*…It manages to recognize a pattern in what should be done. And then it gives a recommendation based on how you solved it previously and adapting it to the new problem.*" (D1)

Cross-referencing the result was important to multiple participants, but they had different ways of doing this. One mentioned using multiple GAIs to run the same tasks and compare results while other used ordinary searching for information.

> "*… You need to be careful with how you use it. At the same time I use Bing chat and ChatGPT against each other. If I am uncertain about the answer, I ask both of them and ask them to check references. Because both of them can do that now. And both use Bing chat but that they check and give references on the information they have. So, I can go through a link to and see how it is described in a blog or another place. And in worst case I google it. But it is not that often I google any longer. A lot less.*" (D8)

Another developer mentioned using GAI to improve the prompts he fed into the GAI.

> "*And I actually use GAI to improve my prompts as well and if it is something very complicated, I ask it to write that prompt in a better and more understandable way.*" (D4)

Another area for maintaining the quality needed in the project is only using code from the GAI the developer understands themselves.

> "*When you work as a data scientist, and you do some steps with the data. If you print some information or create a text file for example. To check it. Or some graphs or something. You always have to do it to make sure that things are correct and makes sense. But mainly it is to never use something if it if I don't understand it myself. It is a rule I basically have for myself.*" (D9)

The quality of prompts was mentioned as a contributor to the quality of the answer with things like precision, simplicity concreteness describing good prompts.

> "*It depends. Often it comes down to how good the prompt you write is, and how easy the answer you are after is. If it is very precise, concrete and with a simple answer it is usually very good immediately.*" (D1)

Setting up demands for the GAI output was also a method to improve the quality and get what you were looking for.

> "*For the most part I use it to quality check itself. Because I give some feedback and set some demands and GAI is very good at understanding these. But of course, afterwards I read through all of it and I run the code I get.*" (D4)

The data sources selected for the GAI can affect the quality of output.

> "*If you use GAI, for example Copilot that is configured to your own data sources the quality is probably better. So, I think it depends a bit on the type of tasks and expectations you have.*" (D3)

Testing was one of the key areas to ensure the generated code functioned as intended.

> "*…In addition to that we do regular code walkthrough of things. Such that we all the time go through and check what is added in code, and discuss it with one or more people. Then we get feedback and adjust things. And in addition to that we make sure that we test what is appropriate. Some code is more important than other code. Some have tests for absolutely everything and some on parts of it and such. We try to test as much as possible to get verification on the behavior over time.*" (D6)

One way to improve chances of getting a good result was using documentation on the specific GAI tool.

> *"If I am talking with Midjourney or Dall-E to create images it is a totally different way to create prompts than ChatGPT. So, on Midjourney for example I stick to the documentation. To know what kind of result I want with realistic pictures. To get these special prompt parts that give me correct format on picture size and other things like that."* (D5)

One approach to improving GAI output was using iterations of prompts to improve the quality of the answer.

> "*…If it is a very precise, concrete, and simple answer, then it is usually very good at once. But if it is a larger more complex problem you might have to do multiple prompts before you get the answer you want.*" (D1)

4.3.3.3 Task complexity and type's affect on what quality looks like

The context around the task affect how the developer needs to approach quality demands. In some cases the demands around quality can be more related to how much time is used to fix the output while in other cases GAIs output is too bad to even be used due to a higher risk of mistakes than is acceptable in the context.

> "*There is some different levels you can put it on. Now I have taken it into use for the functional code part and document understanding. So, it is not so risky with that quality. As long as you are mindful of the pitfalls around it. Like you getting a wrong answer or there be changes. Then you have to go through yourself and verify that it is correct. For places where it could be used later like the field of metadata. Use of GAI for metadata tagging. It is incredibly fancy. But it is sketchy as well. If a mistake happens things can be sorted incorrectly. How could you follow that? Then you need incredible logging systems at least.*" (D2)

> "*In what we do you can't do anything wrong. It is so simple that we are not allowed to do something wrong. So, it is better that we don't use extra time. Mistakes are almost caught automatically. That is the only quality control part. Something needs to be done but the question is how much time it will take.*" (D2)

Tasks with higher risks for errors and problems require higher levels of quality maintenance work. While tasks with lower risks have less requirement to quality control.

> "*…Or if it is something in the testing phase, and I use it only as a concept, and it is low risk. It can happen that I just trust it and use what I get. But still if it something that is going to get deployed like for customers, I need to be careful just in case.*" (D2)

The length of the generated content can need a large amount of time to control the content.

> "*…If you write a longer text you might use a lot of time to go over and check that all the facts are correct.*" (D1)

5 Discussion

This chapter compares the findings from our interviews in relation to our research questions and current literature from the literature review. Through the findings we identified some pieces of information that were completely new, and some information that was backed up by the literature but is viewed in a different context.

