DALARNA UNIVERSITY

ChatGPT as a Supporting Tool for System Developers

Understanding User Adoption

Authors: Mattias Andersson and Tom Marshall Olsson

Supervisor: Azadeh Sarkheyli
Examinator: Vijay Pratap Paidi

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Sammanfattning

Bakgrund AI, specifikt konversations-AI som OpenAI:s ChatGPT, växer snabbt i både privata och professionella sammanhang, vilket erbjuder möjligheter till kostnadsbesparingar och modernisering för företag. ChatGPT kan simulera mänskliga konversationer, vilket kan ge fördelar i flera olika industrier och kan genom samarbete mellan människa och AI potentiellt förbättra anställdas produktivitet. Det huvudsakliga forskningsproblemet är att identifiera faktorer som påverkar systemutvecklarens användning av ChatGPT och beakta dess design och implementation för att minska potentiella negativa effekter.

Syfte Denna studie syftar till att undersöka de faktorer som påverkar användares adoption ChatGPT som ett verktyg för att stödja systemutvecklare. Dessutom syftar studien till att identifiera hur ChatGPT kan hjälpa systemutvecklare i deras dagliga arbete och vilka hinder som finns för att inkorporera ChatGPT i denna kontext.

Metod Genom en fallstudieansats med kvalitativa och kvantitativa datainsamlingsmetoder, använder studien positivistiska och interpretivistiska paradigm.

Resultat Resultatet visar att den uppfattade förmågan hos ChatGPT att förbättra effektiviteten och generera korrekta svar påverkar avsikten att använda tekniken. Faktorer som tidsbesparing, produktivitetsförbättring och användarvänlighet gav dock inte statistiskt signifikanta resultat. Utvecklare finner ChatGPT användbart för att förenkla uppgifter och hjälpa juniora utvecklare, men det finns oro för att hantera komplexa uppgifter och säkerhetsfrågor.

Slutsatser Användarnas acceptans av ChatGPT drivs främst av den uppfattade precisionen och effektiviteten. ChatGPT kan hjälpa till med uppgifter som felsökning, kodgenerering, kodrefaktorering, kodoptimering och teknisk dokumentation, men med vissa potentiella begränsningar när det gäller hantering av alltför komplex kod. Trots detta så finns hinder för införandet i form av oro för integritet, säkerhet och brist på medvetenhet samt funktionella begränsningar.

Följder	De insikter som vunnits kan indirekt gynna företag, inklusive vår affärspartner CGI, genom att bidra till beslutsfattandeprocesser relaterade till adoption och användning av ChatGPT.
Nyckel-ord	AI, Konversations-AI, Systemutvecklare, ChatGPT, TAM

Abstract

Background	AI, specifically conversational AI like OpenAI's ChatGPT, is rapidly expanding in personal and professional settings, offering cost-cutting and modernization opportunities for businesses. This technology, capable of simulating human-like conversations, holds promise across various industries, potentially enhancing productivity through human-AI collaboration. The main research problem is to identify factors influencing system developers' adoption of ChatGPT, considering its design and implementation to mitigate potential negative impacts.
Aim	This study aims to investigate the factors that influence user adoption of ChatGPT as a tool to support system developers. Additionally, it aims to identify how ChatGPT can aid system developers in their daily work, and challenges associated with incorporating ChatGPT in this context.
Method	Using a case study approach with qualitative and quantitative data collection methods, the study employs positivist and interpretivist philosophical paradigms.
Results	Results showed that the perceived ability of ChatGPT to enhance efficiency and generate accurate responses significantly impacts adoption intentions. When examining aspects related to timesaving, productivity enhancement, and user-friendliness, no statistically significant results were found. Among developers, ChatGPT is considered valuable for simplifying tasks and assisting junior developers. There are concerns regarding its capa-

	bility to handle complex tasks and potential security issues. Suggestions for improvement include better integration with integrated development environments (IDEs) and enhanced accuracy.
Conclusions	The findings highlight perceived accuracy and efficiency as driving factors for user adoption regarding ChatGPT. ChatGPT can support tasks like debugging, code generation, code refactoring, code optimization, and technical documentation. However, there may be some potential limitations when dealing with overly complex code. Barriers to adoption include concerns about integrity and security, lack of awareness, and functional limitations.
Implications	The insights gained can indirectly benefit companies, including our business partner CGI, by guiding decision-making processes related to the effective adoption and utilization of ChatGPT.

Keywords	AI, Conversational AI, System developer, ChatGPT, TAM

Acknowledgements

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Abbreviations and definitions

AI	"It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable. " *Source:* (McCarthy, 2007)
Conversational AI	Conversational AI uses natural language processing (NLP), natural understanding processing (NLU), natural language generation (NLG) and machine learning algorithms in order to interpret user input, understand the context and generate an appropriate response. *Source:* (Makasi et al., 2022), (Moussawi et al., 2020)
ChatGPT	Open AI ChatGPT is a chatbot that uses large language models (LLM's) to generate human-like responses to user input. The chatbot is trained on a vast dataset of human conversations, making it capable of producing replies to various topics and prompts. Source*:* (Aydin and Karaarslan, 2022), (Gordjin and Have, 2023), (Haleem et al., 2022)
IS	"IS as a discipline is concerned with the development and use of information systems by individuals, groups, organizations and society, where usually those information systems involve the use of computers." *Source:* (Oates, 2006)
System developer	The System developer is responsible for defining system scope and objectives, integrating computing systems, making software and hardware recommendations, and developing and testing applications. They also analyse and tune

	system performance and develop tools for performance evaluation and security. The role involves various levels of responsibility. Source: (Penn State Human Resources, n.d)
TAM	The Technology Acceptance Model (TAM) is a widely used model describing technology acceptance, with two primary factors influencing an individual's intention to adopt and use new technology: perceived ease of use and perceived usefulness. Source: (Charnees & Boot, 2016)
NLP	"Natural language processing (NLP) refers to the branch of computer science—and more specifically, the branch of artificial intelligence or AI—concerned with giving computers the ability to understand text and spoken words in much the same way human beings can." Source: (IBM, n.d.a)
NLU	Natural language understanding (NLU) is a part of natural language processing that employs syntactic and semantic analysis to determine the meaning of text and speech. It involves analyzing grammar, understanding intended meaning, and creating an ontology to establish relationships between words and phrases. This allows machines to comprehend human language as humans do in conversations. *Source:* (IBM, n.d.b)
NLG	"NLG is the process of producing a human language text response based on some data input. This text can also be converted into a speech format through text-to-speech services." *Source:* (IBM, n.d.b)
ML	"Machine learning is a branch of artificial intelligence (AI) and computer science which

	focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy." *Source:* (IBM, n.d.c)
IT	""IT" is the common term for the entire spectrum of technologies for information processing, including software, hardware, communications technologies and related services. In general, IT does not include embedded technologies that do not generate data for enterprise use." *Source:* (Gartner, n.d)

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1 Introduction

1.1 Background

The implementation of Artificial Intelligence (AI) is expanding rapidly. According to Google, 500 million people around the world use their smart device Google Assistant every month, which is an AI-driven voice-activated digital helper (Eadicicco, 2020). These products' main purpose in personal settings is to help users through different tasks like playing music or finding out the weather forecast. According to Zhang et al. (2021) the number of AI journals publication has grown by 34.5% from 2019 to 2020, which is a higher number than between 2018 to 2019 where the growth was at 19.6%. From the early 2000s the publication around AI has risen over 7 times, which indicates that's the subject of AI is important for the global economy (Cubric, 2020).

According to Ransbotham et al. (2020), MIT Sloan Management Review and Boston Consulting Group conducted a study which found that a majority of companies, 57% to be exact, are experimenting with Artificial Intelligence (AI) technology. Additionally, a similar proportion of businesses, 59%, have developed a strategy for implementing AI in their operations (Ransbotham et al., 2020). The 2019 Gartner CIO Survey showed that CIOs think of conversational AI as the main AI-driven tool that will be utilized in business, where 70% of white-collar workers were projected to work with chatbots in 2022 (Goasduff, 2019). Conversational AI, which is a type of interactive system, is widely used in personal settings but is only beginning to be implemented in enterprise settings (Brachten et al., 2021). The use of conversational AI in enterprise context is not only driven by their potential for reducing costs, but also by their ability to create a modern office environment that attracts the new generation of workers, specifically those who are digital natives. (Goasduff, 2019). The decision to incorporate conversational AI into an enterprise environment is perceived as a complex and multi-faceted one, as it requires a long-term commitment from the company (Kannan & Bernhoff, 2019).

Conversational AI uses natural language processing (NLP) and machine learning (ML) in order to provide a human-like conversation to answer different queries (Gkinko & Elbanna, 2021). NLP which is a subfield of computer science and AI that focuses on the ability of computers to read and understand text and speech in a manner similar to human understanding (ibm n.d.a). The ability for computers to understand text through NLP has several advantages; one popular application that uses NLP to translate text from one language to another is Google Translate (Garousi et al. 2020). The challenges encountered in the field of NLP often surround speech recognition, comprehending natural language, and generating text that is natural to read (Garousi et al. 2020). Syntax-wise, natural language has rules, but understanding language is tough due to the complexity of semantics (Garousi et al. 2020). One study showed that "List the sales of the products produced in 1973 with the products produced in 1972." offered 455 dif-

ferent semantic-syntactic parses (Liddy, 2001). This shows the challenges in NLP. While people can easily understand different meanings, it's hard for computers to understand all the details of natural language.

One specific conversational AI that was launched as a prototype in November 2022 that has attracted interests from system developers, engineers, social media users, business owners and authors is OpenAI's ChatGPT (Haleem, et al., 2022). While there are several conversational AIs on the market today, such as Mitsuku and SimSimi, ChatGPT stands out as the most popular one (Surveypoint, 2023).

ChatGPT is a conversational AI capable of producing human-like responses, with potential implications in various fields such as education, research, journalism, mass communication, IT, and retail. Utilizing machine learning techniques, including deep learning, natural language processing, and unsupervised and semi-supervised ML methods, ChatGPT has been trained on extensive datasets. Its abilities encompass things like text generation, question and answer generation, sentiment analysis, and summarization, with applications ranging from computer code creation and financial analysis to poetry, essays, and impersonations. With these attributes ChatGPT has the ability to impact many different industries such as healthcare, IT, transportation, and education. (Haleem, et al., 2022)

One of the ways for Human and AI to collaborate is to simplify tasks by letting the user interact in natural language by entering queries, and by that access information related to the task (Brachten, 2021). Research made by Dwivedi et al., (2021) shows that collaboration between humans and AI has the potential to increase the performance of the users in an enterprise context. Technological progress in AI has opened the possibility for AI to perform specific roles and tasks which are currently performed by humans, which leads to a broader set of tasks where AI and human can collaborate (Dwivedi, 2021). These advancements around AI technology have been analyzed in studies and a narrative has been created where humans work higher up in the value chain on more creative and cognitive roles in collaboration with AI (DIN and DKE, 2018). According to Storey and Zagalsky (2016), there has been a rapid adoption of conversational AI among system developers. Human and AI collaboration enhances system developer productivity by automating repetitive tasks, keeping them informed about crucial projects or community events, and minimizing distractions (Storey and Zagalsky, 2016). On a team scale, Conversational AI's can streamline and boost the effectiveness of each stage in the software development life cycle, such as coding, testing, operations, and managing user interactions (Storey and Zagalsky, 2016).

1.2 Problem

While factors influencing the adoption of conversational AI have been researched in multiple studies (Marikyan et al., 2022; Moussawi et al., 2020), adoption factors specific to ChatGPT are an unexplored area as

this is a new technology. Therefore, further research is needed to identify the factors that influence users' decision to adopt this technology.

The literature has extensively explored the role of AI in the work context, but the focus has been mainly on the potential of the technology to replace manual processes and, to some extent, replace the human workforce (Cao et al., 2021; Dwivedi et al., 2021).

According to Storey and Zagalsky (2016), conversational AI can increase productivity and effectiveness among workers such as system developers, but there is also a risk of negative impacts on their work. These potential downsides include reduced team interaction, which might lead to less learning and discovery among team members. The use of these systems could also introduce new unintended interruptions, hindering productivity. Trust in auto-generated documentation might decrease, leading to overlooked issues or miscommunications. Finally, ethical concerns may arise when the AI-generated content is not obviously machine-generated, prompting issues of transparency and accountability. These negative impacts emphasize the importance of carefully considering the design and implementation of conversational AI systems in the development process. (Storey & Zagalsky, 2016).

The main research problem is to determine the factors that influence a system developer to adopt ChatGPT, considering its design and implementation during the development process to lessen potential negative impacts. This is important as ChatGPT is a growing technology, and the factors contributing to its adoption remain predominantly uninvestigated. This leads to our research questions:

- What are the underlying factors that influence a system developer's decision to adopt ChatGPT as a support tool in their daily work?
- How can ChatGPT support system developers in their daily work?
- What are the potential challenges associated with the adoption and utilization of ChatGPT among system developers?

1.3 Aim

Given the research gap in adoption factors specific to ChatGPT and the research gap surrounding ChatGPT as a support tool among system developers, the aim of this study is twofold. This study aims to investigate which factors influence system developer's decision to adopt ChatGPT as a support tool in their daily work. Ultimately, this study aims to identify the ways in which ChatGPT can support system developers in their daily work and address potential challenges associated with the adoption and utilization of ChatGPT.

1.4 Contribution

This study aims to contribute to the understanding of ChatGPT's role as a tool to support system developers in their daily work and the factors influencing its adoption. It addresses the gaps in the literature regarding the adoption factors specific to ChatGPT and its potential as a support tool for system developers. The study also identifies the challenges associated with the adoption and utilization of ChatGPT among system developers. The study's findings can provide insights for organizations and developers considering the integration of ChatGPT into their work processes.

1.5 Partner

CGI, founded in 1976 in Canada, ranks among the world's largest IT and business consulting firms. With a workforce of approximately 90,000 employees, the company operates across over 400 locations globally. In Sweden, CGI employs around 3,800 people, including 100 staff members in Borlänge.

CGI serves clients in 21 industries, such as:

- Utilities
- Manufacturing
- Government
- Financial Services
- Healthcare & Life Science
- Retail & Consumer Services
- Oil & Gas etc.

1.6 Limitations

CGI Borlänge is a collaboration partner in this study and therefore the main focus will be to carry out the research at the Borlänge office with the exception of questionnaires that will be sent to a larger target group within the CGI organization. This study is also limited to investigating specifically how system developers within CGI can use conversational AI in their daily work as this is a typical role within the company CGI. This also provides the opportunity to study the subject more deeply compared to if several different roles had been investigated.

