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# Artificial Intelligence in Software Development: Exploring Utilisation, Tools, and Value Creation

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**DEGREE THESIS**

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**Abstract**

This Master's thesis investigates the transformative potential of Artificial Intelligence (AI) integration within the software development industry. Focusing on tools that enhance coding efficiency and have natural language processing (NLP) capabilities, the thesis research explores AI adoption patterns, challenges, and value creation associated with AI. Utilising a survey of 37 software professionals, the thesis analyses real-world application scenarios, identifies barriers to adoption (e.g., ethical considerations, skills gaps), and quantifies benefits for both developers (e.g., increased productivity) and organisations (e.g., competitive advantages).

The findings reveal AI's significant role in boosting productivity, developer experience, accelerating software development lifecycles, and creating a competitive edge for businesses. However, the thesis research acknowledges potential hurdles like ethical concerns, the need for specialised skillsets, data privacy concerns, and integration complexities.

By drawing on established theories of value creation in the context of software development, the thesis situates these practical findings within a theoretical framework. This analysis highlights the unique impact of AI tools on value creation for both development professionals and the employing organisations.

This research contributes to the ongoing dialogue by bridging the gap between theoretical perspectives and real-world applications of AI in software development. It sheds light on the multifaceted role of AI in enhancing development operations and human-computer interaction. Ultimately, this thesis empowers the software development community to make informed decisions about AI adoption and leverage its potential to drive innovation and competitive advantage.

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Language: English
Key Words: Artificial Intelligence (AI), Natural Language Processing (NLP), Software Development, Value Creation, AI-Driven Productivity

**OPINNÄYTETYÖ**

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**Tiivistelmä**

Tämä opinnäytetyö tutkii, miten kehittyneet tekoälyteknologiat voivat muuttaa ohjelmistoalaa, keskittyen erityisesti työkaluihin, jotka tehostavat koodausta ja joilla on kyky ymmärtää luonnollista kieltä. Opinnäytetyössä selvitetään mm. kuinka tekoälyn tarjoamia mahdollisuuksia käytetään ohjelmistoalalla, mitä haasteita niiden käytössä kohdataan ja minkälaista arvoa ne tuottavat sekä käyttäjille että organisaatioille. Opinnäytetyössä hyödynnetään kyselytutkimusta, johon vastasi 37 ohjelmistoalan ammattilaista. Kyselytutkimuksen kautta analysoidaan ohjelmistoalan ammattilaisten todellisia tekoälyn käyttötapauksia, tunnistetaan käyttöönoton esteitä (esimerkiksi eettiset kysymykset, osaamisvajeet) ja mitataan syntyneitä hyötyjä (arvoa) sekä kehittäjille (esimerkiksi lisääntynyt tuottavuus) että organisaatioille (esim. kilpailuetu).

Tutkimustulokset osoittavat, että tekoäly voi merkittävästi lisätä tuottavuutta, parantaa kehittäjäkokemusta, vauhdittaa innovaatioita ja tarjota kilpailuetua. Tutkimus tunnistaa kuitenkin myös mahdollisia haasteita, kuten erilaiset eettiset huolet, osaamistarpeet, tietosuojakysymykset ja integrointihaasteet.

Opinnäytetyö sijoittaa nämä käytännön havainnot teoreettiseen viitekehykseen hyödyntämällä olemassa olevia teorioita arvon luomisesta ohjelmistotuotannossa. Tämä analyysi korostaa AI-työkalujen ainutlaatuista vaikutusta arvon luomiseen sekä kehittäjille että heitä työllistäville organisaatioille.

Tämä opinnäytetyö edistää käynnissä olevaa keskustelua tekoälyn roolista ohjelmistotuotannossa yhdistämällä teoreettisia näkökulmia ja tekoälyn käytännön sovelluksia. Se valotta tekoälyn monipuolista roolia kehitystyön tehostamisessa ja ihmisen ja tietokoneen välisessä vuorovaikutuksessa. Tämän opinnäytetyö tutkimus luo pohjan tuleville tutkimuksille kehittyvistä AI-työkaluista ja niiden vaikutuksesta ohjelmistotuotannon kehitykseen.

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Kieli: Englanti
Avainsanat: Tekoäly, Luonnollisen kielen käsittely (NLP), Ohjelmistokehitys, Arvonluonti, Tekoälypohjainen tuottavuus

## Table of Contents

# List of Figures and Tables

# Abbreviations

**AI (Artificial Intelligence)** The simulation of human intelligence processes by machines, especially computer systems, designed to execute tasks that typically are considered to need human intelligence (Russell & Norvig, 2016).

**AIOPS (Artificial Intelligence for IT Operations)** An umbrella term for multi-layered technology platforms that automate and enhance IT operations by using analytics and machine learning to analyse big data collected from various IT operations tools and devices, in order to automatically spot and react to issues in real time (Gartner, Inc., n.d.).

**AIoT (Artificial Intelligence of Things)** The combination of AI technologies with the Internet of Things infrastructure to achieve more efficient IoT operations, improve human-machine interactions and enhance data management and analytics (Ray, 2018).

**ASR (Automatic Speech Recognition)** Also known as speech to text, it involves the computerized process of converting spoken words into text. ASR systems use algorithms to audio signal identification and text conversion (Yu & Deng, 2014).

**CNN (Convolutional Neural Network)** A certain class of deep neural networks, most applied to analysing visual imagery and used in computer vision. CNNs use a variation of perceptrons in multiple layers designed to minimise the need of pre-processing. They are also called shift invariant or space invariant artificial neural networks, because of their shared-weights architecture and translation invariance characteristics (Krizhevsky et al., 2017).

**CV (Computer Vision)** A field of AI that trains computers to interpret and understand the visual world (Szeliski, 2011).

**DL (Deep Learning)** A subset of ML that uses neural networks with many layers (deep neural networks) to analyse various factors in large amounts of data (LeCun et al., 2015).

**GPT (Generative Pre-trained Transformer)** A type of artificial intelligence model designed to generate text by using deep learning techniques. GPT models are trained on a large corpus of text and then fine-tuned for specific tasks to produce coherent and contextually relevant text based on a given prompt. They are examples of large language models (LLMs) (Radford et al., 2019).

**LLM (Large Language Models)** Advanced language models in machine learning that can understand and generate human language by predicting the next word on sequence given the words that preceded it. LLMs are trained on large datasets. They are instrumental in many NLP tasks e.g., content generation, text summarisation and, machine translation (Brown et al., 2020).

**LSTM (Long Short-Term Memory)** A special RNN, with the capability to learn long-term dependencies. LSTM was designed to avoid the long-term dependency problem, remembering information for long periods as the default behaviour. It is particularly useful for prediction problems where context from the distant past is supportive to the context in the present (Hochreiter & Schmidhuber, 1997).

**ML (Machine Learning)** A subset of AI that involves the use of data and algorithms to imitate the way that humans learn and perform certain tasks without instructions relying on the patterns in data (Goodfellow et al., 2016).

**NLP (Natural Language Processing)** A field of AI that focuses on the human-computer interaction through natural human language. The goal is to give machines the ability to understand text and speech and derive meaning from human languages (Jurafsky & Martin, 2024).

**RAG (Retrieval-Augmented Generation)** A methodology that combines retrieval of informational content with generative processes to enhance the quality and relevance of generated text. RAG models retrieve documents relevant to a given query and then use a sequence-to-sequence model to generate outputs based on the combined understanding from the retrieved content (Lewis et al., 2020).

**RNN (Recurrent Neural Network)** A type of artificial neural network where there are connections between nodes and the nodes form a directed graph along a temporal sequence. This architecture allows it to exhibit temporal dynamic behaviour and process sequences of inputs, making it useful in applications like speech recognition or language modelling (Goodfellow et al., 2016).

**RPA (Robotic Process Automation)** The technology that allows anyone to configure computer software, or a "robot" to emulate and integrate the actions of a human interacting within digital systems to execute a business process (Van der Aalst et al., 2018).

**Slack** Business communication platform developed by Slack Technologies that is now a subsidiary of Salesforce. Slack is designed to facilitate team communication and collaboration within organisation. Slack is widely used across various industries but especially in software industry (Slack, 2024).

**TTS (Text-to-Speech)** A form of speech synthesis that converts text into spoken voice output (Taylor, 2009).

# 1 Introduction

## 1.1 Background

In the beginning of the 21st century, Artificial Intelligence (AI) has transitioned from a field of theoretical exploration to a practical tool driving innovation across various sectors (Russell & Norvig, 2016). The software industry, known for its rapid adoption of cutting-edge technologies, stands at the forefront of this transformation. AI technologies, ranging from machine learning algorithms to natural language processing, have become integral in developing software solutions that are more efficient, intuitive, and capable of addressing complex problems (Goodfellow et al., 2016).

Speculations about AI's impact on the whole technology sector have been very wild since the emergence of the more sophisticated forms of generative AI, such as OpenAI's ChatGPT, in the last quarter of 2022. AI-related changes in the tech industry have been widely discussed and guesses between mass layoffs to huge productivity leaps in software development have been presented (Goldman Sachs, 2023). The mutual ground between many speculators is that AI is here to stay, and it will change various things.

As AI continues to evolve, understanding its utilisation within the software industry not only provides insights into current technological capabilities, but also highlights the potential for future innovations. The integration of AI can lead to significant value creation for users and organisations alike, altering traditional software development paradigms and business models (Porter & Heppelmann, 2017).

## 1.2 Research Objectives and Questions

This thesis investigates AI's utilisation in software development within software industry and its implications for value creation. The thesis is guided by the following objectives:

- To map the current landscape of AI utilisation in the software industry among software development professionals.

- To evaluate the perceived value of AI technologies from the perspective of users and organisations.
- To identify challenges and barriers to AI adoption within the industry
- How do the future trajectories look like for AI?

Correspondingly, the thesis will address the following research questions:

- How and for what purposes AI is being utilised among the software development professionals in the software industry?
    - Which AI tools are being used and by whom?
- What value do users perceive AI to create? (for users and organisations)

In addition to the research questions the thesis will briefly explore the following topics:

- What are the main challenges and barriers to AI adoption in the software industry?
- How does the future of AI look like in software industry?

## 1.3 Scope and Limitations

The thesis focuses on AI's utilisation in software development within the software industry. The research is limited to AI technologies that are somehow directly involved or relevant for software development. While the survey that was conducted for this thesis provides valuable insights, it is acknowledged that the responses may reflect the subjective experiences and perceptions of the respondents. The thesis findings are intended to contribute to a broader understanding of AI's impact but may not capture all industry nuances due to limitations.

The scope of this thesis is the current landscape of Artificial Intelligence (AI) utilisation within the software development professionals in software industry. The thesis identifies and analyses the various ways in which AI technologies are being used in software development practices and the resulting impacts on productivity, innovation, and value

creation. It covers the perspectives of various software professionals (including e.g., software developers, architects, DevOps specialists, project managers, product managers and other stakeholders who interact with AI tools in their work).

The thesis investigates the benefits perceived by these software industry professionals, the challenges they face in adopting and using AI tools, and the ethical considerations that arise. Additionally, this thesis seeks to understand the expectations for future AI integration and the potential shifts in the industry landscape due to evolving AI capabilities.

While this research provides insights into AI's role in the software industry, several limitations must be acknowledged. The sample for this study was obtained through convenience and voluntary response sampling via LinkedIn and via researcher’s workplace Slack channels. This non-probability sampling approach limits the generalizability of the findings, as views of the participants who chose to respond may not represent the views of entire software industry.

The data collected may also be subject to response bias, as individuals with a strong interest in or opinion about AI tooling and AI utilisation are more likely to participate in the survey. This bias can skew the results and it may not accurately reflect the views of the broader population among software industry professionals.

Considering that the survey was distributed through the researcher's professional network in LinkedIn and workplace Slack, the sample may have a higher concentration of respondents from specific geographical regions or company cultures, which may lead to not capturing global or diverse industry practices.

The rapidly changing nature of AI technology means that the study's findings may have a very limited shelf-life. New developments could quickly alter the landscape of AI utilization, making it challenging to keep the study's conclusions fully current: E.g., the tools used in the industry might change very quickly.

While the survey aims to capture a wide range of experiences and opinions, the broadness of the topics covered means that some areas of AI utilisation may not be explored in depth. The open-ended questions allow room for some qualitative insights, but these may not fully

capture the complexity of individual experiences with AI. Every respondent did not respond to open-ended questions.

Ethical considerations have been addressed in the study's design, particularly concerning data privacy. However, the sensitive nature of AI's impact on employment and privacy means that some respondents may have been cautious in their responses, potentially limiting the depth of their answers.

To summarise, this study offers some insights into AI's current usage and potential future role in the software industry. Study and survey results inform readers about how AI is being used by the software professionals and what tools are in use. The limitations highlighted in this chapter are tied to the chosen research approach and must be taken into consideration while interpreting the findings.

## 1.4 Structure of Thesis

The thesis is organized as follows:

Chapter 1: Introduction

- This chapter introduces the study by outlining the background, defining the research objectives and questions, and discussing the scope and limitations of the research. It concludes with an overview of the thesis structure.

Chapter 2: Literature Review

- This chapter reviews the evolution of AI in software development, from early theoretical foundations to recent breakthroughs in machine learning and deep learning. It explores different theoretical frameworks for value creation, particularly focusing on Service-Dominant Logic, and discusses the current challenges in AI adoption.

Chapter 3: Methodology

- Details the research design, survey methodology, and data analysis techniques. It covers questionnaire development, pilot testing, sampling, and ethical considerations, along with the limitations of the study's methodology.

Chapter 4: Survey & Results

- Presents demographic data of respondents and discusses findings related to AI usage, efficiency, productivity, and professional development. It also explores responses to open-ended questions.

Chapter 5: Analysis and Discussion

- Analyses the data in relation to the literature reviewed, discussing how findings align with or challenge existing theories. It highlights the implications of AI for value creation in software development.

Chapter 6: Conclusion and Future Research

- Summarises the study's findings, reflects on the research objectives, and suggests avenues for future research.

Chapter 7: References

- Lists all sources cited in APA format.

Chapter 8: Appendices

- Includes supplementary material e.g., the survey form.

# 2 Literature review

## 2.1 Introduction

The purpose of this literature review is to examine artificial intelligence's diverse and influential role in software development and in software industry. While AI advances across various applications, it redefines traditional views of service delivery, value creation and customer interaction. The literature review seeks to provide analysis of existing literature and to add understanding of AI's contribution to value creation.

The chapter begins with historical perspective on AI's development, tracing its rise from concept level to the complex systems and tools that currently are in use e.g., in software development. After history introduction, the chapter includes evaluation regarding benefits of AI utilisation and addresses the challenges that arise and impede the widespread adoption of AI tools. Furthermore, the chapter extends into an exploration of value creation theories, with an emphasis on Service-Dominant Logic (S-D Logic), that offers insight into AI's service-centric value in software development context.

Later in the chapter, the AI value creation is explored from the user point of view, but also more broadly on an organisation level.

## 2.2 The Evolution of Artificial Intelligence

The concept of artificial intelligence (AI) has intrigued humans for centuries, with stories and myths describing machines with human-like intelligence. Formal logic and computational theory have roots in ancient philosophical inquiries about the nature of the mind and intelligence. In more modern times AI has evolved from theoretical constructs to actual and practical applications that have influence in many aspects of our daily lives.

### 2.2.1 Early concepts and theoretical foundations of AI

Conceptual roots of AI can be tracked back all the way to ancient civilizations, where philosophers such as Aristotle explored the syllogistic logic and laid foundations for computational thinking. The scientific journey of AI has begun much later in the mid-20$^{th}$

century, and it has been fuelled by remarkable advancements both in mathematics and in computer science. George Boole's development of Boolean algebra in the 19th century provided the mathematical basis for handling logical statements and operations in a way that development of computing machines was possible. Groundwork was laid in 1940s with the invention of the programmable digital computer. Pioneers such as Alan Turing and John McCarthy did envision machines that were capable of intelligent behaviour. Turing introduced Turing test in 1950 to benchmark and assess a machine's abilities to exhibit human-like intelligence through conversation (Turing, 1950). Turing has been called father of artificial intelligence in various publications, articles and he is stated to be the "… founding father of artificial intelligence…" also according to Encyclopaedia Britannica (2024).

### 2.2.2 Birth of Artificial Intelligence

The formal beginning for the field of artificial intelligence was in 1956 when the Dartmouth Conference was held and the term "artificial intelligence" was invented by McCarthy (McCarthy et al., 2006). This event marked the very beginning of AI as an academic discipline and at the same time theoretical and practical foundations for the future of this new discipline. The key themes that were established in Dartmouth Conference were problem solving and symbolic representation.

According to Russel & Norvig (2016), the researchers concentrated on the theme of problem solving were keen to explore methods for machines to tackle problems akin to human capabilities, while focusing on decision making, logic and research algorithms. This research led eventually to developments in theorem proving and game playing (Robinson, 1965) (Newell & Simon, 1972).

Early artificial intelligence relied heavily on the symbolic representations of knowledge. This approach involved using symbols and logic to encode knowledge about the surrounding world. Once knowledge was encoded symbolically, algorithms were designed to manipulate these symbols to solve problems (Newell & Simon, 1976) . Especially Newell and Simon's (1976) concept of physical symbol systems were pivotal by suggesting that intelligent behaviour could be generated by machines operating on symbolic

representations of the world. During this period also the Joseph Weisenbaum's (1966) natural language processing computer program ELIZA saw the daylight.

The first years of artificial intelligence were marked by unbounded optimism and ambitious goals. Researchers in the field were very optimistic about the potential of the AI. Aftermath of fast advancements in computer technology during mid-20$^{th}$ century promised good for AI advancements (Crevier, 1993). According to Crevier (1993) AI researchers believed in the potential of machines to achieve human-level intelligence within very short timeframe. Optimism was translated into unrealistic goals. Pioneers such as John McCarthy had made a prediction stating that machines as intelligent as humans could exist within a generation (McCarthy et al., 2006). Even though the initial timeframes for AI advancements were wrong, the enthusiasm and optimism fuelled remarkable progress in areas such as natural language processing (NLP) and robotics (Russell & Norvig, 2016).

Researchers of NLP aimed to develop machines that could understand and generate human language. The work of this research led eventually to advancements e.g., machine translation and question answering (Russell & Norvig, 2016). Other research branch was robotics, where the ambitious aim was to build robots that could interact with physical world. Early research on robotics was concentrating on robot arms and simple manipulation tasks that paved the way for the future developments (Nilsson, 1980) . The winds of optimism surrounding the AI changed swiftly towards a period called AI Winter in late 1970s – continuing into the beginning of 1980s. Various reasons contributed to this, but the key challenges were computational limitations, complexity of human intelligence and cognition together with overpromising and unrealistic expectations.

The 1980s marked a return of interest in AI, fuelled by the advent of machine learning algorithms that allowed computers to learn from data. The introduction of backpropagation for training neural networks remarkably advanced the AI field (Rumelhart et al., 1986). This period saw the development of expert systems and the beginnings of AI's application in areas like logistics, manufacturing, and medicine.

### 2.2.3 The Rise of Big Data

The digital revolution of the early 21st century led to a dramatic increase in data generation, storage, and computational processing capabilities. The emergence of big data technologies made it possible to collect and analyse vast amounts of information, providing the necessary raw material for the development and training of more sophisticated AI models (Jordan & Mitchell, 2015). This abundance of data, combined with the remarkable advances in computational power, particularly using Graphical Processing Units (GPU), facilitated the training of complex models that could learn from data at a scale and speed that was earlier unseen (Owens et al., 2008).

### 2.2.4 Breakthroughs in Machine Learning and Deep Learning & implications in Software development

The field of machine learning, particularly deep learning, underwent significant advancements from early 2010s through the late 2010s. Deep learning, characterised by the employment of multi-layered neural networks, emerged as a fundamental element in numerous AI applications. The introduction of the Transformer model by Vaswani et al. (2017) marked a critical turning point in natural language processing (NLP), facilitating the creation of models capable of handling sequential data more efficiently and with enhanced adaptability compared to earlier methods.

During this era, there was remarkable progress in the evolution and enhancement of Convolutional Neural Networks (CNNs) for tasks like image recognition and analysis. The results of this progress have been employed in various applications, from medical diagnostics to autonomous vehicle technology. Concurrently, advances in Recurrent Neural Networks (RNNs) and their subsequent iterations, such as Long Short-Term Memory (LSTM) networks, have notably enhanced the capabilities of AI systems in comprehending and generating human language (LeCun et al., 2015).

## 2.3 Current State of AI Utilisation in Software development

In the recent past Artificial intelligence has integrated into software development. The change has brought not only improved smooth operations but has made inroads with

innovative methodologies that are changing the conventional way of software development (Rahwan et al., 2019). This section focuses on the current use of AI in software development, its key tools, and the impact such tools are bound to bring to the industry.

AI tools and AI integration is available in various areas of software development e.g., in following areas:

- Code completion and generation with AI-assisted coding tools
- Automated testing & Quality Assurance
- Project Management
- Architecture and Design
- DevOps practices & CI/CD pipelines
- Security and Vulnerability Detection
- Enhanced User Interaction (with AI agents)
- Enhanced problem solving with natural language
- Predictive Analytics in Strategic Decision-Making

Regarding code completion and generation, AI assisted coding tools or pair programming such as GitHub Copilot represent some of the giant leaps AI has taken in the world of software development. The GitHub Copilot helps developer by suggesting code snippets or even whole functions to enhance productivity and lower chances of errors in addition of the chat tool that let's user directly interact with GitHub Copilot via integrated development environment (IDE) (GitHub, Inc., 2022). Interesting statistics in Artificial Intelligence Index Report (2023) is the number of AI related projects in GitHub repositories. AI tools have been introduced but also being developed (See Figure 1.) actively during recent years.

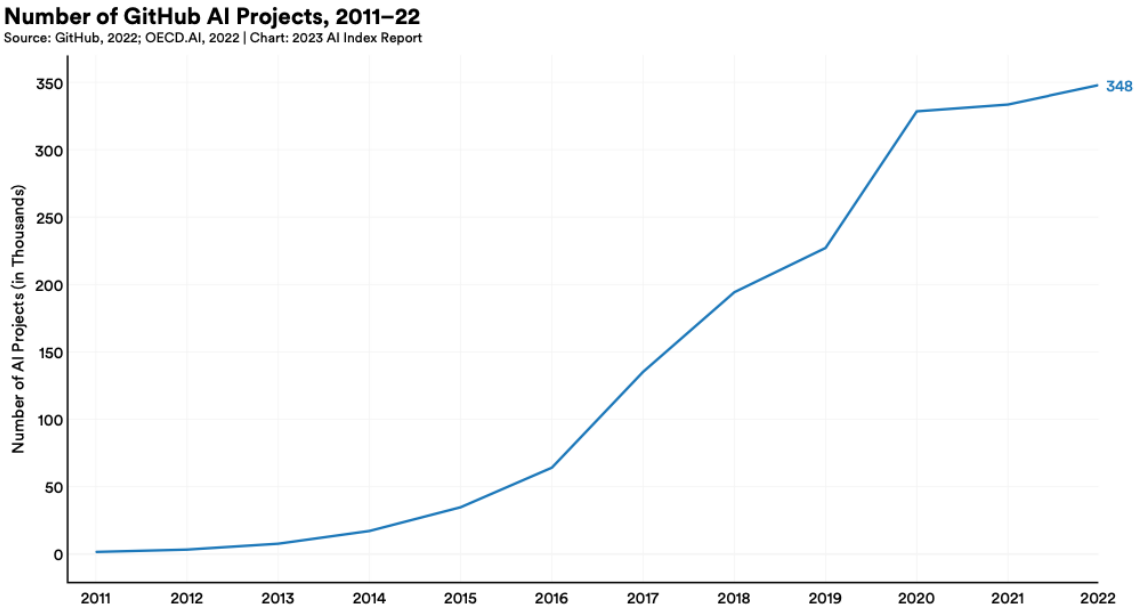



**Figure 1: Number of Github AI projects 2011-2022 (Maslej et al., 2023)**

According to StackOverflow's Developer Survey (2024) developers used AI in development workflow to various use cases (see. Figure 2.). Writing code is the clear "winner" in the AI use cases in StackOverflows survey data.

