UiA University of Agder

Master

The Role of Artificial Intelligence in Enhancing Project Management

A study of Norwegian Project Managers

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AI Won't Replace Humans —
But Humans With AI Will
Replace Humans Without AI

Karim Lakhani
Harvard Business Review

Abstract

Artificial Intelligence (AI) has rapidly expanded across various sectors and industries in recent years, with applications ranging from chatbots to Large Language Models (LLMs) like ChatGPT. Despite its widespread adoption, concerns persist regarding privacy, data handling, and reliability. The integration of AI into Project Management (PM) remains underexplored, possibly due to the rapid expansion and wide usability of LLMs. This thesis aims to address this research gap by investigating the utilization of AI tools by project managers.

We propose the following Research Questions (RQs) to address this gap: (RQ1): What types of AI tools are used in project management, and for what specific purposes?, and (RQ2): How do AI tools affect project management using the PMBOK7 project performance domains of Planning, Uncertainty, and Team?

A literature search and a qualitative study were conducted. The literature search provided insights into the current literature on AI in PM, highlighting gaps and promising areas for future research. Additionally, it identified the PMBOK7 framework to contextualize and validate the findings. The qualitative study involved in-depth, semi-structured interviews with nine Norwegian project managers with an average of 17 years of experience.

The research revealed widespread utilization of AI tools in PM, with five distinct use cases identified as the most common: *discussion partner*, *text refinement*, *meeting transcription*, *PDF summary*, and *work breakdown*. These use cases were analyzed within the context of the PMBOK7 framework, demonstrating how AI tools assist project managers in the subdomains of planning, uncertainty, and team. These findings suggest that AI adoption by project managers is already widespread, yet literature has not fully explored its implications. Additionally, the generalizability of the findings to the PMBOK7 framework implies potential benefits of AI adoption in PM across various industries.

Sammendrag

Kunstig intelligens (KI) har hatt en enorm vekst i ulike sektorer og bransjer de siste årene. Eksempler på dette er chatbots og språkmodeller som ChatGPT, som kan være verdiskapende i mange situasjoner og kontekster. I prosjektledelse finnes det bruk av KI som litteraturen ennå ikke har undersøkt. Denne oppgaven vil fokusere på dette området. Til tross for veksten og interessen, finnes det bekymringer angående dataen tilknyttet KI, som personvern, intellektuelt eierskap og GDPR.

Denne oppgaven har to forskningsspørsmål: (1): Hvilke typer KI-verktøy brukes i prosjektledelse, og til hvilke formål?, og (2): Hvordan påvirker KI-verktøy prosjektledelse i PMBOK7-domenene 'planlegging', 'usikkerhet', og 'team'?

Oppgaven gjennomførte et litteratursøk og brukte en kvalitativ metode. Litteratursøket ga innsikt i dagens litteratur og fremhevet områder innen KI og prosjektledelse med mangelfull forskning. PMBOK7 var prosjektledelsesrammeverket som ble fremhevet i søket og ga et teoretisk grunnlag for funnene. Den kvalitative delen gjennomførte ni dybdeintervjuer med norske prosjektledere om anvendt KI i prosjektledelse. Prosjektlederne hadde en gjennomsnittserfaring på 17 år.

Forskningen fant utbredt bruk av KI-verktøy innen prosjektledelse. KI-verktøy ble brukt som diskusjonspartnere og til tekstforbedring, møtetranskribering, arbeidsnedbrytning og til å lage sammendrag av filer. Disse anvendelsene ble satt i teoretisk kontekst av PMBOK7, som ga et grunnlag om hvordan anvendelsene forbedrer og effektiviserer domenene innen prosjektledelse. Funnene antyder at bruken av KI-verktøy allerede er utbredt og at litteraturen henger etter. Siden funnene har blitt satt i kontekst av PMBOK7, er funnene generaliserbare og kan anvendes i ulike bransjer og av ulike prosjektledere.

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Additionally, thanks to our fellow students who, for the past two years, have continuously worked beside us. Their friendship has contributed to our personal and professional growth. The strong culture we built around studying by showing up each and every day to write and work on the thesis has resulted in a product we are proud of.

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List of Acronyms

AI - Artificial Intelligence

PM - Project Management

PMP - Project Management Professional

PMBOK - Project Management Body of Knowledge

PMI - Project Management Institute

APM - Association for Project Management

IPMA - International Project Management Association

PMJ - the Project Management Journal

PMTQ - Project Management Technology Quotient

PD - Performance Domain

LLM - Large Language Model

NLP - Natural Language Processing

WBS - Work Breakdown Structure

IP - Intellectual Property

MNE - Multi-National Enterprise

RQ - Research Question

NDA - Non-Disclosure Agreement

1. Introduction

1.1 Background

Project Management (PM) is a profession known for its inherent complexity and the need for a multifaceted approach to achieve success (PMI, 2021). This complexity involves balancing the interests of various stakeholders, managing diverse teams, and addressing the needs of potential end-users, among many other factors (Lock, 2020; Murray-Webster & Dalcher, 2019). Despite the recognition of PM as a profession since the 1950s (Kelley Jr & Walker, 1959), project failures persist (NRK, 2024; Sauser et al., 2009; Wijayasekera et al., 2022), indicating that traditional focuses on quality, cost, and time are insufficient (Atkinson, 1999). This persistent gap highlights the need for innovative solutions to reduce complexity and enhance project outcomes.

One of the most transformative technologies driving innovation across various sectors is Artificial Intelligence (AI) (Akundi et al., 2022), which has found extensive applications in both industry and among private consumers. Sectors such as healthcare, finance, retail, and manufacturing have adopted AI to enhance productivity, decision-making, and innovation (Sherfudeen et al., 2024; Taboada et al., 2023). For instance, machine learning algorithms have accurately forecasted COVID-19 mortality rates, aiding healthcare systems in prioritizing resources (Pourhomayoun & Shakibi, 2021). The emergence of Large Language Models (LLMs) like ChatGPT and Gemini highlights the potential of generative AI.

Given the significant challenges in PM, AI presents a promising avenue for improvement. AI can revolutionize PM by automating routine tasks, providing data-driven insights, and enhancing decision-making processes. By addressing inherent complexities and reducing the cognitive burden on project managers, AI could significantly improve project processes, communication, outcomes, and efficiency.

Supporting this, a study by the Project Management Institute (PMI) found that 81% of leaders believe AI will impact projects (PMI, 2023). Furthermore, a majority of project managers view AI as having a "transformative" impact on their profession. Other research aligns with these findings, indicating AI's significant future impact on PM (Soni, 2023; Yigitcanlar et al., 2020). Studies on tools like ChatGPT suggest potential applications for project planning (Barcaui & Monat, 2023; Prieto et al., 2023).

Despite the literature focusing on future impacts of AI (Holzmann et al., 2022; Müller et al., 2024), there is evidence that AI is already widely used in PM today. The widespread adoption of AI tools in other areas, such as healthcare, supports this hypothesis, indicating that AI's integration into PM is both current and growing.

1.1.1 Key Concepts

In this subsection, we define the most important concepts to provide the reader with clarity, consistency, and a fundamental understanding of what we mean by AI and PM (more on definitions in Sections 3.2 and 3.7).

"AI is typically defined as the ability of a machine to perform cognitive functions that we associate with human minds, such as perceiving, reasoning, learning, interacting with the environment, problem-solving, decision-making, and even demonstrating creativity." (Rai et al., 2019, p. 5)

"Project management is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements. It's the practice of planning, organizing, and executing the tasks needed to turn a brilliant idea into a tangible product, service, or deliverable." (PMI, 2021, p. 4)

1.2 Thesis Specificity

In this thesis, we are focused on comprehending the effects of AI tools on PM and identifying how they are utilized.

We seek to anchor our findings in a robust PM framework. This thesis is confined to data gathered from Norwegian project managers and professionals in PM-related roles. *The scope of the thesis will be limited to AI tools and how they impact certain aspects of PM.*

The Project Management Journal's (PMJ) guidelines emphasize the importance of steering clear of speculative, forecasting, and atheoretical manuscripts and maintaining a clear focus on AI for PM (Müller et al., 2024). Considering this, our main inquiry is:

"How do AI tools influence project management?"

In order to answer this inquiry, we propose the following research questions while considering the SMART[1] criteria.

RQ1: What types of AI tools are used in project management, and for what specific purposes?

RQ2: How do AI tools affect PM, using the PMBOK7[2] project performance domains of Planning, Uncertainty, and Team?

[1]SMART, questions have an answer that is: Specific, Measurable, Achievable, Relevant, Time-bound.
[2]PMBOK7 means the 7th edition of PMBOK and PMBOK6 means 6th edition. Both are books on PM from PMI (PMI, 2021).

1.3 Content and structure

The thesis is divided into 6 chapters. The first chapter serves as the introduction, establishing the context and outlining the research questions. The second chapter presents our research method and our literature search findings, which provide an understanding of the theoretical frameworks. Chapter three focuses on the theoretical foundation of the thesis and explains core concepts, including the PM framework. Chapter four reports on the outcomes of the interviews, focusing on AI tools and the identified use cases. Chapter five discusses the findings from the results and places the use cases in the context of the PM framework. Chapter six provides a conclusion, summarizing the findings and suggesting avenues for future research.

2. Methodology

This chapter aims to explain how the research in this thesis was conducted. The chapter starts by explaining the research foundation and approach. The following sections present the literature search before describing the interview process. Finally, the chapter looks at the data analysis process.

2.1 Research Foundation

Conducting the research for this thesis involved numerous considerations regarding the use of AI tools. Firstly, it is important to elaborate on the author's perspective on the use of AI tools in general and how they were employed in this thesis. As academics and software engineers, we have observed the rapid emergence and evolution of AI tools firsthand. The wide availability of AI tools and their diverse applications have made it a frequently applied tool in our daily lives.

In this thesis, several AI tools were employed for restructuring and reformulating the text. Specifically, ChatGPT (2024) (versions 3.5 and 4) and Gemini (2024) were utilized to provide feedback on draft sections, improving their structure and wording. These tools were also used to condense text segments while retaining key information. Additionally, Quillbot (2024) was used to find synonyms and enhance grammar, and the zerogpt paraphraser (2024) assisted in paraphrasing text to meet different standards, such as academic or creative writing.