This study is limited to investigating the conversational AI "ChatGPT". The reason is that this application is said by many to be the fastest growing conversational AI on the market. Reuters reports on February 1, 2023, that in January ChatGPT reached 100 million active users just two months after its launch, which is the fastest user growth measured at some application (Hu, 2023). This means that there is a broad user base and the possibility that respondents are already familiar with or have heard of ChatGPT is greater compared to other similar conversational AI's.

Another limitation of this study is the time constraint, which limited our ability to examine the full extent of system developers' adoption

of ChatGPT using the Technology Acceptance Model (TAM). As a result, we focused on investigating the developers' attitudes and intentions to use ChatGPT, rather than their actual long-term adoption patterns.

The results obtained from this study are limited to the knowledge and experiences of the respondents involved in the study. It should be noted that some participants from the questionnaire and interviews may not have directly used ChatGPT but rather responded based on their understanding of the technology from what they had read or heard about it. Therefore, the findings may be influenced by their perceptions and second-hand information.

1.7 Disposition

The forthcoming text provides a comprehensive exploration of the study's layout, explaining the structure and content on a chapter-by-chapter basis.

The literature review chapter examines the factors that influence the adoption of ChatGPT, within the context of system development. The review discusses essential concepts, including conversational AI, ChatGPT, human-AI collaboration, and technology adoption factors, such as the Technology Acceptance Model (TAM).

The method chapter presents a case study on how ChatGPT can support system developers and what's affecting user adoption of ChatGPT among system developers. The use of the theoretical framework is explained and based on this; a set of hypotheses are proposed. Qualitative and quantitative methods were used to gain a comprehensive understanding of the subject. Interviews and questionnaires were used for qualitative data collection, which were analyzed thematically. Quantitative data was collected through structured questionnaires and analyzed using Spearman's rank correlation test. The chapter also emphasizes the importance of validity, reliability, objectivity, and ethical considerations in the research process to ensure trustworthy findings.

The results chapter presents the results from the interview and questionnaire. The chapter begins with presenting the general knowledge about ChatGPT among the respondents. Then the results from the questionnaire and interviews regarding adoption factors are presented. Under section 4.2.1 the result from the hypothesis testing is presented, both in text and in Table 3. In the last part of the chapter is the result regarding ChatGPT as a support tool for system developers presented.

The discussion chapter provides a detailed discussion of our findings from this study. The chapter follows the same chronological order as the result chapter, where we begin by discussing the general knowledge about ChatGPT among the respondents. The adoption fac-

tors are discussed under section 5.2, and then the discussion concerning the hypotheses follows under section 5.2.1. ChatGPT as a support tool is then discussed in the last section of the chapter.

In the conclusion chapter, the conclusion from this study is presented. There are three sections, which represent the research questions. Under each section the conclusion from each research question is presented.

In the last chapter, further research, we present our thoughts about further research on ChatGPT.

2 Literature review

In the ever-changing landscape of technology, exploring the factors that impact the adoption of new technologies, especially in the field of artificial intelligence (AI) and conversational agents, has become increasingly important. This literature review seeks to offer a deeper understanding of the factors influencing the adoption of ChatGPT, an advanced conversational AI, within the context of system development. By examining a widely recognized model, the Technology Acceptance Model (TAM), this review aims to investigate the primary determinants that drive technology adoption and apply this model to the specific case of ChatGPT.

The review is organized as follows: a theoretical framework is presented, discussing essential concepts, including conversational AI, ChatGPT, human-AI collaboration, technology adoption factors including the Technology Acceptance Model (TAM). At the end of the chapter, two tables are presented to provide a comprehensive overview of the literature (Table 1) and define the key concepts discussed (Table 2).

By integrating insights from the TAM model with an analysis of previous research on ChatGPT and related topics, this literature review strives to provide a solid foundation for further investigation and understanding of the factors affecting the adoption of ChatGPT among system developers.

2.1 Theoretical framework

2.1.1 Conversational AI

Conversational AI is a software application that can interact with users in speech and/or written conversations using natural language (Dale, 2016). The term conversational AI refers to different types of technology that can understand, process, and respond to human language, which includes chatbots and voice assisted software which are AI driven (MarketWatch, 2022). Conversational AI have the capability through machine learning algorithms to learn and evolve over time as users provide the algorithm with data as inputs (Gkinko & Elbanna, 2023a). Conversational AI can be found in different domains today, ranging from personal settings in form of Apple's Siri or Google's Assistant to enterprise context where it's used to support different tasks (Brachten et al, 2022). In enterprise context, conversational AI are recognized for improving productivity (Gkinko & Elbanna, 2023b). It has the possibility to enhance productivity by streamlining a range of business operations and services at a low cost (Gkinko & Elbanna, 2023b).

ChatGPT is a conversational AI language model developed by OpenAI that has the capability to support users in various tasks. Researchers have started to investigate the role, capabilities, and the impact ChatGPT can have in different areas. (Haleem et al, 2022). ChatGPT is trained on a wide variety of text using machine learning algorithms to be able to perform a range of different programming related tasks (Haleem et al, 2022). In recent times ChatGPT has gained recognition

due to its capability to create human-like text with help of its pre-trained transformer language model (Haleem et al, 2022). Several companies have shown big interest in the ChatGPT technique where they can see it help simplify different procedures, develop marketing tools, virtual assistants, and automate tasks like document reviews (Haleem et al, 2022).

ChatGPT have shown impressive capabilities in different domains, but there are some limitations, for example occasionally producing incorrect or nonsensical response, slow response times, and being affected by biases in the training data (Haleem et al., 2022). According to Haleem et al. (2022) there is the possibility to reduce the risks connected these constraints by using company niche models and modify generic models before using AI-generated outputs.

The potential of ChatGPT stretches out to different domains, for example education, where it can help students gather information. When more users in different domains use ChatGPT it learns and improves on its accuracy. It is important to review its potential effects and take safety measures to ensure its ethical and responsible use. (Haleem et al, 2022)

2.1.2 Human-AI collaboration

Artificial intelligence is finding its way into different domains rapidly, which has sparked researchers to find out how Human-AI collaboration can increase productivity in the workplace (Sowa et al., 2021). Sowa et al (2021) has investigated the synergies between human workers and AI in different tasks for managers, for example planning, organizing, and leading. Sowa et al (2021) used a three-staged methodology, where the first phase involves a research review of existing studies to formulate a hypothesis. In the second phase a preference study was made to verify the hypothesis. The third phase included semi-structured interviews and scenario-based design to dive deeper into the insights that came from the second phase. (Sowa et al., 2021). The primary conclusion from this study was that there is an increasingly positive attitude towards AI in knowledge work, but there are some concerns regarding AI used in full automation (Sowa et al., 2021).

Humans and AI can collaborate in different ways, one of them is through conversational AI, in particular AI chatbots. Gkinko & Elbanna (2023a) made a study to investigate the use of conversational AI in day-to-day work. Through a case study where they investigate one company with 30,000 employees and collected data with semi-structured interviews, documents reviews and observation they concluded that there are two key dimensions determining their type of use. The first one is the dominant mode of interaction and the second is users understanding of the AI technology. The study developed a classification of users where they found four different types: early quitters, progressives, pragmatics, and persistence. Each of the classified users had distinct characteristics. (Gkinko & Elbanna, 2023a)

Previous research has shown that trust is one of the key factors for new technology to be successfully implemented in the workplace, but little is known about trust in relation to development in AI technology (Gkinko & Elbanna, 2023a). Trust as a concept in organizations has been considered a cognitive phenomenon grounded on rational thinking and decision making (Kramer, 1995). The study made by Gkinko & Elbanna (2023a) identifies that there are three types of trust experienced by users of conversational AI: emotional, cognitive, and organizational. From those three types of trust the researchers develop a framework of experiential and sustained trust formation. The study highlights the important function of emotional and organizational trust in complementing cognitive trust and from that they point at key design features that promote trust in AI chatbot use (Gkinko & Elbanna, 2023a).

2.1.3 Adoption factors

Numerous studies have been conducted on the factors influencing the use of AI technology in home contexts. Findings from this field may help understand the use of conversational AI in an enterprise context, but further research is required to gain a better understanding of the driving factors for using conversational AI in a professional setting (Brachten et al., 2021). Brachten et al. (2021) conducted a study to investigate the acceptance of conversational AI, focusing solely on conversational AI in a professional context. The study employed a research model based on the decomposed theory of planned behavior and tested it with a survey of 198 participants (Brachten et al., 2021). Results from the study revealed that intrinsic motivation significantly influences employees' intentions to adopt and utilize conversational AI. Perceived usefulness and trust are two factors that's influencing the use of conversational AI in different professional domains, whereas demographics like age and gender do not alter the findings. (Brachten et al., 2021). As most researchers focuses on the factors that make a successful implementation of conversational AI, Schlögl et al. (2019) found fear of job loss and lack of understanding the technology as barriers preventing employees from using AI technology in the workplace.

Kelley (2022) conducted a study on employees' perception on the effective adoption of artificial intelligence where she conducted 49 interviews with employees of 24 organizations across 11 countries. The participants ranged from junior data scientists to chief analytics officers. The research identified 11 components that could influence successful AI principal adoption: communication, management support, training, an ethics officer, a reporting mechanism, enforcement, measurement, accompanying technical processes, sufficient technical infrastructure, organizational structure, and an interdisciplinary approach. These principles are studied in relation to business code adoption theory to provide a framework for understanding methods for a successful implementation of AI principles within the organization. (Kelley, 2022)

Moussawi et al. (2020) conducted a study with focus on personal intelligent agents (PIAs), which are a form of conversational AI. PIAs, such as Siri and Alexa, are unique due to their personalized, intelligent, and human-like behavior. The study draws on research in Information Systems (IS), Artificial Intelligence and the Technology Acceptance Model (TAM) to build and test a model of user adoption of PIAs based on their unique characteristics. Through an interactive lab-based study with new PIA users, the researchers collected data to analyze the significant antecedents of PIA adoption. The results show that both perceived intelligence and anthropomorphism significantly influence PIA adoption. Understanding the adoption and use of PIAs is crucial for both researchers and practitioners as these technologies become increasingly prevalent. (Moussawi et al., 2020)

Marikyan et al. (2022) researched the use of conversational AI in work-related contexts. The study explored the factors that lead to individuals' satisfaction with technology and examined the impact of satisfaction on productivity and job engagement. The theoretical model used in this study drew on the Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), and other research in Information Systems (IS) and Artificial Intelligence (AI). The model was tested using 536 responses from individuals who used digital assistants for work purposes. The results reveal that performance expectancy, perceived enjoyment, intelligence, social presence, and trust were positively related to satisfaction with digital assistants. Furthermore, satisfaction with the digital assistants was found to be correlated with productivity and engagement. (Marikyan et al., 2022)

The Technology Acceptance Model (TAM) (Figure 1) was developed by Davis (1989) and derives from the Theory of Reasoned Action (TRA) proposed by Fishbein and Ajzen (1975). According to TAM, external variables, such as system features, design, implementation process, user training, organizational culture, and individual differences, can affect users' perceptions of a technology's usefulness and ease of use. Perceived usefulness (U) refers to the extent to which users believe that using a technology will enhance their job performance or make their tasks easier, while perceived ease of use (E) represents the degree to which users believe that using a technology is effortless and easy to use. (Davis et al., 1989)

A user's attitude towards using a technology (A), which encompasses their overall positive or negative feelings about using it, is influenced by both perceived usefulness (U) and perceived ease of use (E). A positive attitude towards using a specific technology increases the likelihood of adoption. The user's behavioral intention to use a particular technology (BI) is primarily influenced by their attitude towards using it (A) and the perceived usefulness (U) of the technology. The stronger the behavioral intention, the more likely the user is to actually use the technology. (Davis et al., 1989)

The actual system use, which is the final component, refers to the real-life usage of the technology by the user. It is directly influenced by the user's behavioral intention to use the technology, and when a user has a strong intention to use a technology and follows through with it, the actual system use occurs. (Davis et al., 1989)

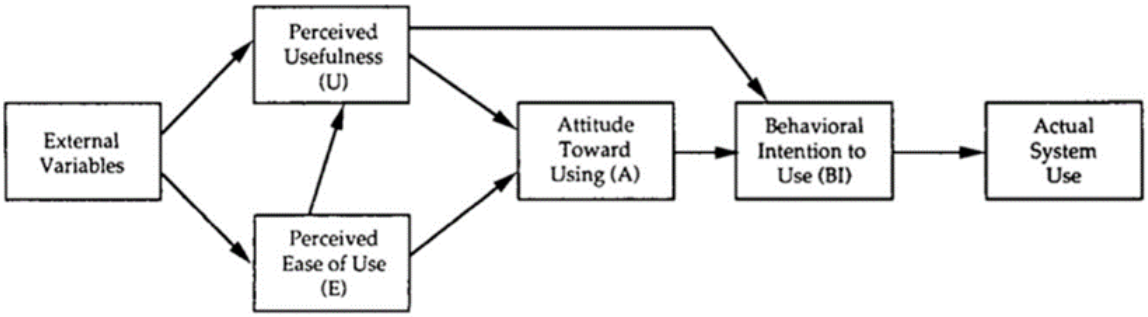

Figure 1 - *Technology Acceptance Model (TAM) (Davis et al., 1989)*

Reference	Concept	Research Objectives	Relevance to this Study
Brachten et al., (2021)	Conversational AI, Human-AI collaboration, Adoption factors	The research objective of this study is to understand how employees accept and adopt Enterprise Bots. The aim is to provide theoretical insights that can help decision-makers introduce such systems effectively in enterprises.	Exploring user acceptance and adoption of AI technology in a professional context.
Dale, R. (2016)	Conversational AI	N/A	The article discusses conversational AI and traditional chatbots. It focuses on the technology's history, today's problems, and future outlook.
Davis, (1989)	Adoption factors, TAM	This study explores how perceived usefulness and perceived ease of use affect people's decisions to adopt or reject technology.	This article discusses the factors explaining user acceptance and adoption of new technology such as perceived usefulness and perceived ease of use.
Davis et al., (1989)	Adoption factors, TAM	The research objective is to understand why people accept or reject computers, and to predict and increase user acceptance of computer systems.	This article discusses how users accept and adopt new technology based on perceived usefulness and perceived ease of use.
Gkinko & Elbanna, (2023a)	Conversational AI, Human-AI collaboration	The study investigates the development and maintenance of employees' trust in conversational AI, including the underlying factors and mechanisms involved.	This article discusses a case study approach to investigate employees trust towards conversational AI in the workplace.
Gkinko & Elbanna, (2023b)	Conversational AI, Human-AI collaboration, Adoption factors	This study explores how employees experience the use of conversational AI in their daily work and aim to create a taxonomy of user types according to their adoption of the technology.	This article discusses the use of conversational AI in the workplace.
Grefen et al., (2003)	Adoption factors, TAM	The research objective is to integrate the perspectives of perceived usefulness and ease-of-use of IT with trust in e-vendor to understand their linkages to behavior in online shopping.	This article discusses how perceived usefulness and perceived ease of use affect online shoppers to adopt consumer facing online platforms.
Haleem et al., (2022)	Conversational AI, Human-AI collaboration, ChatGPT	The research objective of this study is to provide an overview of ChatGPT. The paper also aims to discuss the significant roles of ChatGPT in the current scenario and its potential for adoption in various academic and professional domains.	The article discusses ChatGPT for improving workflow processes.