5.1 How developers use Generative AI

Both the interview and literature pointed to GAI use having potential in a large variety of areas. The variety appeared to come from both what the user thought and knew of GAI, the types of tasks the user had, and the types of GAI they had access to and permission to use.

The findings from the interviews and literature show that there are different ways for developers to use GAI when coding or completing other tasks that can increase their efficiency. Our findings on use of GAI can be split into what is in literature called acceleration mode and exploration mode. Acceleration mode means speeding up work with autocompletions and generation of other usable code and is similar to a assistant you can delegate tasks to. Exploration mode can be used for inspiration in areas like providing examples to help with getting started and ideas for completing the tasks in new and improved ways (Böhm & Schedlberger, 2023). Both modes have different ways of creating benefits for a developer. For example, acceleration mode helps in completing tasks faster while exploration mode helps with how you complete them and gives time saving ideas. Our findings on GAI providing inspiration is also mentioned in with other examples like it's capabilities for providing images and concepts opening avenues of creative thinking (Cai et al., 2023).

There were also a wide variety of use cases and views mentioned between the different developers on different areas within each of these modes. For example, when it came to different challenges, problems, and potential uses indicating that even though developers have different tasks to complete, there are still opportunities where they can use GAI. Meaning efficiency gains can be increased as the knowledge of possibilities and ways to use it spreads.

Some of the main areas with potential is the completion of simple or repetitive tasks like functions, scripts and algorithms that are commonly used and have likely already been created by other developers so many times that GAI can find and recommend examples for most cases. The alternatives the GAI can find can be both better in quality due to previous use and testing of the code and more time efficient timewise for the developer to use.

The findings for use of GAI in non-coding tasks aligned with literature just like those for coding tasks. Non-coding tasks GAI use also could be categorized into acceleration and exploration mode from Böhm & Schedlberger, 2023. The tasks developers mentioned using GAI for outside of coding had a higher chance of falling into the acceleration category due to the more simple and repetitive nature of the tasks. This allows the developers to focus more on other more demanding aspects of their work.

We also found examples where the use of GAI can follow both the definition of exploratory and acceleration mode with improvements of text. Here GAI could perform multiple roles with both improvement of language, generation of ideas for different approaches and generate text to use. Meaning the modes can be combined for certain types of tasks.

From the interview we found different factors affecting how efficient GAI could be used both positively and negatively. Some of the barriers and hinders blocked areas of use that could otherwise give benefits while others only created inefficiencies. There were also different types of knowledge that could facilitate efficient use.

One of the hinders when using GAI was incorrect and low-quality answers making GAI use for efficiency more challenging and complex. There were different types of problems with different perceived causes. From the interviews we have examples like hallucinations and unpersonal or generic results making the results unusable or inefficient due to the demand of more work to achieve quality. These issues are also present in literature where they state that the results need to be evaluated carefully as the they can be to generic or incorrect (Chen et al., 2023). The findings also show how the different technologies with different levels of training data had different results with little training data leading to poor results from GAI. Our findings align with what is in literature with for example, ChatGPT more easily handling python over java (Weisz et al., 2022). Incorrect and low-quality answers also create a higher risk of mistakes for the developers and requires time when the developer tries to avoid or fix it that could be spent otherwise.

There were also barriers to how efficiently GAI can be used that were mentioned in the interviews. These barriers were things like the need to spend time to improve the quality of the answers from GAI or the need to make sure personal data is considered and protected when you use GAI. There were also differences between the versions of GAI some were made for internal use making sure personal data was not an issue when using it. The barriers were more a problem stopping certain uses as it no longer was efficient or allowed to use it in certain contexts. This is also related to the issues with generating code based on open-source large language models from literature where there can be legality issues with the code the large language models result is based on (Liesenfeld et al., 2023).

The different barriers and hinders to efficient use of GAI were approached differently by the developers. Some areas like the care for personal data and sensitive data will likely never disappear but certain GAI tools and methods of use could aid in alleviating the issues from it. The time spent ensuring quality in the work could also be improved with better GAI tools and proper methods for use. Better tools and methods can also be needed with GAI's lack of context awareness, it was described as more severe in some contexts with certain tools, meaning there already are practices and tools developed that improve the issue to some degree that can be used and improved further on.

Through the interviews we found that one of the enablers for efficient GAI use was knowledge of both how to use GAI and of the area the developer wanted to use GAI on. The interviews show that some GAI don't necessarily require a lot of knowledge and the developers had different views on how important knowledge was. One mindset was that knowledge of the field GAI was used would ensure that the developer could control the result and therefore use it effectively. But in areas like selection of the right GAI based on their different strengths and weaknesses, and the developer's capability for spotting opportunities for using the GAI, knowledge was important. Some of the developers believed that a minimum level of knowledge about the possibilities of GAI was required for sufficiently good results, but this sentiment was not shared among all of them.