Furthermore, AI tools were applied to simplify or extract key points from literature and to generate recommendations for search strings (more on string searches in section 2.4.1).

The integration of AI tools into this research reflects a positive outlook on their potential. However, it is acknowledged that this perspective might introduce a slight bias. By openly acknowledging these beliefs, efforts are made to mitigate this bias.

Given the recent emergence of AI tools and the limited documentation on the measurable improvements they offer for PM, a hermeneutic interpretation approach was chosen for this thesis. The goal is to investigate project managers' views of the usefulness of AI by studying their experiences and thoughts, focusing on the subjective value of these tools. Additionally, this research seeks to identify gaps in existing literature and provide new perspectives where possible. An abductive research approach was deemed most suitable, allowing movement between theory and empiricism during the research process (Busch, 2014, p. 51).

2.2 Research Design

As mentioned, there is a lack of measurable and tangible gains from the utilization of AI tools in PM, making an extensive research design a poor fit for our research. With an intensive design, data is gathered from a few sources and goes more in-depth, often through interviews (Busch, 2014). Busch (2014) highlights the strengths of qualitative data in an intensive design. To build on this, Yin (2016) illustrates the strengths of a qualitative design when researching how people manage challenges in a practical project environment (Yin, 2016, p. 3). Yin defines the allure of qualitative studies:

> "It [Qualitative Studies] enables you to conduct in-depth studies about a broad array of topics, including your favorites, in plain and everyday terms."

Due to the quickly evolving nature of AI tools, as previously mentioned, it is imperative to also comment on the time frame of this study. A cross-sectional design was chosen as we wish to examine how things are today. The relevancy of these findings in the future depends largely on how quickly AI tools continue to develop.

Given the nature of the research, time constraints, and scarcity of available project managers, in conjunction with the rapid evolution of AI tools, we opted for an **intensive cross-sectional qualitative** research design (Busch, 2014), supplemented by a literature search.

2.3 Overview of Data Collection and Analysis

For this thesis, a mixed-methods approach was employed for data collection, with interviews as the primary data source. Interviewees also received surveys before and after the interview, acting as a secondary, supplementary data source. This, as noted by Busch (2014), offer strengths by enabling in-depth exploration of AI tool usage by highly engaged individuals likely leading the field. In addition, a literature search was conducted to serve as a theoretical foundation for the findings. The data collection and analysis method, outlined in Figure 2.1, consists of four stages. The design of the method is loosely based on the methods described by Cassell & Symon (2004) and Saunders et al. (2007).

In the first phase, the current literature on AI in PM is evaluated and the most common and general PM frameworks are reviewed to establish an understanding of the state of the art. Then a framework is selected to contextualize the findings and identify gaps in AI research within the PM literature. This sets the basis for the interview guide.

The second phase concentrates on collecting data through interviews, using the interview guide derived in the first phase. Semi-structured interviews were conducted to collect qualitative data. After every interview, the guide and questions were evaluated and adjusted if

needed. Additional tailoring to the interview guide was also done based on the pre-interview survey of each individual.

In the third phase, the data is processed from the interviews to outline a set of use cases. The use cases are a result of a categorization of data, as described by Cassell & Symon (2004, pp. 470–499).

Finally, the use cases are put within the context of the PM framework selected in the first phase. This contextualization is presented in the discussion chapter.

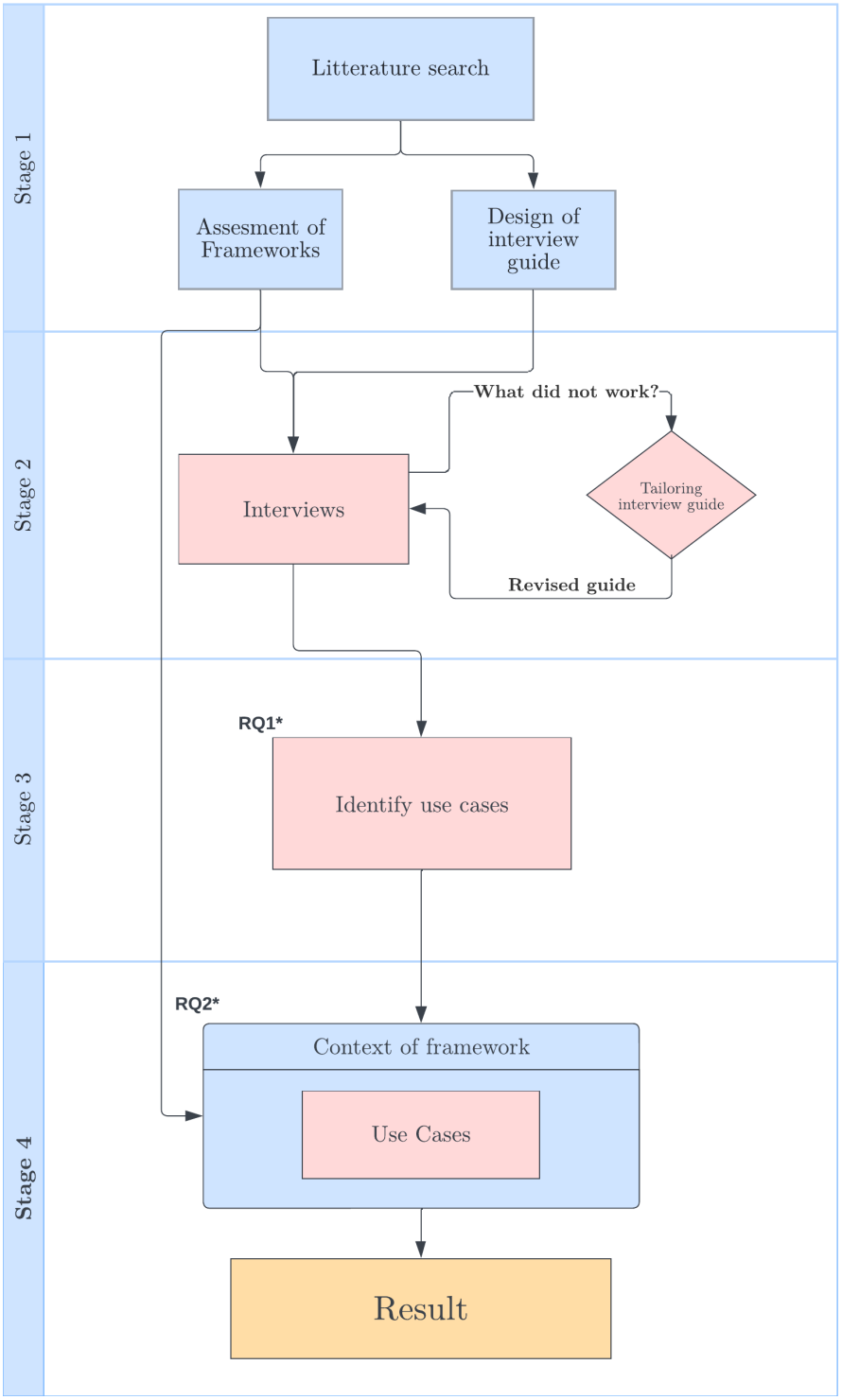

Figure 2.1: Stages of the research process

2.4 Literature Search and Overview

The literature search and the first phase of the data collection delves into key articles found between the dates (DD/MM/YYYY) of 01/12/2023 and 01/04/2024. This is partially conducted with the PRISMA standard (Rethlefsen et al., 2021), which is a guideline on how to conduct systematic and reproducible literature reviews through advanced string matches in databases such as SageJournals, Scopus, or PubMed. The searches were not carried out in a single database to adhere to the PRISMA standard, owing to various factors; thus, it is called a literature search[1]. Searching for "Artificial Intelligence in Project Management" is not guaranteed to make the results reproducible or relevant to the main inquiry.

However, the search will follow some guidelines of PRISMA. Search strings are articulated, and the relevance of each article is assessed based on the abstracts. Articles lacking abstracts related to the influence of AI in PM are discarded. Due to PM being an extensive topic, the search is further narrowed down to articles published after 2019. This is also because of AI's rapid development, highlighted by the release of ChatGPT in 2022.

2.4.1 Literature Searches

A comprehensive search strategy was employed across several search engines, including **Google Scholar**, **Semantic Scholar**, and **Sage Journals**. While not strictly adhering to the PRISMA standard (Rethlefsen et al., 2021), the selected articles were required to explicitly include the phrases "Artificial Intelligence" and "Project Management". To enhance the precision of the searches, additional terms such as *PMBOK*, *ChatGPT*, *LLM* and *NLP*[2] were systematically integrated to increase relevancy.

All articles in section 2.5 adhere to these criteria. For example, the search within **Sage Journals** for "Artificial Intelligence Project Management" yielded over 22,586 results (as of 06.03.2024). However, by including "PMBOK," this number was reduced to 27. Further filtering for publications post-2019 narrowed the selection to 7 articles. After reviewing, only 2 articles proved relevant: Wijayasekera et al. (2022) and Holzmann et al. (2022), both published in the PMJ. The other articles included in the literature overview were found through **Google Scholar** and **Sage Journal**. No articles that were found after April 1, 2024, were added to the literature due to scope creep.

2.5 Literature Overview: AI in PM

This section will introduce the studies and articles that were found through the previously described literature searches. Each study will be presented with key points from the article,

[1]The *literature search* is the method that results in the *literature overview*.
[2]LLM is a subcategory of NLP; more in Section 3.8.2.

such as what was researched or what AI tools were used. This section is not exhaustive, as most research into how AI affects PM is novel.

2.5.1 Saudi Arabia: ChatGPT-3.5 in Construction Planning

Prieto et al. (2023) conducted a study in early 2023 to investigate the efficacy of ChatGPT-3.5 as a project planner in the construction field. Six expert participants with an M.Sc. or PhD in civil engineering, coupled with a minimum of 2 years of industry experience or academic involvement (or both), were involved in the study.