Kelley, (2022)	Adoption factors	The research objective of this study was to explore and understand employee perceptions regarding the effective adoption of AI principles in their organizations. The study aimed to identify the components that could impact the adoption of AI principle.	This article discusses employee's perception on adoption of AI principles in their workplace.
Marikyan et al., (2022)	Conversational AI, Adoption factors, TAM	This study explores which factors that facilitate the use of conversational AI in the workplace and their correlation with job engagement and productivity.	This article discusses how conversational AI can support employees carrying out work-related tasks and what factors influencing user adoption and acceptance of this type of technology.
Moussawi et al., (2020)	Conversational AI, Adoption factors, TAM	Exploring the factors that impact the adoption of intelligent systems by users.	This article discusses the factors affecting user acceptance and adoption of conversational AI. This article also discusses TAM.
Schlögl, S. et al., (2019)	Adoption factors	The research objectives are 1. Identify state-of-the-art Workplace Conversational Agent (WCA) concepts. and 2. Determine aspects to consider when designing WCAs.	This article discusses how conversational AI can support employees carrying out work-related tasks as well as the employees' attitudes towards these technologies.
Sowa et al, (2021)	Human-AI collaboration	The study aims to explore how humans and AI can collaborate to increase productivity in managerial tasks, and whether enterprise bots can collaborate like cobots rather than replace humans.	This article discusses the productivity aspects of human-AI collaboration. The authors emphasize the importance of AI-support instead of full AI automation.

Table 1 - *Concepts, research objectives and relevance of the reference literature*

Concept	Definition	Reference
Conversational AI	Conversational AI uses natural language processing (NLP), natural understanding processing (NLU), natural language generation (NLG) and machine learning algorithms in order to interpret user input, understand the context and generate an appropriate response.	(Makasi et. al, 2022), (Moussawi et. al, 2020)
Human-AI collaboration	Intelligent systems like conversational AI can increase daily productivity by supporting employees in a variety of work-related tasks. The collaboration helps improve the AI's performance while also leveraging the creativity and nuance of human input.	(Marikyan et. al, 2022) (Haleem et al., 2022)
ChatGPT	Open AI ChatGPT is a chatbot that uses Natural Language Processing (NLP) to generate human-like responses to user input. The conversational AI is trained on a vast dataset of human conversations, making it capable of producing replies to various topics and prompts.	(Aydin and Karaarslan, 2022), (Haleem et al., 2022)
Adoption factors	Adoption factors refer to the factors that influence whether people accept or reject the use of information technology, specifically in the context of AI-based applications in the workplace	(Brachten et al., 2021), (Davis, 1989), (Gkinko and Elbanna, 2023b)

Table 2 - *Definitions of this study's concepts*

3 Method

This study focuses on the adoption of ChatGPT as a support tool for system developers using a case study approach. This study utilizes both qualitative and quantitative data collection methods and applies the philosophical paradigms of positivism and interpretivism to gain different perspectives on the research problem (see section 3.1). The literature review is discussed (see section 3.2). This study utilized mixed sampling techniques, including cluster and purposive sampling, to select system developers for both a questionnaire and interviews (see section 3.3 and 3.4). Quantitative and qualitative analysis was employed to interpret the data collected (see section 3.5). The application of the theoretical framework is discussed, and a set of hypotheses are proposed (see section 3.6). We also highlight the importance of validity, reliability, and objectivity in research and provide suggestions for ensuring these aspects in their study (see section 3.7). Furthermore, ethical considerations and the principles of the Swedish Research Council for conducting ethical research are discussed, with an emphasis on obtaining informed consent and safeguarding the confidentiality of personal data (see section 3.8).

3.1 Research design

The research design chosen for this study is a case study approach as indicated in Figure 2. Case study is a research strategy used when the study is focused on a single instance or case of a phenomenon. The phenomenon can be an organization, system, or a decision. Case studies aim to examine the case within its real-life context. (Oates, 2006)

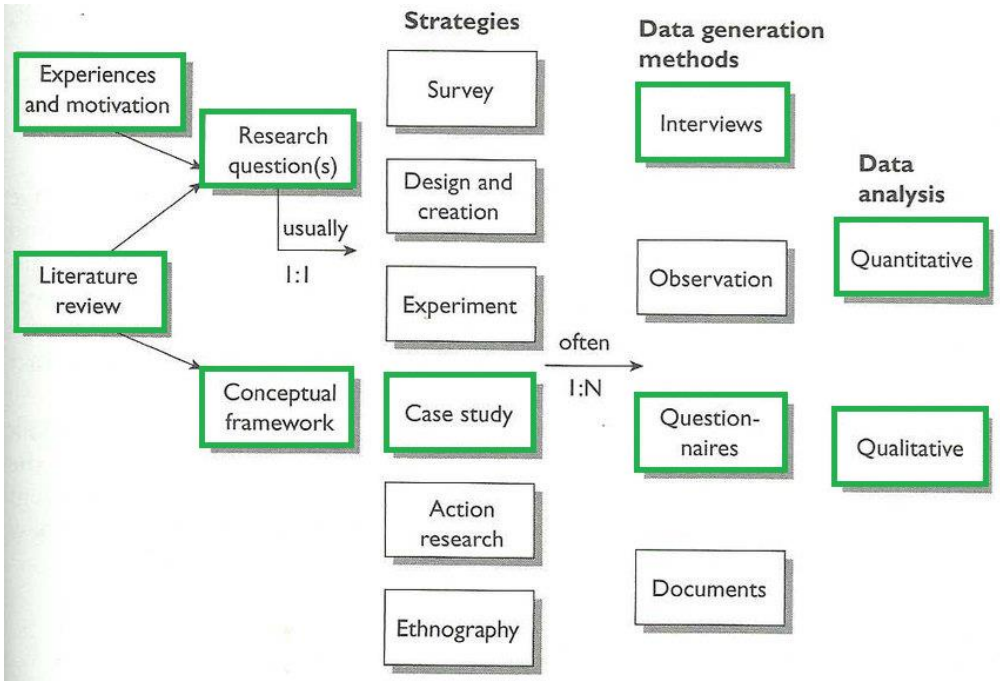

Figure 2 - *Model of the research process adapted from (Oates, 2006), with our research process indicated*

To collect empirical data for this study we used a mixed method approach that included both qualitive and quantitative data collection. The qualitative data was collected through interviews with system developers and the quantitative data was collected through a questionnaire that was answered by system developers as well. The philosophical paradigms used for this study are positivism and interpretivism, which helped us get a supporting perspective on the research problem. Positivism as a philosophical paradigm assumes that the world exists independently of humans and therefore can be studied through observations by researchers (Oates, 2006). Positivism in research is often used when analyzing quantitative data (Oates, 2006). Positivism has its limitations in research when you are studying the social world, since social phenomenon is unique (Oates, 2006). Therefore, other paradigms, for example interpretivism can be used to understand a phenomenon from the social world (Oates, 2006). Studies using interpretivism aim to get a rich understanding of a unique context trough qualitive data analysis (Oates, 2006).

This research used a deduction approach, where we started with the theoretical framework and then used it when designing the questionnaire and interview questions. The deductive approach is characterized by a top-down logic, where you start with the theory and from that make predictions about the empirical data with hypotheses, and then tries to confirm it through gathering of empirical data (Oates, 2006).

3.2 Literature review

A literature review serves two main purposes. Firstly, it helps research students find an appropriate research idea and discover relevant materials related to their chosen topic. This involves exploring academic journals that regularly publish articles in the subject area, identifying frequently cited authors, and reviewing survey articles that summarize previous research and identify gaps for further investigation. This initial exploration helps students gain a better understanding of the field and define their research problem. (Oates, 2006)

Once a topic is chosen, the second part of the literature begins. It continues throughout the research process, including writing the thesis and preparing for presentation. The goal is to gather and present evidence that supports the claim of contributing new knowledge. Furthermore, researchers gather evidence to demonstrate the significance of their chosen topic, avoid duplicating previous work without reason, and showcase their original contributions that were previously unknown. (Oates, 2006)

In this study we mainly utilized the database Summon to find literature relevant to our topics. We also utilized Google Scholar to search for relevant literature. Search phrases were formed based on the words and concepts: AI, Conversational AI, Chatbot, ChatGPT, Enterprise, Organization, TAM, System developer, Tool, and Workplace. A

table summarizing this study's literature review can be found in Appendix 1.

3.3 Sampling and participants

In the context of sampling, a choice must be made as to whether the sampling approach should be probabilistic or non-probabilistic. Probability sampling implies that the sample is chosen based on the researcher's belief that there is a high likelihood that the selected respondents accurately represent the entire population being examined. In other words, they constitute a representative subset of the overall population. (Oates, 2006). According to Oates (2006), non-probability sampling indicates that the researcher is uncertain whether the chosen sample is representative, as each member might possess distinct qualities not found in others within the overall population.

The selection for this study was carried out using mixed sampling techniques, as the research involved both a questionnaire and interviews. As the study did not aim to explore the general public's perception of ChatGPT, the surveys and interviews were targeted specifically at system developers.

The questionnaire was distributed to system developers in all business partner offices located in the northern region of Sweden, an approach that can be considered a form of cluster sampling. Cluster sampling can be used to reduce the number of respondents based on factors such as geographical location, with the hope that the selected sample includes various types of individuals that naturally occur in larger populations (Oates, 2006). As the selection was also defined by a specific job role, the technique of purposive sampling can be discussed as well. Purposive sampling involves selecting samples based on unique characteristics specific to a particular group (Oates, 2006).

The selection for the interviews was also conducted using purposive sampling to intentionally select system developers with multiple years of experience in their profession in order to get valuable insights from a system developer point of view.

The consequences of the sampling choices made in this study include the possibility of overlooking important insights from areas outside the selected geographical region. By concentrating on a particular region, the study might unintentionally leave out useful viewpoints or experiences from people in other areas, which could potentially limit the generalizability and comprehensiveness of the findings (Oates, 2006).

3.4 Data collection

This section provides details on the two data collection methods employed in this study: questionnaires and interviews. Questionnaires were used to gather large amounts of data from a diverse sample of participants in a relatively short period of time. This method is particularly beneficial when obtaining numerical data or information about

people's attitudes, opinions, and behaviors. In contrast, interviews enabled us to gain deeper insight into participants' experiences, perspectives, and emotions, and to explore complex issues that may not be adequately captured through quantitative measures alone. This method was particularly useful when we sought to understand the underlying meaning behind people's responses or to generate new insights and hypotheses.

3.4.1 Questionnaire

To collect quantitative data, we have designed a questionnaire for system developers to answer (see Appendix 2). Questionnaires are defined by pre-defined questions in a pre-defined order for the respondents to answer (Oates, 2006). Questionnaires are best suited when the researchers aim to obtain data for analysis from a large number of people (Oates, 2006). According to Oates (2006), you can divide questions into open questions and closed questions, where open questions leave the respondent to decide what to answer, and closed questions force the respondent to answer from a range of pre-defined options.

We used partially closed-ended questions, closed-ended questions, and open-ended questions. Partially closed-ended questions, where the question begins as an open-ended question and the respondent can provide their own answer, but we also include examples the respondent to choose from. This design choice was to clarify what types of answers we were looking for and to ensure consistency in the responses. Our close ended questions were designed so the respondent could answer on a rating scale, ranging from 0-10. Based on the questionnaire, a set of hypotheses are formulated (see section 3.6).

Our questionnaire was designed with six categories, demographical questions, general knowledge about ChatGPT, perceived usefulness, factors influencing adoption, use cases and preferences, and future outlook. These categories were constructed to provide a logical order for the questions. According to Oates (2006), when designing your questionnaire, it is important to arrange the questions in a logical order that will make sense to the respondents. Avoid jumping from one topic to another. Begin with easier and less sensitive questions, and gradually move towards more complex or sensitive ones as the questionnaire progresses. This approach ensures a smoother flow and increases the likelihood of obtaining accurate responses Oates (2006).

In our questionnaire there were six questions that directly related to answering the research question “What are the underlying factors that influence a system developer’s decision to adopt ChatGPT as a support tool in their daily work?”. These questions were adapted from questionnaire questions discovered in our literature review and are specified below.

Our question: “To what extent do you agree with the following statement: ChatGPT can help system developers save time by providing quick answers to common questions?". This question is based on

Moussawi et al. (2020), “PU1 – If I were to start using Siri, it would enable me to accomplish my tasks more quickly.”

Our question: “How likely do you think ChatGPT can contribute to improving the efficiency of system developers? ". This question is based on Moussawi et al. (2020), “PU3 - If I were to start using Siri, it would enhance my overall effectiveness.”

Our question: “How likely do you think ChatGPT can contribute to improving the productivity of system developers?". This question is based on Marikyan et al. (2022), Measurement Item – “Increases my productivity.”

Our question: “How do you perceive the accuracy of ChatGPT’s responses? ". This question is based on Moussawi et al. (2020), “Plnt5 – Siri is able to provide me with a useful answer.”

Our question: “Do you perceive ChatGPT as user friendly?". This question is based on Moussawi et al. (2020), “PEOU2 –Overall, I believe that Siri is easy to use.”

Our question: “How likely are you to use ChatGPT as a support tool in your work within the next 12 months?". This question is based on Moussawi et al. (2020), “Int1 – I intend to start using Siri within the next month.”

Our questionnaire also contained a handful of questions that generated qualitative data. These questions aimed to identify common themes, patterns, or areas of interest, which can then be explored in more depth during the interviews.

The questionnaire was made in Microsoft Forms. The questionnaire was sent out in a weekly news mail going out to all the CGI offices within the northern region of Sweden. To ensure answers from system developers, a text about the questionnaire was included where we stated that the questionnaire was intended for system developers only. The questions for the questionnaire can be found in Appendix 2.