5.2 How are developers motivated and enabled to use GAI

With this research question, we explore what management in consultant companies can do to facilitate the use of generative AI for its employees, if anything. In this chapter the findings are compared to existing knowledge. From the literature we saw that intrinsic motivation was the biggest influencer for the employees, meaning that employees must want to use generative AI to use it efficiently (Brachten et al., 2021). Using generative AI can be a complex method and requires awareness and knowledge to use efficiently (Acher et al., 2023). Literature also states that efficient generative AI utilizations is to make it complete tedious tasks is a significantly smaller timeframe (Acher & Martinez, 2023).

Among the subjects that participated in the interviews, approximately half had an employer who actively encourages its employees to utilize generative AI whenever they can. They were also given access to more specific language models and courses to understand it better. The rest had employees who did not offer any courses or paid for better models for their employees. This allows us to compare one group with the other. Employees with access to better models had an easier time understanding the model, and its limitations. The interviews show that the employees that are offered training have a much better understanding of the capabilities, limitations, and opportunities of generative AI. This in turn has made them utilize it for far more tasks, while also writing better prompts to return higher quality responses.

Another difference we noticed was that the employees from the enabling employers had a better understanding of the capabilities of different large language models, and which is the best to use in a specific setting. For the subjects from non-enabling employment, we also see a trend with lack of interest in using generative AI because of external limitations like legal and privacy concerns. This is a factor that discourages these employees from using generative AI. Some employees do not see the benefit of using generative AI if the responses are bad or limited, something that further highlights the importance of knowledge. There are also regulations, rules, and laws that users of generative AI must follow, according to their own employer and the customer they are working for. An internal integrated large language model into the IDE removes the possibility for a user to make the mistake of sharing something they shouldn't, as it is a closed environment and cannot share the data it reads. This makes the model more context aware and can in turn give better answers.

This is not to say that generative AI is useless if you don't know how to use it, as the intuitive interface and familiar mechanics invites user to explore it possibilities. If the possibility of committing a mistake is removed, the nature of the interface will motivate users to explore the inner working of generative AI. While privacy concerns are important to be aware of, there are certain tasks where privacy is not a concern, where generative AI is a huge motivator because of how easy it can create the solution, for example a template for a presentation. Examples like this is what the subjects claim they became more interested in generative AI, as they can see how much time it saves them. Since these interviews all were conducted with people with technical backgrounds, it will require further research to figure out how this applies to non-technical professions.

Another thing to note is that several of the subjects were demotivated by the amount of learning they had to do to understand generative AI properly. This was in tune with them not really knowing all the benefits of generative AI and therefore do not see the value of learning something completely new in order to work a bit more effectively. This added amount of reading material, along with a strict set of convoluted rules, is a demotivator for some employees and seen as an ineffective method of work. What seems to be unique for generative AI implementation is that it requires intimate knowledge of how the

relevant large language model behaves, so the user can manipulate the responses, as well as intimate knowledge of their own field, to be able to identify when generative AI delivers answers of quality.

5.3 How can users of generative AI maintain the level of quality that is expected?

This research question explores how users of generative AI can work to deliver quality work at the same level as before. It is known that generative AI has some challenges, some identified through literature, and some identified through interviews. These challenges, if not handled, can be responsible for creating results that are of lower quality than before. From literature we identified how awareness is important to counter challenges (Liesenfeld et al., 2023), and since prompting is the main form of communication between human and AI, the art of writing good prompts is very important (Acher & Martinez, 2023). Because of the challenges that generative AI introduces, it is important that responses are fact-checked or tested before being deployed or used (Acher et al., 2023). From the interviews we identified how important knowledge is, both in the field that one is working on, and the challenges of generative AI. The user must be able to identify a good response from the generative AI, based on their expertise, while also needing experience on how to avoid faulty answers from the model.

The interview subjects that were actively encouraged to learn about and use generative AI had a lot more rules and regulations to follow. They had to inform their customers about how generative AI was used to complete the task. The company itself had a set of rules that every employee needed to comply when using generative AI. Along with these regulations they also had access to an integrated large language model that was trained on company data and did not share or save this data with anyone outside of the company. This solution removes much of the possibilities of committing a mistake and has a better contextual understanding of the solution being created and can provide better answers. The remaining subjects often spent more time on a single prompt, and often had to iterate the same prompt to get a solution they were happy with. Interestingly, while literature highlight the challenges that can come from using a solution created by generative AI (Acher et al., 2023), some of the subjects claim that they will never trust an answer 100% and mainly uses it to get suggestions to a solution they can create themselves. This means that even without a set of rules, with proper knowledge of the field, one can still achieve quality responses when using generative AI.