The study's objective was to assess how well ChatGPT-3.5 could accurately retrieve and provide a detailed breakdown of tasks. The evaluation criteria encompassed aspects such as accuracy, efficiency, clarity, coherence, reliability, relevance, consistency, scalability, and adaptability (Prieto et al., 2023, p. 4). The findings of the study not only shed light on the experts' perspectives regarding ChatGPT-3.5 as a tool but also delved into the aspects that ChatGPT missed and the underlying reasons for these omissions.

The project had an original project plan, which ChatGPT was compared to. ChatGPT had the same experiment run 6 times, once for each participant. ChatGPT was fed the same initial prompt to attempt consistency across runs. The study found that every experiment yielded slightly different results, i.e., different schedules, tasks, and manpower required for each task, highlighting its lack of reliability. Overall, in terms of the number of tasks compared to the study's baseline, ChatGPT got 43/66 tasks (65% accuracy) in all experiments. It is worth noting that it missed the same 2 tasks in all 6 experiments, possibly due to a lack of knowledge, according to the authors.

2.5.2 Brazil: Generative AI vs Project Manager

Barcaui & Monat (2023) conducted a qualitative comparative study on how ChatGPT-4 compares in PM versus a project manager with 10 years of experience and certifications from PMI. In essence, this research prompt engineers ChatGPT-4 and applies the knowledge areas of PMBOK6 to project development (2000). The project goal was to create a mobile application.

The key results are promising. For example, ChatGPT was more thorough in its design and assessment of the Work Breakdown Structure (WBS[3]) than the project manager. It also considered and evaluated project risks considerably more than the project manager. Considering human biases heavily influence risk assessment, it is not surprising that humans are known for being poor at evaluating risks (Blanchette & Richards, 2010). The human project manager exhibited a more comprehensive approach, focusing on various project aspects such

[3]"A hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables." (PMI, 2021, p. 81)

as costs, quality, stakeholder mapping, scope, and scheduling. However, the authors did not provide a thorough explanation of the particular performance metrics and evaluations used to assess the results. Notably, the project involved developing an application within the IT sector, where ChatGPT is presumably most utilized. Omnibus consideratis, the study concludes that ChatGPT-4 is a valuable tool that project managers can employ. The potential synergy between AI tools and project managers is not to be underestimated.

2.5.3 Iceland: Project Managers view on AI

Fridgeirsson et al. (2021) is an authoritative study on AI and PM. The study created a questionnaire, and its respondents had (at least) a Masters in Project Management (MPM). It is based on how much project managers believe AI will influence PM in the next 10 years in different knowledge areas from PMBOK6 (2000). The authoritative study had 81 respondents, with the questionnaire being centered around the 10 knowledge areas of PMBOK6 (PMI, 2000). In general, the 2021 study results had a bell-curve around medium-high influence of AI in the knowledge areas and project managers believe AI will transform most of the existing knowledge areas as defined in PMBOK6. The same authors also did a second, in-depth qualitative cross-sectional study with 12 interviewees on AI's impact on risk, cost and scheduling in PM (Fridgeirsson et al., 2023). This study concludes that cost estimation and risk probabilities are most likely to be affected by AI.

2.5.4 Spain: AI in PM according to PMBOK7

Taboada et al. (2023) conduct a literature review and analyze articles wherein AI is applied to projects or PM. Employing the frameworks of PMBOK7 (PMI, 2021) and Industry 5.0, they scrutinize 128 papers where AI intersects with PM (Taboada et al., 2023, p. 5). The Performance Domains (PDs) from PMBOK7 are detailed in Section 3.3. For now, consider PDs to act as groupings of similar project characteristics. Taboada et al. revealed that half of the papers concentrate on the "planning" and "measurement" domains (33% and 17%, respectively). Nearly 70% of the papers centre around the construction and IT sectors (47% and 22%, respectively). The primary focuses of AI in the papers are forecasting (32%) and decision-making (19%).

The review delineates the PDs and scrutinizes the screened articles to determine the PD to which each article is most closely aligned. The presented articles were summarized by the type of AI employed, its purpose, and the results in a few sentences. It is noteworthy that out of the 128 articles, only one corresponds to Team PD and none of the studies address the Development Approach and Life Cycle PD. They also mention PM Technology Quotient (PMTQ), which is a concept relating to how adaptable people are to incorporating new technology given the organizational or current project needs.

Lastly, Taboada et al. (2023, p. 16) encapsulate their main discoveries and highlight the areas of AI in PM literature that remain unaddressed. They further explain what they consider main areas of future research, such as AI-powered Agile PM and the sustainable impact of AI-assisted PM.

2.5.5 Liverpool: Evaluation of ChatGPT & Bard in PMP Test

Vakilzadeh & Ghalejoogh (2023) investigate the performance of OpenAI's ChatGPT and Google's Bard[4] in answering questions related to the Project Management Professional (PMP) certification exam. The study involves a comparison of these models based on their responses to 400 multiple-choice questions. The primary aim of this study is to assess LLMs capabilities by evaluating its performance in PM-related tasks, aiming to determine its suitability as an assistant for project managers.

ChatGPT-4 outperforms the others, achieving a score of 87.75%. Following are ChatGPT-3.5 with a score of 72.75% and Bard with 72.25%. The authors then employ *prompt engineering* (Section 3.8.2) techniques to elevate ChatGPT-4s performance, achieving an accuracy score of 93.25%. Additionally, the *Few Shot Learning* (FSL) technique is applied to assess the overall performance of all models throughout the test.

The study's conclusion suggests that, while AI-assisted PM is promising, it remains somewhat unreliable, and its repeatability is not precise. Vakilzadeh & Ghalejoogh recommend that project managers should be cautious, highlighting that 1/9 initial responses from ChatGPT-4 were found to be inaccurate. They offer constructive feedback and suggest future research directions, emphasizing the need for enhanced reliability checks for data. Despite these challenges, the study expresses confidence in AI's potential to become an invaluable tool for future project managers

2.5.6 Canada: AI in Mega Projects

Wijayasekera et al.'s (2022) research explores the applications of digital tools in construction, specifically focusing on mega-project management (mega PM) and its future in digitalization. They present findings, stating most mega projects are not completed on time or on schedules, despite having lucrative deals. Furthermore, they argue that digitalizing large-scale projects offers built-in benefits and can provide more precise forecasts of timelines, risks, and expenses related to upcoming mega PM. Digitalizing can be used as a better alternative to existing frameworks, and it is expected to better manage and optimize resources, finances and time.

For project managers, the article emphasizes that AI-based intelligent bots can streamline essential administrative tasks for project managers. This aligns with the current literature's

[4]Bard is the older version of the now re-branded Gemini. Gemini is more capable than Bard, and we distinguish between these two in the same manner as ChatGPT-3.5 and 4.0.

overarching perception.

2.5.7 Delphi Study on AI for PM

Holzmann et al.'s (2022) study constitutes a 3-round Delphi investigation into the perceived impact of AI on the knowledge areas outlined in PMBOK6 (PMI, 2000). There were 52 project managers with various backgrounds who participated in this study, with more than 80% of them having at least 10 years of experience. The study assesses PM aspects. These aspects were acquired through an open-ended questionnaire given to the participants. After a qualitative analysis of the aspects, a list of 50 statements was produced. The list represented ideas for AI applications based on the project managers' needs or wants in PM.

The second round was a validation phase, refining the suggested list. The validation was done through a qualitative analysis. The third round was a consensus phase, where participants were asked to rank the final items on the list. This ranking was achieved by asking the participants to select the seven most important and the three least important items. These were the seven most important aspects, in descending order (Holzmann et al., 2022, p. 444): create a project schedule (frequency 31), analyze implications of missing deadlines (27), create a WBS (25), create a project budget (21), identify scope creep and deviations (21), risk identification and analysis (19), and scope management by extracting deliverables (18). The authors conclude that the main wants of project managers align with the values described as the 'Iron Triangle' or 'Triple Constraint'. The Iron Triangle is described by Atkinson[5] (1999).

2.5.8 Pakistan: ChatGPT in Software Project Management

Abbas et al. (2023) conduct an exploratory study on LLM applications for PM in the software industry, in particular ChatGPT and its versions. The authors suggest 6 different ways to employ LLMs to enhance PM through prompt engineering.

- Enhancing communication through thought-out planning, managing and controlled communication.
- Collecting requirements, coming up with ideas through brainstorming, and generating new concepts.
- Managing constraints: the trade-off between cost, quality and time.
- Aiding project estimates by assisting in project estimation including costs, scheduling, and developing a WBS.

[5]Holzmann et al. cite a different article and prefer the term 'Triple Constraint', but these are very similar.

- Issue tracking and troubleshooting: how to handle bugs, security vulnerabilities, and communication to stakeholders.
- Debugging code.

For example, Abbas et al. emphasize the importance of communication in PM. They suggest that ChatGPT can enhance communication by generating project documentation and fostering teamwork and information sharing among team members. Additionally, ChatGPT's language translation capabilities are valuable for teams distributed across different locations.

The study concludes that while ChatGPT offers many benefits, it also has limitations and is prone to errors in both output and input. Project managers must be mindful of ethical considerations and data privacy and remember that ChatGPT lacks emotional intelligence in order to effectively utilize it.

2.6 Literature Summary

Many of the studies found through the literature search related to ChatGPT as a project planner (Barcaui & Monat, 2023; Prieto et al., 2023), while others related to AI in PM on a more general basis (Abbas et al., 2023; Taboada et al., 2023; Vakilzadeh & Pourahmad Ghalejoogh, 2023).

As previously mentioned, Taboada et al. (2023) provided an overview of AI in PM in the context of Project PDs (defined in Section 3.3) from PMBOK7 (PMI, 2021). Surprisingly, the authors only mapped one study to the Team PD.

Further, the Fridgeirsson et al. (2021, 2023) studies provided insight into what aspects of PM should be further researched based on project managers' opinions. For example, Taboada et al. showed that when evaluating PDs, choosing "Development Approach and Life Cycle" would likely not yield significant empirical evidence since none of the 128 studies had contributed to this. Abbas et al. (2023) suggested use cases for LLMs in software PM to enhance planning, communication, and time and cost estimates. Holzmann et al. (2022) highlight the expectations of current project managers regarding the contributions of AI to PM, with a specific focus on planning and risk as defined in PMBOK6.