3.4.2 Interviews

To collect qualitative data, we conducted interviews (see Appendix 3). As defined by Oates (2006), interviews are planned conversations between typically two people, in which one person seeks to gain knowledge from the other. These conversations do not occur by chance; they are planned by the researcher (Oates, 2006). There are three types of interviews: structured, semi-structured, and unstructured (Oates, 2006). In this study, we conducted semi-structured interviews. semi-structured interviews contain themes and questions, but the order of the questions may change based on the conversation flow (Oates, 2006). Additionally, the researcher has the option to introduce new questions during the interview if new topics arise.

The interviews were conducted with system developers employed at CGI. Our respondents had different levels of experience within the field of system development. The interview questions were designed to get a deeper understanding on how ChatGPT could act as a support tool for system developers and to answer the research questions "How can ChatGPT support system developers in their daily work?" and "What are the potential challenges associated with the adoption and utilization of ChatGPT among system developers?". The interview first included some demographic questions, where we asked the respondent for gender, age, job title and experience within the field of system development. The demographic questions were asked to control that they worked in the field of system development. We then asked the respondent questions regarding ChatGPT, where we presented open ended questions about their experience and thoughts about ChatGPT. There are some overlapping questions in the questionnaire and the interviews. As described in section 3.4.1, some questionnaire questions aimed to find themes, patterns, or areas of interest in which the interviews could delve deeper into.

The interview questions can be found in Appendix 2. These interviews helped us get a better understanding of how ChatGPT could act as a support tool for system developers and shed light on the challenges related to the adoption and utilization of ChatGPT.

The interviews were held on CGI's premises and online. In order to be able to transcribe the interviews they were recorded with the permission of the respondents.

3.4.3 Respondents

Respondent 1
Respondent 1 works as system developer, with 12 years of experience of programming

Respondent 2
Respondent 2 works as a system developer with focus on integration projects, with 15 years of experience of programming.

Respondent 3
Respondent 3 works as a senior system developer, with 15 years of experience of programming.

Respondent 4
Respondent 4 works as a senior lead developer, with 15 years of experience of programming.

3.5 Data analysis

The data collection methods used in this study generated both quantitative and qualitative data, therefore multiple analysis methods were conducted in order to interpret the results. The research question "What are the underlying factors that influence a system developer's decision to adopt ChatGPT as a support tool in their daily work?" will

be answered by testing the hypotheses formulated in section 3.6.1 and 3.6.2 using a quantitative analysis based on the Spearman rank correlation test (see section 3.5.1). The research questions, "How can ChatGPT support system developers in their daily work?" and “What are the potential challenges associated with the adoption and utilization of ChatGPT among system developers” was addressed through a thematic analysis of the qualitative data gathered in this study. The thematic analysis involved identifying recurring patterns and themes in the qualitative data (see section 3.5.2).

3.5.1 Quantitative analysis

Numeric information or evidence obtained mostly through experiments and surveys is referred to as quantitative data. While positivist researchers primarily utilize and analyze this type of data, interpretive and critical researchers also generate quantitative data on occasion. (Oates, 2006)

Demographic information, such as age, gender, job role, and years of experience, can be obtained through a questionnaire and is an example of nominal or categorical data. This type of data can be analyzed for frequency and used to categorize other types of quantitative data. Furthermore, a Likert scale is commonly used in questionnaires to obtain ordinal or ranked data, which represents how data points are ranked concerning each other, but the scale cannot indicate the extent to which they differ from each other. (Oates, 2006)

The quantitative analysis in this study focused on answering the research question “What are the underlying factors that influence a system developer’s intention to adopt ChatGPT as a support tool in their daily work?”. To answer the research question, the hypotheses formulated in section 3.6.1 and 3.6.2 were tested by examining the correlation between answers regarding adoption factors and respondents’ intention to use ChatGPT. To check for correlation between the different variables this study utilized the Spearman’s rank correlation coefficient (Figure 3).

According to Shrober et al. (2018), correlation quantifies the level of a monotonic relationship between two variables, a monotonic relationship is where an increase in one variable results in a corresponding increase or decrease in the other variable. Relationships between two variables can be measured through multiple statistical tests, one of which is simple linear regression. Simple linear regression uses two variables, (x) and (y), where (x) is independent and (y) is dependent on (x) (Kutner et al. 2005).

While a regression line cannot provide information on the strength of the relationship between variables, a correlation can describe the level of this association. The decision to use either a correlation or linear regression depends on the research objective, with correlation used to evaluate the strength of the relationship and linear regression employed to estimate y values from x values. A Pearson correlation anal-

ysis is typically utilized when both variables are assumed to be normally distributed and can be measured to evaluate the strength and direction of their relationship. (Shrober et al, 2018)

According to Kutner et al. (2005), the Spearman correlation coefficient (Figure 3) is like the Pearson correlation coefficient but instead of using the actual values of the variables (x) and (y), the ranks of the values are utilized to calculate the correlation. This coefficient measures the strength of strictly monotonic relationships between two variables by using ranks (Shrober et al., 2018). The ranking of the data transforms a nonlinear strictly monotonic relationship into a linear one, allowing the coefficient to quantify the relationship's strength. The Spearman coefficient is relatively resistant to outliers, making it a robust measure of association between variables (Shrober et al., 2018).

$$\rho = 1 - \frac{6\Sigma\, \mathrm{d}_i^2}{n(n^2 - 1)}$$

Figure 3 - *Spearman's rank correlation formula (Gupta, 2023)*

The Spearman coefficient ranges from -1 to +1 and can describe a perfect monotonic relationship (ρ = -1 or +1) but also a relationship with no association (ρ = 0). An important note is that correlation should not be interpreted as causation, i.e., even if there is a significant correlation between two variables, it does not mean that one variable causes the other or vice versa. (Shrober et al., 2018)

In this study, we used the Spearman's rank correlation to examine the correlation between two sets of ranked variables obtained from our questionnaire responses, which comprised Likert scale items ranging from 0 to 10. Before conducting the Spearman's rank correlation test, we performed data cleaning procedures to ensure accuracy and consistency. The cleaned data was then exported to a CSV file, which was subsequently read into a “Pandas DataFrame” for further analysis. To conduct the Spearman’s rank correlation test we utilized the statistical function “spearmanr” from the “SciPy” library in Python (see Appendix 4). This statistical measure was suitable for analyzing ordinal data and helped us understand the strength of the relationship between variables. Moreover, Spearman's rank correlation coefficient is a reliable method that is less affected by outliers and can be used with small sample sizes. By utilizing this method, we were able to determine if there was a significant correlation between variables and gained insights into the strength of the relationship between them (see section 4.2.1 for results).

3.5.2 Qualitative analysis

Qualitative data covers non-numerical information like words, images, and sounds, which can be found in sources such as interviews, documentation, and websites for example. This type of data is frequently used in case studies, action research and ethnography. The philosophical paradigm connected to studies using qualitive data is interpretivism. To analyze qualitive data different techniques can be used, such as counting the frequency of words or allocation pages to various topics. The most common way to analyze qualitive data involves identifying themes and patterns that are seen as relevant to the research topic. (Oates, 2006)

Qualitive data analysis can be difficult, as it lacks strict instructions and relies on the ability of the researcher to identify themes and patterns in the data. That's one of the main reasons why critics argue that researchers using qualitive data doesn't provide enough information about the analysis process. (Oates, 2006)

The qualitative data used in this study was gathered through the interviews and partly by the questionnaire. The qualitative data was used to answer the research questions "How can ChatGPT support system developers in their daily work?" and "What are the potential challenges associated with the adoption and utilization of ChatGPT among system developers". The interviews were transcribed for thematic analysis. There are two ways to perform thematic analysis for this kind of data, deductive approach, or inductive approach (Oates, 2006). The deductive approach is when you use existing theories and emanate thematic analysis from those theories (Oates, 2006). Inductive approach is when you perform the thematic analysis with an open mind and let the text speak for itself, this way can be seen as biases since you cannot erase personal experience which will affect how you interpret the data (Oates, 2006). In this study, a deductive approach was employed to analyze themes from the qualitative data. Through thematic analysis, challenges related to the adoption and utilization of ChatGPT among system developers were identified. Recurring patterns and themes were discovered, revealing how ChatGPT can support system developers in their daily work.

3.6 Application of the theoretical framework

TAM as a model has been widely used in previous research on technology adoption and has a strong theoretical foundation. The model is based on the belief that users' perceptions of the usefulness and ease of use of a technology are the primary determinants of their intention to adopt it (Davis, 1989). The TAM model has been tested and validated in multiple contexts and industries, including various business to consumer (B2C) applications, gamified e-business applications and applications related to entertainment and pleasure (Grefen et al., 2003; Rodrigues et al., 2016; Van der Heijden, 2004). This indicates its broad applicability and usefulness in understanding technology adoption.

The Technology Acceptance Model (TAM) is still relevant and useful in understanding user adoption of today's technologies. Two recent studies by Moussawi et al. (2020) and Marikyan et al. (2022) both drew on TAM in their research on the adoption and satisfaction with conversational AI and digital assistants. TAM's focus on perceived usefulness and ease of use is still applicable to these technologies, as users still need to perceive them as useful and easy to use in order to adopt and continue using them. Drawing on the principles of the TAM model, we have been able to establish clear and testable hypotheses that provide guidance for our research. This approach has facilitated the design of our study and will allow for effective analysis of our data (see section 3.5.1). Furthermore, the incorporation of TAM concepts as part of our theoretical framework adds credibility to our research and enhances the validity of our findings.

In our research model, we build upon existing literature and models to examine the factors influencing the adoption of ChatGPT. Specifically, this study investigates the strength of the relationships between hypotheses related to the TAM variables perceived usefulness (U) and perceived ease of use (E) - and system developers' attitudes towards using ChatGPT in their daily work (A) (see Figure 1).

To answer the research question “What are the underlying factors that influence a system developer’s decision to adopt ChatGPT as a support tool in their daily work” a set of hypotheses is proposed (see section 3.6.1 and 3.6.2). These hypotheses were tested by checking for correlation between two sets of ranked variables derived from the questionnaire responses (see section 3.5.1).

3.6.1 Hypotheses - Perceived usefulness

The TAM variable perceived usefulness refers to “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989, p. 320).

Recent research suggests that a user who perceives a specific technology as useful is more likely to adopt that technology (Moussawi et al., 2020). According to Marikyan et al. (2022), users in a work-related context are more satisfied with a technology if they find it useful, which also affects their intention to use the technology to a greater extent.

This leads to our hypotheses,

H1: System developers who perceive that ChatGPT can help them save time by providing answers to common questions are more likely to use ChatGPT as a support tool in their work.

This hypothesis is formulated based on the questionnaire question “To what extent do you agree with the following statement: ChatGPT can help system developers save time by providing quick answers to common questions” and tested against the questionnaire question

"How likely are you to use ChatGPT as a support tool in your work within the next 12 months?".

H2: System developers who perceive that ChatGPT can enhance the efficiency of their work tasks are more inclined to utilize ChatGPT as a supportive tool in their work.

This hypothesis is formulated based on the questionnaire question "How likely do you think ChatGPT can contribute to improving the efficiency of system developers?" and tested against the questionnaire question "How likely are you to use ChatGPT as a support tool in your work within the next 12 months?".

H3: System developers who perceive that ChatGPT can enhance their productivity are more likely to use ChatGPT as a support tool in their work.

This hypothesis is formulated based on the questionnaire question "How likely do you think ChatGPT can contribute to improving the productivity of system developers?" and tested against the questionnaire question "How likely are you to use ChatGPT as a support tool in your work within the next 12 months?".

H4: System developers who perceive that ChatGPT can provide accurate responses to their work-related inquiries are more likely to use ChatGPT as a support tool in their work.

This hypothesis is formulated based on the questionnaire question "How do you perceive the accuracy of ChatGPT's responses?" and tested against the questionnaire question "How likely are you to use ChatGPT as a support tool in your work within the next 12 months?".

3.6.2 Hypothesis - Perceived ease of use

The TAM variable perceived ease of use refers to the extent to which a user anticipates that utilizing the system will require little to no effort (Davis, 1989).

Ease of use as a variable has shown mixed results in previous research, with some studies confirming its significance in technology adoption, while others have rejected its importance in influencing users' behavior.

The positive correlation between perceived ease of use and the intention to adopt or use a technology has been demonstrated in various studies, including those investigating the intention to adopt consumer-facing online platforms (Gefen et al., 2003), systems designed for pleasure and enjoyment (Van der Heijden, 2004), and gamified e-business applications (Rodrigues et al., 2016).

In the study conducted by Moussawi et al. (2020), the variable ease of use does not correlate with the intention to adopt the use of personal

intelligent assistants. Instead, perceived usefulness was a driving factor for the users' intention to adopt this technology. On the other hand, ease of use may be an influencing factor when it comes to more complex systems. (Moussawi et al., 2020)

This leads to our hypothesis,

H5: System developers who perceive that ChatGPT is user-friendly are more likely to use ChatGPT as a support tool in their work.

This hypothesis is formulated based on the questionnaire question "Do you perceive ChatGPT as user friendly?" and tested against the questionnaire question "How likely are you to use ChatGPT as a support tool in your work within the next 12 months?".

3.7 Validity, reliability, and objectivity

The trustworthiness of a study can be measured through validity, reliability, and objectivity. Experts in the field have consistently emphasized the significance of considering these aspects in all scientific contexts. (Björklund and Paulsson, 2012)

3.7.1 Validity

Validity refers to the extent to which one measures what's intended to be measured (Björklund and Paulsson, 2012). According to Oates (2006), validity can be divided into internal validity and external validity. Internal validity is concerned with whether the study was well-designed to collect accurate data and examine the appropriate factors, leading to a reliable causal relationship. External validity refers to the generalizability of research findings to other settings, people, or times. It depends on how representative the research samples are, such as subjects in experiments or respondents in surveys. In positivist research, high generalizability is sought to identify general patterns or laws rather than unique findings specific to a particular case. (Oates, 2006)

Using multiple perspectives, such as triangulation, can according to Björklund and Paulsson (2012) enhance the validity of a study. One effective method to increase validity is to use both questionnaires and interviews, by clearly defining the target audience and asking precise and easy-to-understand questions (Björklund and Paulsson, 2012).

3.7.2 Reliability

Reliability refers to measurement consistency and assesses how consistently the same results can be obtained if the research is conducted again (Björklund and Paulsson, 2012). This includes ensuring that the research instruments, such as questionnaires and interviews, are neutral and unambiguous, and that the researchers themselves are consistent in their approach (Oates, 2006). Data analysis techniques need to be used accurately and consistently, particularly for qualitative data. Overall, it is important to ensure that all researchers understand the categories being used and analyze data in a consistent manner to ensure reliability. (Oates, 2006)

To ensure the reliability of research instruments, such as questionnaires, interviews, and data analysis techniques, researchers must strive to minimize potential errors or inconsistencies (Oates, 2006). One approach to increasing reliability is to use control questions in questionnaires and interviews. Control questions are a set of questions that are included in the survey to ensure that the respondent is paying attention and providing accurate answers (Björklund and Paulsson, 2012). By comparing the responses to the control questions and the actual questions, researchers can identify discrepancies and eliminate inaccurate responses, thus increasing the reliability of the collected data (Oates, 2006).