The challenges with achieving GAI quality have implications for how it can be used for efficiency. Quality can require more time and potentially more knowledge when working with GAI to check results and evaluate them compared to the set requirements of the project. This new layer of demands for GAI use also sets requirements for the developer to be capable of evaluating the different situations and results and then use GAI only where it can be time saving or give other benefits. The interviews show that there are clear benefits to efficiency if the challenges with quality are addressed appropriately.

5.4 Generative AI specific and generative AI non-specific areas

During the interviews we found that there were new challenges related to the use of GAI, that required research. Generative AI is unique to other examples of new technologies in the way the challenges present themselves. These GAI specific challenges were scattered through the different themes we encountered in the findings. The challenges identified were handling of personal data, legal issues regarding copyright, and sensitive data. Though these challenges are not unique by themselves, the way GAI interacts with these issues presents a unique challenge because of the insecurity of the tool. The user needs to be aware of how generative AI changes the approach and results to avoid making mistakes. There were differences with the type of GAI tool where some were adapted to be in-house and allow for

more sensitive use and required less control. These in-house solutions focused on maintaining a higher quality in other GAI specific areas like the output where it was stricter and had additional steps taken to hinder incorrect and low-quality answers. The quality of answer concerns is unique with GAI due to the difference in how you use a GAI compared to other tools when it provides answers and assistance. The GAI can be used to a larger degree, on a larger variety of tasks and with higher integration in a whole workday changing the scale of the issue.

Related to motivation and enabling of GAI use there were less areas unique to GAI. The GAI specific areas was around complexities with motivation where the distance between GAI and developer can be described as larger. This is due to things like trust of correctness and understandings of results with more of a Blackbox problem with little explanation of what lies between the input from the developer and what is produced. This unclear and uncertain relation to the GAI output could potentially drive developers to use it less or not use it at all in some tasks. It's also a hindrance that can be especially challenging at the start of using GAI, as that is when the understanding from the developer on how it works is lowest. This uncertainty is also relevant to rules and lack of rules with both bringing challenges for the developers. Little rules could lead to uncertainty and aversion or potentially problematic use, while stricter rules could make too many considerations necessary for it to be worth it.

We also found areas around GAI that are less unique and not specifically for GAI where existing literature therefore is more relevant. This is relevant in areas like the benefit of knowledge and some aspects of the barriers surrounding use. Here previous literature can assist in setting guidelines for how to more generally train developers and create guidelines that apply for personal data that are relevant for multiple areas. Existing literature on enablers and motivational factors which is used in other areas like the implementation of other tools for the developers can also be used for GAI implementation. The literature around enablers and motivation for implementation can therefore be applied. The themes in quality have multiple areas that are unique to GAI with some areas like the time requirement to achieve quality mostly being non-GAI specific and the maintenance of quality having an even split. Here there are other areas like coding and data science that can have some of the same themes for example results being based on the quality of data and availability, the benefits of testing to quality, and the use of documentation for better results with specific tools.

5.5 Limitations & further research

This thesis, while thoroughly conducted, is not without its limitations. Firstly, the phenomenon of generative AI is new, and many researchers are interested in studying this phenomenon in practice. By the time it has taken to conduct this research, the research and development of large language model may have surpassed the relevance of this thesis. Something we identified through the interviews is the benefits of an integrated language model that is trained on company data and does not share this data with any external bodies. This has received continuous development, something that also requires continuous research and study.

The sample pool we interviewed was of different practitioners that provided us with good, varied information, some of the subjects were the only representative from that organization. While we did try to get as many subjects from the same organization as possible, some of the subjects are representing their organizational culture alone. This does not take into consideration the work cultural differences in these companies, which could have an impact on the answers. After the study is completed, we suggest

further studies with two different representative, one batch from an organization that actively encourages its employees and teaches the use of generative AI, and another that does not, to see the affect that organizational influence has on the use of generative AI.

Another limitation is that our subjects were all early users of generative AI, while also working in a field where interest in new technology is natural, or even expected. We are aware that these practitioners have a more natural curiosity and understanding of generative AI than someone who is not as used to working on a computer. The guidelines we identified in this thesis must be tested on other fields of work to check how effectively they work for non-tech-competent professions, and see what differences need to be made.

During the timeframe of which this thesis is written, much has happened in the field of generative AI. Even more large language models have been released, and the interface is better and more understandable than before. The findings from this study may not be as applicable to the newer versions of generative AI. Future studies will need to establish how these newer models change the guidelines established in this thesis.