From the literature search, several promising aspects of AI applications in PM were identified. Aligning these findings with potential future research directions, guided by Müller et al. (2024) in the PMJ, allows for exploration of applied AI in or for PM.

The table 2.1 provides a brief summary of all the studies presented in the literature overview.

Study	Frameworks	Type of Study and Findings	AI tools
Prieto et al. (2023)	None	Experimental: Shows the potential of AI tool applications for planning and WBS.	ChatGPT-3.5
Barcaui & Monat (2023)	PMBOK6	Comparative Study: Shows the potential of AI tools applications for planning, WBS and risk evaluation.	ChatGPT-4
Fridgeirrson et al. (2021)	PMBOK6	Authoritative: Found which parts of, and to what degree, AI will affect project managers and how AI will influence PM in the next 10 years.	None
Fridgeirsson et al. (2023)	PMBOK6	Qualitative: What parts of PM are likely going to be affected the most by AI.	None
Taboada et al. (2023)	PMBOK7, Industry 5.0	Literature review: reviews current papers and what type of AI was used. Applied to the PDs of PMBOK7.	Many
Vakilzadeh & Ghalejoogh (2023)	PMP-test	Experimental: showed that AI tools are able to accurately answer general questions correctly regarding PM, also highlighting the difference between existing models.	ChatGPT-4, ChatGPT-3.5, Gemini
Wijayasekera et al. (2022)	None	Finds applications of AI technology in mega projects in the construction industry.	None
Holzmann et al. (2022)	PMBOK6	A 3-round Delphi study: uncovered the needs, desires, and expectations of seasoned project managers regarding AI tools.	None
Abbas et al. (2023)	APM and PMBOK6 cited.	Exploratory: possible applications of LLMs in software PM.	ChatGPT-4, ChatGPT-3.5, Bard

Table 2.1: Overview of the found literature.

PMI's PMBOK6 (PMI, 2000) was the most applied PM framework.

2.6.1 PM Frameworks

In the literature overview, in addition to secondary sources, three PM organizations were identified: the International PM Association (IPMA), the Association for PM (APM), and the Project Management Institute (PMI). Although each organization adopts a different approach to PM, they collectively cover a broad and similar range of topics within the field.

IPMA	PMI	APM
Perspective	Development approach and Life cycle, Planning,	Setting up for success Preparing for change
People	Team, Stakeholder,	People and behaviors
Practice	Project work, Delivery, Measurement, Uncertainty	Planning and managing deployment

Figure 2.2: Comparing chapters in PM books

Figure 2.2 shows that the three PM frameworks share common focus areas, with significant thematic overlap. In the figure, the authors have attempted to logically categorize among the three frameworks, highlighting their unique contributions to the field of PM. Among the three institutes, PMI stands out for its widespread recognition, as seen in the literature overview: (Barcaui & Monat, 2023; Fridgeirsson et al., 2021, 2023; Holzmann et al., 2022; Taboada et al., 2023). The latest version of the PMBOK was published in 2021, making it the most newly revised of the frameworks (PMI, 2021). The 7th edition marks a significant change from the previous versions of the framework. PMI designed the sixth edition with a focus on project managers and processes, while the seventh edition is more outcome-oriented and revolves around project teams. It focuses on working 'agile' and iteratively, making it an excellent fit for documenting the impacts of AI tools.

In exploring the impact of AI tools and systems on PM, this thesis will focus on the PDs as presented in the current PMBOK7. The qualitative nature of this thesis led to the decision that presenting all the PDs in the PMI framework would be infeasible and lead to scope creep.

In the next section, the findings from the literature search are presented, which identified gaps in the literature and highlighted which PDs this thesis should focus on.

2.6.2 Selection of Performance Domains

While some findings in this thesis may apply to other PDs, this thesis does not cover all PDs in PMBOK7. The choice of domains for contextualizing the findings was simplified as a consequence of the literature overview. For example, Barcaui & Monat's (2023) study concluded that ChatGPT-4 provided greater detail in certain aspects of PM compared to an experienced project manager. Identifying the areas of PM where ChatGPT-4 could reasonably compete provided clarity as to which PDs were feasible choices.

Another example is the widespread applications of Machine Learning (ML, more in section 3.8.1) in many banking and insurance companies to evaluate risks and premiums (Soni, 2023). Consequently, extending the use of AI to PM and risk evaluation to the field of PM seems reasonable. Fridgeirsson et al. (2023) emphasized the significance of risk in PM, suggesting it would make a compelling topic for this thesis.

Both the application in the finance sector and the findings in the literature (Barcaui & Monat, 2023; Fridgeirsson et al., 2023) reinforce the belief that choosing the uncertainty domain is the correct decision. In addition to our understanding of human limitations in risk evaluation (Blanchette & Richards, 2010), it seems prudent to explore further applications of AI tools to manage uncertainty.

Taboada et al. (2023) found "planning" and "measurement" to emerge as the most prevalent PDs. The review of existing literature, particularly by Fridgeirsson et al. (2021, 2023) and Holzmann et al. (2022), further reinforced the perception that findings will likely revolve around planning and measurement.

Although the "measurement" PD was discussed in Taboada et al.'s research, it was not explored further as the gains from the employment of AI tools for PM may not be measurable. Moreover, discussing "measurement" as a PD might be less engaging for project managers, leading to less empirical evidence. Focusing on how AI tools handle complex tasks rather than simple ones could offer more significant benefits to project managers. Hence, the "measurement" PD was not chosen.

In addition, the thesis will focus on the Team PD. This might be perceived as daring, considering the existing literature. Taboada et al. (2023) identified only one instance of AI application in relation to the Team PD (described in Section 3.6), a surprising find. Given the breadth of elements encompassed within this PD, such as critical thinking, the anticipation was to encounter more extensive literature discussing the influence of AI tools on PM.

Having experienced firsthand the utility of AI tools as a collaborative partner, we believed

there were potential applications in the team domain. Note: While "critical thinking" is mentioned within the context of the "stakeholder" PD, it was deemed more sensible to establish the team PD as a foundational aspect rather than the "stakeholder" PD. The Team PD delves more profoundly into the human dimension, aligning with the author's interest in exploring how individuals employ AI tools. Additionally, when accounting for the feasibility of data gathering, it was considered probable that interviewees would be less inclined to discuss stakeholder management. As such, the Team PD was chosen as the final PD.

In summary, the available literature suggests that the domains of planning and uncertainty are most likely to produce significant results. Studies by Barcaui & Monat and Prieto et al. provide a foundation for understanding the application of AI in planning, indicating that planning should be a primary focus. Similarly, literature by Holzmann et al. and Fridgeirsson et al. (2023) suggests that uncertainty should also be chosen as a key domain. The team domain was selected as a third area of focus after assessing the framework, identifying several promising aspects, and noting gaps in the current literature.

At present, there is insufficient research on how project managers can apply AI tools for PDs, with avenues for future research discussed in Section 6.1.

2.7 The DIGITAL framework

Brock & Von Wangenheim (2019) introduces a framework based on organizational research and how to evaluate whether a firm is ready to adopt AI and digital technologies. The study differentiates between DX leaders (digital transformation leaders) and laggards (lagging behind). They evaluated 114 DX leaders and 424 laggards. Further, they examined organizations and found the following organizational traits, which they deem key indicators for the adoption of AI:

> "... area of strategy, leadership, data management, agility, organizational processes, and innovation, as well as country-, industry-, and firm-level factors." (Brock & Von Wangenheim, 2019, pp. 117–118)

Example questions from the study are: how well equipped is a firm to integrate new technologies into projects? Does the firm gather enough quality data to be properly applied? What are the key qualities that differentiate DX leaders from laggards? Considering these questions, the authors identify seven organizational aspects that distinguish future DX leaders from laggards, identified through the DIGITAL framework. The following is a description of the acronym[6]:

- D: data: digital and high-quality data gathering and storing is pertinent for AI.

[6]Several discovery questions to assess how DIGITAL a company is can be found on page 123 (Brock & Von Wangenheim, 2019).

- I: intelligence: having skilled employees and knowledge to effectively implement AI,
- G: grounded: start small, improve existing solutions. Begin modestly, not ambitiously.
- I: integral: AI implementation is a holistic approach and needs to be in line with existing digitization.
- T: Teaming: partnering with technology partners (consulting firms) is key for successful implementation.
- A: agile: "a firm's ability to sense change and respond readily to changes by reconfiguring its resources, processes, and strategies" (Brock & Von Wangenheim, 2019, p. 128),
- L: leadership: managers need to lead, actively participate in and support AI projects.

2.8 Interview guide

The design of the interview guide adheres to qualitative analysis principles, employing a phenomenological process (Cassell & Symon, 2004, p. 13). This approach involves discovering themes or questions through iterative cycles with continuous refinement and revision. The open-ended questions aim to explore AI usage in PM in the context of the PMBOK7 frameworks and 'DIGITAL'. The DIGITAL framework was selected as a supplementary framework to enhance the specificity of AI tools for PM. The final version of the interview guide can be found in appendix I.

The interview guide was altered two times after both the first and second interviews took place. These changes shifted the focus more toward planning and uncertainty (sections 3.4 and 3.5), prioritizing tangible aspects of PM and AI over organizational aspects such as overarching strategies and objectives.

Notably, after the first two interviews, participants seemed more open and engaged regarding these specific topics. This modification was invaluable for us as interviewers, assisting us in steering interviews and significantly enhancing the flow dynamics. By the third interview, the clarity and relevance of the guide were considered satisfactory. This trend continued in later interviews, suggesting a balance between wording and theme was found.

2.9 Finding Interviewees

Locating suitable project managers for our study posed a significant challenge. The challenges mainly revolved around finding managers who also had insight into AI tools. In addition, project managers are notoriously busy, resulting in scheduling problems. Moreover, firms were cautious about revealing their current applications of AI in research and

projects. They were also hesitant about participating due to concerns regarding intellectual property (IP) and personal data security. The search for interviewees encompassed a multifaceted approach. Some individuals were identified through career fairs, while others were reached through established professional networks. Additionally, technology consulting firms were contacted, connecting with individuals possessing relevant experience and a willingness to share their insights. Recognizing the value of alumni who had completed their master's degrees, they were contacted as well. It was anticipated that they could offer valuable and varied insights.