Another approach to increasing the reliability of the study is triangulation. By using different sources and methods, researchers can compare the findings, and identify any discrepancies or inconsistencies. Triangulation can enhance the validity and reliability of the study by increasing confidence in the findings and reducing the potential for errors or biases. (Oates, 2006)

3.7.3 Objectivity

Objectivity in research refers to the degree of researcher bias and whether the study results are influenced or distorted by their own values. It also involves whether the researchers have a particular interest in the study's outcome. If researchers are sponsored by an organization that could benefit from the study's findings, the issue of vested interests may be raised. (Oates, 2006)

Objectivity can according to Björklund and Paulsson (2012) be increased in a study by clearly explaining and justifying the choices made, allowing readers to form their own opinions on the results. Björklund and Paulsson (2012) also state that issues with objectivity can arise when summarizing, paraphrasing, or quoting sources. To maintain objectivity, it is crucial to present the source's content as objectively as possible, avoiding selective use of information (Björklund and Paulsson, 2012).

Objectivity is important for both positivist and interpretivist researchers, although their definitions of objectivity may differ (Oates, 2006). While positivists believe in the possibility of conducting completely objective studies, interpretivists emphasize the importance of honesty, ethics, and morality in achieving objectivity (Björklund and Paulsson, 2012).

3.8 Ethical considerations

The Swedish Research Council (2002) has established ethical principles for conducting research to create norms between researchers and study participants. These principles should serve as guidelines for researchers when planning their research. These requirements include the information requirement, which means that the researcher should inform about the project's purpose. Next is the consent requirement, where participants in the research should be able to decide if they

want to take part in the research. The confidentiality requirement involves treating information about all individuals involved in a study with confidentiality and storing personal data in such a way that unauthorized individuals cannot access it. Lastly, the utilization requirement states that data collected about individuals should only be used for research purposes. (Swedish Research Council, 2002)

4 Results

In this chapter our result is presented from both the interview and the questionnaire. In section 4.1 some general information regarding knowledge about ChatGPT among our respondents are presented. Section 4.2 provides the result from the questionnaire related to adoption factors. Under section 4.2.1 we present the result from the hypothesis testing to answer the research question "What are the underlying factors that influence a system developer's decision to adopt ChatGPT as a support tool in their daily work?". The results of the hypotheses testing are summarized in Table 3. In Section 4.3 we present the result from the interview and questionnaire regarding ChatGPT as a support tool for system developers, to answer the research questions "How can ChatGPT support system developers in their daily work?" and "What are the potential challenges associated with the adoption and utilization of ChatGPT among system developers?".

4.1 Respondents' general knowledge about ChatGPT

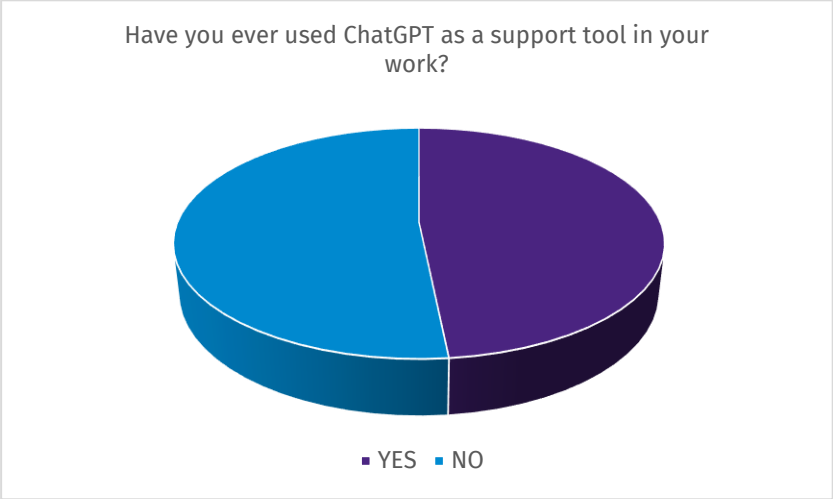

Figure 4 - *Have you ever used ChatGPT as a support tool in your work?*

As Figure 4 shows, 49% of the respondents' from the questionnaire had used ChatGPT as a support tool in their work. The result from the interview where similir to the result from the questionnaire, where respondent 1 and 4 had used it in work related tasks, and respondent 2 and 3 had not.

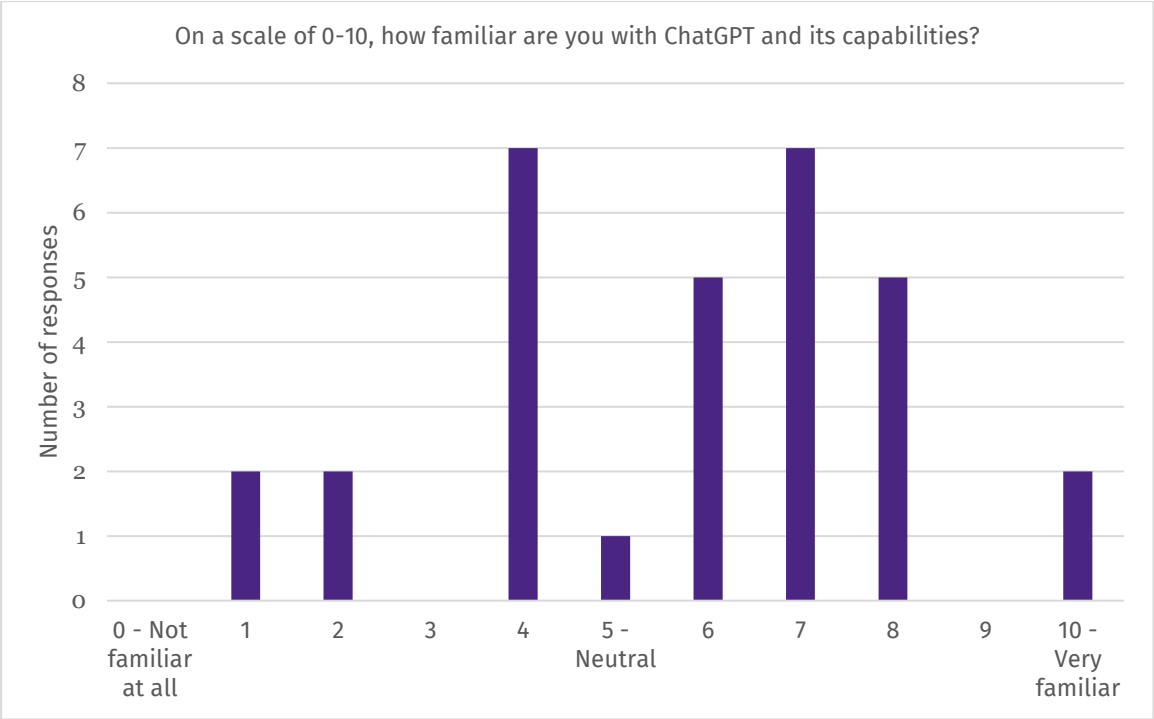

Figure 5 - *On a scale of 0-10, how familiar are you with ChatGPT and its capabilities?*

As Figure 5 shows, 61% of the respondents' from the questionnaire answered 6 or above on how familiar they are with ChatGPT and its capabiltites.

The same question was asked during the interviews, where the respondents' had to choose between 0-10 on a likert scale. Where Respondent 1 did choose 4. The respondent felt comforatble that he had the knowledge about the concept of ChatGPTs capabilities, but was unsure about the areas of use and how to use it effective. Respondent 2 did also choose 4 on how familiar he was with ChatGPTs capabiltites, but was very corious and aimed to increase his knowledge in the near future. Respondent 3 didn't have any own experience from using ChatGPT, but the Respondent did spend a lot of time reading about it, and estimates his his knowledge of ChatGPT as a 7. Respondent 4 thinks their knowledge is limited if he compares it with what he have heared ChatGPT can do, and estimated to 4.

4.2 Adoption factors

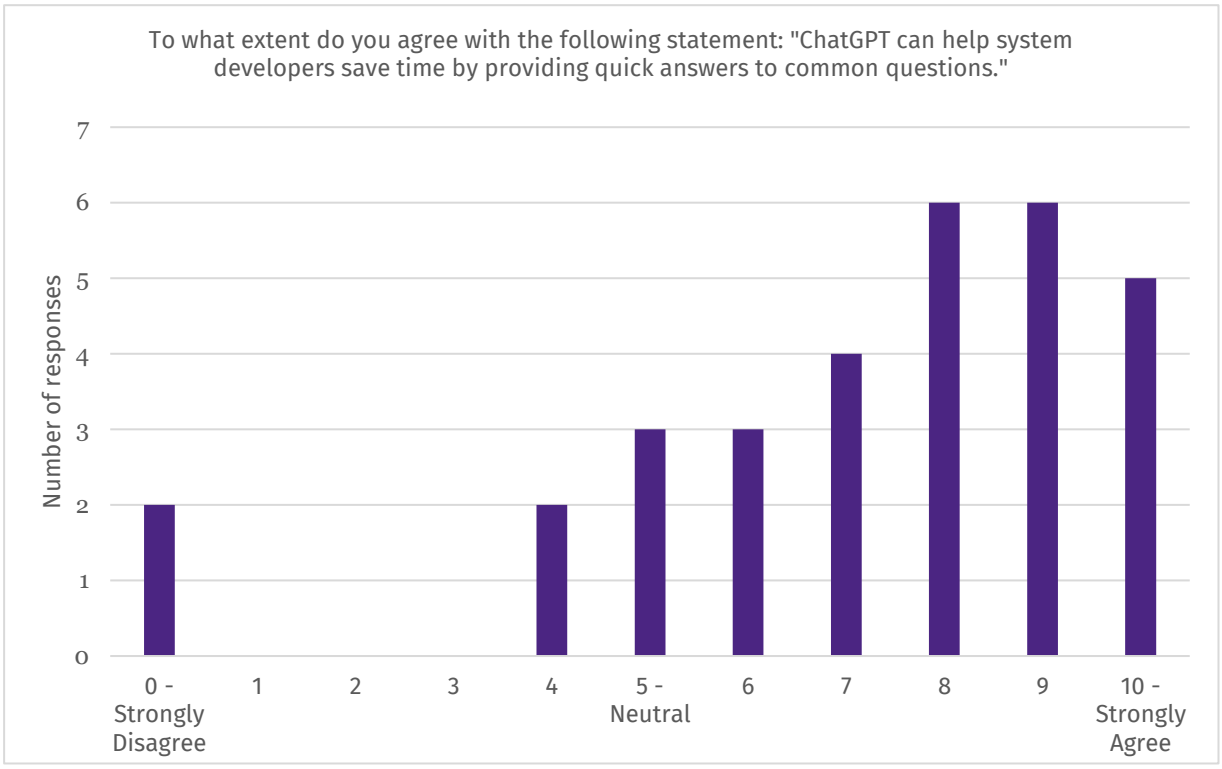

Figure 6 - *To what extent do you agree with the following statement: "ChatGPT can help system developers save time by providing quick answers to common questions."*

Most of the respondents of the questionnaire agreed to some degree with the statement, "ChatGPT can help system developers save time by providing quick answers to common questions". The Figure 6 showcases this prevailing opinion, with a large percentage between agreeing and strongly agreeing with the statement.

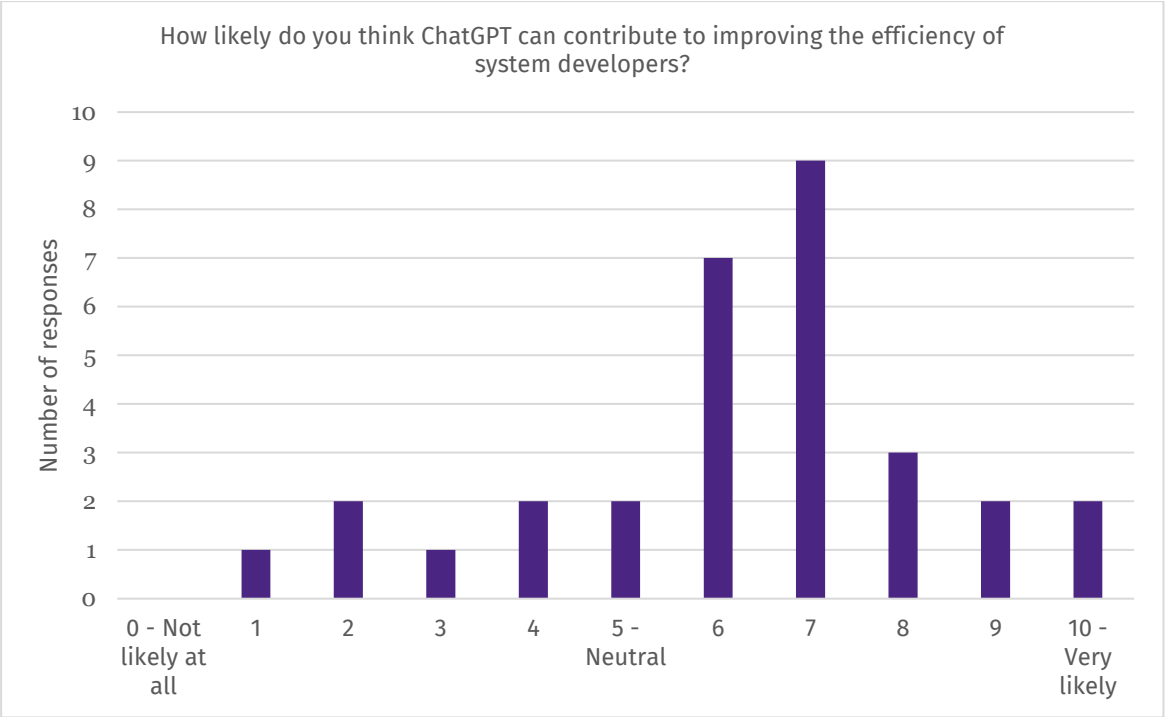

Figure 7 - *How likely do you think ChatGPT can contribute to improving the efficiency of system developers?*

Figure 7 shows that the majority of the respondents are slightly positive that ChatGPT can contribute to improving the efficiency of system developers. 74% of the respondents answered 6 or above.