6 Conclusion

This study has attempted to establish guidelines for organizations who want to incorporate generative AI into their work processes, with the research topic on "How is generative AI used professionally by software practitioners?" Generative AI is a new technology that can communicate as a human and create text based on user prompts. While many have seen it as threatening for their job, many organizations are quick with adapting this technology. The unpredictable nature of generative AI makes it difficult to implement and several studies are conducted on how generative AI changes society, positive and negative.
The aim of this topic is to establish how generative AI has been implemented and utilized in technical fields like programming and compare the theoretical guidelines with perceived practical results to establish practices that managers and developers can initiate to successfully implement generative AI into their own workday. Through literature and interviews we identified three important factors for generative AI success; use case, motivation, and quality. Depending on how a person chooses to use generative AI is crucial to whether the responses are good or not. Good answers and use of generative AI are responses that either increase efficiency or productivity and can increase the quality of the work. To ensure that employees are using generative AI to receive quality answers while avoiding faulty answers and challenges, the users need to be motivated and trained appropriately. This study aims to establish the best methods of use for programmers, in terms of efficiency and quality, and how managers and developers can motivate their employees to utilize generative AI appropriately while achieving its potential benefits.

This is a qualitative study conducted through 11 interviews with 14 candidates, all working or studying programming. Eleven of the subjects are professional practitioners who either work as developers, programmers, or data scientists. The remaining three subjects are students that are soon finished with their degree, in IT, and can give insights into what new employees expect from their future employee regarding generative AI. The interviews were conducted semi-structured, allowing us to ask follow-up questions along the way, and the results were coded according to a thematic perspective.

Through the interviews we identified some key factors that change how employees can draw value from utilization of generative AI. Because generative AI is versatile, success with it is highly dependent on the method of use. There are also several barriers to using generative AI that the user needs to be aware of, and work to avoid while using generative AI. Knowing the best use cases and how to avoid the quality challenges requires extensive knowledge on generative AI and the respective field of work. To gain the knowledge needed to operate it efficiently, the organizations must facilitate training and knowledge sharing within the company. Knowledge of generative AI allows the user to utilize it in creative and efficient ways, while still accommodating for the challenges like legality, and hallucinations. Knowledge also opens new possibilities for use and increases intrinsic motivation as users can complete more boring and tedious work quicker.

6.2 Theoretical Implications

We found that the use of GAI was split between acceleration and exploration mode (Böhm & Schedlberger, 2023). The modes have different areas it can be applied to than can benefit the developers in a range of tasks like semi-automation of simpler and repetitive tasks, generation of a starting framework or a template and inspiration for structure or approaches to a problem. The areas of use have different implications when it comes to quality, regulation, motivation, use-enabling and other areas

touching on how it is applied in work. Our study found that the application of these GAI modes has different challenges, both unique to GAI and more generic, that have implications on how it is used by developers. These challenges have different pain reliefs and improvements that can be applied to enable and ease the use of GAI, that some of the developers and their businesses we interviewed already use to some degree. The challenges were different based on how the developers used GAI and the type of tasks they completed daily, making the methods of solving the different challenges both varying and comprehensive. There is a further need to apply the methods already used for this to a higher degree among different developers as well as further development of existing tools and methods to handle these challenges and changes coming from GAI use. How these challenges are addressed has implications for how much, how efficient, and how responsibly GAI is used.

The findings can be summarized into important practical implications that can be utilized by a management team when implementing generative AI for developers. Firstly, management team must consider how their employees are motivated. A big part of the reason that developers want to utilize generative AI is because of how quickly it can complete boring and tedious tasks, leaving more fun tasks for the human user (Brachten et al., 2021; Wuisang et al., 2023). This increases intrinsic motivation by decreasing the number of boring tasks. We found that intrinsic motivation is the biggest factor in whether an employee decides to utilize generative AI or not, but an organization can facilitate a higher level of intrinsic motivation by offering training and courses. Training and courses are also an important factor to consider when it comes to the most effective use case. Because of the intuitive nature of generative AI, there are countless different methods to utilize generative AI, depending on what kind of task is to be performed. A skilled employee can find new creative methods on how to solve a specific task, while still accommodating for the challenges that comes with generative AI.

When it comes to challenges that arise when using generative AI, it is also important with knowledge so users can avoid the most common mistakes (Virvou & Tsihrintzis, 2023). In some cases, lack of knowledge can be countered by a set of rules and regulations, but the same rules can also demotivate the user. This problem can be countered, depending on what kind of large language model is implemented by management. Local integrated language models trained on company data are created in a way where they have access to the whole code base, without sharing the data. Because of this, users can safely use generative AI at work without needing to worry about making mistakes related to legalities, and the large language model can provide better responses based on a higher contextual understanding. This further facilitates intrinsic motivation. This implies that the success of generative AI implementation is highly dependent on what kind of model is implemented, and the organizations need to be aware of the differences in challenges and benefits between the different models.