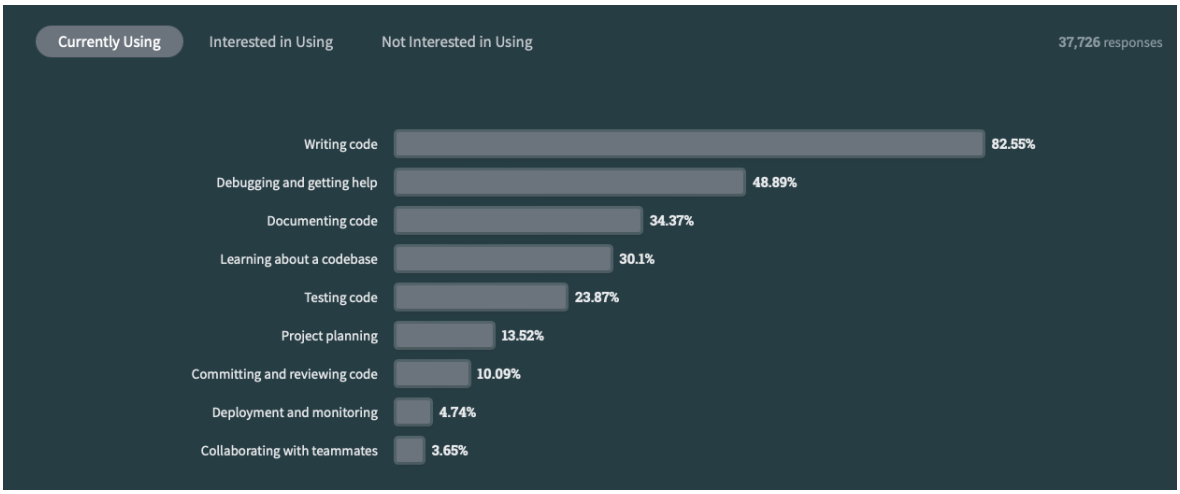



**Figure 2: AI in the development workflow: Use cases (StackOVerflow, 2024)**

AI has also played a huge role also in testing and quality assurance. The automated code reviews and generation of test cases, suites and relentless bug searching capabilities have

been a complete revolution in software testing. Software testing was earlier very much about time consuming manual work (Islam et al., 2023). For example, Selenium has now incorporated AI with its test framework to improve testing accuracy and the efficacy, reducing effort on manual testing. Machine learning algorithms are now capable of predicting potential failures and identifying potentially vulnerable parts of software code. This predictability allows developers to focus their testing and debugging efforts more efficiently to the “right” areas, thus making the software more reliable. Example of this is Facebook’s AI enhanced SapFix tool that not only detects bugs but also suggests fixes automatically. (Marginean et al., 2019)

AI extends further than coding and testing to include the design and architecture of software. Artificial Intelligence-based design tools help in designing interfaces and experiences, suggesting design components based on data extracted about how users are interacting with it. These AI algorithms, in fact, help architects make decisions. They analyse big data to recommend patterns and structures that help in improving performance and scalability of software products (Khan et al., 2024).

AI has influenced project management too. In today's world, AI's predictive analytic capabilities are rapidly increasing and are therefore one of the reasons for their use in project management tools, such as Jira Software. For instance, AI features in these tools make automatic predictions of timelines, resource allocations, and even risk analysis for more informed decisions (Atlassian, 2024).

AI technologies foster enhanced collaboration among distributed development teams. Slack, Microsoft Teams, and a plethora of other tools use AI to filter the most important notifications, suggest action items, and even organise information for much more effective remote collaboration.

AI further integrates with DevOps practices aiming for a full-fledged automation CI/CD pipeline that smoothens the development cycles and helps in the improvement of the product quality (Vemuri et al., 2024). AI in DevOps or AIOps, integrates machine learning to automate and improve multiple DevOps practices e.g. CI/CD, monitoring, and incident

response. AI tools such as IBM Cloud Pak for AIOps and Moogsoft have been introduced in this area (IBM, 2024) (Moogsoft, 2024).

In the cybersecurity domain, AI based solutions are crucial for identifying and helping in mitigating threats. By pattern recognition and anomaly detection techniques, AI enhances and increases the capabilities of detecting vulnerabilities and protects against new emerging cyber threats in a rapidly evolving digital ecosystem (Welukar & Bajoria, 2021).

ChatGPT, a descendant of OpenAI's GPT-3 model, has transformed the creation of interactive chatbots and virtual assistants within software products. These new AI agents provide far more nuanced and context-aware interactions, taking the user experience to new levels (Brown et al., 2020). By leverage brought by the big language model, ChatGPT types of AI assistants can interpret end user inputs with a high degree of understanding, delivering responses that are coherent, contextually relevant, and often indistinguishable from actual human conversation. ChatGPT’s context awareness and ability to understand natural language has made it the most popular AI tool in a year. According to Tech Insight (2023) OpenAI’s chatbot recorded 14.6 billion cumulative visits between September 2022 and August 2023.

AI has also made its place in the domain of predictive analysis; it is playing an important role in strategic planning (within software industry). By using machine learning algorithms, AI can predict the trends, user behaviour, and system performance by processing large data in support of decision making and developmental efforts (Alsheibani et al., 2018).

Some of the problems that AI might face in its integration include e.g., ethical issues, concerns regarding data privacy, and possible loss of jobs within software industry. The complexity of AI models requires tremendous computational resources and expert skills that could make small firms or companies not able to integrate AI with their systems ( Ahmed, 2021).

The status of AI utilisation in the software development is that the industry is undergoing a transformational phase where AI-driven tools and methods are becoming an integral part of the development process. Their influence will keep growing with further development

of AI and its results, bringing even more positive influence not only to software development but also to different areas of productive activity and innovation. Meeting these challenges of AI integration is to be a key point for the technology to be implemented effectively and in an ethically acceptable way.

## 2.4 Theoretical Frameworks for Value Creation

### 2.4.1 Defining Value in AI-enabled Software development

Value creation in the context of AI-enabled software development is multi-dimensional, encompassing multiple aspects e.g., economic, social, and innovation value. Value creation refers to the process through which AI technologies contribute in generating beneficial outcomes for software professionals, business organisations and end-users. The concept of value extends beyond monetary value or financial gain to include aspects from improvements in efficiency, innovation, quality and user satisfaction.

#### 2.4.1.1 Economic Value

Economic value refers to the direct financial benefits derived from AI integration, such as cost reduction, increased efficiency, and revenue growth. AI applications can streamline workflows, automate routine tasks, and optimise resource allocation, leading to significant economic gains for software development firms (Kaplan & Haenlein, 2019).

#### 2.4.1.2 Social Value

This dimension focuses on the impact of AI on social dynamics within development teams and client interactions. AI can enhance collaboration, improve stakeholder engagement, and elevate customer satisfaction through personalised experiences (Bughin et al., 2018).

#### 2.4.1.3 Innovation Value

AI's role in fostering innovation is pivotal. By enabling the development of new products, services, and processes, AI can open new markets and provide a competitive edge. AI-

driven tools can augment the creativity of software developers, leading to innovative solutions that address complex problems (Davenport & Ronanki, 2018).

### 2.4.2 Overview of Value Creation Theory

Value creation theory is the cornerstone theory that aims in understanding how businesses, organisations, entrepreneurs, or whole Economic systems develop and deliver value to stakeholders, shareholders, customers, and society at large. The core of this theory is to examine how value, in its various dimensions, is conceived, generated, and delivered in the economic exchange (Vargo & Lusch, 2004). This concept is central in business strategy and economic theory. It reflects the processes through which new products, services or experiences are created to meet market desires and needs (Sirmon et al., 2007) .

Value creation theory particularly in the context of modern business, does not have a single inventor. It has been developed and expanded upon by multiple scholars over the years. The Value creation theory has evolved over time to reflect shifts in economic models; from industrial to knowledge and network economies. This evolution underlines importance of interconnectedness of global markets and the importance of intangible assets (Prahalad & Ramaswamy, 2004).

According to Vargo and Lusch (2004) the simplest definition for value creation is the process where entities generate goods or services that are found to be worthwhile by people or organisations. The value is more than functionality these products or services provide, it can include other relevant elements such as convenience, innovation, or even emotional connection. Vargo and Lusch (2004) state that value is not merely in the services or goods but can be determined by the recipient’s or customers perception and own experience.

The view of Vargo and Lusch (2004) emphasises value co-creation, where customers are not passive receivers of a pre-defined product, or a service provided by a business. Emergence of co-creation represents a major shift in value creation theory and the Service-Dominant (S-D) Logic introduced by Vargo and Lusch (2004) laid the foundation for this perspective. Prahalad and Ramaswamy (2004) developed further the value co-creation

concept and highlighted the role of customer experience and interactions by suggesting that value co-creation allows more room for personalised and meaningful value outcomes which are rapidly growing importance in today's experience driven economy.

During this digital era, the rapid development and emergence of technologies such as artificial intelligence, internet of things (IoT) and blockchain, the value creation process has been transformed, and more personalised, interconnected, and efficient systems of exchange have been enabled. These new technologies bring new ways of value co-creation and throw a challenge towards traditional business models and strategies. (Porter & Heppelmann, 2014).

### 2.4.3 Service-Dominant Logic (S-D Logic)

The Service-Dominant Logic (S-D Logic) is a framework, introduced by Vargo and Lusch in 2004, redefining the concept of value. It can be seen as a paradigm shift in marketing and business thinking, moving away from traditional very strongly goods centric or goods dominant logic towards a service-centred view of market transactions. S-D logic posits that service for the benefit of others e.g. consumers – is the principle of all economic exchange, not goods. Central to this view are the intangible aspects of products and services as the heart of value creation.

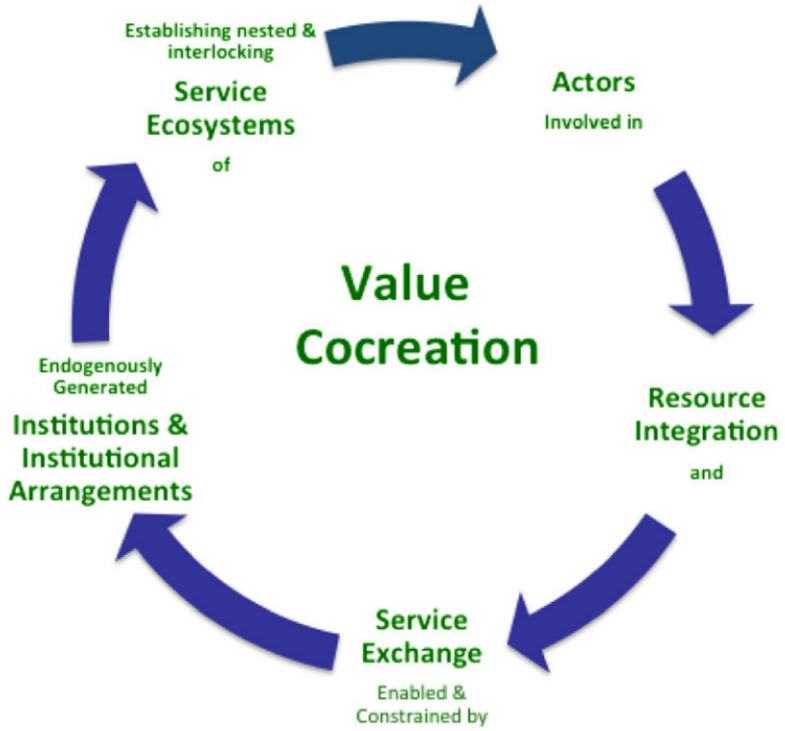



**Figure 3: The narrative and process of S-D Logic (Vargo & Lusch, 2016, p. 7)**

Vargo and Lusch have outlined several foundational premises of Service-Dominant Logic such as co-creation of value, the role of operant resources (knowledge and skills), and the view of customers participating actively in the value creation process. The most important tenet of the S-D Logic is the value is not in a good or service, but rather co-created through the service competence(s) by both the service provided and the customer within a service economy (Vargo & Lusch, 2008).

According to Vargo and Lusch (2004) value co-creation process is fuelled by three key elements: service competences, operand resources and service ecosystem. Service competences represent the knowhow and skillset that both customers and businesses bring in. Businesses take advantage of their expertise in service delivery, while consumers or customers contribute their own skills and knowledge about their preferences and individual needs. Operand resources are provided by the consumer or customer and are integrated with service competences to create value. Co-creation does not occur in

vacuum. It takes place in a service ecosystem, that is a network of actors who interact with each other and exchange resources. (Vargo & Lusch, 2004)

Embracing Service-Dominant Logic requires businesses to re-evaluate their approach to marketing, moving their focus on relationships, delivery of services, and the co-creation of value together with customers. Markets are reimagined as platforms for collaborative creation of value, defining the success of companies by their capacity to foster meaningful interactions with customers and other stakeholders (Vargo & Lusch, 2014).

According to Vargo and Lusch (2016) the rise of digital economy, the world powered by Internet, mobile technologies, and online platforms, has highlighted the importance and relevance of Service-Dominant logic. Digital technologies have altered the ways how companies are in interaction with their customers, enabling more personalised, context specific and real time services.

Importance of Service-Dominant logic is amplified by the following aspects of digitalised landscapes:

- Fuelling Co-Creation
    - Personalisation
    - Real-Time Interaction & Big Data
    - Context-Specific Value
- Strengthening Core S-D Logic principles
    - Focus on Service
    - Co-Creation at Scale
- Benefits for Businesses
    - Enhanced Customer Satisfaction

Digital platforms provide dynamic spaces for interaction and transactions and offer companies unseen possibilities to engage with the customers meaningfully and directly. Via these platforms, businesses can seek and gather insights into customer preferences and behaviours simultaneously allowing for the co-creation of value that is personalised and directly aiming to fulfil individual needs. By directly engaging with customers, the company fosters environment of reciprocal value co-creation, as described in S-D Logic. Service-Dominant logic emphasises value co-creation through shared experiences and interactions between service providers and customers (Vargo & Lusch, 2016).

Backbone of the digital economy, the big data, and analytics offer companies possibilities to provide services in real-time, customised, and tailored to the specific context of each customer interaction. These capabilities to offer immediate response appropriately to customer needs or situations exemplifies service-dominant view, where service delivery is adaptive and customer-centric. The capability to empower analytics and analyse huge datasets ensures that provided services are not only delivered at the right time but also highly relevant, enhancing the overall customer experience and facilitating more immense value creation (Vargo & Lusch, 2016).

According to Vargo and Lusch (2016) the collaborative approach to innovation where digital technologies have democratised the process of innovation, enabling customers to contribute feedback, ideas, and even content that can enhance the value of products and services is typical to Service-Dominant logic. S-D logic sees market participants such as customers, as resource integrators and potential innovators. The digital economy enhances this principle by offering the needed tools and platforms that enable this collaboration on a broad scale, making it both feasible and impactful.

In the context of digital economy, S-D Logic offers a robust framework for understanding and navigating the complex market exchanges of modern economy. It highlights the meaningfulness and importance of service, relationships, and co-creation in a digitally connected world, where consumer plays a more dynamic and essential role.

While artificial intelligence is transforming the business landscape, its integration with Service-Dominant logic holds magnificent potential for supercharging the value co-

creation. AI technologies are inherently service-oriented (Huang & Rust, 2018). They usually process, analyse, and act on information to serve specific purpose acting as an operant resource that facilitate the value co-creation. Artificial intelligence's ability to learn and adapt aligns with the Service-Dominant Logic emphasis on reciprocal and dynamic process of value co-creation (Vargo & Lusch, 2014).

#### 2.4.3.1 Co-creation of Value with AI

In the domain of AI and software development, S-D Logic provides a useful lens through which to understand value creation. AI systems, from machine learning models to complex data analytics platforms, exemplify the S-D Logic perspective by acting as operant resources that apply knowledge and skills to benefit users. The value of these AI systems is not inherent in the technology itself but is realised in the service they provide—be it enhancing decision-making, automating routine tasks, or generating new insights from data (Zhu et al., 2022).

A key tenet of S-D Logic is the co-creation of value between providers and users. In the context of AI and software development, this co-creation is evident in how technology providers and users collaborate to tailor AI solutions to specific needs. User feedback and interaction are crucial in refining AI systems, making the development process iterative and adaptive.

For instance, the deployment of AI in software development tools, such as automated testing frameworks, involves continuous feedback loops where developers use the tools, report issues, or suggest improvements, and the tool evolves over time. This collaborative process between the technology provider and the users ensures that the AI service remains relevant, effective, and valuable to its users.

Moreover, the open-source movement in software development exemplifies co-creation of value at a large scale, where communities of developers contribute to the creation and improvement of AI tools and libraries. This collective effort accelerates innovation and value creation, underscoring the importance of operant resources (the developers' knowledge and skills) in driving forward technological advancements.

## 2.5 AI's Impact on Value Creation in Software Development

Artificial Intelligence (AI) adoption and integration in the software development industry is being welcomed, pointing at the beginning of a new technological era. The research findings from the field underpin that AI is a disruptive technology with attributed benefits, including e.g., efficiency, greater accuracy, and improved user experiences, among others.

The efficiency in the processes of software development is largely increased by infusing AI. Automated testing and deployment applications are making it easy for software delivery with minimal manual oversight and fast delivery of the software product, courtesy of using AI algorithms (Harman et al., 2012). Automating workflows eliminates the chance for human error or risk and allows a far quicker pace of iteration and innovation.

The data processing capabilities of AI greatly surpass human capabilities, and therefore it enhances the accuracy of such works, from code generation to predictive analytics. For example, AI-based pair programming tool or AI coding assistant, GitHub Copilot, provides developers with context-aware, precise suggestions that are meant to enhance their productivity and quality (Chen et al., 2021).

In other words, AI technologies such as ChatGPT—the power of conversational interfaces—were revolutionizing users' experiences. These were the technologies that allowed software applications to become not only more intuitive but also more engaging than ever before, with output that replicates human conversation (Brown et al., 2020) .

### 2.5.1 Value for Development professionals

The advent of Artificial Intelligence (AI) in software development has marked a significant shift in how development professionals approach their tasks, solve problems, and innovate. This thesis explores the multifaceted value AI delivers to development professionals, emphasizing efficiency, quality, learning, innovation, and personalised experiences. GitHub's study from (2023) indicate that GitHub Copilot is the most used AI developer tool with more than one million developers and over 20,000 organisations. The data was collected with a survey with more than 900 000 respondents. In the same study it was stated that 92% of the developers said they are using AI both in work and during free time.

70% of surveyed developers stated that they see remarkable benefits when using AI tools. All this underlines how rapidly and totally these AI tools are changing the whole developer experience and the landscape of software development.

#### 2.5.1.1 Enhanced Efficiency and Productivity

One of the foremost benefits AI offers to development professionals is the substantial increase in efficiency and productivity. AI-powered tools like GitHub Copilot provide code suggestions in real-time, significantly reducing the time developers spend on routine coding tasks (GitHub, 2021). Additionally, automated testing frameworks powered by AI can execute complex test scenarios rapidly, identifying bugs and errors that might elude manual testing methods (Zhao, 2020).

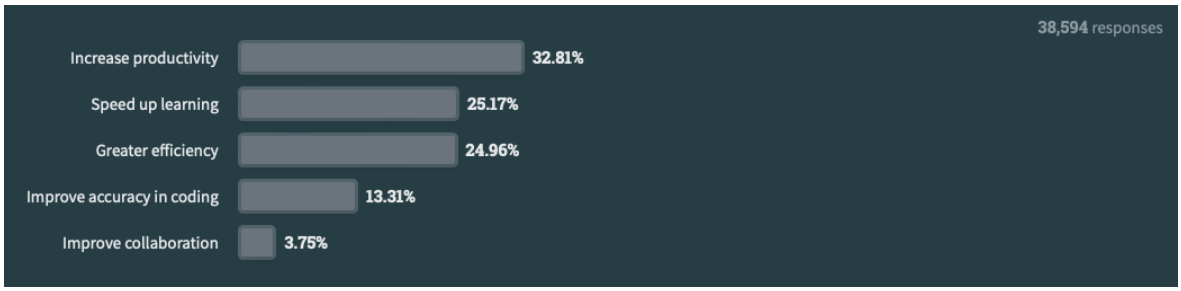



**Figure 4: Benefits of AI tools according to StackOvcrflow Developer Survey 2023**

Developer Survey organised by StackOverflow in 2023 stated that the biggest benefit of AI usage in software development is the increase in productivity and the gains in efficiency and learning speed (See Figure 4.).

**Table: Survey responses measuring dimensions of developer productivity when using GitHub Copilot**

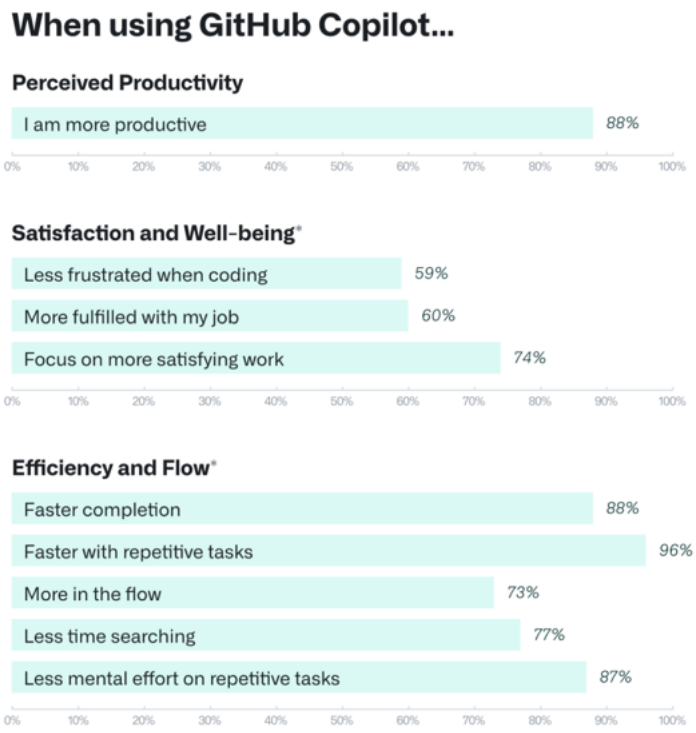



**Figure 5: GitHub survey data Developer productivity when using GitHub Copilot (GitHub, Inc., 2022)**

Similarly, GitHub's survey results regarding GitHub Copilot usage (in Figure 6.) have high percentages in productivity and efficiency ratings. Github's research (2023) with sample of 934, 533 developers indicates that users accept about 30% of all code Copilot is suggesting and are reporting increase in productivity because of these acceptances. It is remarkable that this 30% gain in efficiency is the baseline, but the impact increases over time (see Figure 6.). The same study reveals that Copilot speeds up coding tasks up to 55%. Same study reveals also that less experienced developers have greater advantage with AI, or in other words their acceptance rates / increase in productivity are higher.

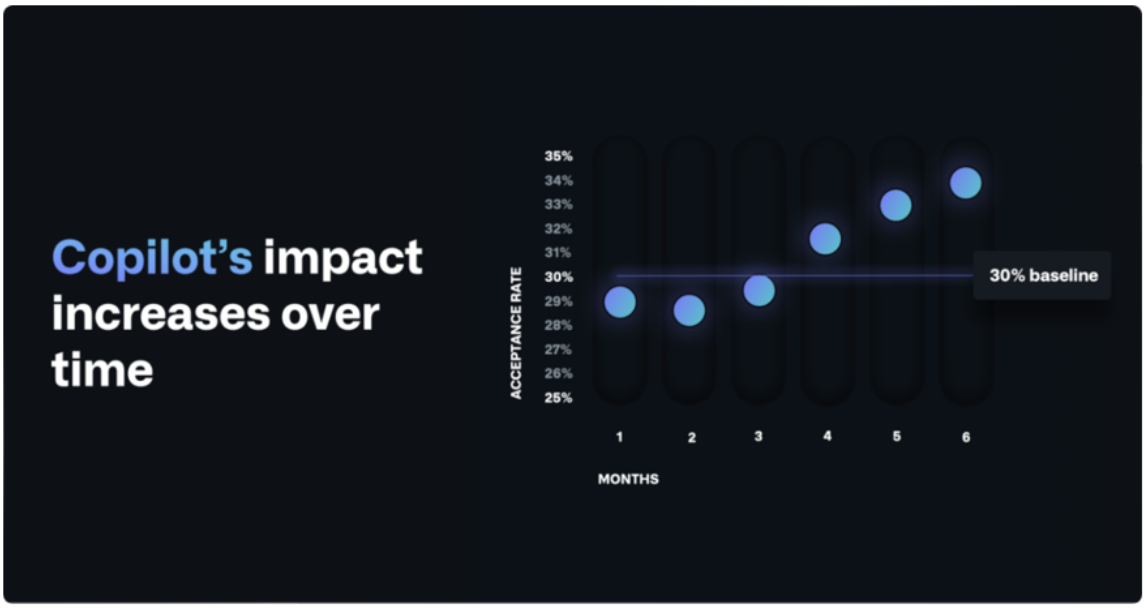



**Figure 6: GitHub Copilot's impact over time (GitHub Inc, 2023)**

#### 2.5.1.2 Increased Satisfaction & Improved DevEx

Developer experience (DX) or DevEx has been trending term while companies in the software industry have had a tough competition about the best talents on the market. McKinsey Digital (2022) states that: "For IT organisations that have gone through agile transformations and cloud migrations, the next set of opportunities to unlock engineering productivity is in developer experience (DX).". According to McKinsey Digital the DevEx is important for e.g., talent attraction or retention, productivity and costs savings, consistency and quality, security and compliance and speed.

For individual developers the good DevEx means that developers are enabled to do their best work without additional or unnecessary burdens and simultaneously their satisfaction and happiness related to work is increased. A preferable side product is the efficiency improvement.

GitHub's survey data (GitHub, Inc., 2022) indicates that by using AI based GitHub Copilot the satisfaction and well-being metrics were indicating that GitHub Copilot had a good impact on DevEx (See Figure 5.). Nearly three quarters (74%) reported that they can focus

on more satisfying work and 60% reported feeling more fulfilled with their job. Important metrics were also the “More in the flow” 73% and “Less mental effort on repetitive tasks” 87%. In GitHub’s (2023) developer survey the respondents indicated clearly that AI tools can prevent burnout with share of 41% of over 1000 respondents stating that. In GitHub’s survey in 2023 73% of the respondents answered that they feel more fulfilled at work with using AI tools.