Respondent 3 and 4 from the interviews viewed it as very likely for ChatGPT to improve the efficiency of system developers. Respondent 4 compared it to when "stackoverflow", a forum where programmers can discuss their solutions with other programmers, was introduced. Respondent 4 was sure that the use of "stackoverflow" had improved the efficiency of system developers, and he thought that ChatGPT would have similar impact. Respondent 2 saw it as very likely that some type of conversational AI will improve the efficiency for system developers but wasn't sure if ChatGPT would be that tool. Respondent 1 thought that in the future ChatGPT might improve the efficiency of system developers, but it will be some time before system developers have learned how to use it correctly. Respondent 1 believed that copying and pasting code from ChatGPT, which the system developer doesn't fully understand, could create problems.

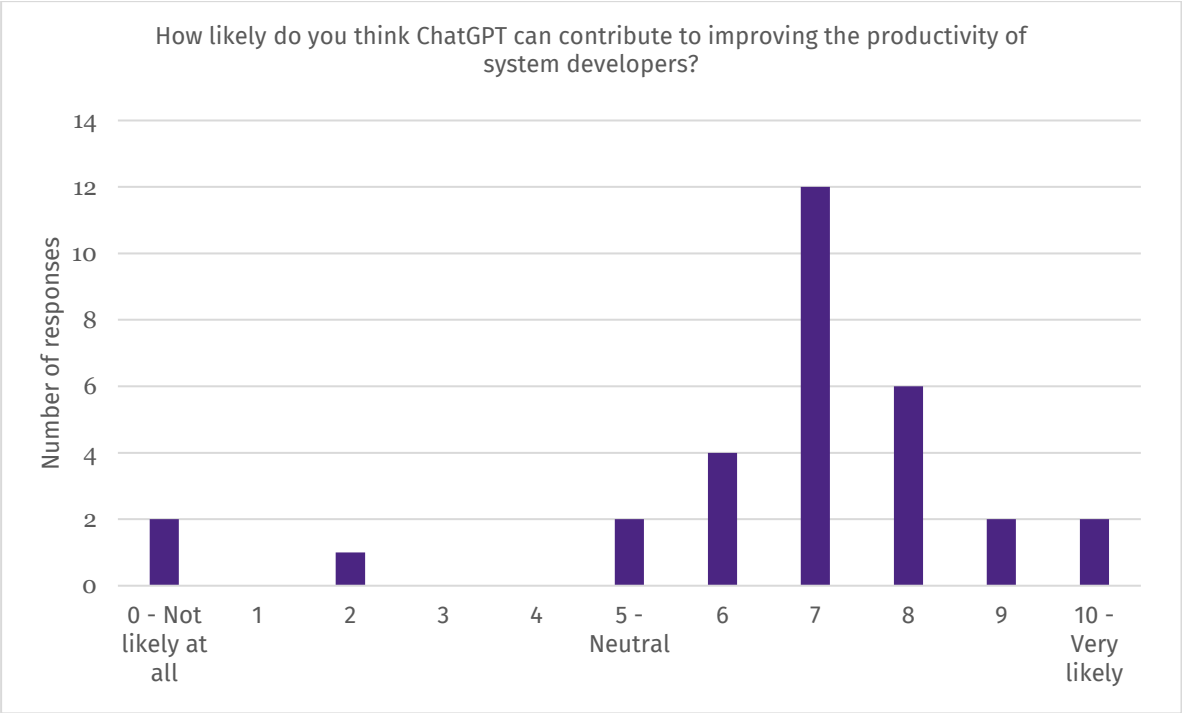

Figure 8 - *How likely do you think ChatGPT can contribute to improving the productivity of system developers?*

As Figure 8 shows, the majority of the respondents in the questionnaire were slightly positive that ChatGPT can improve productivity for system developers. 83% of the respondents answered 6 or above.

The respondents from the interview's answers were in line with their answers regarding efficiency, where they all answered the same for both questions.

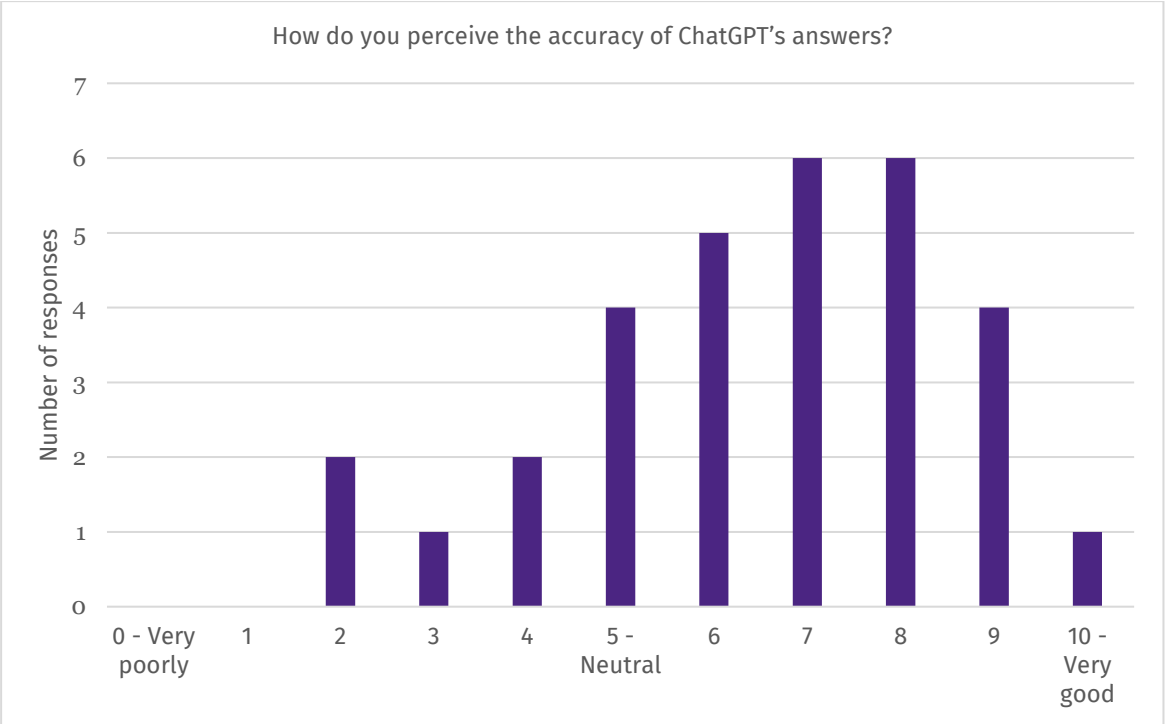

Figure 9 - *How do you perceive the accuracy of ChatGPT's responses?*

Figure 9 shows how the respondents from the questionnaire rated how they perceive the accuracy of ChatGPT's answers. It indicates that the majority of the respondents rated it between neutral and very good, with 83% of the respondents in that range. The respondents from the interviews were slightly negative in the ability of ChatGPT to create accurate code, but also said that in some subjects it can be very accurate. Respondent 4 said "If you give it good specific questions as input, it will provide you with good answers as output, but it's very hard to be specific in the question". Both respondent 2 and 3 didn't have much experience using ChatGPT to support their system development, but from what they have heard it wasn't too accurate when it comes to code. Respondent 1 perceived that ChatGPT sometimes guessed the answers, and displayed it as facts, which made the respondent question the accuracy.

The respondents from the interview were asked if ChatGPTs accuracy affect their decision to use it as a support tool. Respondent 1 says that the accuracy of ChatGPT's answers is dependent on what it is used for. The respondent said that if you want to learn something, it is important to be aware that not everything ChatGPT says is true and to examine the output closely and be doubtful. Respondent 2 says that accuracy is not so important as long as the user is aware of the limitations and takes the results with a "pinch of salt". Respondent 3 says that accuracy is not important because the respondent viewed ChatGPT more as a source of inspiration and ideas, not as an exact solution. Respondent 4 says that accuracy is extremely important, because the respondent wants to understand all code the respondent uses and not just take in unknown code.

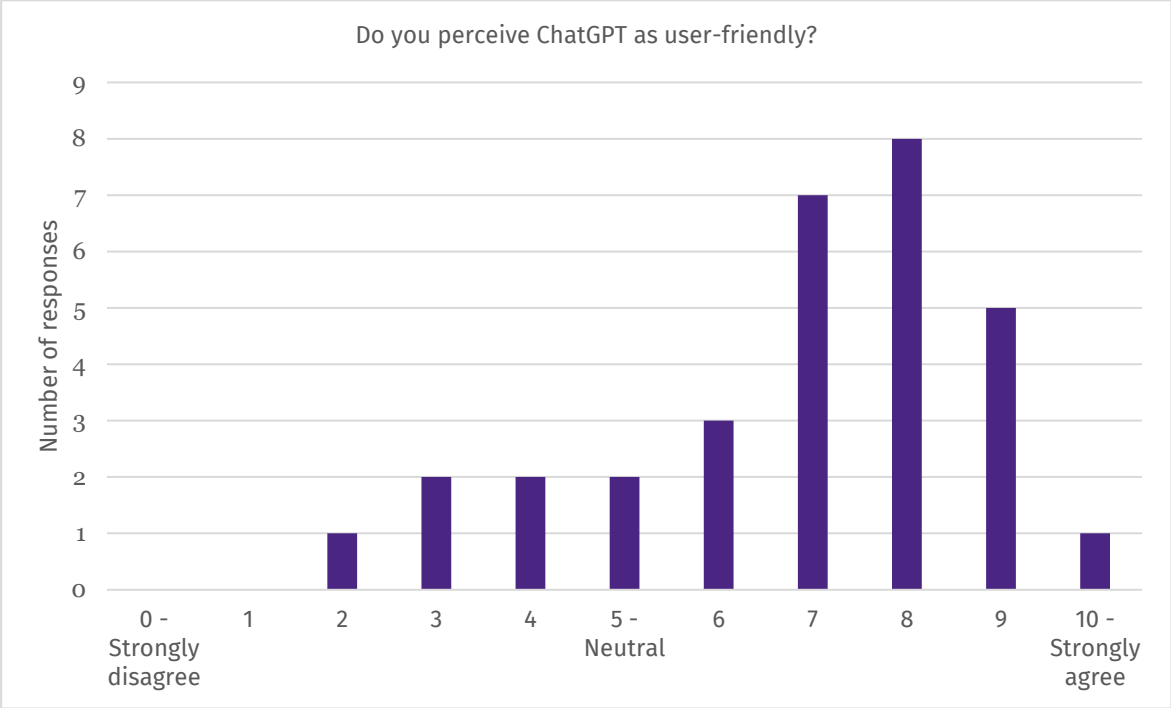

Figure 10 - *Do you perceive ChatGPT as user friendly?*

The majority of respondents in Figure 10 perceived ChatGPT as user-friendly, with 78% of the ratings falling in between 6 or above.

The respondents from the interview were asked if user-friendliness is important for their decision to use it as a support tool for system developers. Respondent 1 believes that the user-friendliness of ChatGPT is important, the respondent mentioned that it would be good if ChatGPT could provide a percentage indicating how confident it is in its answer. Respondent 1 thinks that integrating ChatGPT into other tools with plugins could increase its usability. Respondent 2 argues that user-friendliness is important for increasing productivity where If ChatGPT is too complex to use, the respondent doesn't think it will increase productivity for system developers. Respondent 3 believes that the user-friendliness of ChatGPT is important to a certain degree and would give ChatGPT a six on a scale of one to ten in user-friendliness. Respondent 3 wants a user-friendly experience but says it does not have to be perfect. Respondent 4 thinks that user-friendliness is very important and wants ChatGPT to be easy to use, if it's not easy to use it will make the respondents look at other sources for information.

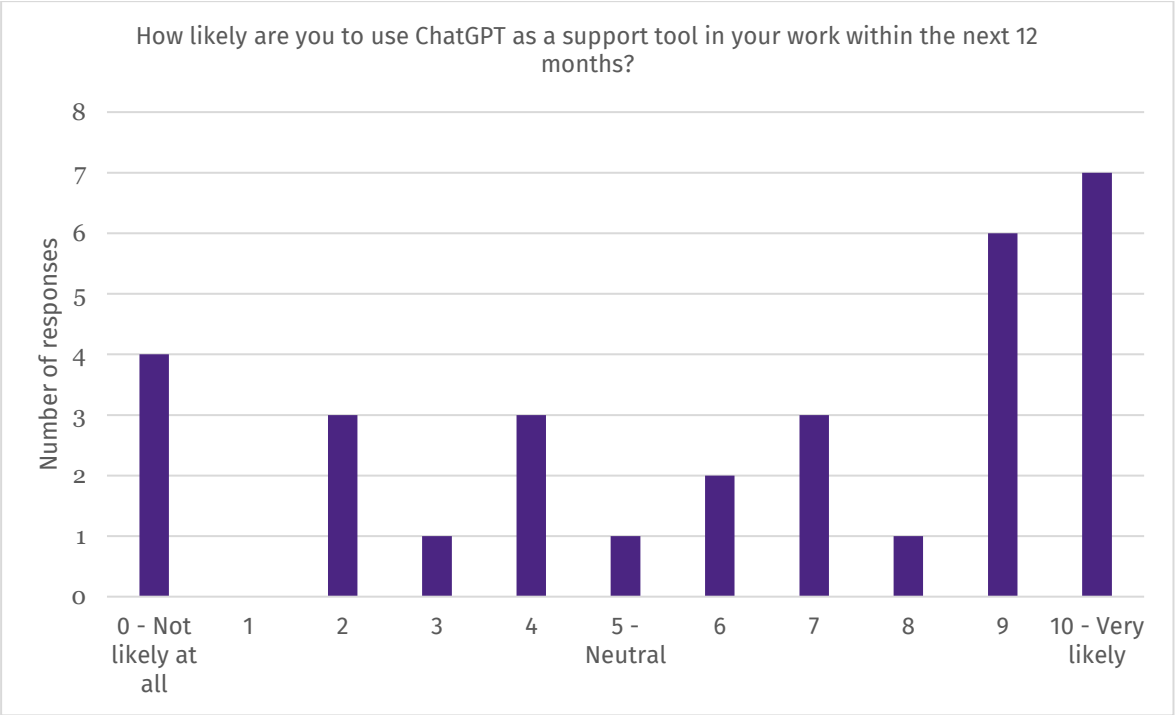

Figure 11 - *How likely are you to use ChatGPT as a support tool in your work within the next 12 months?*

Figure 11 shows how the respondents from the questionnaire answered about the likelihood for them to use ChatGPT in their work within the next 12 months. 61% of the respondents answered 6 or above on the Likert scale, which indicates that most of the respondents are going to use it within the next 12 months in work related tasks.