Table 2.2 shows the background of the respondents:

Respondent ID	Background and Work Experience
S-1	Bachelor´s in electrical engineering with 25+ years of experience in industry and PM. Currently an industry project manager for a Multi-National Enterprise (MNE).
S-2	Master´s in IT Management with 3+ years of technology consulting experience. Currently an IT consultant for an MNE.
S-3	Bachelor degree in Computer Science & 25+ years of IT consultancy and PM experience. Currently an IT consultant for an MNE.
S-4	Master´s degree with 15+ years of geomatics, digitization and PM experience. Currently an industry project manager for an MNE.
S-5	Master´s in Industrial Economics, & 5+ years of software development and PM experience. Currently an industry project manager for an MNE.
S-6	Masters in IT and less than 3 years of experience working as a Software Developer. Currently a software developer for a large national bank.
S-7	Master's degree with 25+ years of IT infrastructure projects and PM. Currently an IT consultant for an MNE.
S-8	Master's degree with 25+ years of industry, PM and department management experience. Currently a department head for IT projects at a large national bank.
S-9	Master's degree; 15+ years of working as a senior engineering manager in IT. Currently a senior engineering manager in IT for an MNE.

Table 2.2: Respondents and their background

2.10 Pre-Interview Survey

The survey was constructed in a manner that would allow us to gain insight into each participant's epistemology of AI for PM, as well as work experience and higher-level education. All of the questions can be found in appendix II. Questions with a discrete scale of "strongly disagree" to "strongly agree," including the (option) "I do not know," were asked. Similarly, other questions were asked on a scale of "no impact" to "high impact.". Finally, there was an optional field of what parts of PM the respondents believe AI can significantly improve,

of which these were the responses:

(Optional) Are there any parts of PM you believe AI can improve significantly?
scope clarification, risk areas, communication
To make the first draft, to summarize big documents
Planning workshops, transcribe meetings and create summaries, explain new topics, brainstorm ideas
Management and refining the planning aspects, also communication and coordination. Probably some other manually labor task such as writing and so on..
Complying with contract, standards, rules and regulations
Communication and risk management
Administrative tasks, communication

Figure 2.3: Answers from respondents.

Figure 2.3 illustrates several common usage scenarios, and many of them coincide with the chosen PDs. Not all respondents opted to answer this category. The survey findings found unanimous positivity among respondents regarding the potential of AI tools. All answers can be found in appendix II.

2.11 Interviews

Before the interview, the interview guide was distributed to all participants, giving them an opportunity to familiarize themselves with the questions and prepare responses, in line with Saunders et al. (2007, p. 320). In addition, the PMBOK7 framework and the relevant subdomains were introduced to interviewees to give them context. Despite this potentially introducing biases, the benefits of providing a foundation for the interviews were considered to outweigh the drawbacks. Dynamic follow-up questions were asked during the interviews. Cassell et al.'s (2004, pp. 17–20) framework guided the interview process, addressing potential pitfalls and keynotes for ensuring effective interviews, such as setting appropriate relationships with interviewees.

Finally, before analyzing the interviews, they first transcribed them using Microsoft Teams and removed redundant information. The study participants were then asked to accredit the transcriptions and verify their contents.

2.12 Post-Interview Survey

This survey aims to further validate the empirical evidence and results collected and verify whether the respondents agree with the findings. The survey was constructed based on the data analyzed from the interviews and pre-interview surveys. The questions were related to organizational traits, which were later compared to traits as described by DIGITAL (Brock & Von Wangenheim, 2019).

These were the key findings (all results can be found in the appendix III):

- 67% agreed that firm strategies significantly impact the organization's ability to implement AI in project planning.
- 89% agreed that organizational culture and hierarchy affect their ability to effectively integrate AI technology in their PM practices.
- 89% agreed on "firm strategies strongly influence my organization's ability, culture and will to integrate new AI-technologies."
- 78% agreed that "if I employ AI technologies and use the result, I hold full accountability for the outcome, particularly if circumstances take a negative turn."

According to the survey and interviews, 89% of the interviewees had utilized AI to address complicated problems, with 78% using it regularly, whether to simplify tasks or serve as a discussion partner (see table 4.2 for more information).

2.13 Data Analysis

The analysis of the data presented in this thesis roughly follows a qualitative analysis process (Cassell & Symon, 2004, p. 478). Qualitative data from the interviews was analyzed using NVivo-14, a qualitative analysis software. The analysis consisted of two phases. In the first phase, NVivo was configured to categorize the interview data into distinct use cases, representing similar patterns of usage with descriptions. After each interview, the data was analyzed, and statements that described the applications of AI tools were highlighted. The statements were then categorized by which AI tools were described and how the tools were employed, resulting in the use cases. During the process, the categories changed; some were removed and others were merged.

In the second phase, the categorized use cases were further put into the context of the PM framework, trying to identify which aspects of PM AI tools provided assistance.

To begin, the chosen PDs were first created in NVivo, with all the subdomains as described in the PMBOK7. Using the defining traits of the subdomains to guide how the described

assistance from AI tools ties into the different subdomains. This resulted in each use case being tied to a set of different PDs.

3. Theory

In this chapter, the theoretical foundation for the thesis will be presented. The chapter will present PM and elaborate on the chosen PDs. Following this, the chapter will take a look at AI and describe commonly used AI tools.

3.1 Projects

Understanding a project is crucial to comprehending PM. Projects usually have common characteristics such as defined goals or results, following limitations such as time and budget, and a set of related tasks (Murray-Webster and Dalcher, 2019, p. 3; PMI, 2021, p. 14). Projects can range from massive and intricate projects like Fornebubanen (NRK, 2024), NASA's Mars Climate Rover (Sauser et al., 2009)[1], to smaller tasks like making a paper airplane. Even with their distinctions, they are all categorized as "projects."

Different sectors are considered, namely private and public. These sectors manage projects differently and pursue varied objectives. While the private sector typically focuses on profit maximization, public projects prioritize delivering benefits to the public (Gasik, 2016, p. 400). Gasik notes a cross-section where private companies may undertake public projects, typically infrastructure. Public projects are often perceived as more complex by project managers. This is due to factors such as involving numerous stakeholders, facing organizational resistance to change, and experiencing frequent changes in management.

Finally, projects are usually divided into distinct project phases. A phase is defined as "a collection of logically related project activities that culminates in the completion of one or more deliverables" (PMI, 2021, p. 33). The number of phases in a project varies depending on factors such as size, type, and scope. The PMBOK7 offers a generic template for project stages, which include Initiation, Plan, Development, Test, Deploy, and Close (PMI, 2021, p. 47).

3.2 Project Management

The literature extensively debates the definition of PM, with origins tracing back to the 1950s (Atkinson, 1999; Kelley Jr & Walker, 1959; Lock, 2020). Atkinson (1999) outlines the 'Iron Triangle' of PM, highlighting quality, cost, and time as key components. However, Atkinson argues for additional categories beyond this triangle to eliminate project failures. He introduces the 'Square Route' model, which adds three categories, namely stakeholder

[1]These projects are used as examples in the discussion chapter.

and organizational benefits, and information system considerations (Atkinson, 1999, p. 341). Project management has several definitions:

(1): "Project management is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements. It's the practice of planning, organizing, and executing the tasks needed to turn a brilliant idea into a tangible product, service, or deliverable." (PMI, 2021, p. 4)

(2): "Project Management is the application of a collection of tools and techniques (such as the CPM and matrix organisation) to direct the use of diverse resources toward the accomplishment of a unique, complex, one-time task within time, cost and quality constraints. Each task requires a particular mix of these tools and techniques structured to fit the task environment and life cycle (from conception to completion) of the task." (Atkinson, 1999)

There are many more; however, due to the framework chosen being PMBOK7, definition 1 will be chosen as it is from the same framework.

3.2.1 Historical Project Management

Initially, PM was seen as scheduling work rather than a separate role (Atkinson, 1999). Gradually, this focus shifted to not only scheduling but also cost reduction. It was important to find critical jobs[2] and establishing the critical path[3], to optimize schedules (Kelley Jr & Walker, 1959). The emergence of IT in the 1970s and 1980s further transformed PM practices, making IT skills essential (Lock, 2020, pp. 4–5). Today, PM has evolved beyond industrial and IT distinctions, shaped by technological advancements. There are some key organizations contributing to its collective understanding.

3.3 Project Performance Domains

The books "A Guide to the PM Body of Knowledge" (PMI, 2000, 2021) serves as a comprehensive foundation for project managers across industries, offering an extensive compilation of practices, methodologies, and concepts critical to project success.

PMBOK is divided into two distinct parts: "The Standard for Project Management" and "A Guide to the Project Management Body of Knowledge". The first part tries to "provide a basis for understanding project management and how it enables intended outcomes" (PMI, 2021, p. 3), while the second part describes the PDs.

"A **Performance Domain** is a group of related activities that are critical for the effective delivery of project outcomes. Project performance domains are interactive, interrelated, and

[2]A critical job signifies a task that acts as a bottleneck for time or resources.

[3]These critical jobs collectively form the critical path, influencing a project's timeline and resource allocation.

interdependent areas of focus that work in unison to achieve desired project outcomes." (PMI, 2021, p. 7)

The domains will provide the basis for contextualizing how AI tools impact PM. PMBOK7 describes eight distinct PDs that all contribute to the effective delivery of project outcomes and can be seen in Figure 3.1.