6.3 Practical Implications

Based on our research where some GAI tools were easier and more beneficial for developers to use, therefore we recommend using GAI tools like copilot over tools like the net-based version of ChatGPT for most developers. This is due to how much easier issues like personal data, legalities around generated code, and how improved GAI context understanding is in a project. Due to the better handling of barriers and integration with the project GAI tools like copilot is especially beneficial for acceleration mode use opening for autocompletion of code and generation of code in a more efficient and safe manner. Considering this trend of large language models being designed and developed to be integrated, it becomes increasingly important for management to be aware of the differences of each model. While GitHub Copilot is a preferred tool for programming, Office Copilot is more preferred when creating

documents, spreadsheets or presentations. Management teams must therefore be aware of the tasks that employees need to perform, while also understanding which model is the right solution for their specific organization. This also suggests further research on the potential these models have on other professions.

With the issues of where and when to use GAI we found that the developers were required to recognize the situations where use generated value for their work in the long term. This means that even though they use more time than before in the start it can still be beneficial to use GAI for the task if they can develop the knowledge and skill to more effectively complete tasks with GAI in the future. Therefore, we recommend that the developers also practice their ability to use GAI in areas where it is possibly inefficient in the start to both gain more skill in use from more difficult examples and figure out how and where GAI can be efficient. This is however dependent on the scale of use in these areas as too much use in inefficient areas is likely not worth it long term. The goal long term is to avoid the areas where it is inefficient while still building skill in areas where use is more complicated. This implies how important it is for managers to facilitate knowledge development.

These implications mainly highlight how to increase efficiency of workers. While it is important to avoid making mistakes with generative AI, it is just as important that organizations implementing generative AI have a human centered approach. Neither of the subjects interviewed in this thesis was especially worried about their job being replaced by generative AI, and mainly saw possibilities of work relief. The findings imply that a good cooperation between human and generative AI can achieve more than a human or generative AI separately.

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Appendix

Consent form

Vil du delta i forskningsprosjektet

«Hvordan utviklere bruker generativ kunstig intelligens ti lå utføre arbeidsprosesser.»

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å kartlegge hvordan generativ AI kan brukes til å forbedre arbeidsprosesser. I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

1.1 Formål

Vi skal intervjue utviklere og konsulenter som tar i bruk generativ AI og kartlegge hvordan dette blir brukt, om teknologien leverer svar av god kvalitet og hvordan brukere tar hensyn til ansvarlig bruk. Denne undersøkelsen er en i sammenheng med en masteroppgave i Informasjonssystemer ved Universitetet i Agder.
Resultatene fra intervjuet vil bli brukt til å svare på problemstillingen, samt forsterke intervjuguiden for å kunne stille mer relevante spørsmål.

1.2 Hvem er ansvarlig for forskningsprosjektet?

Ilias Pappas, professor ved UiA og leder av studiegruppen Human Centrered AI er ansvarlig for prosjektet.

1.3 Hvorfor får du spørsmål om å delta?

Du blir spurt om å delta fordi du har et yrke hvor generativ AI er blitt implementert og brukes til å gjennomføre enkelte arbeidsprosesser.

1.4 Hva innebærer det for deg å delta?

Din deltagelse består av et semi-strukturert intervju på ca. 40 minutter, hvor din stemme vil bli tatt opp for transkribering. Etter transkribering vil opptaket slettet, og all data som kan være identifiserbare vil bli anonymisert i transkriberingen. Under intervjuet vil vi spør om spørsmål angående dine arbeidsprosesser, hvordan generativ AI har påvirket disse. Vi vil også spør om hvordan du, og din arbeidsgiver tar hensyn til at det som blir generert er av tilstrekkelig kvalitet.

1.5 Det er frivillig å delta

Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykket tilbake uten å oppgi noen grunn. Alle dine personopplysninger vil da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

1.6 Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger

Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket. Dataen vi samler inn vil være tilgjengelig for begge studentene i denne masteroppgaven, samt prosjektansvarlig Ilias Pappas. All

informasjon vil bli lagret i personlig OneDrive delt ut av Universitetet i Agder. Ingen personopplysninger annet enn yrke og arbeidsprosesser vil bli spurt om, og det skal ikke være mulig å identifisere deg basert på dataene som blir samlet inn.
Opptakene vil bli transkribert av oss, og ingen eksterne personer eller organisasjoner skal behandle opptakene.

1.7 Hva skjer med personopplysningene dine når forskningsprosjektet avsluttes?

Prosjektet vil etter planen avsluttes 10.06.2024. Etter prosjektslutt vil opptakene slettes, og transkriberte intervju vil være helt anonyme.