AI’s personalization algorithms can tailor the development environment to match individual preferences and working styles, enhancing usability and satisfaction. Whether through customised code suggestions or adaptive user interfaces, AI creates a more engaging and efficient development experience for professionals (Kaplan & Haenlein, 2019).

#### 2.5.1.3 Improved Code Quality

AI’s capability to analyse and learn from vast datasets enables it to identify patterns and anomalies in code, leading to improved code quality. Static code analysis tools, such as SonarQube, leverage AI to detect potential vulnerabilities, code smells, and bugs, guiding developers towards more efficient and secure coding practices (SonarQube, n.d.).

#### 2.5.1.4 Facilitated Learning and Skill Enhancement

Continuous learning is a cornerstone of software development. AI-driven platforms, including ChatGPT, serve as on-demand mentors, offering explanations, coding tips, and up-to-date information on the latest programming trends and best practices (Brown et al., 2020). This instant access to knowledge not only enhances developers’ skills but also keeps them abreast of evolving technologies.

A survey conducted by GitHub (2023) states that 57% of the respondents acknowledged that using AI helps them develop their coding language skills. This result indicates that developers consider AI as a tool to upskill.

#### 2.5.1.5 Innovation and Creativity

By automating routine and repetitive tasks, AI allows development professionals to devote more time to creative problem-solving and innovation. This shift in focus fosters an environment where new ideas and approaches can flourish, leading to the development of ground-breaking software solutions (Brynjolfsson & McAfee, 2017).

#### 2.5.1.6 Risk Reduction and Predictive Analytics

AI's predictive analytics capabilities enable developers to foresee potential issues and risks in the software development process. By analysing historical data and current project metrics, AI tools can predict project delays, cost overruns, and potential quality issues, allowing teams to mitigate risks proactively (Davenport & Ronanki, 2018)

### 2.5.2 Value for Organisations

The impact of Artificial Intelligence (AI) extends beyond individual development professionals, offering substantial benefits to organisations within the software industry. This chapter outlines the advantages AI brings to organisations, from operational efficiencies and cost savings to fostering innovation and ensuring competitive advantage.

#### 2.5.2.1 Operational Efficiency and Cost Savings

AI-driven tools automate and optimise many aspects of the software development lifecycle, from initial design to deployment and maintenance. This automation reduces the manual effort required, speeding up the development process and leading to significant cost savings. For instance, AI can automate the more tedious aspects of coding and testing, reducing the need for extensive manual labour and lowering the likelihood of costly errors. This reduction in labour hours translates directly into cost savings. According to a study conducted by McKinsey (2023) companies that take advantage of AI in their development processes see a productivity impact in between 20-45% of the current annual spending on the function. The increase in efficiency came primary from reduced time spent on tasks. In McKinsey's study AI was seen as a strong accelerator in software development.

Research conducted by Deloitte (2022) indicates that predictive maintenance strategies and usage of advanced analytics can increase equipment uptime by up to 20% and reduce breakdowns by 70%. According to Deloitte's study predictive maintenance can increase productivity up to 25% and long-term maintenance costs can be decreased by up to 25 % by preventing extensive repairs and downtime. AI-enhanced tools can provide predictive maintenance capabilities that can foresee potential system failures and software bugs. Addressing these issues before escalation can drastically reduce software downtime costs.

A GitHub (2023) study indicates that developer productivity benefits could boost global GDP by over $ 1.5 trillion while using 30% as productivity enhancement number with an estimate of 45 million professional developers in 2030. This means at large about efforts of additional 15 million developers in capacity (see Figure 7.).


**Figure 7: AI productivity gains for global economy (GitHub Inc, 2023)**

#### 2.5.2.2 Enhanced Product and Service Quality

The use of AI in software development enables organisations to produce higher-quality products and services. Through advanced analytics and machine learning algorithms, AI tools can predict user needs and preferences, guiding the development of more relevant

and user-centric software solutions. Additionally, AI's ability to detect and rectify code anomalies improves software reliability and security (Lwakatare et al., 2016).

#### 2.5.2.3 Driving Innovation and Competitive Advantage

AI technologies are at the forefront of innovation in software development, enabling organisations to explore new markets and create novel solutions. By leveraging AI, companies can identify emerging trends and adapt quickly, maintaining a competitive edge in the fast-paced technology sector (Bughin et al., 2018).

Report from Bain & Company (2023) shows that AI tools could help in speeding up 20% of development related tasks without negative impacts in quality. By increase in developer efficiency, AI tools help speed up the development lifecycle. Faster coding, immediate bug detection, and faster testing cycles enable companies to bring products to market rapidly than before AI. According to a report by Bain & Company (2023) 76% of executives in companies using generative AI-based coding assistants said that AI has exceeded their expectations and that biggest perk from AI usage has been faster time to market. Quicker launches create faster return on investment.

#### 2.5.2.4 Data-Driven Decision Making

AI's ability to process and analyse vast amounts of data equips organisations with insights for more informed decision-making. From optimizing resource allocation to predicting market trends, AI empowers organisations to make strategic decisions that align with their business objectives and customer needs (Agrawal et al., 2018).

#### 2.5.2.5 Attracting and Retaining Talent

Organisations that adopt AI technologies in their software development processes can attract and retain top talent. Development professionals are often drawn to companies that embrace cutting-edge technologies, providing them with opportunities to work on innovative projects and enhance their skills (Kaplan & Haenlein, 2019).

## 2.6 Challenges and Barriers to AI Adoption and Utilisation

Examination of the benefits and challenges of AI integration into the software industry illustrates a landscape that is marked by very significant advancements and complex dilemmas at the same time. This chapter delves into the literature on the barriers to effective AI adoption within the software industry, highlighting cultural, technological, and regulatory hurdles, workforce displacement and ethical concerns and briefly explores potential strategies for overcoming these obstacles.

### 2.6.1 Cultural Barriers

Cultural barriers represent one of the significant obstacles to AI adoption within organisations. A resistance to change, rooted in the fear of the unknown and potential job displacement, can hinder the willingness of both management and employees to embrace AI technologies. Additionally, a lack of understanding and trust in AI systems contributes to scepticism about their effectiveness and potential benefits (Davenport & Ronanki, 2018). To overcome these cultural barriers, organisations must make investments in education and training programs to demystify AI and demonstrate its value proposition. Creating a culture of innovation and continuous learning can foster a more fruitful environment towards AI technology adoption.

### 2.6.2 Workforce Displacement

The most concerning issue, however, is the fear of job displacement with the emergence of AI. Most of these jobs include routine tasks easily taken over by automation. In fact, the migration to AI might add another layer of challenge to the already snowballing problems in retooling the workforce for shifts in certain sectors (Frey & Osborne, 2017).

A study from GitHub (2023) states that: *"… this collision of AI and the software developer will not lead to a decrease in developer jobs – it will lead to AI augmented developer potential and accelerating human progress."*. This statement from GitHub indicates that not all are expecting a decrease in development jobs.

### 2.6.3 Technological Barriers

Technological challenges also pose significant barriers to AI adoption. These include issues related to data quality, integration with existing systems, and the complexity of AI technologies. The success of AI projects heavily relies on the availability of high-quality, structured data, which can be a significant limitation for organisations with legacy systems and unstructured data repositories (McKinsey&Company, 2017). Overcoming these technological barriers requires a strategic approach to data management and governance, as well as investments in infrastructure that can support the seamless integration of AI technologies. Additionally, simplifying AI tools and offering more user-friendly platforms can lower the threshold for adoption.

### 2.6.4 Regulatory Barriers

The regulatory landscape represents another critical hurdle for the adoption of AI in the software industry. Concerns around privacy, data protection, and ethical use of AI have led to increased scrutiny and regulatory requirements. Navigating this complex regulatory environment can be challenging for organisations, particularly small and medium-sized enterprises with limited legal resources (Wirtz et al., 2019). To address these barriers, it is essential for organisations to stay informed about relevant laws and regulations, and to develop AI applications in alignment with ethical guidelines and best practices. Collaborating with regulatory bodies and seeking clarity on compliance requirements can also mitigate the risk of regulatory infringements.

### 2.6.5 Lack of transparency and explainability

Many of the complex AI models operate as "black boxes," where the decision-making process behind their outputs remains unclear for the user. This lack of transparency makes it difficult to understand how AI systems arrive at their conclusions, hindering accountability and raising questions about fairness. Developing explainable AI models that can provide insights into their reasoning is crucial. This allows for human oversight, error correction, and fosters trust in the system's decision-making (Samek et al., 2017). Great example of this black-box AI decision making could be an AI-powered loan approval system

that might deny a loan application without providing clear reasons, leaving the applicant frustrated and unsure of how to appeal the decision.

### 2.6.6 Ethical Concerns

Rapid increase in usage of AI has raised multiple ethical questions. The ethical oversight to guarantee transparent and fair AI systems operation demands long-term scrutiny together with formulating ethical guidelines for the use of AI (Jobin et al., 2019). Ethical concern topics raised in Chinese AI ethics papers in Figure 6.

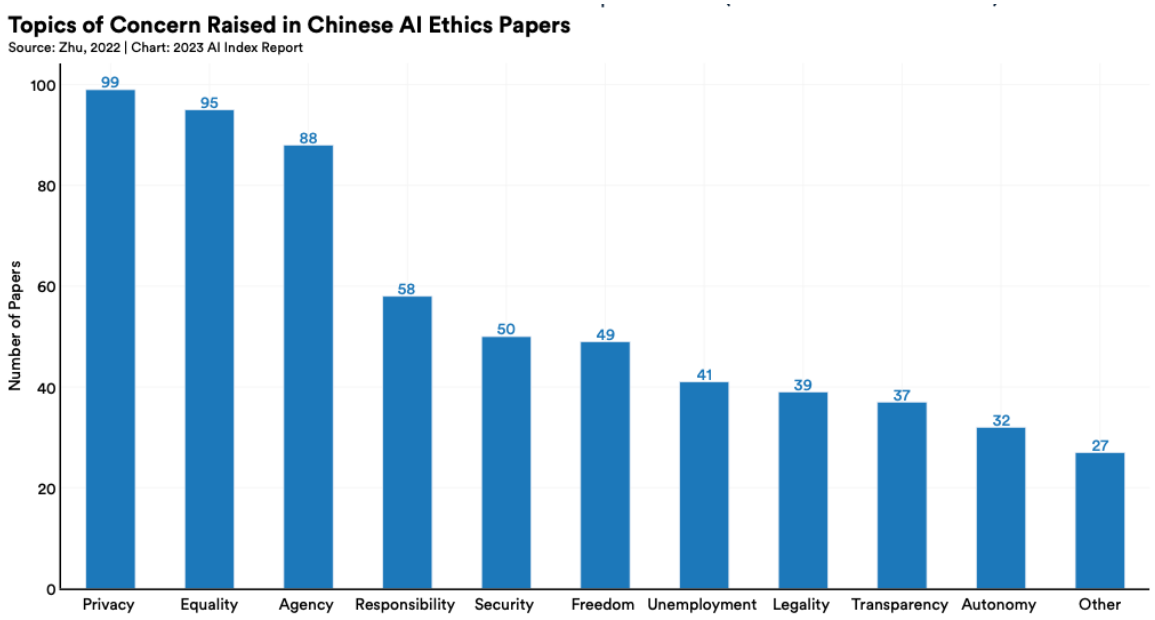



**Figure 8: Topics of Concern Raised in Chinese AI Ethics Papers (Maslej et al., 2023)**

One of the most significant ethical concerns with AI in software development is the potential for bias and discrimination. AI algorithms learn from the data they are trained on, and if this data reflects existing societal biases (e.g., racial, gender, socioeconomic), the resulting AI tools could perpetuate or amplify these biases. This can e.g., lead to discriminatory outcomes in areas like hiring algorithms, loan applications, or facial recognition systems (Bender et al., 2021). Mitigating bias requires careful selection and cleansing of training data, diverse development teams, and ongoing monitoring of AI outputs for potential bias.

According to Artificial Intelligence Index Report 2023 (Maslej et al., 2023) the number of incidents and controversies regarding ethical misuse of AI has increased remarkably. The number has increased 26 times since 2012. The same report also states that interest in AI ethics is high. Figure 7. Represents the toxicity levels within AI models. According to Vakkuri (2022) software industry can be supported in addressing AI ethics concerns by empowering the developers and dev teams to address ethical considerations. Vakkuri states that AI ethics guidelines (if created) should be actionable (Vakkuri, 2022).

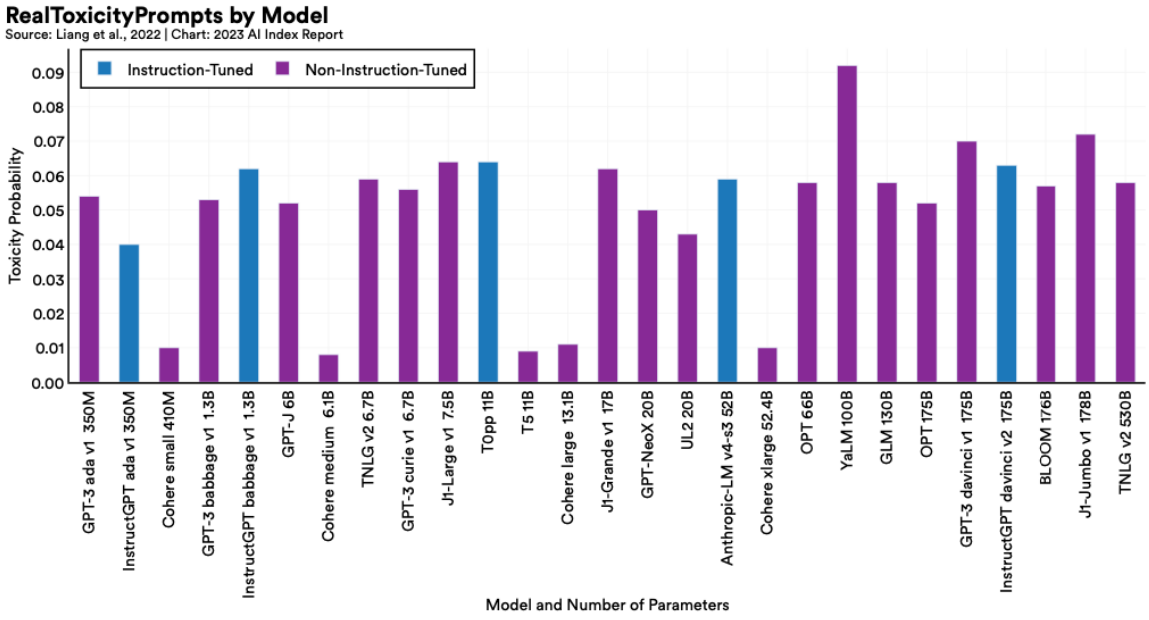



**Figure 9: RealToxicityPrompts by Model (Maslej et al., 2023)**

# 3 Methodology

## 3.1 Introduction

Purpose of this chapter is to introduce the chosen methodology, in this case survey research that was conducted as a part of this Master's Thesis. First and most important goal for the author is to be able to contribute valuable insights to the field of AI after analysing the survey results.

The purpose of the survey was to gather data on how software development professionals in software industry use AI tools and to what purposes, to identify the tools in use, identify potential challenges and perceived benefits. Furthermore, purpose was to assess effectiveness of AI tools by surveying professionals about their experiences, the impact of AI on their work and ant perceived benefits or drawbacks. Survey also investigated briefly ethical concerns such as questions regarding bias, potential impact of AI on jobs and data privacy/security and briefly about barriers to adoption and future trajectories of AI tools in software industry.

Data analysis techniques have been selected to examine the collected survey data from multiple angles. Quantitative data analysis will rely on descriptive statistics, while qualitative analysis is used to interpret open ended responses and extract themes.

This chapter provides a blueprint of the research methodology, starting with a description of research design, followed by explanation of the survey design, sampling, data collection, and analysis procedures. Ethical considerations and research limitations are also briefly discussed to ensure transparency and reflexivity in the research process.

## 3.2 Research Design

Survey research is defined by the Check& Schutt (2011) as "the collection of information from a sample of individuals through their responses to questions". Surveys can include both quantitative research strategies as well as qualitative strategies or mix of both. Survey

as method is frequently used to explore and describe human behaviour e.g., in psychological and social research (Singleton et al., 1988).

Survey was selected as a primary data collecting method in this thesis for various reasons. Firstly, it was easy to distribute online, and a diverse group of software industry professionals had easy access to it. Secondly, survey could incorporate a good mix of question types, from Likert scale and multiple-choice questions to open-ended responses. This allowed for the collection of both quantitative data and qualitative insights to ensure understanding nuanced views and experiences with AI tools. Mixed-methods approach could provide well rounded view of AI utilisation. Third reason to choose survey as method is the structured nature of surveys. Especially the closed-ended questions ensure that the data is collected in a standardised and comparable format. This made it easier to compare responses across different groups, analysing of trends and differences in AI utilisation based on demographics, job roles, or experience levels.

Fourth reason for choosing survey as a method is its efficiency. Data can be collected from a relatively large group of respondents without the need of extensive time or resources. Fifth reason is that surveys are particularly adept at gauging perceptions, attitudes, and possible future trends. These are essential for understanding how software industry professionals see the role of AI in their work, the benefits they perceive, and their concerns or challenges with AI tools and technologies. Finally, surveys can be designed to ensure respondent anonymity. Anonymity may encourage more honest and candid responses, especially on potentially sensitive topics such as challenges and risks associated with AI tool usage. Honest feedback on the other hand is vital for realistic assessment of AI's impact on the software industry and software development.

## 3.3 Survey Design

### 3.3.1 Questionnaire Development

Researcher conducted a literature review analysis and familiarised herself with the earlier studies of AI, before beginning the process of developing the survey questions. She also tested various AI tools to better understand which questions could be asked and which

statements could be deemed relevant for the AI tool users. Combining both the literature review and usage experience helped to create a baseline for the questions and statements. AI tools such as Google Gemini and ChatGPT4 were used in the survey question brainstorming phase.

Survey consists of various question types. Altogether there were 33 questions in the survey (can be found in appendix). Different question types used are multiple choice, numerical input, Likert scale, check-all-that-apply and open-ended.

The survey structure is constructed around nine themes and the question types, counts and purposes are described as follows:

**Demographics and Background Information**

- Count: 2 questions
- Type: Multiple choice, numerical input
- Purpose: Gather respondent demographic and professional background information.

**AI Usage & Training**

- Count: 4 questions
- Type: Multiple choice
- Purpose: Assess AI tool usage and interest in future use and training.

**Familiarity with AI Tooling**

- Count: 12 questions (11 Likert scale, 1 Check-all-that-apply)
- Type: Likert scale (Options: 1: Not familiar, 5: very familiar), check-all-that-apply
- Purpose: Gauge familiarity with specific AI tools and their work usage.

**AI Usage Purposes**

- Count: 1 question
- Type: Check-all-that-apply
- Purpose: Identify the purposes for which AI tools are used.

**Perceived Benefits I & II**

- Count: 2 questions (altogether 32 statements)
- Type: Likert scale
- Purpose: Understand perceived benefits of AI tool usage in various aspects of work.

**Risks & Challenges**

- Count: 2 questions (Likert scale (18 statements in one of them), open-ended)
- Type: Likert scale, open-ended
- Purpose: Explore challenges and concerns associated with AI tool usage.

**Ethics and Bias**

- Count: 2 questions (1 Likert scale, 1 open-ended)
- Type: Likert scale (options: very concerned, somewhat concerned, neither concerned nor unconcerned, somewhat unconcerned, very unconcerned), open-ended
- Purpose: Address ethical considerations and experiences with bias in AI.

**Impacts of AI**

- Count: 5 questions (2 Likert scale, 3 open-ended)
- Type: Likert scale (options 1: AI tools have not affected, 5: AI tools have definitely had an effect), (options: Not satisfied, Very much satisfied), open-ended
- Purpose: Evaluate the impact of AI on efficiency, job satisfaction, and specific work tasks.

**Future Trajectories**

- Count: 3 questions (1 Likert scale, 2 open-ended)
- Type: Likert scale (options: 1: Not confident, 5: Definitely more confident), open-ended
- Purpose: Gather expectations and suggestions for the future role and integration of AI in software development.

### 3.3.2 Pilot Testing

Pilot testing was done with 3 participants. First pilot tester was researcher's spouse who is also working in software industry and other two pilot testers were fellow students who work full time in the software industry. After pilot testing some changes and adjustments were made to certain questions. Number of questions went down from 38 to 33 and the number of statements in "questions" 20.-22. was diminished. Some spelling errors were corrected and few alterations to the order of the question was made.

However, the biggest change based on the pilot tests happened in the survey online platform. Originally the survey was built on Microsoft Forms online platform. During the pilot tests it was found out that Microsoft's platform had remarkable problems with statements that used Likert scale (see Figure 2. below). Likert scale answer options were visible only as user scrolled the screen sideways and thus the usability was horrible. Issue was well known, and Microsoft had received a lot of feedback regarding this bug based on the Microsoft's online discussion forums.

The survey was already on the heavier side with quite many questions and statements, the Likert scale issue threatened to cause real problems. Survey was tested on various browsers, various screen resolutions, screen sizes and both computer screens and mobile screens. Only browser's developer setting adjustments helped in the Likert scrolling issue, but this was not something one should have to do to participate in a survey. Researcher decided to move the survey from Microsoft Forms to Google Forms platform instead, since Google's platform did not suffer about similar problems. It is worth mentioning that Microsoft fixed the bug during the data collection period of the survey.

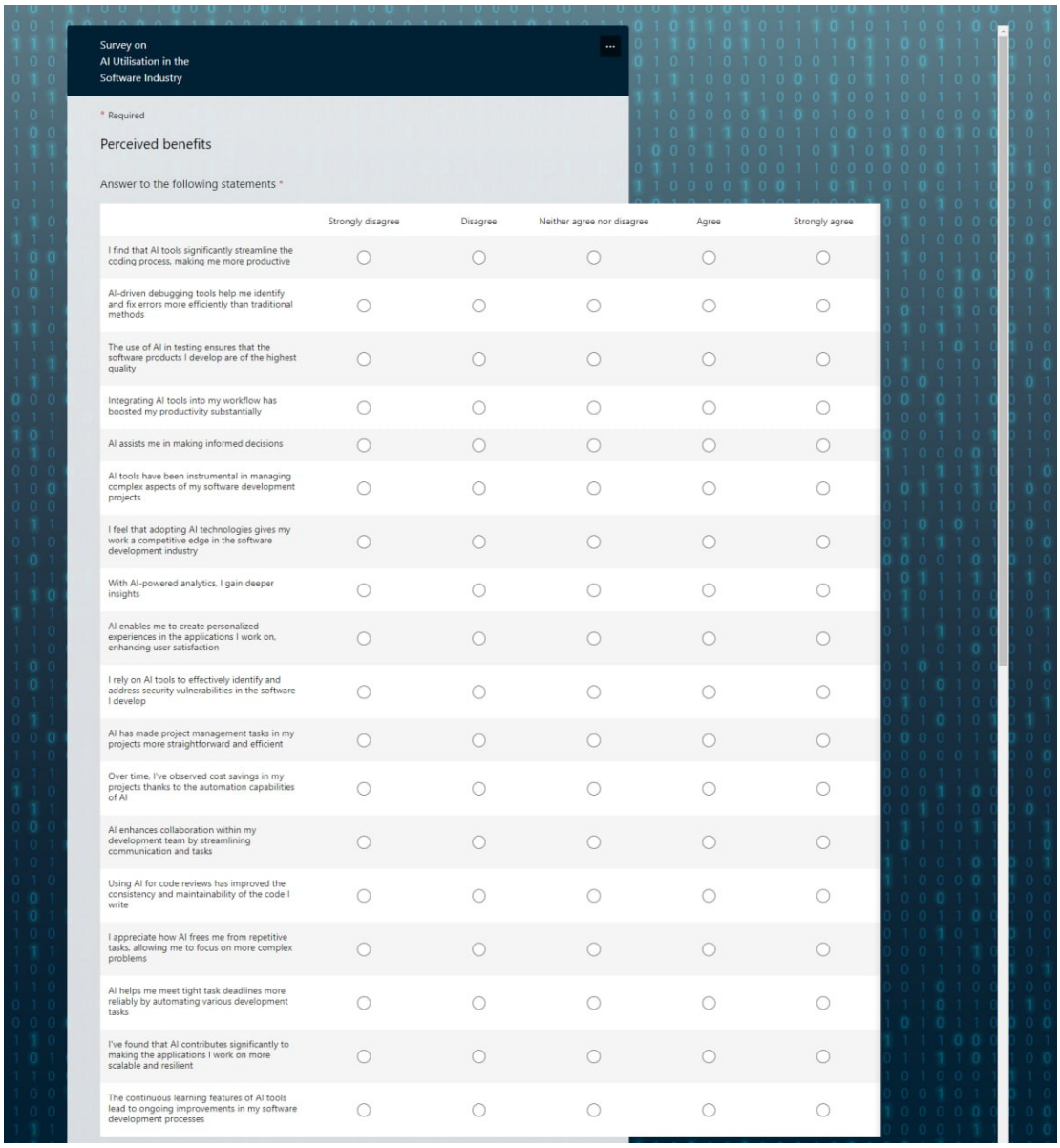



**Figure 10: Likert scrolling issue in Microsoft Forms fixed by adjustments made in browser developer settings**

## 3.4 Sampling

### 3.4.1 Population and Sample

Population of interest in this Thesis survey includes all the professionals working within the software industry who are engaged in roles that may interact or be influenced by AI technologies or tools. Ideally the population would span across various job functions, different experience levels to provide a comprehensive understanding of the AI utilisation across the software industry.