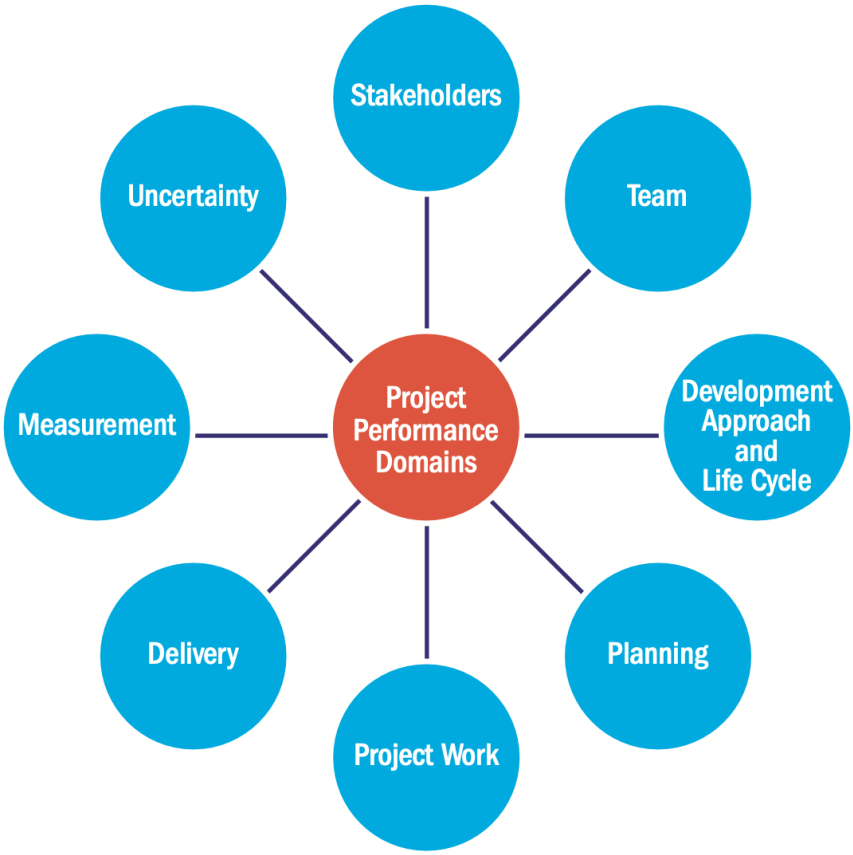

Figure 3.1: The eight Performance Domains (PMI, 2021, p. 5)

Based on the literature overview, three domains were chosen to be the scope of this thesis. The following sections will detail the three chosen domains and relevant subdomains. Only the subdomains that were found relevant after the fact have been detailed in the sub-sections.

3.4 Uncertainty Performance Domain

The *Uncertainty Performance Domain* focuses on activities and functions associated with uncertainty (PMI, 2021, p. 116). Uncertainty is defined as "a lack of understanding and awareness of issues, events, paths to follow, or solutions to pursue." (PMI, 2021, p. 117). The objective of the domain is to provide a framework that project managers can use to effectively navigate uncertainty so that a project reaches a desired outcome. PMBOK7 differs from the traditional approach by emphasizing various types of uncertainty, which is often more encompassing than risk (failures) in other frameworks (Atkinson, 1999; PMI, 2000, 2021). Figure 3.2 shows the several different subdomains described to refine and clarify the

broader term of uncertainty.

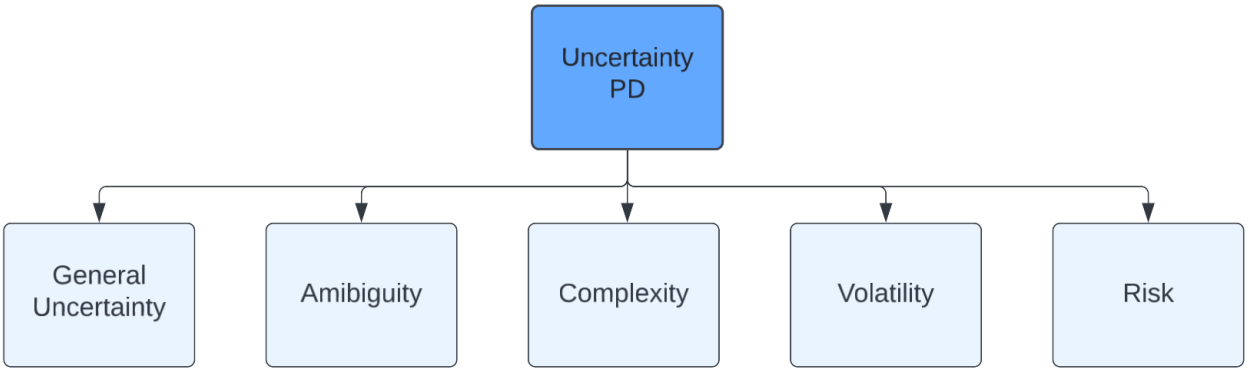

Figure 3.2: Uncertainty Performance Domain (PMI, 2021, p. 117)

3.4.1 Risk

The risk subdomain is often what people consider first when trying to quantify uncertainty in a project. These might be pitfalls, events, or conditions that may occur during a project that can affect it both positively and negatively. Risks that might affect a project positively are commonly referred to as **opportunities**. For opportunities, there are mainly five different strategies that should be considered: exploit, escalate, share, enhance, and accept. (PMI, 2021, p. 125) The counterparts to opportunity are **threats**. Threats are events or conditions generally negatively impacting a project. There are mainly five ways that are presented to deal with threats (PMI, 2021, p. 123):

- Avoid: eliminate or remove threat from project
- Escalate: the decision is above the project manager's authority
- Transfer: transfer ownership of the threat to a third-party
- Mitigate: strategies to reduce the impact or probability of a threat
- Accept: accept the threat and create a contingency plan, or simply do nothing.

3.4.2 Ambiguity

> *"Ambiguity - the fact of something having more than one possible meaning and therefore possibly causing confusion"* (Cambridge University, 2024)

PMI presents two distinct types of ambiguity that might occur during a project: firstly, **conceptual ambiguity**. This type of ambiguity refers to the confusion that occurs when two parts have different interpretations of a concept or an idea (PMI, 2021, p. 120). **Situational**

ambiguity is the second type of ambiguity. It is the ambiguity that occurs when there are multiple ways to solve a problem.

PMBOK7 presents three different ways to deal with ambiguity. The first way is progressive elaboration, akin to a step-by-step iterative process. With each iteration, more details are added as new information emerges. The second solution to ambiguity is experimentation. This is a series of experiments that can be performed to better identify relationships and cause and effect within a project (PMI, 2021, p. 120). Finally, prototyping can help reduce ambiguity by clearly distinguishing connections between different variables.

3.4.3 Complexity

While complexity is difficult to precisely define, it manifests as a characteristic within a program, project, or its surroundings. It is influenced by human behavior, system dynamics, or ambiguity as described in section 3.4.2 (PMI, 2021, p. 120). Complexity emerges when numerous interconnected relationships exhibit diverse behaviors. In such complex environments, aggregation can result in unexpected or unintended outcomes (PMI, 2021, p. 120). PMI (2021, p. 121) presents three main ways of working with complexity in a project.

System-Based: Dealing with system-based complexity involves two approaches. Decoupling involves identifying and separating parts of a system. This breakdown helps people understand how each part works. Simulation, on the other hand, uses unrelated scenarios to simulate smaller project components.

Reframing: Changing the perspective of a project, usually through two methods. The first method involves embracing diversity, using techniques like brainstorming or Delphi-like processes. The second method aims for balance. Instead of depending only on forecasting or past information, it combines data with neutralizing impacts, thus providing new perspectives.

Process-Based techniques for managing complexity involve three approaches. First, using an iterative process means gradually building up a project with small steps, thus allowing for learning and adjustments after each step. Second, engagement involves actively involving stakeholders to minimize assumptions and increase their commitment to the project. Lastly, integrating fail-safes offers backup plans for critical failures, ensuring safety or slower degradation if problems occur.

3.5 Planning Performance Domain

The *Planning Performance Domain* encompasses tasks and operations related to the initial, ongoing, and evolving organization and coordination required to deliver project deliverables and outcomes (PMI, 2021, p. 51). Project managers need to have a holistic approach to

project delivery. It is important to make sure project milestones and progress are well defined, spend adequate time on planning to fit the scope, prepare for the change in resources and outcomes, and properly manage stakeholder expectations. The main purpose of planning is to preemptively develop a way to create the project deliverables (PMI, 2021, p. 52).

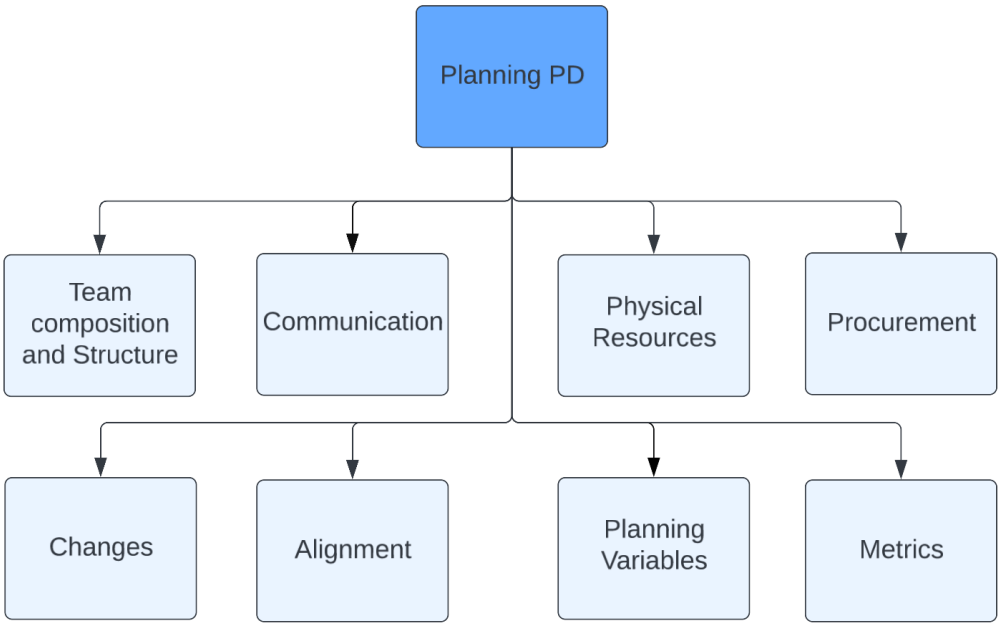

Figure 3.3: Planning Performance Domain (PMI, 2021, p. 51)

Compared to the other domains and looking at Figure 3.3, the Planning PD is one of the more complicated domains. The subdomains within project planning greatly influence the dynamics of the other PDs, and as such, its relevance cannot be understated.