1.8 Hva gir oss rett til å behandle personopplysninger om deg?

Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra *Institutt for Informasjonssystemer ved Universitetet i Agder* har Sikt – Kunnskapssektorens tjenesteleverandør vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

1.9 Dine rettigheter

Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke opplysninger vi behandler om deg, og å få utlevert en kopi av opplysningene
- å få rettet opplysninger om deg som er feil eller misvisende
- å få slettet personopplysninger om deg
- å sende klage til Datatilsynet om behandlingen av dine personopplysninger

Hvis du har spørsmål til studien, eller ønsker å vite mer om eller benytte deg av dine rettigheter, ta kontakt med:

- Ilias Pappas (ilias.pappas@uia.no) ved Institutt for Informasjonssystemer, Universitet i Agder.
- Jaran Faret (jaran.faret@uia.no)
- Stig Hagum (stigha@uia.no)
- Vårt personvernombud: *personvernombud@uia.no*

Hvis du har spørsmål knyttet til vurderingen som er gjort av personverntjenestene fra Sikt, kan du ta kontakt via:

- Epost: personverntjenester@sikt.no eller telefon: 73 98 40 40.

Med vennlig hilsen

Jaran Faret & Stig Hagum

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet *«hvordan utviklere bruker generativ kunstigintelligens til å utføre arbeidsprosesser»*, og har fått anledning til å stille spørsmål. Jeg samtykker til:

☑ å delta i intervju.

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet

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(Signert av prosjektdeltaker, dato)

Interview guide 1

1. Har vi ditt samtykke til å ta opp dette intervjuet til transkribering og analysering.
2. beskriv rollen din i bedriften
    a. Hva er dine tidligere stillinger og utdanning?
    b. Hvor mye erfaring har du?
3. Hvilke typer oppgaver gjør du i løpet av en vanlig arbeidsdag.
    a. Av disse arbeidsoppgavene, hvor mange av disse blir gjennomført på en datamaskin?
    b. Hvor mye tid bruker du på arbeidsoppgavene på en datamaskin i løpet av en dag?
4. Har du kjennskap med generativ AI i form av chatboter som Bing eller ChatGPT?
    a. Kan du kort forklare med egne ord hva din oppfatning av generativ AI er?
    b. Hva er ditt inntrykk på GAI?
        i. Hvilke potensiale tror du det GAI har på din arbeidsplass?
5. I hvilke arbeidsoppgaver bruker du eller har tidligere brukt AI?
    a. hvordan bruker du AI i denne oppgaven?
    b. Hvordan har du opplevd å bruke AI I oppgavene?
    c. hvordan avgjør du om du kan bruke GAI i en oppgave?
    d. Hvordan er forskjellen på å bruke GAI i simple oppgaver imot de mer komplekse?
    e. Hvordan påvirker GAI tidsbruken din?
    f. Hvordan ble du introdusert med GAI?
    g. Hvordan bestemte du deg for å bruke GAI?
    h. Føler du at du har de nødvendig kunnskaper for å bruke GAI effektivt?

        i. Hvor går du frem med å lage prompts som gir deg de resultatene du ønsker?
        ii. Bruker du iterasjoner av prompts for å påvirke resultatet?
    i. Hvor lett eller vanskelig var det for deg å ta i bruk GAI i utgangspunktet?
        i. Hvor lang tid brukte du på å sette seg inn i bruken av generativ AI
    j. Har du noen negative sider har du opplever med bruk av GAI personlig og?
6. Hvor forholder du deg til kvalitetssikring når du bruker GAI i oppgaver?
    a. Definere hva som er kvalitet?
    b. I hvilken grad føler du at det som blir generert er av tilstrekkelig kvalitet?
        i. Stoler du på svarene som blir gitt av AI?
    c. På hvilken måte sørger du for at det som blir generert er av tilstrekkelig kvalitet?
        i. Føler du at du kan kontrollere hva GAIen gir som svar?
    d. Bruker du mye tid på å kvalitetssikre arbeidet?
        1. Når er tiden du bruker på å kvalitetsikre arbeidet verdt det?
    e. Hvor godt forstår hva som ligger bak når GAI responderer?
        i. Føler du at denne forståelsen forsterker / forhindrer bruken din av dette verktøyet?
7. Hvordan stiller arbeidsplassen din seg til bruken av GAI?
    a. Finnes det spesielle krav om bruk av AI?
    b. Har organisasjonen satt opp spesifikke regelverk for å sørge for ansvarlig bruk av dette verktøyet?
        i. Hva slags regler er dette?
        ii. Føler du at de fungerer hensiktsmessig?
    c. Har organisasjonen et sett med normer som angår bruk av GAI?
    d. Stiller organisasjonen krav på dokumentasjon på hvordan det er brukt?
    e. Stiller organisasjonen krav til personinformasjon og annet sensitiv data ved bruk av GAI?
    f. Har du egne meninger rundt når du kan bruke GAI?
    g. Har du fått opplæring, eller oppfordring til bruk av GAI av din arbeidsgiver?
    h. Har arbeidsplassen din motivert deg til å bruke generativ AI på noen som helst måte?
8. Hvordan stiller kundene dine seg på bruken av generativ AI?
    a. Har kundene noen spesielle krav som kolliderer med din arbeidsgivers krav?
9. Hvordan tror du fremtiden ser ut for ditt yrke mtp. GAI?
    a. Har noen arbeidsprosesser endret seg totalt etter introduksjonen av GAI?
    b. Er det arbeidsprosesser du mener burde bli totalt endret eller fjernet etter introduksjon av generativ AI?
    c. Har du arbeidsprosesser som kunne bli gjennomført ved hjelp av generativ AI, men av andre grunner ikke er mulig?
        i. Hvilke hindringer handler dette om?