The selected sampling strategy aligns with non-probability sampling, especially convenience and voluntary response sampling. The survey was distributed via two main channels: LinkedIn, a professional networking site, and Slack, a communication platform used within software consultancy company where the researcher is employed.

By distributing the survey via LinkedIn, the reach was extended to a broad array of professionals connected to the researcher's network, which includes individuals from various sectors within software industry. However, it is remarkable to note that the sample drawn from LinkedIn may exhibit a self-selection bias, as it is comprised of individuals who have chosen to engage with the researcher's content and may have particular interest in AI.

In addition to LinkedIn, the link to the survey was also shared on multiple Slack channels within the software consultancy company where researcher is employed. This channel utilised by colleagues spanning a range of roles pertinent to DevOps and software development. The rationale for selecting this channel is its accessibility and the high engagement level of potential respondents familiar with AI tools and their implications in the workplace.

The resulting sample is therefore a mixture of convenience and self-selection, which may influence the diversity and representativeness of the responses. The participants who responded to the survey likely constitute a more engaged segment of the population concerning AI software development, which can yield very valuable insights into the most current and active uses of AI within the industry.

One of the limitations of this sampling method is the potential bias introduced non-random selection processes. Respondents may possess characteristics that make them more likely to see and respond to the researcher's survey – such as being in the researcher's network or working as colleagues within the same company as the researcher. Caution must be exercised when generalising the findings from this particular sample to the entire population.

While the sampling mechanism does not allow for statistical generalisation, it provides insightful and practical data that can be used to infer patterns and trends in AI utilisation among a segment of the software industry that is easily and readily accessible for the researcher. The insights gathered from this study will contribute to a foundational understanding and may inform subsequent research employing more systematic sampling techniques.

### 3.4.2 Sample Size

The sample size for the survey was determined primarily by the reach of the distribution channels rather than a predetermined number based on statistical power analysis. As the survey's distribution channels were researcher's LinkedIn network and researcher's work-related Slack channels, the size of the sample was contingent on the number of individuals within the researcher's network and company who had access to and engaged with these platforms.

Given the non-probability nature of convenience and voluntary response sampling methods that were used, the survey did not aim to fulfil the requirements of a statistically representative sample, where size can be precisely calculated to achieve certain confidence level or margin of error. Instead, the sample size is reflective of the number of respondents who voluntarily chose to participate after encountering the survey posting on the mentioned platforms.

On LinkedIn, the potential reach was to the extent of the researcher's professional network and any subsequent shares or visibility the posting gained through LinkedIn platform algorithms. Within the workplace Slack channels, the sample was limited to the number of active colleagues who saw the posting and chose to engage with the survey link. Company X , where the link was shared in Slack, has more than 600 employees.

Due to the factors, the total number or responses received serves as the sample size of the study. This number (37 responses), while not statistically generalisable, does still provide valuable insights into AI utilisation trends and perceptions among a segment of professionals who were reachable and motivated to share their experiences.

## 3.5 Data Collection

### 3.5.1 Online Survey

Survey was conducted with Google Forms online platform. The survey was composed of a series of questions with aim of receiving both quantitative and qualitative responses. The survey included various question types, such as Likert scales, multiple-choice questions, and open-ended questions, allowing for a rich dataset that captures a multitude of perspectives on AI usage within software development domain. See Appendix.

### 3.5.2 Purpose of the study

Respondents participated to the survey based on their own free will and interest. Separate consent information was not collected. There was no prize or money offered in return for the participation. Everyone who participated knew why the survey was conducted and that their answers helped in the authors Master's Thesis research and were thus providing value for the scientific community. See Appendices for Introduction text of the survey.

### 3.5.3 Distribution of the Survey Link

The survey was disseminated through two main channels to reach participants within the software industry:

- LinkedIn: Utilizing the professional networking capabilities of LinkedIn, the survey was published as a post with a call to action for all the eligible industry professionals to participate. This method facilitated access to a diverse audience, encompassing different roles, experience levels, and geographical locations.

- Workplace (Company X) Slack: The survey was also shared in Slack channels within the researcher's Workplace (software consultancy company). This channel was chosen due to its engaged user base and the likelihood of gathering informed responses from professionals interested in AI technology.

### 3.5.4 Data Collection Period

Survey responses were collected between 13th - 25th of March 2024 and within that time 37 responses were recorded.

### 3.5.5 Response Tracking

Responses were collected and tracked using Google Forms. The online survey platform was configured to anonymise respondents and not collecting any IP-addresses or email addresses thereby protecting privacy of respondents and encouraging honest and candid participation.

### 3.5.6 Data Handling

Upon completion, the survey responses were extracted from Google Forms as an csv file and securely stored for researcher' s analysis. Personal data was not collected, and all responses were treated as confidential, with access restricted to the researcher.

## 3.6 Data Analysis

### 3.6.1 Quantitative Data Analysis

Quantitative survey data was analysed with SPSS Statistics software in a macOS computer. Initial steps included data cleaning, coding, and grouping to prepare the survey data for proper analysis. Given the convenience and voluntary response nature of the sampling, the quantitative analysis will focus on descriptive statistics such as mean, frequencies and percentages for categorical data were generated from the survey data. Also, where seen relevant, cross-tabulations were conducted to properly examine the relationships between categorical variables. The limitations imposed by the sampling method, inferential statistical methods such as ANOVA or chi-square tests were not conducted.

### 3.6.2 Qualitative Data Analysis

The qualitative analysis in this thesis aims to deepen the understanding of the survey results by providing contextual insights that qualitative data cannot offer alone.

Seven open-ended questions were included in the survey. Open ended questions were about risks and challenges, bias, efficiency and benefits, negative impacts, AI adoption and AI's future role. Qualitative data (from the open-ended questions) is analysed by the researcher using manual thematic analysis. Excel was used as a helping tool in the thematic analysis.

Besides open-ended questions, also the statements were manually thematically grouped to offer more comprehensive understanding of the study's research questions.

## 3.7 Ethical Considerations

Respondents participated to the survey based on their own free will and interest. Separate consent information was not collected. In conducting this research, ethical considerations were given utmost priority to protect the dignity, rights, and welfare of all participants. The survey and thesis research were designed and carried out in full compliance with the ethical standards of academic research, as outlined by the American Psychological Association (APA).

### 3.7.1 Confidentiality and Anonymity

To maintain confidentiality, no personal identifying information was collected. The online survey platform was configured to anonymise IP addresses, email addresses and other indirect identifiers. Individual respondents cannot not be traced in the published results.

### 3.7.2 Data Usage and Security

Participants were informed that the collected data is to be used for academic purposes only. Data security measures were implemented to protect the information collected from participants. All digital data was stored in a computer that has disk encryption in use. Only the researcher has access to the dataset.

### 3.7.3 Minimisation of Risk and conflict of interest

The survey was designed to minimise any potential risk to participants. The survey did not collect sensitive personal information or ask questions that could cause psychological distress.

The thesis research was conducted impartially, and no external funding with stipulations that could influence the outcome of the research was accepted.

## 3.8 Limitations

The research design and methodology for this thesis on AI utilisation in the software industry inherently possess certain limitations that must be acknowledged. These limitations stem from the sampling method, the survey design, and the generalisability of the findings.

### 3.8.1 Sampling Limitations

The biggest limiting factor arises from the sampling strategy. As the survey was distributed through LinkedIn and the researcher's workplace Slack channels, it reflects a convenience sampling method, which does not guarantee a representative sample of the entire software industry. This method often yields a self-selecting group of respondents who are more likely to have an interest or opinion (on AI in this case), potentially skewing the results. Additionally, the voluntary nature of participation may result in response bias, where those who have strong opinions—either positive or negative—may be more inclined to participate.

### 3.8.2 Survey Design Limitations

Although researcher took extra care in the design of the survey, the complex nature and rapid evolution of AI technology / AI tools might mean that despite best efforts not all aspects of its utilisation are captured. Furthermore, the survey relies on self-reported data, which can always be subject to inaccuracies due to recall bias or the desire of respondents to present themselves in a more favourable light.

### 3.8.3 Data Analysis Limitations & Generalisability

Given the non-probability nature of the sample, the quantitative data analysis predominantly focuses on descriptive statistics, limiting the ability to make inferential conclusions about the population as a whole. The findings of this survey are specific to the sample obtained and may not be generalisable to all software industry professionals. The sample is likely to reflect the characteristics of the researcher's network and the employees of the specific software consultancy company. Thus, results should be interpreted with caution.

# 4 Survey and Results

Purpose of this chapter is to discuss the results of the survey that was organised as a part of this thesis. Results are presented here in this chapter in a rather plain manner without deeper analysis. Chapter 5. continues to analyse the findings further and ties them into existing literature.

## 4.1 Respondent Demographics

Sample size for the survey is 37. Table 1. below is representing the different work roles of the survey respondents and their percentual shares and actual number of respondents.

The biggest group or survey respondents are Software developers / Engineers / Designers with 24,32% and 9 participants. The second biggest group of survey respondents are Software Architects with share of 16,22% and 6 respondents. Third group are DevOps / DevSecOps Specialists 13,51% and 5 respondents. One survey respondent reported to be a DevOps Transformation Lead and if this role is included in other DevOps roles in statistics, survey had altogether 16,22% / 6 DevOps related respondents. Three Product Owners (8,11%) participated along with one Product Manager (2,70%). Altogether 4 (10,81%) product related respondents. There were also 2 respondents among Lead Consultants, Managers, Project Managers, System Administrators and UI/UX Designers. Also, one System Specialist and one Team lead responded.

**Table 1: Work role percentages in survey results**

| Role | Work role (Count) | Work role % |
|---|---|---|
| DevOps / DevSecOps Specialist | 5 | 13,51 % |
| DevOps Transformation Lead | 1 | 2,70 % |
| Lead Consultant | 2 | 5,41 % |
| Manager | 2 | 5,41 % |
| Product Manager | 1 | 2,70 % |
| Product Owner | 3 | 8,11 % |
| Project Manager | 2 | 5,41 % |
| Software Architect | 6 | 16,22 % |
| Software Developer / Engineer / Designer | 9 | 24,32 % |
| System Administrator | 2 | 5,41 % |
| System Specialist | 1 | 2,70 % |
| Team lead | 1 | 2,70 % |
| UI/UX Designer | 2 | 5,41 % |
| **Grand Total** | **37** | **100,00 %** |

The work experience years within roles can be seen in Table 2. On average the respondents had 14 years of experience. Experience levels of participants varied from 1 year to over thirty years. Further in this result analysis the experience distribution of the participants is divided in 6 groups (seen in Table 3.). Biggest experience groups are 0-5 years and 10-15 years with the frequency of 9 and share of 24,3%. Third group is 20-25 years with the frequency of 7 and share of 18,9%. Fourth group is 5-10 years with frequency of 6 and share of 16,2%. Last equally sized groups are 15-20 years and 25+ years both having the frequency of 3 and share of 8,1%

**Table 2: Respondent experience levels within work roles**

| Role | Average of How many years of relevant experience you have in software industry? |
|---|---|
| DevOps / DevSecOps Specialist | 16 |
| DevOps Transformation Lead | 23 |
| Lead Consultant | 24 |
| Manager | 14 |
| Product Manager | 35 |
| Product Owner | 11 |
| Project Manager | 12 |
| Software Architect | 15 |
| Software Developer / Engineer / Designer | 8 |
| System Administrator | 4 |
| System Specialist | 3 |
| Team lead | 15 |
| UI/UX Designer | 24,5 |
| **Grand Total** | **14** |

**Table 3: Experience group percentages**

**Experience**

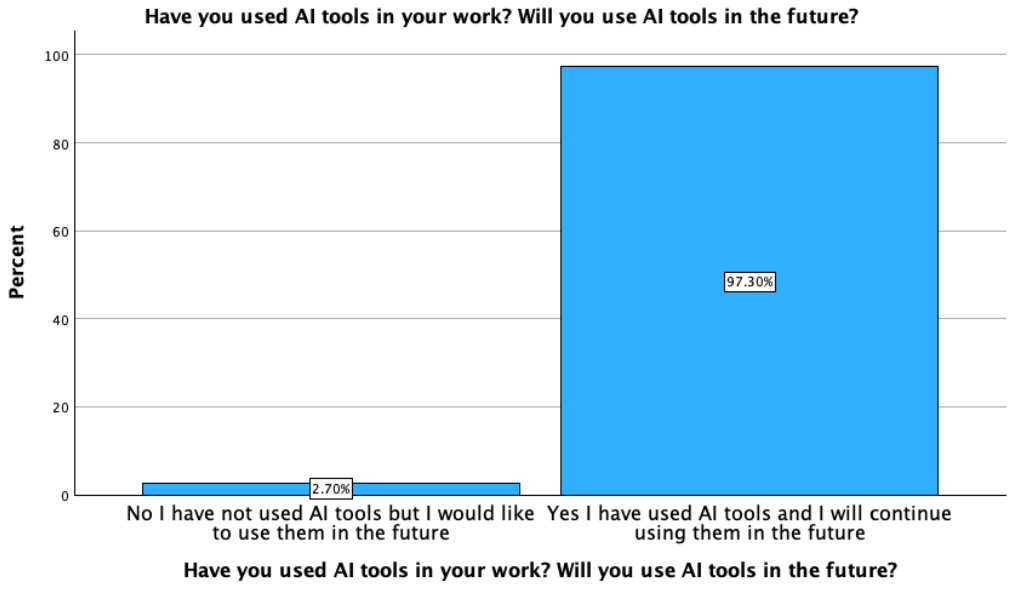
| | | Frequency | Percent |
|---|---|---|---|
| Valid | 0-5 years | 9 | 24.3 |
| | 5-10 years | 6 | 16.2 |
| | 10-15 years | 9 | 24.3 |
| | 15-20 years | 3 | 8.1 |
| | 20-25 years | 7 | 18.9 |
| | 25+ years | 3 | 8.1 |
| | Total | 37 | 100.0 |

A comparison between the percent shares of thesis survey respondent roles and Google Gemini's estimate of role distribution percentages in software industry is presented in Table 4.

**Table 4: Comparison between thesis survey respondents and Google Gemini's estimate of role distribution in Software industry in March 2024 (Google Gemini, 2024)**

| Row Labels | Work role percentages in thesis survey | Google Gemini's estimate of role distribution in Software industry in March 2024 |
|---|---|---|
| DevOps / DevSecOps Specialist | 13,51 % | 10-15 % |
| DevOps Transformation Lead | 2,70 % | 2-5 % |
| Lead Consultant | 5,41 % | 5-8 % |
| Manager | 5,41 % | 12-18 % |
| Product Manager | 2,70 % | 8-12 % |
| Product Owner | 8,11 % | 5-8 % |
| Project Manager | 5,41 % | 8-12 % |
| Software Architect | 16,22 % | 5-8 % |
| Software Developer / Engineer / Designer | 24,32 % | 30-50 % |
| System Administrator | 5,41 % | 5-10 % |
| System Specialist | 2,70 % | 2-5 % |
| Team lead | 2,70 % | 8-12 % |
| UI/UX Designer | 5,41 % | 5-8 % |

**Table 5: AI usage in work**




Thirty-six (97,3%) out of thirty-seven respondents said that they have been using AI tools in their work and that they will continue AI tool usage in the future. Only one (2,7%) respondent had not used AI tools in work but was keen to use them in the future (see Table 5.). AI tool usage frequency is shown in Table 6. Biggest group with 35,1% were the daily users. Over half of the respondents (54%) are either daily users or using AI multiple times

a day. Weekly users were 27% and 18,9% used AI once in a month or less. Results indicate that respondents were using AI tools relatively actively.

**Table 6:AI usage frequency in work**

| How often do you use AI in your work? | | |
|---|---|---|
| | N | % |
| Daily | 13 | 35.1% |
| Weekly | 10 | 27.0% |
| Multiple times per day | 7 | 18.9% |
| Once in a month or less | 7 | 18.9% |

Role distribution within usage frequency can be seen in Table 7. Most active group were the Lead Consultants with 100% using AI tools multiple times a day. Other roles that had more than 1 respondent and reported 100% in same usage slot were Product Owners (Weekly) and System Administrators (Daily). Variation in usage seems to be strong within roles. Daily or multiple times per day users represented 100% of Lead Consultants, Team Leads, Product Managers and System Administrators, 83,4% of Software Architects, 60% of DevOps Specialists, 50 % of Project Managers and UI/UX Designers and 44,4% of Software developers. Weekly users consisted of 100% of Product Owners and System Specialists, 50% of UI/UX Designers and Managers, 22,2 % Software Developers, 20% of DevOps Specialists and 16,7% of Software Architects. Rare users (once in a month or less) consisted 100% of DevOps Transformation Leads, 50% of Managers and Project Managers, 33,3% of Software Developers and 20% of DevOps Specialists.

**Table 7:AI use frequency per role group**

| What is your current work role? * How often do you use AI in your work? Crosstabulation | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | How often do you use AI in your work? | | | | |
| | | | Daily | Multiple times per day | Once in a month or less | Weekly | Total |
| What is your current work role? | DevOps / DevSecOps Specialist | Count | 2 | 1 | 1 | 1 | 5 |
| | | % within What is your current work role? | 40.0% | 20.0% | 20.0% | 20.0% | 100.0% |
| | DevOps Transformation Lead | Count | 0 | 0 | 1 | 0 | 1 |
| | | % within What is your current work role? | 0.0% | 0.0% | 100.0% | 0.0% | 100.0% |
| | Lead Consultant | Count | 0 | 2 | 0 | 0 | 2 |
| | | % within What is your current work role? | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| | Manager | Count | 0 | 0 | 1 | 1 | 2 |
| | | % within What is your current work role? | 0.0% | 0.0% | 50.0% | 50.0% | 100.0% |
| | Product Manager | Count | 1 | 0 | 0 | 0 | 1 |
| | | % within What is your current work role? | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| | Product Owner | Count | 0 | 0 | 0 | 3 | 3 |
| | | % within What is your current work role? | 0.0% | 0.0% | 0.0% | 100.0% | 100.0% |
| | Project Manager | Count | 0 | 1 | 1 | 0 | 2 |
| | | % within What is your current work role? | 0.0% | 50.0% | 50.0% | 0.0% | 100.0% |
| | Software Architect | Count | 4 | 1 | 0 | 1 | 6 |
| | | % within What is your current work role? | 66.7% | 16.7% | 0.0% | 16.7% | 100.0% |
| | Software Developer / Engineer / Designer | Count | 2 | 2 | 3 | 2 | 9 |
| | | % within What is your current work role? | 22.2% | 22.2% | 33.3% | 22.2% | 100.0% |
| | System Administrator | Count | 2 | 0 | 0 | 0 | 2 |
| | | % within What is your current work role? | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| | System Specialist | Count | 0 | 0 | 0 | 1 | 1 |
| | | % within What is your current work role? | 0.0% | 0.0% | 0.0% | 100.0% | 100.0% |
| | Team lead | Count | 1 | 0 | 0 | 0 | 1 |
| | | % within What is your current work role? | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| | UI/UX Designer | Count | 1 | 0 | 0 | 1 | 2 |
| | | % within What is your current work role? | 50.0% | 0.0% | 0.0% | 50.0% | 100.0% |
| Total | | Count | 13 | 7 | 7 | 10 | 37 |
| | | % within What is your current work role? | 35.1% | 18.9% | 18.9% | 27.0% | 100.0% |

AI usage happened in 91,9% of responses both in work and during free time. Only 5,4% used AI exclusively at work and 2,7% only during free time (see Table 8.). Results reveal that usage AI usage has already strong foothold in both personal and work life among software professionals.

**Table 8: Where AI tools are being used**

| Where do you use AI-tools? | | |
|---|---|---|
| | N | % |
| Both work and free time | 34 | 91.9% |
| At work | 2 | 5.4% |
| During free time | 1 | 2.7% |

Over half (56,7%) of the respondents had not received any AI tool related training but were interested in AI tooling related trainings in the future. Nearly a third (32,4%) had already participated in an AI related training. Small minority of 10,8% had not received any AI related training and did not express interest towards future trainings (see Table 9.).

**Table 9:AI training participation / willingness**

| Have you received any kind of training regarding the usage of AI tools? | N | % |
|---|---|---|
| No but I would be interested in AI tooling related trainings | 21 | 56.8% |
| Yes I have participated in AI tool related training | 12 | 32.4% |
| No and I am not interested in AI tooling related trainings | 4 | 10.8% |

## 4.2 AI usage

AI use cases are presented in Table 10. Survey results reveal that 73% of all AI use case related answers mention “Getting information / Problem solving”. Next frequent use cases are “Writing / generating code” with 62,2%, “Prompt engineering” with 59,5%, “Generating documentation” with 54,1% and “Understanding and explaining code” with 43,2%. Other coding related use cases such as “Bug-fixing” and “Refactoring code” had both 35,1% of the answers. “Document drafting and summary creation” had a share of 29,7%. “Database operations” and “CI/CD pipeline related tasks” had both a share of 18,9%. “Language translation” and “Requirement analysis” both had the share of 16,2%. “Data analysis and insights” represented 13,5% of the use cases.

**Table 10: AI use case frequency percentages**

**$Use_cases Frequencies**

| | | Respons... N | Percent of Cases |
|---|---|---|---|
| Use cases[a] | Writing / generating code | 23 | 62.2% |
| | Prompt engineering | 22 | 59.5% |
| | Bug-fixing | 13 | 35.1% |
| | Refactoring code | 13 | 35.1% |
| | Understanding and explaining code | 16 | 43.2% |
| | Generating documentation | 20 | 54.1% |
| | Language translation | 6 | 16.2% |
| | AI-based verification | 1 | 2.7% |
| | Automated code review | 3 | 8.1% |
| | Requirement analysis | 6 | 16.2% |
| | Software security | 1 | 2.7% |
| | CI/CD pipeline related tasks | 7 | 18.9% |
| | Data analysis and insights | 5 | 13.5% |
| | Document drafting and summary creation | 11 | 29.7% |
| | Database operations | 7 | 18.9% |
| | Observability / Monitoring | 3 | 8.1% |
| | Getting information / problem solving | 27 | 73.0% |
| | Market analysis | 3 | 8.1% |
| | User profiling | 2 | 5.4% |

In Table 11. there is a crosstabulation between the AI use cases and experience groups. Interesting picks from this crosstabulation is that the most active group in reporting varied AI use cases were the respondents with experience of 10-15 years (51 use cases, 26,98% share). Second most active group are the most junior respondents (46 use cases and 24,33% share). Third and fourth experience groups were 5-10 years (32 use cases, 16,93% share) and 20-25 years (31 use cases, 16,4% share). Least active or varied in terms of AI use cases were the experience groups 15-20 years (12 use cases, 6,34% share) and the most experienced group of users 25+ years (17 use cases, 8,99% share).