3.5.1 Communication

When planning for communication in a project, PMBOK7 presents a list of key factors (the 6 W's) that are deemed essential for communication (PMI, 2021, p. 64):

- Who needs information
- What information does each stakeholder need?
- Why should information be shared with stakeholders?
- What is the best way to provide information?
- When and how often is information needed?
- Who has the information needed?

Accurately determining the answers to these questions sets the foundation for good communication during a project (PMI, 2021, p. 64).

3.5.2 Alignment

During a project, it is essential to maintain close integration between planning activities and their associated artifacts[4] (PMI, 2021, p. 67). Ensuring integration involves ensuring that the planning of scope and quality requirements is in sync with; commitments to deliverables, budget allocations, resource types and availability, handling project uncertainties, and stakeholder needs. Companies often have several simultaneous projects. An important part of alignment is making sure these align with each other in terms of resources and other constraints mentioned previously. For larger projects, it is common to plan artifacts into a larger PM plan. In contrast, for smaller projects, a detailed plan may be inefficient. Regardless of the size or complexity of a project, or the timing, frequency, and status of planning, all project aspects must stay coordinated and integrated (PMI, 2021, p. 67).

3.5.3 Planning Variables

The subdomain of planning variables revolves around defining the development approach, project deliverables, organizational requirements, market conditions, and regulatory restrictions (PMI, 2021, p. 54). This subdomain entails estimating time, defining deliverables, workloads and resources, including personnel and physical assets, to create a project schedule.

3.5.4 Metrics

Enacting a project involves many considerations, among which planning, execution, and performance evaluation are interconnected through metrics (PMI, 2021, p. 66). Metrics establish a baseline and threshold for evaluating the project's progress, whether favorably or unfavorably. Good metrics should provide valuable insight into project status, and only variables deemed important for a project should be measured. Typically, a project will feature various categories of metrics. Budget and schedule metrics adhere to organizational norms, while other metrics may be more project-specific and exhibit greater variability.

3.5.5 Team Composition and Structure

When preparing for a project, project managers have to consider many factors, most notably team composition (PMI, 2021, p. 63). It is important to identify the specific skills for a project and assess the proficiency level, and years of experience of potential team members. Additionally, project managers should consider the costs versus benefits of using external versus internal teams. Finally, the planning should include considerations for the team's

[4]Artefact means any document or tangible output during the planning and execution of a project.

location and size.

3.6 Team Performance Domain

The *Team Performance Domain* contains five distinct subdomains, as seen in Figure 3.4. This domain primarily aims to foster a supportive culture and environment that enables teams to transform into high-performing teams (PMI, 2021, p. 20). It delves into various activities that facilitate team development and promote collective responsibility among all team members.

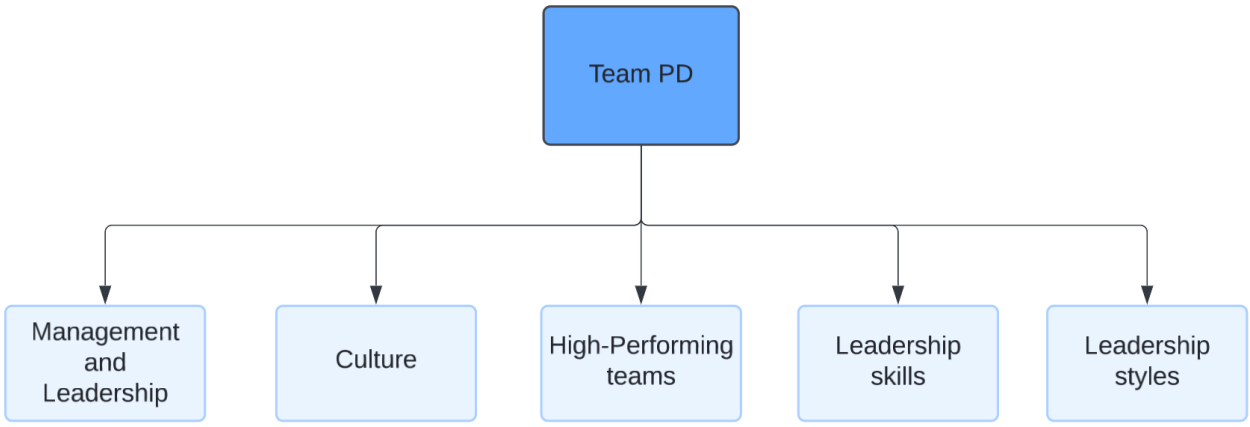

Figure 3.4: Team Performance Domain (PMI, 2021, p. 16)

3.6.1 Project Team Management and Leadership

PM involves the application of knowledge, skills, tools, and techniques for both management and leadership activities (PMI, 2021, p. 17). Management activities concentrate on ensuring effective processes, planning, coordination, measurement and monitoring to achieve project objectives. While leadership activities centre around people, including influencing, motivating, listening, enabling, and other actions related to the project team (PMI, 2021).

There is a broad range of focus areas within this subdomain, all relating to effective team management and types of leadership. Although all team members should practice leadership, there is generally a need for one person to be accountable for a type of activity. For instance, a project manager needs to communicate effectively about whether the team can have large autonomy over decisions or if decisions have to be centralized.

A great project manager eliminates barriers and distractions while fostering the encouragement, development, and growth of team members. They are often characterized as "servant leaders" (PMI, 2021, p. 17), guiding team growth and autonomy. Other traits include soft skills that facilitate constructive discourse, exhibiting courage in challenging situations, providing support during technical challenges, and much more.

3.6.2 Leadership Skills

Leadership skills are vastly useful in PM, for both project managers and project team members (PMI, 2021, p. 23). As mentioned in section 3.6.1, all persons should practice leadership skills. This subdomain explains the traits and activities that PMI associates with leadership skills. There are 4 sub-categories in the book, namely "Establishing and Maintaining Vision," "Critical Thinking," "Motivation," and "Interpersonal Skills."

Establishing and Maintaining Vision refers to the ability to create a vision for the project team (PMI, 2021, p. 23). The project team should understand the purpose of the project, its success criteria, and whether the project is deviating from the envisioned path. The vision should be clearly defined, concise, cohesive, and capable of inspiring project members to contribute.

Critical Thinking entails recognizing potential biases throughout PDs, which is pertinent for both project managers and team members (PMI, 2021, p. 24). It is crucial to uncover root causes and maintain a high level of awareness regarding uncertainties (section 3.4), among other considerations. Additionally, it entails the capacity to conduct impartial research, comprehend one's influence on others, employ reasoning, and identify biases.

Motivation is described as the ability to inspire team members. It is crucial for achieving high performance and commitment to project goals (PMI, 2021, p. 24). It can be intrinsic, driven by personal growth, recognition, or satisfaction from the work itself. It can also be extrinsic, driven by external rewards like bonuses. Project managers need to understand the individual motivations of team members to optimize the performance of the team.

Interpersonal Skills are skills in PM related to emotional intelligence decision-making and conflict resolution (PMI, 2021, p. 25). Emotional intelligence refers to a person's ability to effectively understand themselves and other individuals. This requires self-awareness, self-management, social awareness, and social skills.

Interpersonal skills are also used for effective decision-making (PMI, 2021, p. 25). While unilateral decisions offer speed, they are prone to errors and may demoralize those affected. Group-based decision-making, on the other hand, enhances commitment and leverages collective knowledge but may temporarily halt progress. Methods like Roman voting and fist-of-five voting facilitate group decisions. When decisions exceed the team's scope, they can provide solutions to the relevant authority, aligning with the "give me solutions, not problems" philosophy (PMI, 2021, p. 28).

Conflict Management is the final aspect of interpersonal skills (PMI, 2021, p. 29). Within project teams, adept management of conflicts is crucial. Both project managers and team members must handle conflicts appropriately. The manner in which conflicts are addressed can either escalate tensions or facilitate better decision-making, leading to superior solutions. When resolving conflicts, it is essential to address the underlying issues rather than

attributing blame. Maintaining respect and openness is paramount, as conflict often evokes anxiety. Project teams must operate cohesively and evaluate decisions objectively.

3.6.3 Team Culture

Within each project team, a unique team culture develops. The culture is defined by the actions and behaviors of each individual member of a team. The culture is often developed both through the establishment of deliberate team norms and informally through the behaviors and actions of the team members (PMI, 2021, p. 20). The PMBOK7 highlights seven key factors for creating a good team culture: transparency, integrity, respect, positive discourse, support, courage, and celebrating success.

	Subdomain	Description	Defining traits
Uncertainty PD	**Risk**	Assesses threats and opportunities in a project	Opportunities and Threats
	Ambiguity	Defines how project managers should handle situations that can have multiple meanings	Conceptual and Situational ambiguity
	Complexity	Defines complexity which emerges when numerous interconnected relationships exhibit diverse behaviors and how project managers should handle it	System-based, Reframing and Process-based complexity
Planning PD			
	Communication	Defines key factors for communication in a project	Who, What, Why, What, When and Who. (6 W´s)
	Alignment	Highlights the importance of keeping planning activities and artifacts closely integrated throughout a project	Stakeholder, Company and Project alignments
	Planning Variables	Revolves around defining the development approach, project deliverables, organizational requirements, market conditions, and regulatory restrictions	Development approach, project deliverables, organizational requirements, market conditions, and regulatory restrictions
	Metrics	Metrics provide insight into project status	Tangible and measurable progress
	Project Team Management and Leadership	Considerations to be take when assembling a project team	Compostion, skills, proficiency, size and location
Team PD			
	Project Team Management and Leadership	Defines the role of project managers within a team setting	Fostering a conductive team culture, promoting transparency, integrity, and respect among team members.
	Team Culture	Norms established through behaviors and actions of team members	Transparency, integrity, respect, positive discourse, support, courage and celebrating success.
	Leadership Skills	Important leadership skills	Establishing and maintaining vision, critical thinking, motivation, and interpersonal skills

Table 3.1: Summary of relevant PDs as defined in PMBOK7 (PMI, 2021)

3.7 Historical Artificial Intelligence

This section provides an overview of AI, tracing its historical development and highlighting its contemporary significance. AI has several definitions:

1: "AI is typically defined as the ability of a machine to perform cognitive functions that we associate with human minds, such as perceiving, reasoning, learning, interacting with the environment, problem-solving, decision-making, and even demonstrating creativity." (Rai et al., 2019, p. 5)

2: "Artificial intelligence (AI) has been defined as the study of algorithms that give machines the ability to reason and perform functions such as problem solving, object and word recognition, inference of world states, and decision-making." (Witkowski & Ward, 2020)

Of these definitions, definition 1 is the most relevant to the thesis topic and provides the definition most closely related to the solutions to the issues in PM.