The respondents from the interview were asked about how likely they were to use ChatGPT in work-related tasks within the next 12 months. Respondent 1 viewed it as having a relatively low chance right now, but maybe they will change their mind later when they become more comfortable with the functions and areas of use. Respondent 2 thought it was not entirely unlikely, but the respondent wasn't sure about the areas of use. Respondent 3 answered, "basically zero probability," as their work tasks require critical thinking and creativity, where they thought ChatGPT would offer no support. Respondent 3 also viewed the time needed to learn the tool as an obstacle in implementing it in their daily work. Respondent 4 saw ChatGPT as very likely to be used in work-related tasks, with an interest in trying new technology and seeing if it works as well as claimed as the main reason.

4.2.1 Hypotheses testing

In order to answer the research question "What are the underlying factors that influence a system developer's decision to adopt ChatGPT as a support tool in their daily work?", the hypotheses formulated in section 3.6 was tested based on the questionnaire questions described in Figure 6, 7, 8, 9 and 10 compared with Figure 11. The Spearman's rank correlation test was utilized (see Appendix 4), and the results are as follows:

H1: System developers who perceive that ChatGPT can help them save time by providing answers to common questions are more likely to use ChatGPT as a support tool in their work.

Spearman's rank correlation was computed to assess the relationship between Figure 6 and Figure 11.

There was a positive correlation between the two variables, $r(29) = .31$, $p = .084$.

H2: System developers who perceive that ChatGPT can enhance the efficiency of their work tasks are more inclined to utilize ChatGPT as a supportive tool in their work.

Spearman's rank correlation was computed to assess the relationship between Figure 7 and Figure 11.

There was a significant positive correlation between the two variables, $r(29) = .62$, $p = .001$.

H3: System developers who perceive that ChatGPT can enhance their productivity are more likely to use ChatGPT as a support tool in their work.

Spearman's rank correlation was computed to assess the relationship between Figure 8 and Figure 11.

There was a positive correlation between the two variables, $r(29) = .32$, $p = .080$.

H4: System developers who perceive that ChatGPT can provide accurate responses to their work-related inquiries are more likely to use ChatGPT as a support tool in their work.

Spearman's rank correlation was computed to assess the relationship between Figure 9 and Figure 11.

There was a significant positive correlation between the two variables, $r(29) = .53$, $p = .002$.

H5: System developers who perceive that ChatGPT is user-friendly are more likely to use ChatGPT as a support tool in their work.

Spearman's rank correlation was computed to assess the relationship between Figure 10 and Figure 11.

There was a positive correlation between the two variables, r(29) = .34, p = .062.

Hyphothesis	Path	Spearman's rank	P-value	Remarks
H1	To what extent do you agree with the following statement: "ChatGPT can help system developers save time by providing quick answers to common questions." --> How likely are you to use ChatGPT as a support tool in your work within the next 12 months?	r(29) = .31	p = .084	p > 0.05 Rejected
H2	How likely do you think ChatGPT can contribute to improving the efficiency of system developers? --> How likely are you to use ChatGPT as a support tool in your work within the next 12 months?	r(29) = .62	p = .001	p < 0.05 Supported
H3	How likely do you think ChatGPT can contribute to improving the productivity of system developers? --> How likely are you to use ChatGPT as a support tool in your work within the next 12 months?	r(29) = .32	p = .080	p > 0.05 Rejected
H4	How do you perceive the accuracy of ChatGPT's responses? --> How likely are you to use ChatGPT as a support tool in your work within the next 12 months?	r(29) = .53	p = .002	p < 0.05 Supported
H5	Do you perceive ChatGPT as user friendly? --> How likely are you to use ChatGPT as a support tool in your work within the next 12 months?	r(29) = .34	p = .062	p > 0.05 Rejected

Table 3 - *The results of the tests of hypotheses*

4.3 How can ChatGPT support system developers in their daily work, and what challenges are associated with its adoption and utilization?

The questionnaire contained four open-ended questions addressing the respondents' views on ChatGPT as a support tool for system developers. During the interviews, the respondents were asked the same four questions to gain further insights into the topic.

The first question regarding ChatGPT as a support tool was: In your opinion, what are the potential benefits of using ChatGPT as a support tool for system developers?

The questionnaire results revealed that many respondents believe ChatGPT can significantly aid system developers in improving error detection and debugging code. During the interview, respondent 2 emphasized that if ChatGPT is trained with the specific code being inspected for errors, it can greatly support developers in identifying issues. Respondent 1 also expressed confidence in ChatGPT's ability to assist, particularly for junior system developers who may not yet have learned all code-related best practices.

Another topic that was addressed in the questionnaire results was ChatGPT's ability to quickly provide accurate software code. Respondent 1 said during the interview that ChatGPT most certainly could support by providing accurate code as long as it's very simple code. Respondent 3 was on the same track and stressed that ChatGPT could help with simpler repetitive code writing but does not think it can provide complete solutions to very complex problems.

Other responses from the questionnaire highlighted that ChatGPT can improve efficiency in generating technical documentation, promote creativity and innovation, swiftly answer common questions, and function as a digital co-worker. In the interview, Respondent 4 underscored ChatGPT's potential to serve as a collaborative partner for brainstorming solutions to challenges or sparking fresh ideas.

The second question regarding ChatGPT as a support tool was: What specific tasks or activities do you think ChatGPT could be most helpful for in the context of system development?

The questionnaire results showed a wide variety of answers, but the main part focused on activities like code generation, code testing, answering common questions, and some responses where ChatGPT would not be helpful in any way.

During the interviews, ChatGPT's capacity for generating code emerged as a key topic. Respondent 3 believes that ChatGPT could assist with refactoring and optimizing existing code, emphasizing its usefulness in writing repetitive code. Respondent 1 also sees potential in ChatGPT for refactoring code, particularly for individuals who struggle with understanding best practices and writing easily comprehensible

code for others. Additionally, Respondent 1 anticipates that ChatGPT may eventually become more adept at generating complex code but expresses concern that the model (ChatGPT) could be trained with poor-quality code examples, limiting its ability to tackle complex coding problems in the future.

Respondent 2 views ChatGPT's primary strength as error detection and code flaw identification, but also recognizes its potential in generating data models. They mention that one of their coworkers has experimented with this function and achieved positive results.

According to respondent 4, the main value of ChatGPT lies in its ability to quickly provide answers to common questions and that high availability is ChatGPT's most important attribute since it is available 24 hours a day, 7 days a week.

The third question addressing ChatGPT as a support tool for system developers was: "What do you think are the main barriers to integrating ChatGPT into the daily work of system developers?"

The questionnaire results showed three major aspects that might act as barriers for integrating ChatGPT in system developers' daily work. The barriers were: concerns regarding integrity and security, ChatGPT's lack of awareness, and functional limitations.

The interviews followed the same theme as the questionnaire. Respondent 3 thinks that integrity and security are the main barrier. Many companies and authorities might be hesitant to use ChatGPT since it is an external service and there is no way to know how the data shared with ChatGPT might be used. Respondent 4 feels that licensing models and legal issues are currently present barriers. As a consultant for the Swedish Transport Administration (Trafikverket), they work with sensitive information subject to strict confidentiality. In the Swedish public sector, using cloud services is generally prohibited. This makes it difficult for them to use ChatGPT since they cannot share the code they have written. They also express concern about licensing models. When ChatGPT generates code, the source of that code is unclear, which may introduce unwanted complexities in their work.

Respondent 1 says that the primary problem might be the assumption that ChatGPT is all-knowing and possesses the entire internet's knowledge while also containing false information. Based on their experience, the respondent notes that ChatGPT can make assumptions and "guess" responses that may not be accurate. When engaging in conversations unrelated to system development, ChatGPT may assert incorrect information as correct due to insufficient data sources. The respondent advises users to be critical and assess whether the generated code is reasonable to implement.

Respondent 1 also points out that potential barriers include technical limitations, such as the presence of a proxy on a client's computer that

blocks or slows down certain requests, making it difficult to use ChatGPT. This issue may not be exclusive to the respondent's client.

Respondent 3 thinks that another barrier is the lack of understanding about how to use the tool and the reluctance to change established practices. People might question why they should adopt a new method when they have been doing things a certain way for 20 years. This mindset may lead them to avoid using the tool, even if they understand its potential benefits. The respondent believes that resistance to changing existing work methods is more prominent. They observe people developing new applications using outdated approaches simply because that's how they have always done it, without considering learning something new. However, for those who are willing to adapt, the respondent thinks there are minimal barriers. They have noticed that once developers experience a tool that genuinely helps, they never go back; instead, they embrace it and use it extensively.

The fourth and final question addressing ChatGPT as a support tool for system developers was: “In your opinion, what improvements or features should be added to ChatGPT to make it more useful for system developers?”

The questionnaire results provided a wide variety of answers with the key aspects being clarification of the confidentiality of shared data with ChatGPT, support for integration of ChatGPT in IDE’s (Integrated Development Environment), and improved accuracy of ChatGPT’s responses.

During the interview, respondent 2 does not have a specific example regarding security concerns but emphasizes the importance of clarifying how ChatGPT handles the information users share with it. Users need to be mindful when formulating questions for ChatGPT to avoid disclosing trade secrets or sensitive information that shouldn't be circulated freely. The security aspect is essential, as companies are interested in understanding how ChatGPT works so they can develop policies for its usage within the organization. The respondent mentions that users might not want to share their project code with ChatGPT if they are uncertain about how the information is shared or distributed. In such cases, they might need to censor or simplify the code before using ChatGPT.

Respondent 1 thinks that there should be a clearer explanation surrounding the functionalities of ChatGPT so that users can utilize its full potential.

Respondent 4 suggests enhancing the user experience by providing a dedicated input feature for code, such as an improved text editor specifically designed for handling code. This would make the process of adding code to ChatGPT more user-friendly and efficient, even though they think that the existing method is relatively simple.

5 Discussion

In this chapter, we provide a detailed discussion of our findings from the study. We begin by summarizing the key results regarding the respondent's general knowledge about ChatGPT. We then examine the adoption factors that emerged from the study and evaluate their impact on system developers' intention to adopt ChatGPT in the next 12 months.

We also discuss the qualitative data collected from the study, which sheds light on system developers' views on ChatGPT as a support tool. We identify the potential benefits of ChatGPT in improving efficiency, simplifying tasks, and enhancing productivity, as well as the main barriers to integrating ChatGPT, including concerns about integrity and security, functional limitations, lack of awareness, and legal issues.

Finally, we discuss the implications of our research for companies such as our business partner CGI. We also address the ethical implications of our study. We conclude by reflecting on our research methodology and discussing the strengths and limitations of our study.

5.1 Respondents' general knowledge about ChatGPT

Under section 4.1, we explored how system developers incorporated ChatGPT as a support tool in their work and their familiarity with its capabilities. Our findings suggest that nearly half of the participants used ChatGPT for work-related tasks, demonstrating its value as a tool in professional settings.

With respect to familiarity, a majority of the participants reported a moderate to high level of understanding of ChatGPT and its potential applications. Participants showed diverse levels of knowledge, ranging from those who felt confident about the concept of ChatGPT but were unsure about its practical use, to those who were curious and eager to expand their understanding in the future.

Some participants, despite not having direct experience with ChatGPT, had invested time in researching the tool and attained a relatively high level of knowledge. Some individuals felt that their understanding of ChatGPT was limited in comparison to its full potential.

5.2 Adoption factors

Under section 4.2, we aimed to understand system developers' perceptions of ChatGPT's potential to save time, improve efficiency, and enhance productivity in their work. The majority of participants agreed that ChatGPT could provide quick answers to common questions and help improve efficiency and productivity. Some of the respondents draw parallels to the impact of platforms like Stack Overflow, where other system developers post their code in a forum like conversations. However, opinions varied regarding whether ChatGPT or another conversational AI would be the tool to achieve this.

When it comes to accuracy of ChatGPT, most participants rated ChatGPT's answers as neutral to very good, although some interviewees expressed concerns about its code accuracy. The interview participants had more programming experience, with an average of 14.25 years, compared to the questionnaire respondents, who had an average of 8.5 years. This difference might influence their perception of the code's accuracy generated by ChatGPT. The influence of accuracy on developers' decisions to use ChatGPT as a support tool varied, with some prioritizing accuracy while others viewed the tool as a source of inspiration rather than exact solutions.

User-friendliness was shown to be important for most participants. They believed that ease of use would impact productivity and were more likely to adopt ChatGPT if it was user-friendly. Overall, the respondent thought of ChatGPT as user-friendly. Suggestions for improving usability included integrating ChatGPT into other platforms where ChatGPT could have direct access to the directory where the developer worked on their code. Another suggestion was that ChatGPT could provide a confidence indicator for its answers, to give the user a chance to evaluate the code before using it in their own development.

Most respondents indicated they were likely to use ChatGPT in their work within the next 12 months, but the level of enthusiasm varied. Some respondents were open to using the tool once they gained familiarity with its features but were uncertain about investing the time needed to learn how to use it for enhanced productivity and efficiency.

5.2.1 Hypotheses

The research question “What are the underlying factors that influence a system developer’s decision to adopt ChatGPT as a support tool in their daily work?”, was answered by testing the hypotheses in section 4.2.1. The findings supported two out of the five hypotheses that relate to system developers' intention to adopt ChatGPT in the next 12 months. The results suggest that ChatGPT's ability to improve efficiency among system developers (H2) has a significant impact on their intention to adopt the technology. Additionally, the study found that ChatGPT's ability to generate accurate responses (H4) also has a significant impact on respondents' intention to adopt the technology. Both these hypotheses relate to the TAM variable perceived usefulness which has been confirmed as an adoption factor in multiple studies (Marikyan et al., 2022; Moussawi et al., 2020).

The results did not support the hypotheses related to system developers' perception of ChatGPT's ability to save time by providing answers to common questions (H1) and enhance productivity (H3). While there were positive correlations between these factors and system developers' intention to adopt ChatGPT, they were not statistically significant.

The hypothesis that system developers who perceive ChatGPT as user friendly are more likely to use it as a support tool in their work (H5) was not supported by the results. This hypothesis is based on the TAM

variable “perceived ease of use”, which has been both supported (Gefen and Straub, 2003; Rodrigues et al., 2016; Van der Heijden, 2004) and rejected (Marikyan et al., 2022; Moussawi et al., 2020) in previous research. Although there may be a positive correlation between user-friendliness and intention to adopt ChatGPT, the result was not statistically significant.

5.3 How can ChatGPT support system developers in their daily work, and what challenges are associated with its adoption and utilization?

In this study, we collected qualitative data regarding system developers' views on ChatGPT as a support tool. We used a questionnaire and interviews to get insight into the potential benefits of ChatGPT and to identify if there are any tasks where it could provide meaningful assistance. We also explored what the main challenges to integrate ChatGPT as a support tool and gathered suggestions for improvements or potential new features.