**Table 11: Experience groups x AI use cases crosstabulation**

**Exp_years*$Use_cases Crosstabulation**

| | | Experience | | | | | | | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0–5 years | | | 5–10 years | | | 10–15 years | | | 15–20 years | | | 20–25 years | | | 25+ years | | | |
| | | Count | % within Exp_years | % within $Use_cases | Count | % within Exp_years | % within $Use_cases | Count | % within Exp_years | % within $Use_cases | Count | % within Exp_years | % within $Use_cases | Count | % within Exp_years | % within $Use_cases | Count | % within Exp_years | % within $Use_cases | Count |
| Use cases[a] | Writing / generating code | 5 | 10.9% | 21.7% | 4 | 12.5% | 17.4% | 6 | 11.8% | 26.1% | 2 | 16.7% | 8.7% | 4 | 12.9% | 17.4% | 2 | 11.8% | 8.7% | 23 |
| | Prompt engineering | 3 | 6.5% | 13.6% | 3 | 9.4% | 13.6% | 5 | 9.8% | 22.7% | 3 | 25.0% | 13.6% | 6 | 19.4% | 27.3% | 2 | 11.8% | 9.1% | 22 |
| | Bug-fixing | 4 | 8.7% | 30.8% | 3 | 9.4% | 23.1% | 2 | 3.9% | 15.4% | 1 | 8.3% | 7.7% | 3 | 9.7% | 23.1% | 0 | 0.0% | 0.0% | 13 |
| | Refactoring code | 5 | 10.9% | 38.5% | 3 | 9.4% | 23.1% | 2 | 3.9% | 15.4% | 0 | 0.0% | 0.0% | 3 | 9.7% | 23.1% | 0 | 0.0% | 0.0% | 13 |
| | Understanding and explaining code | 6 | 13.0% | 37.5% | 3 | 9.4% | 18.8% | 3 | 5.9% | 18.8% | 1 | 8.3% | 6.3% | 2 | 6.5% | 12.5% | 1 | 5.9% | 6.3% | 16 |
| | Generating documentation | 4 | 8.7% | 20.0% | 5 | 15.6% | 25.0% | 7 | 13.7% | 35.0% | 0 | 0.0% | 0.0% | 2 | 6.5% | 10.0% | 2 | 11.8% | 10.0% | 20 |
| | Language translation | 1 | 2.2% | 16.7% | 2 | 6.3% | 33.3% | 1 | 2.0% | 16.7% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 2 | 11.8% | 33.3% | 6 |
| | AI-based verification | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 1 | 2.0% | 100.0% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 1 |
| | Automated code review | 1 | 2.2% | 33.3% | 1 | 3.1% | 33.3% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 1 | 3.2% | 33.3% | 0 | 0.0% | 0.0% | 3 |
| | Requirement analysis | 1 | 2.2% | 16.7% | 0 | 0.0% | 0.0% | 2 | 3.9% | 33.3% | 0 | 0.0% | 0.0% | 1 | 3.2% | 16.7% | 2 | 11.8% | 33.3% | 6 |
| | Software security | 0 | 0.0% | 0.0% | 1 | 3.1% | 100.0% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 1 |
| | CI/CD pipeline related tasks | 3 | 6.5% | 42.9% | 1 | 3.1% | 14.3% | 2 | 3.9% | 28.6% | 1 | 8.3% | 14.3% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 7 |
| | Data analysis and insights | 0 | 0.0% | 0.0% | 1 | 3.1% | 20.0% | 2 | 3.9% | 40.0% | 0 | 0.0% | 0.0% | 1 | 3.2% | 20.0% | 1 | 5.9% | 20.0% | 5 |
| | Document drafting and summary creation | 3 | 6.5% | 27.3% | 0 | 0.0% | 0.0% | 4 | 7.8% | 36.4% | 1 | 8.3% | 9.1% | 2 | 6.5% | 18.2% | 1 | 5.9% | 9.1% | 11 |
| | Database operations | 4 | 8.7% | 57.1% | 0 | 0.0% | 0.0% | 3 | 5.9% | 42.9% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 7 |
| | Observability / Monitoring | 1 | 2.2% | 33.3% | 1 | 3.1% | 33.3% | 1 | 2.0% | 33.3% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 3 |
| | Getting information / problem solving | 5 | 10.9% | 18.5% | 4 | 12.5% | 14.8% | 7 | 13.7% | 25.9% | 3 | 25.0% | 11.1% | 6 | 19.4% | 22.2% | 2 | 11.8% | 7.4% | 27 |
| | Market analysis | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 2 | 3.9% | 66.7% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 1 | 5.9% | 33.3% | 3 |
| | User profiling | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 1 | 2.0% | 50.0% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 1 | 5.9% | 50.0% | 2 |
| Total | | 46 | | | 32 | | | 51 | | | 12 | | | 31 | | | 17 | | | 189 |

Percentages and totals are based on responses.

a. Dichotomy group tabulated at value 1.

In Table 12. there is a cross tabulation regarding work related AI use cases and work roles. Answer data correlates quite well with general understanding of which use cases are relevant in different role descriptions.

**Table 12: AI use cases x Work roles crosstabulation**



**$AI_use_cases*$Roles_multiset Crosstabulation**

| | | | Roles_multiset[a] | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | DevOps / DevSecOps Specialist | DevOps Transformation Lead | Lead Consultant | Manager | Product Manager | Product Owner | Project Manager | Software Architect | Software Developer / Engineer / Designer | System Administrator | System Specialist | Team lead | UI/UX Designer | Total |
| AI_use_cases[a] | Writing / generating code | Count | 5 | 1 | 2 | 1 | 0 | 0 | 0 | 5 | 7 | 1 | 0 | 1 | 0 | 23 |
| | | % within $AI_use_cases | 21.7% | 4.3% | 8.7% | 4.3% | 0.0% | 0.0% | 0.0% | 21.7% | 30.4% | 4.3% | 0.0% | 4.3% | 0.0% | |
| | | % within $Roles_multiset | 100.0% | 100.0% | 100.0% | 20.0% | 0.0% | 0.0% | 0.0% | 83.3% | 77.8% | 50.0% | 0.0% | 100.0% | 0.0% | |
| | Prompt engineering | Count | 4 | 1 | 2 | 1 | 1 | 2 | 0 | 4 | 5 | 0 | 0 | 1 | 2 | 22 |
| | | % within $AI_use_cases | 18.2% | 4.5% | 9.1% | 4.5% | 4.5% | 9.1% | 0.0% | 18.2% | 22.7% | 0.0% | 0.0% | 4.5% | 9.1% | |
| | | % within $Roles_multiset | 80.0% | 100.0% | 100.0% | 20.0% | 100.0% | 66.7% | 0.0% | 66.7% | 55.6% | 0.0% | 0.0% | 100.0% | 100.0% | |
| | Bug-fixing | Count | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 3 | 5 | 0 | 0 | 0 | 0 | 13 |
| | | % within $AI_use_cases | 30.8% | 0.0% | 0.0% | 7.7% | 0.0% | 0.0% | 0.0% | 23.1% | 38.5% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | | % within $Roles_multiset | 80.0% | 0.0% | 0.0% | 20.0% | 0.0% | 0.0% | 0.0% | 50.0% | 55.6% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | Refactoring code | Count | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 4 | 4 | 1 | 0 | 0 | 0 | 13 |
| | | % within $AI_use_cases | 23.1% | 0.0% | 0.0% | 7.7% | 0.0% | 0.0% | 0.0% | 30.8% | 30.8% | 7.7% | 0.0% | 0.0% | 0.0% | |
| | | % within $Roles_multiset | 60.0% | 0.0% | 0.0% | 20.0% | 0.0% | 0.0% | 0.0% | 66.7% | 44.4% | 50.0% | 0.0% | 0.0% | 0.0% | |
| | Understanding and explaining code | Count | 3 | 0 | 2 | 1 | 0 | 0 | 0 | 4 | 4 | 1 | 1 | 0 | 0 | 16 |
| | | % within $AI_use_cases | 18.8% | 0.0% | 12.5% | 6.3% | 0.0% | 0.0% | 0.0% | 25.0% | 25.0% | 6.3% | 6.3% | 0.0% | 0.0% | |
| | | % within $Roles_multiset | 60.0% | 0.0% | 100.0% | 20.0% | 0.0% | 0.0% | 0.0% | 66.7% | 44.4% | 50.0% | 100.0% | 0.0% | 0.0% | |
| | Generating documentation | Count | 1 | 1 | 2 | 5 | 1 | 1 | 2 | 3 | 4 | 2 | 0 | 1 | 0 | 20 |
| | | % within $AI_use_cases | 5.0% | 5.0% | 10.0% | 25.0% | 5.0% | 5.0% | 10.0% | 15.0% | 20.0% | 10.0% | 0.0% | 5.0% | 0.0% | |
| | | % within $Roles_multiset | 20.0% | 100.0% | 100.0% | 100.0% | 100.0% | 33.3% | 100.0% | 50.0% | 44.4% | 100.0% | 0.0% | 100.0% | 0.0% | |
| | Language translation | Count | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 1 | 0 | 6 |
| | | % within $AI_use_cases | 16.7% | 0.0% | 16.7% | 0.0% | 0.0% | 0.0% | 0.0% | 33.3% | 0.0% | 0.0% | 16.7% | 16.7% | 0.0% | |
| | | % within $Roles_multiset | 20.0% | 0.0% | 50.0% | 0.0% | 0.0% | 0.0% | 0.0% | 33.3% | 0.0% | 0.0% | 100.0% | 100.0% | 0.0% | |
| | AI-based verification | Count | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | | % within $AI_use_cases | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | | % within $Roles_multiset | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 16.7% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | Automated code review | Count | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 3 |
| | | % within $AI_use_cases | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 66.7% | 33.3% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | | % within $Roles_multiset | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 33.3% | 11.1% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | Requirement analysis | Count | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 6 |
| | | % within $AI_use_cases | 0.0% | 0.0% | 33.3% | 16.7% | 16.7% | 16.7% | 0.0% | 0.0% | 33.3% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | | % within $Roles_multiset | 0.0% | 0.0% | 100.0% | 20.0% | 100.0% | 33.3% | 0.0% | 0.0% | 22.2% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | Software security | Count | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | | % within $AI_use_cases | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | | % within $Roles_multiset | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 16.7% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | CI/CD pipeline related tasks | Count | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 7 |
| | | % within $AI_use_cases | 42.9% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 14.3% | 14.3% | 14.3% | 0.0% | 14.3% | 0.0% | |
| | | % within $Roles_multiset | 60.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 16.7% | 11.1% | 50.0% | 0.0% | 100.0% | 0.0% | |
| | Data analysis and insights | Count | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 5 |
| | | % within $AI_use_cases | 0.0% | 0.0% | 20.0% | 20.0% | 20.0% | 20.0% | 0.0% | 0.0% | 40.0% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | | % within $Roles_multiset | 0.0% | 0.0% | 50.0% | 20.0% | 100.0% | 33.3% | 0.0% | 0.0% | 22.2% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | Document drafting and summary creation | Count | 2 | 0 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 0 | 0 | 1 | 0 | 11 |
| | | % within $AI_use_cases | 18.2% | 0.0% | 9.1% | 18.2% | 9.1% | 9.1% | 9.1% | 18.2% | 18.2% | 0.0% | 0.0% | 9.1% | 0.0% | |
| | | % within $Roles_multiset | 40.0% | 0.0% | 50.0% | 40.0% | 100.0% | 33.3% | 50.0% | 33.3% | 22.2% | 0.0% | 0.0% | 100.0% | 0.0% | |
| | Database operations | Count | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 1 | 1 | 0 | 7 |
| | | % within $AI_use_cases | 0.0% | 0.0% | 14.3% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 42.9% | 14.3% | 14.3% | 14.3% | 0.0% | |
| | | % within $Roles_multiset | 0.0% | 0.0% | 50.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 33.3% | 50.0% | 100.0% | 100.0% | 0.0% | |
| | Observability / Monitoring | Count | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 3 |
| | | % within $AI_use_cases | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 33.3% | 33.3% | 0.0% | 0.0% | 33.3% | 0.0% | |
| | | % within $Roles_multiset | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 16.7% | 11.1% | 0.0% | 0.0% | 100.0% | 0.0% | |
| | Getting information / problem solving | Count | 4 | 0 | 2 | 5 | 1 | 2 | 2 | 5 | 5 | 1 | 0 | 1 | 2 | 27 |
| | | % within $AI_use_cases | 14.8% | 0.0% | 7.4% | 18.5% | 3.7% | 7.4% | 7.4% | 18.5% | 18.5% | 3.7% | 0.0% | 3.7% | 7.4% | |
| | | % within $Roles_multiset | 80.0% | 0.0% | 100.0% | 100.0% | 100.0% | 66.7% | 100.0% | 83.3% | 55.6% | 50.0% | 0.0% | 100.0% | 100.0% | |
| | Market analysis | Count | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 3 |
| | | % within $AI_use_cases | 0.0% | 0.0% | 33.3% | 33.3% | 33.3% | 0.0% | 0.0% | 0.0% | 33.3% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | | % within $Roles_multiset | 0.0% | 0.0% | 50.0% | 20.0% | 100.0% | 0.0% | 0.0% | 0.0% | 11.1% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | User profiling | Count | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| | | % within $AI_use_cases | 0.0% | 0.0% | 50.0% | 50.0% | 50.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | | % within $Roles_multiset | 0.0% | 0.0% | 50.0% | 20.0% | 100.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | |
| Total | | Count | 5 | 1 | 2 | 5 | 1 | 3 | 2 | 6 | 9 | 2 | 1 | 1 | 2 | 37 |

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

Table 13. shows AI tool usage (in work) frequency related data. Most frequently mentioned tool with nearly 70% of the responses is ChatGPT 3.5 and combined with ChatGPT 4 the result is 119,4%. This is very much consistent with the use case statistics stating that getting information and problem solving had the biggest percent share. Biggest thing explaining the difference between these two is that ChatGPT 3.5 has been freely available and ChatGPT 4 is included only in paid subscription as of now in April 2024. OpenAI's products are very dominant in this area since the next similar chat tool Google Gemini has only a share of 11,1%. Second most common tool is GitHub Copilot + Chat with the percentage of 61,1%. Interestingly other tools fall very far back the next being AI features in cloud services such as AWS and Azure with the share of 22,2%. Image tools such as Dalle 3 and Midjourney reached together the share of 27,7%, Dalle 3 being the more commonly used. AI features of static code analysis tool SonarQube had a share of 11,1%. Least used tool (which got a mention) was Tabnine with share of 2,8%.

**Table 13:AI tool usage frequencies**

**$AI_tools_in_use Frequencies**

| | | Responses N | Percent of Cases |
|---|---|---|---|
| AI tools in use[a] | GitHub Copilot + Chat | 22 | 61.1% |
| | Tabnine | 1 | 2.8% |
| | ChatGPT 3.5 | 25 | 69.4% |
| | ChatGPT 4 | 18 | 50.0% |
| | Google Gemini | 4 | 11.1% |
| | DALLE·3 | 7 | 19.4% |
| | Midjourney | 3 | 8.3% |
| | SonarQube (AI features) | 4 | 11.1% |
| | AI features in cloud services (AWS, Azure, etc.) | 8 | 22.2% |

Table 14. presents AI tool usage (in work) within experience groups. ChatGPT 3.5 was most actively used AI tool and biggest share of its users came from experience groups 0-5 years and 10-15 years both with the share of 28%

**Table 14: Experience groups x AI tools in use crosstabulation**

**Exp_years*$AI_tools_in_use Crosstabulation**

| | | Experience | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0-5 years | | 5-10 years | | 10-15 years | | 15-20 years | | 20-25 years | | 25+ years | | |
| | | Count | % within $AI_tools_in_use | Count | % within $AI_tools_in_use | Count | % within $AI_tools_in_use | Count | % within $AI_tools_in_use | Count | % within $AI_tools_in_use | Count | % within $AI_tools_in_use | Count |
| AI tools in use[a] | GitHub Copilot + Chat | 5 | 22.7% | 5 | 22.7% | 4 | 18.2% | 2 | 9.1% | 4 | 18.2% | 2 | 9.1% | 22 |
| | Tabnine | 0 | 0.0% | 0 | 0.0% | 1 | 100.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1 |
| | ChatGPT 3.5 | 7 | 28.0% | 3 | 12.0% | 7 | 28.0% | 1 | 4.0% | 5 | 20.0% | 2 | 8.0% | 25 |
| | ChatGPT 4 | 2 | 11.1% | 5 | 27.8% | 4 | 22.2% | 2 | 11.1% | 3 | 16.7% | 2 | 11.1% | 18 |
| | Google Gemini | 1 | 25.0% | 0 | 0.0% | 1 | 25.0% | 0 | 0.0% | 1 | 25.0% | 1 | 25.0% | 4 |
| | DALLE·3 | 1 | 14.3% | 4 | 57.1% | 1 | 14.3% | 0 | 0.0% | 0 | 0.0% | 1 | 14.3% | 7 |
| | Midjourney | 0 | 0.0% | 1 | 33.3% | 2 | 66.7% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 3 |
| | SonarQube (AI features) | 1 | 25.0% | 1 | 25.0% | 2 | 50.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 4 |
| | AI features in cloud services (AWS, Azure, etc.) | 0 | 0.0% | 1 | 12.5% | 4 | 50.0% | 1 | 12.5% | 2 | 25.0% | 0 | 0.0% | 8 |
| Total | | 8 | | 6 | | 9 | | 3 | | 7 | | 3 | | 36 |

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

In Table 15. there is a crosstabulation between the use case reports and AI tools in use. The results regarding reported use cases correlate well with the reported usage of AI tools. For example, respondents who have reported use cases related to coding, understanding code, refactoring code, prompt engineering, bug-fixing, and code review have systematically checked tools that are relevant and capable such as GitHub Copilot or ChatGPT's. Similarly, respondents who answered using AI to Getting information / problem solving, generating documentation and document drafting and summary creation report usage of suitable tools such as ChatGPT's and Google Gemini.

**Table 15: AI use cases x AI tools in use crosstabulation**

**$Use_cases*$AI_tools_in_use Crosstabulation**

| | | | AI tools in use[a] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | GitHub Copilot + Chat | Tabnine | ChatGPT 3.5 | ChatGPT 4 | Google Gemini | DALLE·3 | Midjourney | SonarQube (AI features) | AI features in cloud services (AWS, Azure, etc.) | Total |
| Use cases[a] | Writing / generating code | Count | 19 | 1 | 15 | 12 | 2 | 4 | 3 | 4 | 7 | 23 |
| | Prompt engineering | Count | 16 | 1 | 15 | 12 | 4 | 5 | 3 | 3 | 6 | 22 |
| | Bug-fixing | Count | 10 | 0 | 9 | 6 | 1 | 4 | 1 | 2 | 3 | 13 |
| | Refactoring code | Count | 10 | 0 | 9 | 6 | 1 | 3 | 0 | 2 | 3 | 13 |
| | Understanding and explaining code | Count | 13 | 1 | 9 | 9 | 2 | 3 | 1 | 3 | 4 | 15 |
| | Generating documentation | Count | 13 | 1 | 14 | 13 | 2 | 5 | 3 | 3 | 5 | 20 |
| | Language translation | Count | 5 | 0 | 2 | 3 | 0 | 1 | 1 | 2 | 2 | 5 |
| | AI-based verification | Count | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Automated code review | Count | 2 | 0 | 2 | 2 | 1 | 2 | 0 | 2 | 2 | 3 |
| | Requirement analysis | Count | 5 | 1 | 4 | 5 | 3 | 2 | 1 | 2 | 2 | 6 |
| | Software security | Count | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| | CI/CD pipeline related tasks | Count | 7 | 0 | 6 | 2 | 1 | 2 | 1 | 2 | 1 | 7 |
| | Data analysis and insights | Count | 3 | 0 | 4 | 3 | 1 | 2 | 1 | 1 | 1 | 5 |
| | Document drafting and summary creation | Count | 5 | 0 | 8 | 4 | 1 | 2 | 1 | 2 | 6 | 11 |
| | Database operations | Count | 4 | 0 | 5 | 2 | 1 | 1 | 1 | 3 | 2 | 6 |
| | Observability / Monitoring | Count | 3 | 0 | 2 | 2 | 1 | 2 | 1 | 3 | 2 | 3 |
| | Getting information / problem solving | Count | 15 | 0 | 18 | 14 | 3 | 6 | 2 | 4 | 7 | 27 |
| | Market analysis | Count | 2 | 1 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 3 |
| | User profiling | Count | 1 | 0 | 1 | 2 | 1 | 1 | 0 | 1 | 1 | 2 |
| Total | | Count | 22 | 1 | 25 | 18 | 4 | 7 | 3 | 4 | 8 | 36 |

When looking into role-based AI tool usage in work (see Table 16.) we can reveal interesting facts. GitHub Copilot + Chat is in use among 100% of DevOps roles, Lead Consultants, System Administrators and Team Leads. Among Product Owners and Software Architects GitHub Copilot has a share of 66,7%. In case of the Software Developers the usage share was 44,4%. Only Project Managers and UI/UX Designers did not use GitHub Copilot at all. Tabnine got share of 11,1% Software Developers. ChatGPT's were widely used. Free version (ChatGPT 3.5) got an 88,9% share of Software Developers which was surprisingly the highest percent of all AI tools used by Software developers. Software Developers reported using all of the tools in the Table 15. System Administrators are using GitHub Copilot and ChatGPT 3.5. UI/UX Designers reported usage of ChatGPT's and Google Gemini. Similarly, the DevOps Transformation lead had reported limited use of tools (only ChatGPT's and GitHub Copilot). Software Architects reported quite varied AI tool usage (Google Gemini, Tabnine and Midjourney being the only tools not in use in Table 16).

**Table 16:AI tools in use x Work roles crosstabulation**

**$Roles_within_industry*$AI_tools_in_use Crosstabulation**

| | | | AI tools in use[a] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | GitHub Copilot + Chat | Tabnine | ChatGPT 3.5 | ChatGPT 4 | Google Gemini | DALLE·3 | Midjourney | SonarQube (AI features) | AI features in cloud services (AWS, Azure, etc.) | Total |
| Role[a] | DevOps / DevSecOps Specialist | Count | 5 | 0 | 3 | 1 | 0 | 1 | 0 | 0 | 1 | 5 |
| | | % within $Roles_within_industry | 100.0% | 0.0% | 60.0% | 20.0% | 0.0% | 20.0% | 0.0% | 0.0% | 20.0% | |
| | DevOps Transformation Lead | Count | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | | % within $Roles_within_industry | 100.0% | 0.0% | 100.0% | 100.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | Lead Consultant | Count | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 1 | 2 |
| | | % within $Roles_within_industry | 100.0% | 0.0% | 0.0% | 100.0% | 0.0% | 0.0% | 0.0% | 50.0% | 50.0% | |
| | Manager | Count | 1 | 0 | 3 | 5 | 1 | 2 | 0 | 0 | 1 | 5 |
| | | % within $Roles_within_industry | 20.0% | 0.0% | 60.0% | 100.0% | 20.0% | 40.0% | 0.0% | 0.0% | 20.0% | |
| | Product Manager | Count | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| | | % within $Roles_within_industry | 0.0% | 0.0% | 100.0% | 100.0% | 100.0% | 100.0% | 0.0% | 0.0% | 0.0% | |
| | Product Owner | Count | 2 | 0 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 3 |
| | | % within $Roles_within_industry | 66.7% | 0.0% | 100.0% | 0.0% | 0.0% | 33.3% | 0.0% | 0.0% | 0.0% | |
| | Project Manager | Count | 0 | 0 | 1 | 2 | 0 | 1 | 0 | 0 | 1 | 2 |
| | | % within $Roles_within_industry | 0.0% | 0.0% | 50.0% | 100.0% | 0.0% | 50.0% | 0.0% | 0.0% | 50.0% | |
| | Software Architect | Count | 4 | 0 | 3 | 4 | 0 | 1 | 0 | 1 | 3 | 6 |
| | | % within $Roles_within_industry | 66.7% | 0.0% | 50.0% | 66.7% | 0.0% | 16.7% | 0.0% | 16.7% | 50.0% | |
| | Software Developer / Engineer / Designer | Count | 4 | 1 | 8 | 4 | 2 | 2 | 2 | 1 | 1 | 9 |
| | | % within $Roles_within_industry | 44.4% | 11.1% | 88.9% | 44.4% | 22.2% | 22.2% | 22.2% | 11.1% | 11.1% | |
| | System Administrator | Count | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| | | % within $Roles_within_industry | 100.0% | 0.0% | 100.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | |
| | Team lead | Count | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| | | % within $Roles_within_industry | 100.0% | 0.0% | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% | 100.0% | 100.0% | |
| | UI/UX Designer | Count | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| | | % within $Roles_within_industry | 0.0% | 0.0% | 50.0% | 50.0% | 50.0% | 0.0% | 0.0% | 0.0% | 0.0% | |
| Total | | Count | 22 | 1 | 25 | 18 | 4 | 7 | 3 | 4 | 8 | 36 |

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

## 4.3 Efficiency & Productivity

Regarding efficiency and productivity, the survey included several questions. Here are the results of the direct questions (with scale 1-5, 1 being the low end and 5 high). Means in Table 17. indicate that respondents are rather satisfied (mean 3.49) with the results that are currently achieved with AI tools. Effectiveness on improving productivity is rated on a mean of 3.74. In Tables 18. and 19. the respective results are shown as percent per response option.