   d. Har du arbeidsprosesser som kunne blitt erstattet helt av generativ GAI?
10. har du noe mer du føler du kan si om bruken din av GAI?

Intervju guide 2 (Students)

1. Har vi ditt samtykke til å ta opp dette intervjuet til transkribering og analysering?
   a. Hva er dine tidligere stillinger og utdanning?
   b. Hvor mye og hvilken type erfaring har du?
   c. Hvilket yrke ser du for deg å gjøre etter endt studietid.
2. Har du kjennskap med generativ AI i form av chatboter som Bing eller ChatGPT?
   a. Kan du kort forklare med egne ord hva din oppfatning av generativ AI er?
   b. Hva er ditt inntrykk på GAI?
      i. Hvilke potensiale tror du GAI har på din fremtidige arbeidsplass?
3. I hvilke arbeidsoppgaver bruker du eller har tidligere brukt AI?
   a. hvordan bruker du AI i denne oppgaven?
   b. Hvordan har du opplevd å bruke AI I oppgavene?
   c. hvordan avgjør du om du kan bruke GAI i en oppgave?
   d. Hvordan er forskjellen på å bruke GAI i simple oppgaver imot de mer komplekse?
   e. Hvordan påvirker GAI tidsbruken din?
   f. Hvordan påvirker GAI kvaliteten på arbeidet ditt?
   g. Hvordan ble du introdusert med GAI?
   h. Hvordan bestemte du deg for å bruke GAI?
   i. Føler du at du har de nødvendig kunnskaper for å bruke GAI effektivt?
      i. Hvor går du frem med å lage prompts som gir deg de resultatene du ønsker?
      ii. Bruker du iterasjoner av prompts for å påvirke resultatet?
      iii. Hvordan har du fått disse kunnskapene?
   j. Hvor lett eller vanskelig var det for deg å ta i bruk GAI i utgangspunktet?
      i. Hvor lang tid brukte du på å sette seg inn i bruken av generativ AI
   k. Har du noen negative sider har du opplever med bruk av GAI personlig og?
4. Hvordan forholder du deg til kvalitetssikring når du bruker GAI i oppgaver?
   a. Definere hva som er kvalitet?
   b. I hvilken grad føler du at det som blir generert er av tilstrekkelig kvalitet?
      i. Stoler du på svarene som blir gitt av AI?
      ii. Trenger du å stole på svarene som blir gitt av GAI?
   c. På hvilken måte sørger du for at det som blir generert er av tilstrekkelig kvalitet?
      i. Føler du at du kan kontrollere hva GAIen gir som svar?
   d. Bruker du mye tid på å kvalitetssikre arbeidet?
      1. Når er tiden du bruker på å kvalitetsikre arbeidet verdt det?
   e. Hvor godt forstår hva som ligger bak når GAI responderer?

        i. Føler du at denne forståelsen forsterker / forhindrer bruken din av dette verktøyet?
5. Hvordan stiller samarbeidsbedriften deres seg på bruken av generativ AI?
    a. Har de noen spesielle krav som kolliderer med hvordan dere vil bruke GAI?
    b. Stiller organisasjonen krav til personinformasjon og annet sensitiv data ved bruk av GAI?
    c. Har dere egne meninger rundt når du kan bruke GAI?
    d. Har dere fått noe tilrettelegging for bruk av GAI?
6. Hvordan tror du fremtiden ser ut for ditt GAI bruk mtp. GAI?
    a. Har noen arbeidsprosesser endret seg totalt etter introduksjonen av GAI?
    b. Hvordan tror du bruk av GAI vil endre seg når du jobber i en bedrift i forhold til som student med hensyn til hvordan du kan bruke det?
    c. Har du oppgaver som kunne bli gjennomført ved hjelp av generativ AI, men av andre grunner ikke er mulig?
        i. Hvilke hindringer handler dette om?
    d. Har du arbeidsprosesser som kunne blitt erstattet helt av generativ GAI?
7. har du noe mer du føler du kan si om bruken din av GAI?