The results showed that many respondents believed that ChatGPT could improve or simplify tasks like error detection, debugging, and code generation. Simplification of business tasks on a general level is also discussed in previous research where Haleem et al. (2022) found that ChatGPT has the potential to simplify and assist companies in various business tasks. This is also emphasized by Ginko & Elbanna (2023b), who suggests that conversational AI has the possibility to enhance productivity in a range of business operations. The results from the interview indicated that the respondents thought that ChatGPT only could help with code related tasks if the code wasn’t too complex. They also noted that it could aid junior developers, where ChatGPT could help in educational purposes. ChatGPT’s ability to aid in educational purposes is also highlighted by Haleem et al. (2022). Our results indicated that ChatGPT could be a valuable tool in assisting with the creation and maintenance of technical documentation. The result also highlighted that ChatGPT could enhance creativity as it can act as a collaborative partner when brainstorming. One key aspect of ChatGPT as a collaborative partner was shown to be its availability, as ChatGPT is available 24 hours a day.

The respondents were asked about specific tasks where ChatGPT could support system developers, where several respondents thought it could improve or simplify tasks like code generation, code testing, and refactoring and optimizing existing code. Also here, more notable from the more experienced system developers, there was concerns regarding the quality of the code and ChatGPT's ability to handle complex coding problems.

Regarding the main challenges to integrating ChatGPT, the questionnaire results and interviews pointed to concerns about ChatGPT’s lack of awareness, functional limitations, and legal issues. ChatGPT’s functional limitations are lifted in previous research, due to biases in the training data, ChatGPT may produce incorrect or illogical output

Haleem et al. (2022). Integrity and security were highlighted as an issue as several of the interview respondents worked with confidential code exclusive to the specific project. Therefore, the idea of providing ChatGPT with access to such sensitive information was a major barrier. If confidential code where leaked there could be legal issues, which the respondents thought of as a major challenge in implementing ChatGPT. The result highlighted lack of awareness of ChatGPT functions and potential as a barrier to implementation. Many respondents pointed out that time constraints hindered their ability to fully understand and navigate this tool.

Finally, the results revealed suggestions for improvements and features that could make ChatGPT more useful for system developers.

- Clarifying the confidentiality of shared data.
- Integrating ChatGPT with IDEs.
- Improving the accuracy of responses.
- Providing clearer explanations of functionalities.
- Enhancing the user experience by adding a dedicated input feature for code.

5.4 Implications

Our research provides insight into the factors that impact the adoption of ChatGPT as a support tool for system developers, which could have indirect benefits for companies, including our business partner CGI. By identifying and addressing barriers to adoption and areas of use related to ChatGPT, our research could contribute to more effective implementation of this tool. Moreover, other companies could benefit from our findings as a valuable resource for gaining insights into the effective adoption of ChatGPT.

In terms of ethics, this study should have no implications for the respondents. All participants provided informed consent, and no confidential or personal information was collected during the study. While there are no direct ethical implications of the study's results, it is essential to take into consideration the potential ethical concerns and ensure that ChatGPT is used ethically and in compliance with relevant legal requirements and regulations.

One ethical implication of our research is related to the authors employment with the business partner CGI. Since both authors have been offered employment and financial compensation upon completion of the thesis, some may argue that this creates a potential conflict of interest or bias in the research. Specifically, there could be concerns that the authors' employment and financial benefits from the research could influence their findings or interpretations.

5.5 Reflection

The reason why the case study approach was selected for this study was due to the nature of our research questions. Our research ques-

tions were focused on understanding the real-life phenomena of developers integrating ChatGPT into their daily work within the context of a single organization, CGI Borlänge. These types of research questions, which delve into the 'how' and 'why' of a particular phenomenon in its real-life setting, are best answered through a case study approach (Oates, 2006).

In this study, we allowed for respondents with mixed knowledge and experience of ChatGPT. However, to enhance the reliability of our study, it would have been preferable to exclusively select respondents with personal experience of using ChatGPT in their daily work.

Our study employed two primary methods of data collection: questionnaire and semi-structured interviews. To complement the quantitative data generated from the questionnaire, we conducted semi-structured interviews where qualitative data was generated. The reason for this was to gather in-depth insights about the use of ChatGPT among system developers. We did include some questions in the questionnaire which generated qualitative data, which in afterthought should have been avoided. We think the result could have been clearer if the questionnaire only provided quantitative data, and the interviews was the only source of qualitative data.

Our choice to study the particular organization of CGI came down to availability, where we got the chance to get insights into their organization. This allowed us to get a detailed understanding of how system developers work inside that organization, but it also limited the generalizability of our findings.

6 Conclusion

This chapter concludes the main findings of this study. The results indicate that factors such as efficiency and accuracy significantly influence adoption, while factors such as saving time, enhancing productivity, and user-friendliness did not have a significant impact. Additionally, this chapter concludes how ChatGPT can support system developers in their daily work and identifies potential barriers and challenges associated with its adoption and implementation.

6.1 What are the underlying factors that influence a system developer's decision to adopt ChatGPT as a support tool in their daily work?

This study aimed to investigate the factors that impact system developers' intention to adopt ChatGPT as a support tool in their work. The results showed that ChatGPT's ability to improve efficiency and generate accurate responses are significant factors that influence adoption. However, the study did not find statistically significant results to support the hypotheses related to ChatGPT's ability to save time by providing answers to common questions, enhance productivity, and perceived user-friendliness. These findings suggest that system developers prioritize efficiency and accuracy over other factors when considering adopting ChatGPT.

6.2 How can ChatGPT support system developers in their daily work?

The result from this study, as discussed in section 5.3, indicates that ChatGPT could help system developers with:

- Code debugging.
- Code generation.
- Code refactoring.
- Code optimization.
- Educate junior developers.
- Technical documentation
- Act as a collaborative partner when brainstorming.

However, ChatGPT may have potential limitations when dealing with complex code.

6.3 What are the potential challenges associated with the adoption and utilization of ChatGPT among system developers?

The main challenges associated with the adoption and utilization of ChatGPT among system developers include concerns about integrity and security, particularly with confidential code, lack of awareness about ChatGPT's functions, and functional limitations.

7 Further research

As ChatGPT is a relatively new technology, there are numerous directions in which further research can be conducted to explore its potential and address the limitations identified in this study. While the study supported the significance of perceived accuracy and efficiency as driving factors for the adoption of ChatGPT, it would be valuable to investigate additional factors that may influence users' intentions to adopt this technology. For example, factors such as trust and compatibility with existing workflows could be explored to provide a more comprehensive understanding of the adoption process.

Considering that this study was conducted as a case study within a single organization, future research could extend the investigation to other organizations to explore how employees in different contexts perceive ChatGPT's ability to assist them in their daily work. This would provide insights into the generalizability and applicability of ChatGPT as a support tool across diverse settings and industries.

Addressing the concerns surrounding security and confidentiality identified in this study presents an opportunity for future research to delve deeper into these topics. Investigating methods to ensure the protection of sensitive data while using ChatGPT, exploring encryption techniques, and developing privacy-preserving approaches would contribute to addressing the barriers associated with data security and confidentiality.

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Appendix 1: Literature review

Reference	Title	Source	Search word
Brachten et al., (2021)	The acceptance of chatbots in an enterprise context – A survey study	Summon	Chatbot + Enterprise
Dale, R. (2016)	The return of the chatbots	Summon	Chatbot
Davis, (1989)	Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology	Summon	TAM
Davis et al., (1989)	User acceptance of computer technology: A comparison of two theoretical models	Summon	TAM
Gkinko & Elbanna, (2023a)	Designing Trust: The formation of employees trust in conversational AI in the digital workplace	Summon	Conversational AI + Workplace
Gkinko & Elbanna, (2023b)	The appropriation of conversational AI in the workplace: A taxonomy of AI chatbot users	Summon	Conversational AI + Workplace
Grefen et al., (2003)	Trust and TAM in Online Shopping: An Integrated Model	Summon	TAM
Haleem et al., (2022)	An era of ChatGPT as a significant futuristic support tool: A study on features, abilities, and challenges	Summon	ChatGPT
Kelley, (2022)	Employee perceptions of the effective adoption of AI principles	Summon	AI + Organization
Marikyan et al., (2022)	Alexa, let's talk about my productivity: The impact of digital assistants on work productivity	Summon	AI + Workplace
Moussawi et al., (2020)	How perceptions of intelligence and anthropomorphism affect adoption of personal intelligent agents	Summon	AI + Workplace
Schlögl, S. et al., (2019)	Artificial Intelligence Tool Penetration in Business: Adoption, Challenges and Fears	Summon	AI + Tool
Sowa et al, (2021)	Cobots in knowledge work: Human–AI collaboration in managerial professions	Summon	AI + Chatbot
Storey & Zagalsky (2016)	Disrupting developer productivity one bot at a time	Google Scholar	System developer + AI

Appendix 2: Questionnaire questions

Demographic Questions

What is your age? (Select one: 18-24, 25-34, 35-44, 45-54, 55-64, 65+)

What is your gender? (Select one: Male, Female, Non-binary/Third gender, prefer not to say

What is your current job role or title?

How many years of experience do you have in programming?

General AI and Chatbot Awareness

Have you ever used ChatGPT as a support tool in your work? (Yes/No)

On a scale of 0-10, how familiar are you with ChatGPT and its capabilities?

Perceived Benefits

In your opinion, what are the top potential benefits of using ChatGPT as a support tool for system developers? (Partially closed-ended)
A) Improved efficiency in writing technical documentation
B) Faster and more accurate software code generation
C) Increased creativity and innovation in product development
D) Better error detection and troubleshooting
E) Streamlined communication between development teams and stakeholders.
F) OTHER/OTHERS (Open-ended option)

How likely do you think ChatGPT can contribute to improving the efficiency of system developers? (Likert scale: 0 - Not likely at all, 10 - Very likely)

How likely do you think ChatGPT can contribute to improving the productivity of system developers? (Likert scale: 0 - Not likely at all, 10 - Very likely)

To what extent do you agree with the following statement: "ChatGPT can help system developers save time by providing quick answers to common questions." (Likert scale: 0 - Strongly disagree, 10 - Strongly agree)

Factors Influencing Integration

What do you think are the main barriers to integrating ChatGPT into the daily work of system developers? (Open-ended)

How do you perceive the accuracy of ChatGPT's responses? (Likert scale: 0 - Not accurate at all, 10 - Very accurate)

Do you perceive ChatGPT as user friendly? (Likert scale: 0 - Not at all user-friendly, 10 - Very user-friendly)

Use Cases and Preferences

What specific tasks or activities do you think ChatGPT could be most helpful for in the context of system development? (Open-ended question)

Future Outlook

How likely are you to use ChatGPT as a support tool in your work within the next 12 months? (Likert scale: 0 - Not likely at all, 10 - Very likely)

In your opinion, what improvements or features should be added to ChatGPT to make it more useful for system developers? (Open-ended question)

Appendix 3: Interview questions

Can you tell me about your experience using ChatGPT?

On a scale from 0 to 10, how familiar are you with ChatGPT and its capabilities? How did you first become aware of ChatGPT?

Have you used ChatGPT in work-related contexts?

> If yes: What were some of the factors that influenced your decision to try ChatGPT in a work setting?
>
> If no: Are there any factors preventing, you from using ChatGPT in your work?

In your opinion, how can ChatGPT support system developers in their daily work?

What are the top three potential benefits of using ChatGPT as a support tool for system developers, according to your perception?

How likely do you think ChatGPT can contribute to improving system developers' efficiency? Why? Give examples.

How likely do you think ChatGPT can contribute to improving the productivity of system developers? Why? Give examples.

What do you think are the main obstacles to integrating ChatGPT into system developers' daily work?

How important is the accuracy of ChatGPT's answers for your decision to use it as a support tool?

How do you perceive ChatGPT's accuracy?

How important is the user-friendliness of ChatGPT for your decision to use it as a support tool?

How do you perceive the user-friendliness of ChatGPT?

How likely is it that you will use ChatGPT as a support tool in your work over the next 12 months? Why? Why not?

In your opinion, what improvements or features should be added to ChatGPT to make it more useful for system developers?

Is there anything else you would like to add?

Do you have any questions for us before we conclude the interview?

Appendix 4: Hypotheses Testing

```python
import pandas as pd

# Read the CSV file into a DataFrame
df = pd.read_csv('results.csv', header=0, sep=";")
```

```python
df.head(5)
```

	Percieved ability to answer easy questions	Percieved productivity	Percieved efficiency	Percieved accuracy	Percieved user-friendlyness	Intention to use
0	8	8	6	7	8	4
1	8	7	6	8	8	0
2	9	6	6	6	8	6
3	0	2	2	2	2	0
4	4	7	6	4	3	10

```python
from scipy.stats import spearmanr

# Calculate the Spearman rank correlation coefficients for all columns compared with the column "Use"

col1 = df['Percieved ability to answer easy questions']
col2 = df['Percieved productivity']
col3 = df['Percieved efficiency']
col4 = df['Percieved accuracy']
col5 = df['Percieved user-friendlyness']
col6 = df['Intention to use']

```

```python
corr1, pval1 = spearmanr(col1, col6)
print(f"Spearman rank correlation coefficient between Percieved ability to answer easy questions and Intention to use: {corr

corr2, pval2 = spearmanr(col2, col6)
print(f"Spearman rank correlation coefficient between Percieved productivity and Intention to use: {corr2:.2f} (p-value: {pv

corr3, pval3 = spearmanr(col3, col6)
print(f"Spearman rank correlation coefficient between Percieved efficiency and Intention to use: {corr3:.2f} (p-value: {pval

corr4, pval4 = spearmanr(col4, col6)
print(f"Spearman rank correlation coefficient between Percieved accuracy and Intention to use: {corr4:.2f} (p-value: {pval4:

corr5, pval5 = spearmanr(col5, col6)
print(f"Spearman rank correlation coefficient between Percieved user-friendlyness and Intention to use: {corr5:.2f} (p-value
```

```
Spearman rank correlation coefficient between Percieved ability to answer easy questions and Intention to use: 0.31 (p-value:
0.084)
Spearman rank correlation coefficient between Percieved productivity and Intention to use: 0.32 (p-value: 0.080)
Spearman rank correlation coefficient between Percieved efficiency and Intention to use: 0.62 (p-value: 0.000)
Spearman rank correlation coefficient between Percieved accuracy and Intention to use: 0.53 (p-value: 0.002)
Spearman rank correlation coefficient between Percieved user-friendlyness and Intention to use: 0.34 (p-value: 0.062)
```