**Table 17: Descriptive statistics of efficiency and productivity questions**

**Descriptive Statistics**

| | N | Mean |
|---|---|---|
| How do you rate the effectiveness of AI tools in improving your productivity? | 35 | 3.74 |
| How satisfied you are with the results that you are currently achieving with AI tools? | 37 | 3.49 |
| Valid N (listwise) | 35 | |

**Table 18: Satisfaction over current results achieved with AI tools**

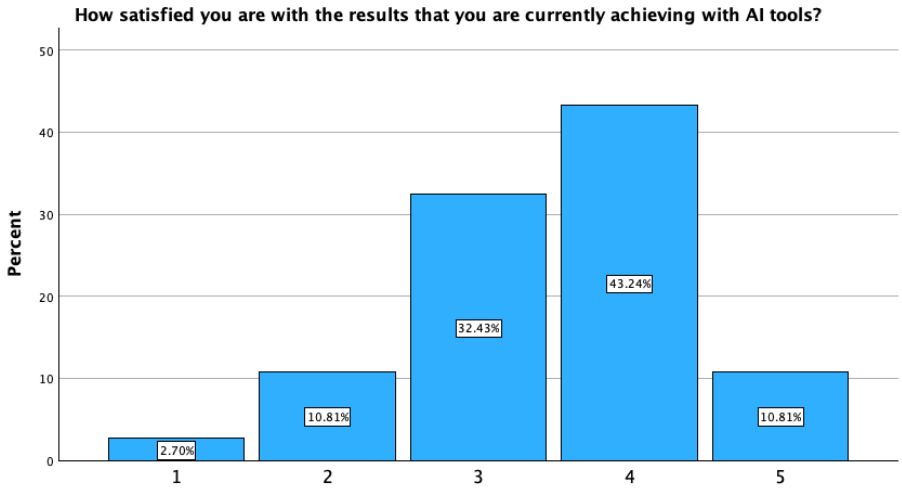
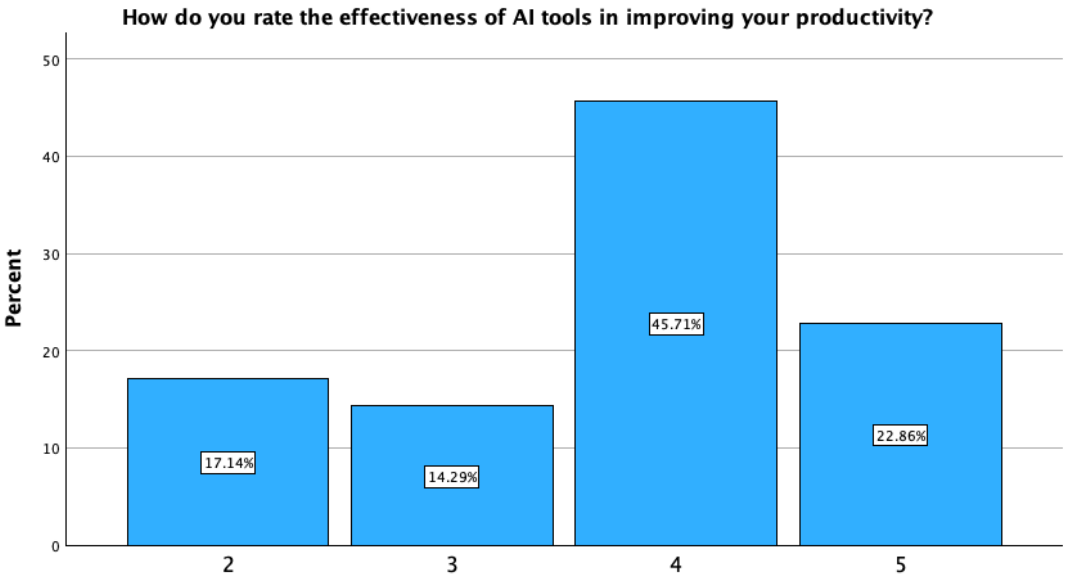


**Table 19: AI effectiveness in improving productivity**




It can be seen in Tables 18. And 19. That percentage of respondents that responded 4 or 5 is quite high in both Tables. In Table 18. it is 54,05% and in Table 19. 68,71%. Respondents consider AI tools effective in improving the productivity and over half of the respondents are happy or very happy with the current results that they can achieve wit AI tools.

In Table 20. There is a crosstabulation of experience groups and satisfaction with current AI tools. Statistics show that 83,3% of experience group of 5-10 years gave top scores (four or five). They were the most satisfied experience group. Interestingly the most senior group 25+ years gave scores no. 4 in 66,7% of answers. The least satisfied experience group was 20-25 years with 28,6% of score 2 answers. Next experience group of less satisfied respondents was among 10-15 years with 22,2% of responses being 1 or 2.

**Table 20: AI usage satisfaction x Experience groups**

**Exp_years*Howsatisfiedyouarewiththeresultsthatyouarecurrentlyachievingwith Crosstabulation**

| | | | How satisfied you are with the results that you are currently achieving with AI tools? | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | Total |
| Experience | 0-5 years | Count | 0 | 1 | 4 | 3 | 1 | 9 |
| | | % within Exp_years | 0.0% | 11.1% | 44.4% | 33.3% | 11.1% | |
| | | % within Howsatisfiedyouarewiththeresultsthatyouarecurrentlyachievingwith | 0.0% | 25.0% | 33.3% | 18.8% | 25.0% | |
| | 5-10 years | Count | 0 | 0 | 1 | 3 | 2 | 6 |
| | | % within Exp_years | 0.0% | 0.0% | 16.7% | 50.0% | 33.3% | |
| | | % within Howsatisfiedyouarewiththeresultsthatyouarecurrentlyachievingwith | 0.0% | 0.0% | 8.3% | 18.8% | 50.0% | |
| | 10-15 years | Count | 1 | 1 | 2 | 4 | 1 | 9 |
| | | % within Exp_years | 11.1% | 11.1% | 22.2% | 44.4% | 11.1% | |
| | | % within Howsatisfiedyouarewiththeresultsthatyouarecurrentlyachievingwith | 100.0% | 25.0% | 16.7% | 25.0% | 25.0% | |
| | 15-20 years | Count | 0 | 0 | 2 | 1 | 0 | 3 |
| | | % within Exp_years | 0.0% | 0.0% | 66.7% | 33.3% | 0.0% | |
| | | % within Howsatisfiedyouarewiththeresultsthatyouarecurrentlyachievingwith | 0.0% | 0.0% | 16.7% | 6.3% | 0.0% | |
| | 20-25 years | Count | 0 | 2 | 2 | 3 | 0 | 7 |
| | | % within Exp_years | 0.0% | 28.6% | 28.6% | 42.9% | 0.0% | |
| | | % within Howsatisfiedyouarewiththeresultsthatyouarecurrentlyachievingwith | 0.0% | 50.0% | 16.7% | 18.8% | 0.0% | |
| | 25+ years | Count | 0 | 0 | 1 | 2 | 0 | 3 |
| | | % within Exp_years | 0.0% | 0.0% | 33.3% | 66.7% | 0.0% | |
| | | % within Howsatisfiedyouarewiththeresultsthatyouarecurrentlyachievingwith | 0.0% | 0.0% | 8.3% | 12.5% | 0.0% | |
| Total | | Count | 1 | 4 | 12 | 16 | 4 | 37 |

Percentages and totals are based on responses.

In Table 21 there is a crosstabulation between experience groups and AI tool effectiveness in improving productivity. First it is good to mention that no-one gave the lowest score 1. The group which saw most productivity benefits were the most experienced with 100% of the responses in the highest score. The second experience group in productivity gains was the group of juniors (0-5 years) with share of 77,8% of answers in two of the highest scores. The least productivity gains were found from the experience group of 10-15 years with the 66,7% of respondents giving score 2. This correlates also in the results in Table 19. where the same experience group was in the lower end of AI usage satisfaction score.

**Table 21: Experience groups x AI tools effectivity in improving productivity crosstabulation**

**Exp_years*HowdoyouratetheeffectivenessofAItoolsinimprovingyourproductivity Crosstabulation**

| | | | How do you rate the effectiveness of AI tools in improving your productivity? | | | | |
|---|---|---|---|---|---|---|---|
| | | | 2 | 3 | 4 | 5 | Total |
| Experience | 0-5 years | Count | 1 | 1 | 6 | 1 | 9 |
| | | % within Exp_years | 11.1% | 11.1% | 66.7% | 11.1% | |
| | | % within HowdoyouratetheeffectivenessofAItoolsinimprovingyourproductivity | 16.7% | 20.0% | 37.5% | 12.5% | |
| | 5-10 years | Count | 1 | 1 | 2 | 2 | 6 |
| | | % within Exp_years | 16.7% | 16.7% | 33.3% | 33.3% | |
| | | % within HowdoyouratetheeffectivenessofAItoolsinimprovingyourproductivity | 16.7% | 20.0% | 12.5% | 25.0% | |
| | 10-15 years | Count | 1 | 1 | 3 | 3 | 8 |
| | | % within Exp_years | 12.5% | 12.5% | 37.5% | 37.5% | |
| | | % within HowdoyouratetheeffectivenessofAItoolsinimprovingyourproductivity | 16.7% | 20.0% | 18.8% | 37.5% | |
| | 15-20 years | Count | 2 | 0 | 1 | 0 | 3 |
| | | % within Exp_years | 66.7% | 0.0% | 33.3% | 0.0% | |
| | | % within HowdoyouratetheeffectivenessofAItoolsinimprovingyourproductivity | 33.3% | 0.0% | 6.3% | 0.0% | |
| | 20-25 years | Count | 1 | 2 | 4 | 0 | 7 |
| | | % within Exp_years | 14.3% | 28.6% | 57.1% | 0.0% | |
| | | % within HowdoyouratetheeffectivenessofAItoolsinimprovingyourproductivity | 16.7% | 40.0% | 25.0% | 0.0% | |
| | 25+ years | Count | 0 | 0 | 0 | 2 | 2 |
| | | % within Exp_years | 0.0% | 0.0% | 0.0% | 100.0% | |
| | | % within HowdoyouratetheeffectivenessofAItoolsinimprovingyourproductivity | 0.0% | 0.0% | 0.0% | 25.0% | |
| Total | | Count | 6 | 5 | 16 | 8 | 35 |

Percentages and totals are based on responses.

## 4.4 AI tool familiarity

Respondents answered about the AI tool familiarity in a scale from one to five (see Table 22.). One represented unfamiliarity and five that the tool was very familiar. At the top are OpenAI's ChatGPT's with familiarity ratings of 3.89 and 3.41. In top three there was also GitHub Copilot with rating of 2.81. Fourth tool is DALL-E 3 with familiarity rating is already

down to 2.16. Rest of the tools received ratings under 2. The least familiar tools were Tabnine (1.11) and Codium (1.16).

**Table 22: Ai tool familiarity**

**Descriptives**

**Descriptive Statistics**

| | N | Mean |
|---|---|---|
| How familiar you are with ChatGPT 3.5? | 37 | 3.89 |
| How familiar you are with ChatGPT 4? | 37 | 3.41 |
| How familiar you are with Github Copilot? | 37 | 2.81 |
| How familiar you are with DALL·E 3? | 37 | 2.16 |
| How familiar you are with AI features offered by cloud services (such as Azure, AWS etc) | 37 | 1.92 |
| How familiar you are with Google Gemini? | 37 | 1.89 |
| How familiar you are with Midjourney? | 37 | 1.59 |
| How familiar you are with SonarQube AI features? | 37 | 1.57 |
| How familiar you are with Dolly? | 37 | 1.24 |
| How familiar you are with Codium? | 37 | 1.16 |
| How familiar you are with Tabnine? | 37 | 1.11 |
| Valid N (listwise) | 37 | |

## 4.5 Statements

Purpose of this chapter is to present the results of the survey's statements. In the survey there were 54 statements that were thematically grouped into following six themes:

- Efficiency & Productivity
- Competitive Advantage & Quality
- Wellbeing & Professional development

- Collaboration
- Ethics and Bias
- Risks, Challenges & Considerations

Most of the thematic groups include both positive and negative statements. Answers were given on a Likert scale where the response options were:

- 1 = Strongly disagree
- 2 = Disagree
- 3 = Neither agree nor disagree
- 4 = Agree
- 5 = Strongly agree

Result analysis is done mainly by looking into mean of statements. If mean is above 3, it can be stated that respondents are positive towards the statement. If the mean is under 3, their approach is negative. Some key statements are individually analysed in addition.

### 4.5.1 Efficiency & Productivity

Altogether there are 16 statements within the efficiency and productivity theme. In the Table 23. There are positive statements (and means) regarding efficiency and productivity. Twelve out of fourteen statements got positive responses from respondents, those were the statements that had mean over 3. Only two statements received response with mean under 3. More statistics are represented about the top three answers (based on means) in Tables 24, 25 and 26.

**Table 23: Efficiency & Productivity statements I**

**Efficiency & Productivity statements I**

| | N | Mean |
|---|---|---|
| I use less time seeking and searching answers | 37 | 4.1622 |
| [I have become more productive] | 37 | 3.7568 |
| I finish my tasks faster | 37 | 3.7568 |
| [I write code faster than before usage of AI] | 37 | 3.7297 |
| I find that AI tools significantly streamline the coding process, making me more productive | 37 | 3.6486 |
| Integrating AI tools into my workflow has boosted my productivity substantially | 37 | 3.5946 |
| AI-driven debugging tools help me identify and fix errors more efficiently than traditional methods | 37 | 3.5405 |
| I appreciate how AI frees me from repetitive tasks, allowing me to focus on more complex problems] | 37 | 3.4865 |
| [I am in a flow state more often than before] | 37 | 3.2162 |
| Onboarding to new codebase has been faster and easier] | 37 | 3.0811 |
| AI helps me meet tight task deadlines more reliably by automating various development tasks] | 37 | 3.0541 |
| Over time, I've observed cost savings in my projects thanks to the automation capabilities of AI | 37 | 3.0541 |
| AI has made project management tasks in my projects more straightforward and efficient | 37 | 2.9730 |
| AI tools have been instrumental in managing complex aspects of my software development projects | 37 | 2.9189 |
| Valid N (listwise) | 37 | |

From Table 24 can be seen that 89,2 percent of respondents agreed or strongly agreed about using less time seeking answers now when they have the help of AI tools.

**Table 24: statement about using less time seeking and searching answers**

**Answer how true following statements are in your work with you using AI tools [I use less time seeking and searching answers]**

| | N | % |
|---|---|---|
| Agree | 21 | 56.8% |
| Strongly agree | 12 | 32.4% |
| Neither agree nor disagree | 3 | 8.1% |
| Strongly disagree | 1 | 2.7% |

In Table 25. one can interpret that 64,8 percent of respondents agreed or strongly agreed becoming more productive with the help of AI tools.

**Table 25: Statement about becoming more productive**

| Answer how true following statements are in your work with you using AI tools [I have become more productive] | | |
|---|---|---|
| | N | % |
| Agree | 18 | 48.6% |
| Neither agree nor disagree | 11 | 29.7% |
| Strongly agree | 6 | 16.2% |
| Disagree | 2 | 5.4% |

In Table 26 one can interpret that 67,6 percent of respondents agreed or strongly agreed on finishing tasks faster with the help of AI. The results (see Table 23.) of various statements (stating same in a bit varied forms and differentiated sentences) are well aligned with the contents of Table 25.

**Table 26: Statement about finishing tasks faster**

| Answer how true following statements are in your work with you using AI tools [I finish my tasks faster] | | |
|---|---|---|
| | N | % |
| Agree | 20 | 54.1% |
| Neither agree nor disagree | 10 | 27.0% |
| Strongly agree | 5 | 13.5% |
| Disagree | 2 | 5.4% |

Table 27. represents the statements that got lowest means (2.97 & 2.91). It is worth mentioning that both means are only very little below the middle number three, so respondents did not think these to be totally irrelevant or useless. Statements divided those who answered something else than “Neither agree nor disagree” In first statement

18,9% agreed or strongly agreed with the statement. With second statement the percent was 21,6%. Disagreeing or strongly disagreeing percentages were slightly higher, on first statement 21,6. % and on second 29,7%.

**Table 27: Statements about project management tasks**

| Answer to the following statements [AI has made project management tasks in my projects more straightforward and efficient] | | |
|---|---|---|
| | N | % |
| Neither agree nor disagree | 22 | 59.5% |
| Disagree | 5 | 13.5% |
| Agree | 4 | 10.8% |
| Strongly agree | 3 | 8.1% |
| Strongly disagree | 3 | 8.1% |

| Answer to the following statements [AI tools have been instrumental in managing complex aspects of my software development projects] | | |
|---|---|---|
| | N | % |
| Neither agree nor disagree | 18 | 48.6% |
| Disagree | 9 | 24.3% |
| Agree | 6 | 16.2% |
| Strongly agree | 2 | 5.4% |
| Strongly disagree | 2 | 5.4% |

Table 28 shows the negative statements regarding efficiency and productivity. Both statements received means under the middle number three and thus can be seen that respondents thought that these statements were a bit more untrue (closer to value 1) than true in their cases.

**Table 28: Efficiency & Productivity statements II**

| Efficiency & Productivity statements II | | |
|---|---|---|
| | N | Mean |
| Integrating AI into our established development pipelines has sometimes led to unexpected disruptions and delays] | 37 | 2.8108 |
| The time and effort required to take AI tools into use can sometimes negate the perceived efficiency gains] | 37 | 2.6216 |
| Valid N (listwise) | 37 | |

### 4.5.2 Competitive Advantage & Quality

In the theme of competitive advantage and quality there were 12 different statements. In Table 29. There are 8 positive statements regarding competitive advantage and quality. The means of the statements range from 2.72 to 3.59, majority being above the middle value

3. One could interpret that respondents were mainly favourable or agreeing with the statements. The top 2 results from each end are analysed in Tables 30 and 31.

**Table 29: Competitive Advantage & Quality statements I**

**Competitive Advantage & Quality statements I**

| | N | Mean |
|---|---|---|
| I feel that adopting AI technologies gives my work a competitive edge in the software development industry | 37 | 3.5946 |
| My code quality has improved | 37 | 3.4054 |
| The continuous learning features of AI tools lead to ongoing improvements in my software development processes | 37 | 3.3243 |
| The use of AI in testing ensures that the software products I develop are of the highest quality | 37 | 3.1081 |
| Regulations and standards are met more easily | 37 | 3.0811 |
| Using AI for code reviews has improved the consistency and maintainability of the code I write | 37 | 3.0000 |
| AI enables me to create personalised experiences in the applications I work on, enhancing user satisfaction | 37 | 2.8649 |
| I've found that AI contributes significantly to making the applications I work on more scalable and resilient | 37 | 2.7297 |
| Valid N (listwise) | 37 | |

Table 30. reveals that nearly half of the respondents (48,6%) agree or strongly agree that adopting AI technologies into work gives a competitive edge in software development industry and that. Similarly, 29,7% seem to agree or strongly agree that their code quality has improved when AI has been used.

**Table 30: Top 2 statements by means in Competitive Advantage & Quality**

| Answer to the following statements [I feel that adopting AI technologies gives my work a competitive edge in the software development industry] | N | % |
|---|---|---|
| Neither agree nor disagree | 18 | 48.6% |
| Agree | 13 | 35.1% |
| Strongly agree | 5 | 13.5% |
| Disagree | 1 | 2.7% |

| Answer how true following statements are in your work with you using AI tools [My code quality has improved] | N | % |
|---|---|---|
| Neither agree nor disagree | 24 | 64.9% |
| Strongly agree | 6 | 16.2% |
| Agree | 5 | 13.5% |
| Disagree | 2 | 5.4% |

Based on the information in Table 31. Respondents were somewhat divided about personalisation and enhanced user experience creation and about AI contributing in making applications more scalable and resilient. This lead to means staying below 3. In first statement about creating personalised experiences 27% of respondents disagreed or strongly disagreed. In second statement 29,7% were disagreeing or strongly disagreeing.

**Table 31:Statements with lowest means in Competitive Advantage & Quality section**

| Answer to the following statements [AI enables me to create personalised experiences in the applications I work on, enhancing user satisfaction] | N | % |
|---|---|---|
| Neither agree nor disagree | 20 | 54.1% |
| Disagree | 7 | 18.9% |
| Agree | 6 | 16.2% |
| Strongly disagree | 3 | 8.1% |
| Strongly agree | 1 | 2.7% |

| Answer to the following statements [I've found that AI contributes significantly to making the applications I work on more scalable and resilient] | N | % |
|---|---|---|
| Neither agree nor disagree | 22 | 59.5% |
| Disagree | 8 | 21.6% |
| Agree | 4 | 10.8% |
| Strongly disagree | 3 | 8.1% |

In Table 32. there are negative statements regarding competetive advantage and quality theme. Three out of four statements got favourable or agreeable responses from respondents. The agreeing was not very strong since the highest mean was only 3.29. One statement about AI's decision making process clarity was disagreed by respondents.

**Table 32: Competitive Advantage & Quality statements II**

**Competitive Advantage & Quality statements II**

| | N | Mean |
|---|---|---|
| I've noticed that AI-powered testing tools may overlook bugs that a human tester would typically identify | 37 | 3.2973 |
| The understandability and maintainability of AI-generated code can be a challenge | 37 | 3.2162 |
| I've observed instances where AI-generated code deviates from established coding standards and best practices | 37 | 3.1892 |
| AI decision-making processes lack clarity, making it harder for me to debug and troubleshoot software issues | 37 | 2.8108 |
| Valid N (listwise) | 37 | |

### 4.5.3 Wellbeing & Professional Development

There are altogether 11 different statements within the wellbeing and professional development theme. In Table 33. the positive statements and their means can be seen. All nine statements have received means above the middle number 3. Respondent results are in favour of these statements and some of the individual results will be interpreted more thoroughly in Tables 34.- 39.

**Table 33: Wellbeing & Professional Development statements I**

| Wellbeing & Professional Development statements I | N | Mean |
|---|---|---|
| I have learned new skills by using AI | 37 | 3.9730 |
| My job satisfaction has increased | 37 | 3.7027 |
| AI assists me in making informed decisions | 37 | 3.6757 |
| With AI-powered analytics, I gain deeper insights | 37 | 3.4865 |
| My focus is on more satisfying work (vs. without using AI) | 37 | 3.3784 |
| My coding language skills have developed further | 37 | 3.3784 |
| I make more informed decisions than before | 37 | 3.3514 |
| I feel more fulfilled with my job | 37 | 3.3243 |
| Using AI can prevent burnout | 37 | 3.0811 |
| Valid N (listwise) | 37 | |

In Table 34. there is a statement about learning new skills by using AI. This statement got the highest mean (3.97) and 81,1% reported on agreeing or strongly agreeing. Remarkable is that no one disagreed strongly, only 5,4% disagreed and only 13,5% neither agreed nor disagreed.

**Table 34: I have learned new skills by using AI**

| Answer how true following statements are in your work with you using AI tools [I have learned new skills by using AI] | N | % |
|---|---|---|
| Agree | 22 | 59.5% |
| Strongly agree | 8 | 21.6% |
| Neither agree nor disagree | 5 | 13.5% |
| Disagree | 2 | 5.4% |

In Table 35. The statement is about increased job satisfaction. Statement got mean of 3.70 and 59,4% respondents agreed or strongly agreed with the statement. Only 8,1% disagreed. This result is remarkable in terms of AI being a factor in making developer experience (or DX) better.

**Table 35: Increase of Job satisfaction**

| Answer how true following statements are in your work with you using AI tools [My job satisfaction has increased] | | |
|---|---|---|
| | N | % |
| Agree | 15 | 40.5% |
| Neither agree nor disagree | 12 | 32.4% |
| Strongly agree | 7 | 18.9% |
| Disagree | 3 | 8.1% |

The results in Tables 35. and 36. continue the same developer experience (DX) theme. In Table 36. 54% of the respondents agreed or strongly agreed that their focus is on more satisfying work when they can use AI and in Table 37. 40,5% agreed or strongly agreed that they feel more fulfilled with their job when using AI (see Table 37.). These results can be interpreted in a way that AI can be used as a competitive advantage by companies to lure top professionals in companies when they offer better developer experience than competitors (without AI in use). At the same time results can indicate that companies can keep their key resources happy and satisfied by providing them AI tools.

**Table 36: Focus in more satisfying work with AI usage**

| Answer how true following statements are in your work with you using AI tools [My focus is on more satisfying work (vs. without using AI)] | | |
|---|---|---|
| | N | % |
| Agree | 15 | 40.5% |
| Neither agree nor disagree | 13 | 35.1% |
| Disagree | 5 | 13.5% |
| Strongly agree | 3 | 8.1% |
| Strongly disagree | 1 | 2.7% |

**Table 37: I feel more fulfilled with my job when using AI**

| Answer how true following statements are in your work with you using AI tools [I feel more fulfilled with my job] | N | % |
|---|---|---|
| Neither agree nor disagree | 18 | 48.6% |
| Agree | 14 | 37.8% |
| Disagree | 4 | 10.8% |
| Strongly agree | 1 | 2.7% |

The Negative statements regarding the wellbeing and professional development theme can be seen in Table 38. Respondents are not agreeing with the statements and the mean results are below the middle number 3. Based on the means, respondents have not had a steep learning curve to AI tool usage (mean 2.40) and they are not worried about their core programming skills getting worse with AI usage (mean 2.72.).

**Table 38: Wellbeing & Professional Development statements II**

| Wellbeing & Professional Development statements II | N | Mean |
|---|---|---|
| I'm concerned that using AI for coding could slowly diminish my core programming skills | 37 | 2.7297 |
| I have faced a steep learning curve to use AI tools effectively | 37 | 2.4054 |
| Valid N (listwise) | 37 | |

One additionally remarkable perspective is presented in the Table 39. where the statement is about AI's capability to prevent burnout. While this was clearly a statement where many survey participants did not feel confident to respond (62,2% answered Neither agree nor disagree) it is important to notice that nearly a quarter (24,3%) agreed or strongly agreed on the AI's capability in preventing burnout.

**Table 39: Using AI can prevent burnout**

| Answer how true following statements are in your work with you using AI tools [Using AI can prevent burnout] | N | % |
|---|---|---|
| Neither agree nor disagree | 23 | 62.2% |
| Agree | 8 | 21.6% |
| Disagree | 3 | 8.1% |
| Strongly disagree | 2 | 5.4% |
| Strongly agree | 1 | 2.7% |

### 4.5.4 Collaboration

In statement analysis there was a single statement about collaboration (see Table 40.). Nearly 60% of the respondents did not clearly state their stance. Rest of the respondents did not find statement favourable since only 16,2% agreed with the statement. There were 24,3% of respondents that disagreed or strongly disagreed. It might be that many of the respondents did not think about the AI features of their daily communication platforms when answering in this.

**Table 40: AI enhancing collaboration within development team by streamlining communication and tasks**

| Answer to the following statements [AI enhances collaboration within my development team by streamlining communication and tasks] | N | % |
|---|---|---|
| Neither agree nor disagree | 22 | 59.5% |
| Agree | 6 | 16.2% |
| Strongly disagree | 5 | 13.5% |
| Disagree | 4 | 10.8% |

### 4.5.5 Ethics & Bias

Ethics and Bias section includes the analysis of two relevant statements (see Tables 41. - 43.) and the results of a third related question (See Table 44.) that was presented separately after the statement section in the survey.

Both statements in Table 41. received agreeable responses from the respondents. Means of both statements are over the middle number 3.

**Table 41: Ethics & Bias statements**

**Ethics & Bias statements**

| | N | Mean |
|---|---|---|
| Without diverse training data, AI can introduce bias that can have affect on outcomes | 37 | 3.7297 |
| I'm concerned about the ethical considerations and the accountability of decisions made with AI | 37 | 3.2432 |
| Valid N (listwise) | 37 | |

In Table 42. The statement about diverse training data 40,5% of respondents did not clarify their stance but 56,7% expressed that they either agree or strongly agree. The statement got mean of 3.72. From these answers reader can interpret that respondents are concerned about the diversity of the data used to train AI models.

**Table 42: Without Diverse Training Data, AI can introduce bias that can have effect on outcomes**

**Answer to following statements [Without diverse training data, AI can introduce bias that can have affect on outcomes]**

| | N | % |
|---|---|---|
| Neither agree nor disagree | 15 | 40.5% |
| Agree | 14 | 37.8% |
| Strongly agree | 7 | 18.9% |
| Disagree | 1 | 2.7% |

Table 43. interprets the statement regarding concern about ethical considerations and the accountability of decision made with AI. About one fifth (21,6%) did not clarify their view but 51,3% either agreed or strongly agreed. Mean of this statement was 3.24.

**Table 43: Ethical Considerations and Accountability of AI**

| Answer to following statements [I'm concerned about the ethical considerations and the accountability of decisions made with AI] | N | % |
|---|---|---|
| Agree | 16 | 43.2% |
| Neither agree nor disagree | 8 | 21.6% |
| Disagree | 7 | 18.9% |
| Strongly agree | 3 | 8.1% |
| Strongly disagree | 3 | 8.1% |

Table 44. presents the results of the ethics question that was presented separately in the survey. It is remarkable that 70,3% agree or strongly agree and only 5,4% were either somewhat or very unconcerned. Based on the results in this ethics and bias section, it is safe to say that AI usage raises ethical concerns among users.

**Table 44: Concern about ethical issues related using AI in software development**

| How concerned you are about ethical issues related to using AI in software development? | N | % |
|---|---|---|
| Somewhat concerned | 21 | 56.8% |
| Neither concerned nor unconcerned | 9 | 24.3% |
| Very concerned | 5 | 13.5% |
| Somewhat unconcerned | 1 | 2.7% |
| Very unconcerned | 1 | 2.7% |

### 4.5.6 Risks, Challenges & Considerations

In this risks, challenges and considerations section there were altogether 11 statements (see Table 45). Variation of means was between 2.43 to 3.97. Six out of eleven statements

had favourable / agreeable responses, one response got mean of 3 (the middle number in Likert scale) and four statements received disagreeable responses (means under 3).

**Table 45: Risks, Challenges & Considerations statements**

**Risks, Challenges & Considerations statements**

| | N | Mean |
|---|---|---|
| Using AI can endanger confidential material/ information | 37 | 3.9730 |
| AI tools have shown limitations and are not universally adaptable across all types of software development work | 37 | 3.3514 |
| There's a wide variance in the performance of AI tools, which can result in unpredictable outcomes | 37 | 3.1622 |
| AI integration has, on occasion, introduced unique security risks that were previously not a concern in software development | 37 | 3.1351 |
| AI tools hallucinate too often | 37 | 3.1081 |
| The automation capabilities of AI, while beneficial, have raised concerns about losing jobs in the industry | 37 | 3.0541 |
| The rapid advancement of AI technologies makes it difficult to commit to specific tools due to concerns about obsolesce | 37 | 3.0000 |
| My experience suggests that relying on AI for tasks could introduce risk and become a single point of failure | 37 | 2.9459 |
| It is difficult to prompt AI successfully | 37 | 2.5405 |
| I rely on AI tools to effectively identify and address security vulnerabilities in the software I develop | 37 | 2.5135 |
| Taking AI into use is too expensive | 37 | 2.4324 |
| Valid N (listwise) | 37 | |

Results (see Table 46.) state clearly that views of the respondents are rather unified, 81,1% of respondents either agree or strongly agree with the statement about AI possibly endangering confidential material.

**Table 46:Using AI can Endanger Confidential material / information**

**Answer to following statements [Using AI can endanger confidential material/ information]**

| | N | % |
|---|---|---|
| Agree | 24 | 64.9% |
| Neither agree nor disagree | 7 | 18.9% |
| Strongly agree | 6 | 16.2% |

The statement that got the most disagreeable responses is presented in Table 47. Results showed that 54% of respondents did not think that taking AI into use is too expensive. Only 10,8% agreed with the statement.

**Table 47: Taking AI into use is too expensive**

| Answer to following statements [Taking AI into use is too expensive] | N | % |
|---|---|---|
| Disagree | 15 | 40.5% |
| Neither agree nor disagree | 13 | 35.1% |
| Strongly disagree | 5 | 13.5% |
| Agree | 4 | 10.8% |

One view that has been a lot in the news while taking about AI is the risk of losing jobs. In Table 48. there is a statement regarding this. Nearly a quarter (24,3%) did not express their views. Mean of this statement was 3.05 meaning it was just a bit over the middle number and thus can be seen as a favourable. There were 40,5% of respondents that agreed or strongly agreed, but at the same time there were 35,1 % of respondents that disagreed or strongly disagreed. Views are divided but this clearly is an active concern among the professionals.

**Table 48: Risk of Losing Jobs in Industry due AI**

| Answer to following statements [The automation capabilities of AI, while beneficial, have raised concerns about losing jobs in the industry] | N | % |
|---|---|---|
| Agree | 12 | 32.4% |
| Disagree | 10 | 27.0% |
| Neither agree nor disagree | 9 | 24.3% |
| Strongly agree | 3 | 8.1% |
| Strongly disagree | 3 | 8.1% |

## 4.6 Other statements

In Tables 49 and 50 there are results from confidence levels of AI users if the AI solution in use would be internal company dedicated and trainer AI solution. The scale in Table 49. Is from 1-5 and in this the number three is not an "inactive" response option. Mean (3.89) is represented in Table 50. Over 70% of respondents gave responses four or five. Only 8,1% of respondents had responded low end scores one or two.

**Table 49: Confidence of AI usage with company dedicated and trained AI solution**

| Would you feel more confident in using AI if you had a company dedicated and trained AI solution available? Scale 1-5 | | |
|---|---|---|
| 4 | 15 | 40.5% |
| 5 Definitely more confident | 11 | 29.7% |
| 3 | 8 | 21.6% |
| 2 | 2 | 5.4% |
| 1 Not confident | 1 | 2.7% |

**Table 50: Confidence of AI usage with company dedicated and trained solution (mean)**

| Descriptive Statistics | | |
|---|---|---|
| | N | Mean |
| Would you feel more confident in using AI if you had a company dedicated and trained AI solution available? | 37 | 3.89 |
| Valid N (listwise) | 37 | |

With this simple analysis it is rather evident that most of the users would be more confident in using company dedicated and trainer ai solutions. This statement is a bit related to the earlier sections (Risks, Challenges, and considerations) statement about AI possibly endangering confidential material/information (see Table 46.).

## 4.7 Open ended questions

Survey included seven open ended questions that were divided around different themes. Answers have been manually thematically analysed and from each question researcher has

tried to identify key topics / themes that the respondents have mentioned. In answer analysis the most interesting response quotes have been picked up and presented in the text.

### 4.7.1 Risks & Challenges

The respondents gave 7 open ended answers to question “Do you identify other risks or challenges in AI tool usage (apart from the previous statements)?”. Response rate was 18,9%. Answers of the respondents highlight the importance of human verification of AI outputs and the risks of junior engineers not developing critical skills due overdependence on AI. After analysis of the responses, the identified risks could be divided into following six themes:

- Ethical considerations
- Technical limitations of AI tools and their development challenges
- Concern of misuse
    - A scary scenario where AI becomes harmful and is used for evil purposes
- Organisational and risks and slowness of bureaucracies to adopt AI tools
- Job market and career development
    - Diminishing entry level positions
        - Quote*: “Entry-level positions could diminish with AI automation and therefore junior developers might face issues to improve their skill-set and actually understand what is required from the tasks and what AI is suggesting.”*

- Verification and reliance
    - *Quote1: “You cannot blindly rely on the solutions provided by AI. You must verify and cross-check the response from other sources. “*
    - *Quote2 “Fear of junior software engineers relying too much to AI and therefore not understanding and recognising for example hallucination.”*

### 4.7.2 Bias

Three respondents (8,1%) responded to the question: “Have you encountered situations where AI has introduced bias? If so, how did you address the bias(es)?”. First two answers were about AI inaccuracy and error where these inaccuracies could stem from biased datasets or somehow flawed logic. The theme of the third answer was broader and highlighted the need for enhanced control and contextual understanding for AI. This response indicated a recognition of bias as an issue and points towards the solution being in the next developmental phase of AI engineering.

- Quote: *“"do not think of a pink elephant" AI needs more contol layers on top of the LLM hippocampus to address context and with context, bias. that is the engineering layer of ai that needs to come next.”*

### 4.7.3 Impacts of AI

Efficiency

To the question: “In your own words, has AI had an impact in your efficiency? What kind of impact?” respondents gave total of 24 responses, and this means that response rate was 64,8%. Single response could include multiple themes/topics, thus there are 28 listed responses below. Majority of the responses were rather positive AI usage and gained efficiency. Responses highlight AI as a beneficial tool for improving productivity in various areas of software development. Biggest gains were perceived in coding and scripting and in general task efficiency.

Responses are divided into following 7 themes with respective percents:

- Coding & scripting efficiency
  - 8 responses, 33,33% of respondents in this question
  - Quote1: "*Writing scripts has been much faster process"*
  - *Quote2: "Fast mockup codes are nice."*
  - *Quote3: "generating unit tests straight from code and running them through humans and then coverage tools has helped a lot to create more robust test sets."*
- Research and information gathering
  - 2 responses, 8,33% of respondents in this question
- Document and content creation
  - 5 responses, 16,66% of respondents in this question
  - Quote1: "*poc implementation, article writings, text production, learning new, architecture insights*"
  - *Quote2: "huge impact in making presentations, sales decks, pitches, RFQs. "can you make me a 12 page RFP document in an hour?" "yes i can""*
- Problem-solving and decision-making
  - 8 responses, 33,33% of respondents in this question
  - Quote1: "*Problem solving - I get solutions more efficiently."*
  - Quote2: *"AI has helped me in situations where I have been stuck and I have needed a nudge to move forward."*

- Creative assistance, UX & Design
  - 2 response, 4,17% of respondents in this question
  - Quote1: *“UX design tasks where AI currently is useful are complex enough that they are singular...*"
- Limited use or exploration of AI
  - 1 response, 4,17% of respondents in this question
  - Quote1: *“Not a lot, but I haven't investigated AI that much, It could and probably would if I used it more.”*
- Limitations and inefficiencies
  - 3 responses, 12,5% of respondents in this question
  - Quote1: *“it brings tools to write bloat code fast but it takes time to check and verify AI's answers.”*
  - Quote2: *“Sometimes creating prompts is very slow and you have to go through different approaches until you get a solution that works.”*

When respondents were specifically asked about sharing work related experiences where AI significantly reduced the time spent on a specific task, 17 responses were acquired. Majority of responses highlight AI’s positive role in code writing, optimisation, and document creation. Thematically the responses could be divided in following four themes:

- Code writing and optimisation
  - 8 responses, 47% of responses
  - Quote1: *“Easy one or two liner codes.”*

- Quote2: "*Repetitive scaffolding of similarly structured modules; Implementing first set of unit tests for simple business logic."*
- Quote3: *I created a simple script that browses through the files.*
- Quote4: *To write complex SQL queries with multiple joins.*
- Quote5: *Faster boilerplate code generation.*
- Quote6: *Code review has become faster with AI.*

o Information gathering and research

- 4 responses, 23,52% of responses
- Quote1: "*Seeking information on various things, generating document templates, creating fast summaries etc."*
- Quote2: *"It speeds up finding answers significantly."*

o Document creation and management

- 5 responses, 29,41% of responses
- Quote1: "*Formulating customer proposals and information, ideas around speechwriting."*
- Quote2: *"Creating project documentation from scratch. It is for example easy and faster to ask AI to create a high level table of content of a project plan etc."*
- Quote3: *"Ir might have reduced time when writing documents."*
- Quote4: *"Data analytics, summarizing large documents, synthesis creation, brainstorming new ideas"*

o Design & UX

- 1 response, 5,88% of responses

When respondents were asked to share their work-related experiences about AI's negative impacts, twelve responses were received. Majority of the faced issues were related to inaccuracies and the additional work to rectify AI-generated solutions. Misdirection and challenges of junior developers were also a constitute of significant concerns. All in all, responses seemed to steer reader to thinking that AI alone cannot solve everything alone, professionals are needed along. The responses could be divided into following four themes:

- Overreliance and unrealistic expectations
    - 2 responses, 16,67% of responses
    - Quote1: *"Trying to do too much with AI"*
    - Quote2: *"Adapting new tools takes time, and sometimes one need to wait that tools can do what expected. One should not trust AI results blindly."*
- Inaccuracies and extra work required
    - 6 responses, 50% of responses
    - Quote1: *"Problems figuring out how to ask for specific information. Wrong (incorrect for my situation/environment) information in database questions."*
    - Quote2: *"tried to generate specific functions but AI gives different answers each time and every time has some minor bugs."*
    - Quote3: *"The prompt given to the AI was clear, and while it gave a first solution, it was not usable, and required more time fixing it than it would have been to start without AI."*
- Misdirection and misleading solutions
    - 2 responses, 16,67% of responses
    - Quote: *"Since AI does not necessarily know all the code base, it could lead to the path where you get stuck into a solution which does not fit to the environment."*

- Junior developers' challenges
  - 2 responses, 16,67% of responses
  - Quote: *"I see this more from juniors where 'I can do it faster than copilot' or 'chatgpt just gives random information'. You still have to know what you want and validate what you get."*

### 4.7.4 Future trajectories

When respondents were asked about how they perceived the future role of AI in software development, 20 responses were received. Responses strongly reflect optimism about the AI's role in accelerating development and enhancing productivity. At the same time the responses also highlight the challenges in the integration and adaptation and the potential shift in workforce dynamics.

The responses can be divided into following five themes:

- AI as development accelerator
  - 5 responses, 25% of responses
  - Quote1: *"Good for fast-paced examples or parts of the code."*
  - Quote2: *"It can be a good tool to write a massive amount of bloat code."*
  - Quote3: *"Significantly reduces the need to write boilerplate."*
- AI's role in workforce dynamics
  - 4 responses, 20% of responses
  - Quote1: *"Those who won't use it are left behind."*
  - Quote2: *"It could replace the need for offshore junior developers."*

- Quote3: *“Less coding knowledge is needed, but understanding of software development work is still needed.”*
- Quote4: *“I believe AI to have a strong foothold in the software industry.”*

- AI and productivity and quality booster
  - 5 responses, 25% of responses
  - Quote1: *“When used effectively, it can boost productivity.”*
  - Quote2: *“Makes new programmers good in a shorter time and helps good programmers be more on top of their work.”*

- AI integration and adaptation challenges
  - 3 responses, 15% of responses
  - Quote: *“AI will impact heavily on software development, but exactly how is a bit unclear.”*

- Evolution of the software development processes
  - 3 responses, 15% of responses
  - Quote1: *“AI is the next layer of abstraction on top, and I'm gladly waiting for us to transition to actual code by specification time.”*
  - Quote2: *“AI makes some annoying simple tasks easier to do, and in that way, coding keeps more fun.”*

While asking about the perceptions and opinions of the respondents regarding necessary steps to enhance AI tool adoption among professionals working in software industry, 20 responses were received. Responses indicate that education and training were perceived as the most critical steps for increasing AI tool adoption, followed by addressing ethical and legal considerations. Respondents also thought that organisations / management need to take stronger role in introducing AI tools and usage guidelines. Possibility of isolated "private" and safe AI solutions was hoped and needed.

The responses can be divided into following five themes:

- Education and training
    - 9 responses, 45% of responses
    - Quote1: *"Teaching people not to use it for everything."*
    - Quote2: *"Give tool for users, give basic training, share best practices, repeat."*
    - Quote3: *"Clear decision-making "logging". Training in task-specific use. Ideas available on how AI could be added to different roles/tasks."*
    - Quote4: *"Organisations need to take a stance and introduce tools to their workers."*
    - Quote5: *"More trainings for decision-makers and also for the users."*
- Ethical and legal considerations
    - 4 responses, 20% of responses
    - Quote1: *"Ethic side, improve the ability to give better suggestions based on the larger context."*
    - Quote2: *"Transparency on solutions to show that code/info is not leaked to AI training if agreed."*

- Privacy and confidentiality
  - 3 responses, 15% of responses
  - Quote1: *“Isolated environments so that confidential data is not leaked outside.”*
  - Quote2: *“More visible opportunities to create internal e.g., self-hosted AI solutions that can be "safely" used, without needing to reveal any secrets to commercial service providers.”*
- Organisational support and culture
  - 3 responses, 15% of responses
  - Quote1: *“Organisations need to take a stance and introduce tools to their workers.”*
  - Quote2: *“More support from the company/management and clear guidelines to when and how AI can be used.”*
- Tool development and integration
  - 2 responses, 10% of responses
  - Quote1: *“We probably need several (independent and specialized) AI tools that work well together.”*
  - Quote2: *“Integrating basic LLM functionality and building a ladder of inference tooling around it.”*

# 5 Analysis and Discussion

## 5.1 Interpretation of Survey Findings

### 5.1.1 Landscape of AI Utilisation

In summary, the overview of AI utilisation in software development is marked by widespread adoption, routine use, and a focus on efficiency-enhancing applications. There is a clear trend of AI tools being used to optimise coding processes, automate routine tasks, and assist with complex problem-solving. The industry's willingness to embrace AI tools is tempered by the need for more structured training and education to fully harness their potential.

#### 5.1.1.1 Adoption Rate and Scope

The survey data underscore that a substantial 97.3% of professionals report using AI tools in their work and around 92% reporting usage both work and free time, indicating near-universal adoption within the respondent pool. This reflects an industry-wide recognition of AI's transformative potential. AI tools are not merely experimental but are integral to the software development life cycle.

AI adoption rate was higher among the thesis survey respondents than e.g., in survey of StackOverflow in March 2023, where the AI adoption rate was 43,78% and 25,46% planned on starting AI usage soon. GitHub’s study from 2023 stated that 92% of their (U.S. based) survey respondents were already using AI tools both at work and at free time. The AI adoption results of this thesis survey are more aligned with GitHub’s data.

#### 5.1.1.2 Engagement with Specific AI Tools

The data highlight a particularly strong engagement with AI tools that facilitate code generation and optimisation. GitHub Copilot, for instance, is used by 61.1% of respondents, underlining its prominence. This aligns with an industry trend where efficiency and quality are paramount, and AI tools are leveraged to automate and streamline coding tasks.

Variants of ChatGPT were used by around 70% of the thesis survey respondents. These tools are primarily used to problem-solving tasks, documentation, and coding assistance. These high usage rates are well aligned with the Tech Insight (2023) statistics about OpenAI's ChatGPT being the most popular AI tool in the world.

#### 5.1.1.3 Use Cases

When exploring specific thesis survey use cases, 'Getting information/Problem-solving' is reported by 73% of respondents, making it the most common application of AI tools. This aligns with a proactive approach to utilising AI for real-time decision-making and issue resolution. 'Writing/generating code' and 'Prompt engineering' are the next dominant use cases, reported by 62.2% and 59.5% of respondents, respectively. This reflects the industry's focus on leveraging AI for enhancing developer productivity and creativity.

StackOverflow's (2024) survey reveals that the most common use case was "Writing code" with 82,55%, next result was "Debugging and getting help" with the share of 48,89% (see Figure 2.). All results are pointing to the same direction, but the emphasis was more on generating code in StackOverflow's survey. This might be due to respondents being mostly software developers.

#### 5.1.1.4 Frequency of Use

The frequency of AI tool utilisation further reinforces the depth of integration within professional workflows. Over half of the survey participants (54%) are either daily users or use AI multiple times a day, indicating that AI tools have become a staple in the daily routines of software professionals.

#### 5.1.1.5 Training and Willingness to Learn

While AI tool usage is high, there is still a significant gap in formal training. Results of the thesis survey show that 56.7% of professionals are expressing interest in future AI related training. This demonstrates a gap in the market for educational programs that can equip professionals with the knowledge to leverage AI tools more effectively.

### 5.1.2 Perceived Value and Impact

The perceived value and impact of AI in software development are multifaceted and undeniably significant. The software industry professionals who participated in the thesis survey commonly view AI as a transformative tool that enhances productivity, improves quality, and provides a competitive edge. It also plays a critical role in professional development and job satisfaction. These findings are indicative of AI's integral role in not only the present but also the future of software development, positioning AI as a central component in the industry's ongoing evolution.

#### 5.1.2.1 Quantitative Insights

Survey results reveal that professionals perceive AI as a catalyst for value creation across several dimensions, including enhanced productivity, improved code quality, and more efficient problem-solving.

#### 5.1.2.2 Productivity Gains

A key finding from the survey is the perceived impact on productivity. A notable 68.7% of respondents affirmed that AI has improved their productivity, and the result was confirmed with other similar type of statement where nearly 65% of the respondents stated that they have become more productive. Nearly 90% of survey respondents reported that they are using less time seeking and searching answers. These findings are in line with the research conducted by GitHub in 2023 where 88% of the respondents reported being more productive (See Figure 5.). Thesis survey data indicates favourable approach (means over 3) to statements regarding efficiency and productivity (See Table 25). Faster task completion was reported by 67,6% of respondents.

Interesting fact regarding the survey results was that the AI usage effectivity in improving productivity was highest among the most junior (0-5 years of experience) and the most senior (25+ years) of the experience groups (see Table 23.).

#### 5.1.2.3 Quality of Work

Improvements in work quality are also reported, with AI tools contributing to more robust and error-free code. This is reflected in the survey where 64,9% of professionals acknowledge an enhancement in the quality of code since integrating AI into their processes.

#### 5.1.2.4 Learning and Development

The survey data points to a significant value in terms of professional development. Approximately 81% of thesis survey participants credit AI tools with aiding in the development of their skills, suggesting that AI is not only a work facilitator but also a learning aid. The thesis survey results are pointing to the same direction as e.g., GitHub's (2023) survey where 57% of respondents had stated that AI tools help them to develop their coding skills.

#### 5.1.2.5 Satisfaction and Well-Being

Respondents of the thesis survey report that AI tools contribute to job satisfaction and well-being by enabling them to focus on more intellectually rewarding tasks. With nearly 60% of thesis survey respondents are reporting of increase in job satisfaction and 54% stated that they can concentrate on more satisfying work due to AI tool usage. This aligns quite well with earlier research data collected by GitHub (2022), where 60% had reported being more fulfilled in their job and 74% were concentrated on more satisfying work. GitHub's newer study from 2023 revealed that 73% of respondents felt more fulfilled in their work.

Nearly 25% of the thesis survey respondents stated that AI can prevent burnout and in GitHub's developer survey (2023) the share of respondents stating the same was 41%. These results give human resource teams in companies some food for thoughts. Too many working aged employees in IT industry have suffered from burnout and if using AI can be way to prevent it, the topic should be investigated more thoroughly. Each burnt out employee is a huge cost for employers, society but more importantly the amount of

personal suffering is enormous. Preventing the tragedy has a great value for the employees but also for companies, society, and friends & family of the employee.

Based on the thesis survey and the literature review, AI tools already have a remarkable impact on the developer experience.

#### 5.1.2.6 Competitive Advantage

The thesis survey indicates that organisations perceive a competitive advantage from AI adoption. Nearly 49% of thesis survey respondents believed that adopting AI technologies gives them competitive edge in the industry. About 76% of executives in GitHub's survey express that AI has exceeded their expectations, particularly in enabling faster time-to-market for software products. While executives were more optimistic, still the results of thesis survey point towards the same direction and one can interpret that adopting AI gives competitive advantage. When the AI adoption rate rises in the future, it might be that using AI is the new normal and not using it will be a "competitive disadvantage".

#### 5.1.2.7 Economic Implications

While efficiency gains are remarkable on an individual level, a study by McKinsey (2023) revealed that companies utilising AI in their software development can increase their development related productivity by 20-45% of the current annual spending to software development function. Deloitte's (2022) study data indicates that nearly 25% savings are possible in long term maintenance costs for companies utilising advanced analytics as a part of predictive maintenance strategies. Same study reveals that productivity can be increased by 25% and breakdowns reduced by 70%. Undeniably AI has remarkable economical potential for company / organisation level. AI's impact on the broader economy is underlined, with projections suggesting that developer productivity benefits could potentially contribute to a global GDP increase. GitHub data (2023) indicates global economy benefits worth of 1.5 trillion U.S. dollars by 2030. This is reflective of AI's role in scaling human effort and creating economic value beyond immediate organisational boundaries. Current survey findings on enhanced efficiency and productivity support the

theory of remarkable global economy benefits if and when AI is widely adopted among developers.

#### 5.1.2.8 Impact on Innovation

AI's role as an innovation driver is evident, with professionals highlighting its utility in fostering creative problem-solving and the development of novel software solutions. This is seen in the reported use of AI for exploratory coding and design tasks.

### 5.1.3 Ethical and Bias Considerations

Ethical considerations and potential biases in AI emerged as pertinent themes among respondents. There is a clear concern regarding the transparency of AI decision-making processes, as well as the need for diversity in training data to prevent inherent biases from influencing outcomes. This reflects a growing awareness of ethical implications as AI becomes more integrated into professional practices. The survey responses underscore an industry-wide call for ethical AI practices that include accountability, transparency, and fairness. The need for regulatory guidance, better training, and the development of technologies that can reduce bias are highlighted as key areas for action. These findings stress the urgency with which the industry views the ethical ramifications of AI tools and the critical role of ethical considerations in the responsible deployment of AI technologies.

#### 5.1.3.1 Ethical Awareness and Concerns

The ethical considerations surrounding AI tool usage are recognised and taken seriously by the industry professionals. A significant portion of the thesis survey respondents, approximately 70%, acknowledge concerns regarding ethical issues related to AI in software development. This is indicative of a heightened awareness and sensitivity towards the ethical implications of AI systems.

#### 5.1.3.2 Bias in AI Systems

Bias within AI systems emerges as a prominent theme, with 56,7% of the thesis survey respondents acknowledging potential biases introduced by AI, particularly in relation to the

diversity of training data. The qualitative responses underline a recognition of the challenge of ensuring that AI models are trained on representative datasets to mitigate bias.

#### 5.1.3.3 Handling Bias

Addressing bias is a multifaceted challenge. Some respondents discuss the necessity of enhanced control layers on AI systems to better understand context and reduce bias, suggesting a direction for future AI development that emphasises transparency and accountability.

#### 5.1.3.4 AI and Decision-Making

Concerns about AI decision-making processes are prevalent among the thesis survey respondents, with a notable portion expressing the need for AI systems to be more transparent. This reflects an industry call for 'explainable AI' (XAI), where AI systems are not only accurate but also capable of explaining their reasoning, decisions, and processes.

#### 5.1.3.5 Training and Misuse

The importance of proper training in AI tools is emphasised to prevent misuse and to address ethical concerns. Misuse of AI can lead to unintended consequences, and proper education is seen as a safeguard against such risks. Moreover, it can ensure that AI is used in a manner that upholds ethical standards.

#### 5.1.3.6 Regulatory and Legal Framework

The results also shed light on the importance of a robust regulatory and legal framework to guide the ethical use of AI. Compliance with data protection laws and the development of industry-specific ethical guidelines are cited as crucial for maintaining trust in AI tools.

## 5.2 Aligning with Theoretical Frameworks

### 5.2.1 Service-Dominant Logic and AI

The findings of the thesis survey resonate with the principles of Service-Dominant Logic (S-D Logic), where value is co-created through interactions between providers and users. AI tools serve as operant resources, facilitating this co-creation by enhancing knowledge and skills. The survey results reflect this value co-creation in AI's role in amplifying productivity and innovation.

#### 5.2.1.1 Integration with Service-Dominant Logic

The findings align closely with the principles of Service-Dominant Logic (S-D Logic), as AI tools are increasingly being utilised as facilitators of service rather than mere technological products. A large percentage of respondents acknowledge the shift towards service-oriented models of value co-creation, where AI tools are instrumental.

#### 5.2.1.2 AI as Operant Resource

AI tools are perceived as operant resources that significantly augment the skills and knowledge of professionals. The data indicates that developers are leveraging AI to enhance their competencies, which is a core tenet of S-D Logic, with most professionals agreeing on the expanded capabilities offered by AI.

#### 5.2.1.3 Co-Creation of Value

Responses underscore the co-creation of value between AI tool providers and users. There's a consensus on the iterative and collaborative nature of AI tool development, where user feedback plays a critical role in refining AI systems, confirming the S-D Logic's focus on the interaction between service providers and beneficiaries.

#### 5.2.1.4 Value Beyond Efficiency

While efficiency gains are prominent, the survey reveals that professionals also value the contribution of AI towards more qualitative aspects of service, such as innovation and

personalised user experiences, reflecting the S-D Logic's emphasis on intangible value propositions.

#### 5.2.1.5 Ethical AI as a Service Imperative

Ethical considerations emerge as an essential aspect of AI as a service, resonating with S-D Logic's view on ethical business practices. Professionals call for AI to be developed and implemented responsibly, aligning with broader societal values and customer well-being.

### 5.2.2 Challenges in AI Adoption and Utilisation

In summarising the challenges in AI adoption and utilisation, the discussion reflects on the multifaceted nature of the obstacles faced by the software industry. Technical complexities, cultural factors, ethical considerations, and regulatory compliance as key areas that require attention. The insights point towards a need for holistic approaches that not only solve technical issues but also consider the human and ethical dimensions of AI technology.

#### 5.2.2.1 Addressing Technical and Cultural Hurdles

The transition to AI-assisted operations is not without its challenges. Technical barriers, such as data quality and integration issues, are cited as significant impediments. Cultural resistance also emerges as a notable obstacle, with a portion of the workforce expressing scepticism towards AI tools, possibly due to concerns over job security and the transparency of AI decision-making processes.

#### 5.2.2.2 Training and Knowledge Gaps

A substantial number of respondents highlight the need for comprehensive training programs to facilitate smoother AI adoption. The survey reveals a knowledge gap that could potentially enhance the acceptance and effective use of AI in software development practices, if fixed.

#### 5.2.2.3 Ethical and Bias Considerations

The survey underlines concern over AI's propensity to manifest bias, stemming from the data it's trained on. Professionals call for more transparent and explainable AI systems to address potential biases and foster trust among users.

#### 5.2.2.4 Regulatory and Compliance Issues

Another challenge is navigating the complex regulatory landscape surrounding AI. Professionals indicate that regulatory compliance, particularly concerning data protection and privacy, is a considerable concern for organisations, potentially stalling AI integration efforts. About 81% of the thesis survey respondents were worried about the possibility of AI endangering confidential material and over 70% of respondents indicated that they would be more confident in using AI if they had a company dedicated and trained AI tool available. One way to mitigate the risks and make users more confident could be development towards retrieval-augmented generation (RAG) solutions that would be tailored for company specific AI solutions. This approach could take advantage of generative models such as GPT and the precision of targeted information retrieval systems to create company internal applications that are customised with company data and thus efficient for internal use. These types of RAG solutions are secure and taking maximal leverage of the company internal data.

## 5.3 Implications for Software Development

### 5.3.1 Workforce Dynamics

AI integration in software development is reshaping the professional landscape, as highlighted by the survey responses. While there are fears of job displacement, there is also a strong belief in the augmentation potential of AI, which can enhance human capabilities rather than replace them. Organisations must adapt by fostering environments conducive to continuous learning and by providing training that equips their workforce with the skills to leverage AI effectively. This transformation, while being challenging, offers an

opportunity to enrich job roles and create a more dynamic, skilled, and inclusive workforce equipped to tackle the complexities of modern software development.

#### 5.3.1.1 Reconfiguration of Job Roles

AI tools are not just auxiliary aids; they are redefining job roles. Where routine coding tasks are being automated, software developers are evolving into supervisors and collaborators of AI, guiding, and refining its outputs. This role evolution is creating a demand for professionals who are not only proficient in coding but are also adept at interacting with, managing, and directing AI systems. Industry will see huge rise in need of “prompt skills” or “prompt engineering”. Also, Sauvola et al. (2024) have stated in their research that new roles around e.g., AI system supervision and optimisation will emerge and some existing roles may yet be replaced due adoption of generative AI tools in software development.

#### 5.3.1.2 Shift in Skill Requirements

As mundane tasks are automated, the skill set required for software development professionals is undergoing a transformation. There's a growing need for skills in AI literacy, including understanding AI outputs, prompt engineering, and AI system management. This transition marks a move away from repetitive coding towards problem-solving, innovation, and strategic thinking. According to Sauvola et al. (2024) workforce in software development sector must acquire new and relevant skills and expertise to be capable to control, understand and design AI solutions and systems.

#### 5.3.1.3 Professional Development and Continuous Learning

The continuous advancement of AI tools requires creating an environment of lifelong learning within the workforce. Software development professionals must remain updated of the latest AI technologies and methodologies. This trend is fostering a culture where professional development is not a distinct phase but an integral part of the daily workflow.

#### 5.3.1.4 Impact on Entry-Level Opportunities

AI's capacity to undertake basic coding tasks has implications for entry-level positions. Responses to open-ended questions in the thesis survey speculated shift in job market, Junior developers may find fewer opportunities to engage in traditional coding tasks. This might e.g., compel educational institutions and organisations to reassess the training and onboarding processes for newcomers in the field.

#### 5.3.1.5 Workforce Inclusivity and Diversity

The levelling effect of AI tools, which can assist less experienced developers to perform at higher proficiency levels, may lead to a more inclusive and diverse workforce. However, this also raises concerns about ensuring diversity within AI development teams to prevent inherent biases in AI outputs.

#### 5.3.1.6 Emphasis on Soft Skills

Alongside technical proficiency, soft skills such as communication, teamwork, and adaptability are becoming increasingly vital. As AI tools facilitate more collaboration and higher-level decision-making, the ability to work effectively in teams and communicate complex concepts clearly is paramount.

# 6 Conclusions

## 6.1 Key Findings and Industry Implications

The thesis survey data reveals a near-universal adoption of AI tools among software development professionals, with an impressive 97.3% of participants integrating AI into their workflow. The substantial engagement with AI tools, particularly those enhancing coding processes and problem-solving (like GitHub Copilot and ChatGPT variants), reflects an industry at the cusp of a significant shift towards efficiency and augmented problem-solving capabilities.

A majority of the respondents report that AI has enhanced their productivity and quality of work, confirming AI's role as not only a facilitator but also an enhancer of software development practices. Furthermore, the positive correlation between AI tool usage and job satisfaction suggests a promising avenue for improving developer experiences and evening mitigating burnout. These findings translate into value for companies and organisations as well. AI is not just a tool but more like a transformative force that can offer significant value (also economic value) for organisations if integrated wisely.

However, the survey also uncovers a disparity between the high rate of AI tool usage and the availability of formal training, indicating a significant opportunity for educational initiatives tailored to these technologies. Need of AI related training or education and acquisition of new skills has been highlighted in this thesis, but the need is recognised also among other researchers. E.g., Sauvola et al. (2024). Moreover, the discussion on ethics and bias in AI highlights an industry-wide call for transparent, accountable AI practices, aligning with the ethical imperatives of Service-Dominant Logic.

## 6.2 Workforce Dynamics and Professional Evolution

The integration of AI is redefining roles within the software development landscape, automating routine tasks, and prompting a shift in skill requirements. As a result, there is an emergent demand for continuous learning and adaptation to maintain pace with technological advancements. Findings of Sauvola et al. (2024) Bull and Kharuffa (2024) are

similar to the findings of this thesis in this regard; Work roles are changing and further learning and new skills are needed. According to Bull and Kharuffa (2024) AI automation creates new opportunities in software development.

This transformation presents opportunities for a more dynamic and inclusive workforce but also poses challenges, particularly for junior developers who may find traditional entry-level coding opportunities diminished. The emphasis on soft skills underscores the evolving nature of the software development profession in an AI-augmented ecosystem.

## 6.3 Recommendations for Future Research and Practice

Based on the findings, it is recommended that industry and academia collaborate to establish robust training programs that address the current knowledge gaps in AI. Also Bull and Kharuffa (2024) are envisioning similar ideas. To be more precise their vision is to integrate AI development tools and practices into the education of software professionals.

Additionally, organisations should consider developing private, company-specific AI solutions that ensure data confidentiality and cater to unique corporate needs, potentially leveraging retrieval-augmented generation models for enhanced security and customisation.

Future research should investigate the long-term impacts of AI on job roles and market dynamics, as well as the effectiveness of different educational interventions in enhancing AI literacy. The development of ethical frameworks and regulatory compliance strategies for AI is also an urgent area requiring scholarly attention. Sauvola et al. (2024) have similar considerations in their research and they are recommending creation of legally sound guidelines regarding AI assisted creation.

## 6.4 Concluding Remarks

In conclusion, AI is transforming the software development industry, yielding significant productivity gains and quality improvements. Ethical considerations, training needs, and the future of workforce dynamics remain critical areas for further exploration. As AI

continues to evolve, a proactive and informed approach is essential to harness its full potential while ensuring ethical integrity and inclusivity in the workplace.

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# 8 Appendices

## Survey on AI Utilisation in the Software Industry

**Purpose of the survey**

Welcome, and thank you for your willingness to participate in this survey. Your insights are crucial to my research as part of a Master's Thesis for a Master of Business Administration (MBA) degree at Novia University of Applied Sciences in Finland.

The focus of this survey is to understand the current landscape of Artificial Intelligence (AI) tools in software development. I am interested in how professionals like you are utilising these tools, the benefits you perceive, any challenges you may have encountered, and your outlook on the future integration of AI in the software industry.

This survey should take approximately 10 minutes to complete. Please answer as accurately and honestly as possible; there are no right or wrong answers. All responses will be kept strictly confidential and will only be used for academic research purposes. The aggregated findings may contribute to a deeper understanding and advancement of AI practices in our field.

Your expertise and time are greatly appreciated! To begin, please click '**Next**'.

If you have any questions or you require further information, feel free to contact me at:

sini.tistelgren@edu.novia.fi

Thank you once again for your participation.

Sini Tistelgrén

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Novia University of Applied Sciences

* Indicates required question

Demographics and background information

1. What is your current work role? *

   Select the option that describes best your current work role.

   *Mark only one oval.*

   - ◯ Software Developer / Engineer / Designer
   - ◯ Software Architect
   - ◯ DevOps / DevSecOps Specialist
   - ◯ QA Engineer
   - ◯ UI/UX Designer
   - ◯ Product Manager
   - ◯ Product Owner
   - ◯ Project Manager
   - ◯ Data Analyst
   - ◯ System Administrator
   - ◯ Scrum Master / Agile Coach
   - ◯ Security Engineer
   - ◯ Manager
   - ◯ Other: _____

2. How many years of relevant experience you have in software industry? *

   Write a number of years

   _____

AI Usage & training

3. Have you used AI tools in your work? Will you use AI tools in the future? *

   *Mark only one oval.*

   - ◯ No I have not used AI tools but I would like to use them in the future
   - ◯ No I have not used AI tools and I am not interested in using them in the future
   - ◯ Yes I have used AI tools and I will continue using them in the future
   - ◯ Yes I have used AI tools but I will not continue using them in the future

4. Where do you use AI-tools? *

   If you use AI tools, is it at work, during free time or both?

   *Mark only one oval.*

   - ◯ At work
   - ◯ During free time
   - ◯ Both work and free time
   - ◯ I do not use AI tools at all

5. How often do you use AI in your work?

   *Mark only one oval.*

   - ◯ Multiple times per day
   - ◯ Daily
   - ◯ Weekly
   - ◯ Once in a month or less

6. Have you received any kind of training regarding the usage of AI tools? *

   *Mark only one oval.*

   - ◯ No and I am not interested in AI tooling related trainings
   - ◯ No but I would be interested in AI tooling related trainings
   - ◯ Yes I have participated in AI tool related training

Familiarity with AI tooling

7. Which AI tools you use in your work regularly?

You can select multiple options

*Tick all that apply.*

- [ ] Github Copilot + Chat
- [ ] Tabnine
- [ ] Codium
- [ ] ChatGPT 3.5
- [ ] ChatGPT 4
- [ ] Google Gemini
- [ ] Dolly
- [ ] DALL·E 3
- [ ] Midjourney
- [ ] SonarQube (AI features)
- [ ] AI features in cloud services ( AWS, Azure etc.)
- [ ] Other: _____

8. How familiar you are with Github Copilot? *

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Very familiar |

9. How familiar you are with Tabnine? *

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Very familiar |

10. How familiar you are with Codium? *

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Very familiar |

11. How familiar you are with ChatGPT 3.5? *

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Very familiar |

12. How familiar you are with ChatGPT 4? *

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Very familiar |

13. How familiar you are with Google Gemini? *

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Very familiar |

14. How familiar you are with Dolly? *

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Very familiar |

15. How familiar you are with DALL·E 3? *

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Very familiar |

16. How familiar you are with Midjourney? *

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Very familiar |

17. How familiar you are with SonarQube AI features? *

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Very familiar |

18. How familiar you are with AI features offered by cloud services (such as Azure, AWS etc) *

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Very familiar |

AI usage purposes

19. For what purposes do you use AI in your work

You can select multiple options

*Tick all that apply.*

- [ ] Writing / generating code
- [ ] Prompt engineering (explaining the problem to solve)
- [ ] Bug-fixing
- [ ] Refactoring code
- [ ] Understanding and explaining code
- [ ] Generating documentation
- [ ] Language translation (programming languages)
- [ ] AI-based verification
- [ ] Automated code review
- [ ] Requirement analysis
- [ ] Testing / Quality assunrance
- [ ] Software security
- [ ] Predictive maintenance
- [ ] CI/CD pipeline related tasks
- [ ] User behavious analysis
- [ ] Data analysis and insights
- [ ] Risk assessmet and mitigation
- [ ] Document drafting and summary creation
- [ ] Database operations
- [ ] Observability / Monitoring
- [ ] Getting information / problem solving
- [ ] Market analysis
- [ ] User profiling
- [ ] Other: _____

Perceived benefits I

20. Answer to the following statements *

*Mark only one oval per row.*

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongl agree |
|---|---|---|---|---|---|
| **I find that AI tools significantly streamline the coding process, making me more productive** | | | | | |
| **AI-driven debugging tools help me identify and fix errors more efficiently than traditional methods** | | | | | |
| **The use of AI in testing ensures that the software products I develop are of the highest quality** | | | | | |
| **Integrating AI tools into my workflow has boosted my productivity substantially** | | | | | |
| **AI assists me in making informed decisions** | | | | | |
| **AI tools have been instrumental in managing complex aspects of my software development projects** | | | | | |
| **I feel that adopting AI technologies gives my work a competitive edge in the software development industry** | | | | | |
| **With AI-powered analytics, I gain deeper insights** | | | | | |
| **AI enables me to create personalised experiences in** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| the applications I work on, enhancing user satisfaction | | | | | |
| I rely on AI tools to effectively identify and address security vulnerabilities in the software I develop | | | | | |
| AI has made project management tasks in my projects more straightforward and efficient | | | | | |
| Over time, I've observed cost savings in my projects thanks to the automation capabilities of AI | | | | | |
| AI enhances collaboration within my development team by streamlining communication and tasks | | | | | |
| Using AI for code reviews has improved the consistency and maintainability of the code I write | | | | | |
| I appreciate how AI frees me from repetitive tasks, allowing me to focus on more complex problems | | | | | |
| AI helps me meet tight task deadlines more reliably by automating various development tasks | | | | | |
| I've found that AI contributes significantly to making the applications I work on more scalable and resilient | | | | | |
| The continuous learning features of AI tools lead to ongoing improvements in my software development processes | | | | | |

Perceived benefits II

21. Answer how true following statements are in your work with you using AI tools *

*Mark only one oval per row.*

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongl agree |
|---|---|---|---|---|---|
| **My job satisfaction has increased** | | | | | |
| **My code quality has improved** | | | | | |
| **I write code faster than before usage of AI** | | | | | |
| **I finish my tasks faster** | | | | | |
| **I have become more productive** | | | | | |
| **My coding language skills have developed further** | | | | | |
| **Using AI can prevent burnout** | | | | | |
| **I have learned new skills by using AI** | | | | | |
| **I am in a flow state more often than before** | | | | | |
| **My focus is on more satisfying work (vs. without using AI)** | | | | | |
| **I use less time seeking and searching answers** | | | | | |
| **I feel more fulfilled with my job** | | | | | |
| **I make more informed decisions than before** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Regulations and standards are met more easily** | | | | | |
| **There are less merge conflicts** | | | | | |
| **Onboarding to new codebase has been faster and easier** | | | | | |

Risks & Challenges

22. Answer to following statements *

*Mark only one oval per row.*

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongl agree |
|---|---|---|---|---|---|
| **The understandability and maintainability of AI-generated code can be a challenge** | | | | | |
| **Taking AI into use is too expensive** | | | | | |
| **I've noticed that AI-powered testing tools may overlook bugs that a human tester would typically identify** | | | | | |
| **The time and effort required to take AI tools into use can sometimes negate the perceived efficiency gains** | | | | | |
| **I'm concerned that using AI for coding could slowly diminish my core programming skills** | | | | | |
| **AI integration has, on occasion, introduced unique security risks that were previously not a concern in software development** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| AI decision-making processes lack clarity, making it harder for me to debug and troubleshoot software issues | ○ | ○ | ○ | ○ | ○ |
| Without diverse training data, AI can introduce bias that can have affect on outcomes | ○ | ○ | ○ | ○ | ○ |
| I've observed instances where AI-generated code deviates from established coding standards and best practices | ○ | ○ | ○ | ○ | ○ |
| Integrating AI into our established development pipelines has sometimes led to unexpected disruptions and delays | ○ | ○ | ○ | ○ | ○ |
| The rapid advancement of AI technologies makes it difficult to commit to specific tools due to concerns about obsolescence | ○ | ○ | ○ | ○ | ○ |
| AI tools hallucinate too often | ○ | ○ | ○ | ○ | ○ |
| There's a wide variance in the performance of AI tools, which can result in unpredictable outcomes | ○ | ○ | ○ | ○ | ○ |
| My experience suggests that relying on AI for tasks could introduce risk and become a single point of failure | ○ | ○ | ○ | ○ | ○ |
| I have faced a steep learning curve to use AI tools effectively | ○ | ○ | ○ | ○ | ○ |
| AI tools have shown limitations and are not universally adaptable across all types of software development work | ○ | ○ | ○ | ○ | ○ |

| | | | | | |
|---|---|---|---|---|---|
| **It is difficult to prompt AI successfully** | | | | | |
| **I'm concerned about the ethical considerations and the accountability of decisions made with AI** | | | | | |
| **The automation capabilities of AI, while beneficial, have raised concerns about losing jobs in the industry** | | | | | |
| **Using AI can endanger confidential material/ information** | | | | | |

23. Do you identify other risks or challenges in AI tool usage (apart from the previous statements)?

Ethics and bias

24. How concerned you are about ethical issues related to using AI in software development?

*Mark only one oval.*

- Very concerned
- Somewhat concerned
- Neither concerned nor unconcerned
- Somewhat unconcerned
- Very unconcerned

25. Have you encountered situations where AI has introduced bias? If so, how did you address the bias(es)?

Impacts of AI

26. How do you rate the effectiveness of AI tools in improving your productivity?
(If you have used AI tools in your work)

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| AI tc | ◯ | ◯ | ◯ | ◯ | ◯ | AI tools have definitely had an effect |

27. How satisfied you are with the results that you are currently achieving with AI tools? *
(If you have used AI tools in your work)

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Very much satisfied |

28. In your own words, has AI had an impact in your efficiency? What kind of impact?

25. Have you encountered situations where AI has introduced bias? If so, how did you address the bias(es)?

Impacts of AI

26. How do you rate the effectiveness of AI tools in improving your productivity?
(If you have used AI tools in your work)

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| AI tc | ◯ | ◯ | ◯ | ◯ | ◯ | AI tools have definitely had an effect |

27. How satisfied you are with the results that you are currently achieving with AI tools? *
(If you have used AI tools in your work)

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Very much satisfied |

28. In your own words, has AI had an impact in your efficiency? What kind of impact?

29. Can you share any (work related) experiences where AI significantly reduced the time sper on a specific task?

30. Can you share any (work related) experiences where AI had a negative impact?

Future trajectories

31. Would you feel more confident in using AI if you had a company dedicated and trained AI solution available?

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Definitely more confident |

32. What steps do you think are necessary to enhance AI tool adoption among people workinç software industry?

29. Can you share any (work related) experiences where AI significantly reduced the time sper on a specific task?

30. Can you share any (work related) experiences where AI had a negative impact?

Future trajectories

31. Would you feel more confident in using AI if you had a company dedicated and trained AI solution available?

*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Not | ◯ | ◯ | ◯ | ◯ | ◯ | Definitely more confident |

32. What steps do you think are necessary to enhance AI tool adoption among people workinç software industry?

33. How do you perceive the future role of AI in software development?