3.7.1 Historical Development

The origins of AI trace back to Alan Turing's conceptualization of a "thinking machine" in the 1950s (Turing, 1950). This era saw the Dartmouth Summer Research Project on Artificial Intelligence in 1956, considered the beginning of AI research (Weizenbaum, 1966). The decades after witnessed milestones such as the ELIZA program, which simulated human-like conversation. However, concerns and funding reductions led to the "AI Winter" in the 1970s, characterized by a decline in AI research (Haenlein & Kaplan, 2019, p. 3).

In the late 1990s and early 2000s, AI experienced a resurgence, with IBM's Deep Blue defeating the world chess champion in 1997 (IBM, 2024). More recently, Google's AlphaGo achieved a significant breakthrough by defeating the world Go champion in 2017 (Silver et al., 2017).

3.7.2 Artificial Intelligence Today

Today, AI is saturated throughout our lives for many people without even knowing it. This accelerated integration is in part due to the efforts of pioneers such as OpenAI and Google. OpenAI, with its revolutionary introduction of ChatGPT-2 in June of 2018, and even more so with ChatGPT-3 in late 2022, has set a new standard for AI and LLMs (Marr, 2024). OpenAI's LLMs can engage in surprisingly human-like conversations and generate text-based content on a variety of topics. This platform, in particular, has truly been a catalyst for the mainstream employment of AI tools.

Not long after the release of ChatGPT, Google released its own platform for interacting with

AI, namely Gemini (previously Bard) (Pichai, 2023). The platform offers similar services as ChatGPT but utilizes Google's vast data, knowledge, and information.

3.8 Types of AI

This section will give a brief overview and introduction to commonly used types of AI and existing technologies. These techniques provide the perceived intelligence behind AI tools.

3.8.1 Machine Learning

Machine Learning (ML) is a branch of AI focused on developing algorithms that learn patterns from data to make predictions or decisions (Jordan & Mitchell, 2015). ML employs various algorithms, like neural networks, random forests, extreme gradient boosting, the KNN algorithm, and linear and logistic regression, to mention some. These are typically evaluated based on accuracy, which measures the proportion of correct classifications over the total number of classifications. Essentially, ML functions as a mapping, with each input x corresponding to an output y, which may also take the form of a probability distribution.

In the field of ML, there are three primary paradigms: supervised learning, unsupervised learning, and an intermediate approach (Jordan & Mitchell, 2015). While they are often seen as separate, it is more accurate to view supervised and unsupervised learning as opposite ends of a spectrum rather than completely different categories.

Supervised learning involves algorithms trained on a set of inputs (x, y), where x represents input parameters and y is the classifier, typically binary classification. Subsequently, when presented with a new input x*, the algorithm leverages its training set to predict y* (Jordan & Mitchell, 2015).

Unsupervised learning entails the examination of unlabeled data, operating under the assumption that inherent structural properties exist within the dataset (Jordan & Mitchell, 2015, p. 258). The specific nature of these properties is unknown; instead, algorithms strive to discover the underlying structures. For instance, it can be applied to grouping customers based on purchasing patterns or reducing the dimensionality of a dataset while retaining its essence.

Reinforcement learning, a hybrid of supervised and unsupervised methods, represents a third machine learning paradigm (Jordan & Mitchell, 2015, p. 258). It relies on dataset cues to guide learning, similar to trial-and-error. This approach is closely linked to psychology and neuroscience (Jordan & Mitchell, 2015). For example, Jordan & Mitchell refer to a study on how reinforcement learning was used to predict how monkeys' dopaminergic neurons respond to stimuli[5]. Reinforcement learning also applies to training AI in tasks like video

[5]In simple terms, the model predicted if the brain's reward area activated when a certain light was seen.

games, refining performance iteratively.

3.8.2 Natural Language Processing and Language Models

Natural Language Processing, abbreviated to NLP, is a collection of computational techniques for analyzing languages (Chowdhary & Chowdhary, 2020, p. 604). NLP is a branch of AI that focuses on enabling computers to understand, interpret, and generate human language in a way that is both meaningful and contextually appropriate. LLMs are a sub-branch of NLPs that are capable of generating human-like text. The most prevalent examples of state-of-the-art LLMs are OpenAI's ChatGPT and Google's Gemini, both of which are also classified as generative AI. Both of these AI´s function as one can enter a message (so-called prompt) into a chat box, and the AI will try to generate an appropriate response. Responses are usually slightly differently formulated, even with the exact same prompts[6]. This is generally due to variability in training data and statistical generation. Language is also often ambiguous, where context is easy for humans to understand but hard for machines (Chowdhary & Chowdhary, 2020, p. 604). NLPs are most commonly applied for information retrieval, extraction, translation, text summary, and question answering (Chowdhary & Chowdhary, 2020, p. 609).

With the widespread availability of LLMs, there has been growing interest in compute-optimal language models, also referred to as Small Language Models (SLMs) (Hoffmann et al., 2022). SLMs are lightweight language models optimized for a more focused area of knowledge compared to LLMs. As such, they are mostly useful for niche knowledge areas and are not applicable to an array of topics like LLMs. They have become somewhat popular because of their ability to provide the foundation for custom company SLMs. The company custom SLMs are trained on internal and often sensitive company data, and this data is usually not allowed to be shared externally. This data is IP and provides the decision-making foundation that firms are skeptical of sharing with outsiders.

Prompt Engineering

For language models, it is common to utilize "prompt engineering," which includes prompting techniques and techniques to customize NLPs, usually for ChatGPT or other LLMs (Kocoń et al., 2023). Essentially, the user creates a description prompt, "engineering how they want and expect the language model to behave," for example, Chain of Thought (answering step-by-step). This results in widely different answers from even the same language model and is convenient in situations where a generic answer is insufficient. Prompt engineering results in more accurate and relevant answers for the user, and it is also customizable for different users.

[6]As shown in the experiment with Prieto et al. (2023)

Copilots

Copilots represent a novel form of AI that effectively operates in accordance with its name, serving as copilots, with the primary purpose of aiding the user (Bendersky, 2024). These function as assistants that are intelligent, with a wide variety of applications. Copilots come in many different forms, such as Microsoft Copilot, Salesforce's Einstein, or customer service chatbots. Copilots can provide support in managing emails, summarizing transcripts and documents, and providing automated customer service, among many other features.

4. Results

This chapter will present the results from the data analysis of the interviews. It will explore how AI tools are employed and present the findings through five distinct use cases that were identified during the analysis (detailed in section 4.2). The identified AI tools and the use cases will answer RQ1.

4.1 AI tools

The interview part of the study revealed several promising and intriguing applications of AI in PM. It was discovered that 89% of the interviewees had used or were actively using some form of AI for PM-related cases. The analysis of the interviews revealed that primarily six AI tools were applied. Table 4.1 displays the AI tools utilized by each interviewee, while table 4.2 specifies the use cases of interviewees.

R-ID	ChatGPT-4	ChatGPT-3.5	Gemini	Company SLM	Custom GPTs	Other
S-1		X		X		X
S-2		X	X	X		X
S-3		X		X		X
S-4	X	X		X		X
S-5						
S-6	X	X	X		X	X
S-7		X				X
S-8	X	X			X	X
S-9	X	X	X	X		X

Table 4.1: AI tools used by the project managers for PM

There was a common consensus that the tools were, by and large, helpful and had diverse applications. LLMs and SLMs, especially ChatGPT-3.5, were the most commonly applied tools, with around 89% of participants stating they used them regularly. ChatGPT-4 and Gemini were also quite prevalent but lagged behind ChatGPT-3.5.

Company SLMs were the second most common tool after LLMs. Company SLMs are presented by the interviewees as "GPTs" trained on internal documents. They provide many of the functionalities that the public LLMs provide but are confined by more strict data-sharing policies. There was a common consensus among the interviewees that the company SLMs performed considerably worse than the publicly available LLMs for general use. In addition, it was found that the company SLMs could be applied in different ways than the publicly

available LLMs and could provide insight into internal company information.

The next category that was found pertains to custom GPTs. There were several of the interviewees who described quite technical and advanced applications of GPTs, to the point where they were not considered the same tool as the standard ChatGPT-3.5 or Gemini. Despite basing themselves on the standard LLMs, they could differ vastly from the expected outcome of the standard LLMs. One such example is how **S-6** created a custom GPT to help "translate" technical details into a more understandable and business-oriented language. This was achieved by training a model almost as a translator in addition to prompts that directed the original language. Cases like this were significantly different from the standard LLMs and were thus considered separate from the standard LLMs.

Finally, some edge cases could not be included in any of the other categories. These were often AI tools that deviated from the generic models, such as machine vision tools, data analytics tasks related to error reduction and handling, and the transcription tool in Microsoft Teams.

4.2 Use Cases

Throughout the interviews, there were similarities in how the different AI tools were utilized. These uses were condensed down into five main, distinct categories, which the following subsections will present in descending order of employment. The use cases are strictly defined from applications described by the project managers and will be further put into the context of PDs in the discussion chapter. The identified use cases can be found in Figure 4.1, and an overview of the interviewees' AI tools can be seen in Table 4.1. The found use cases will be presented in descending order based on frequency.

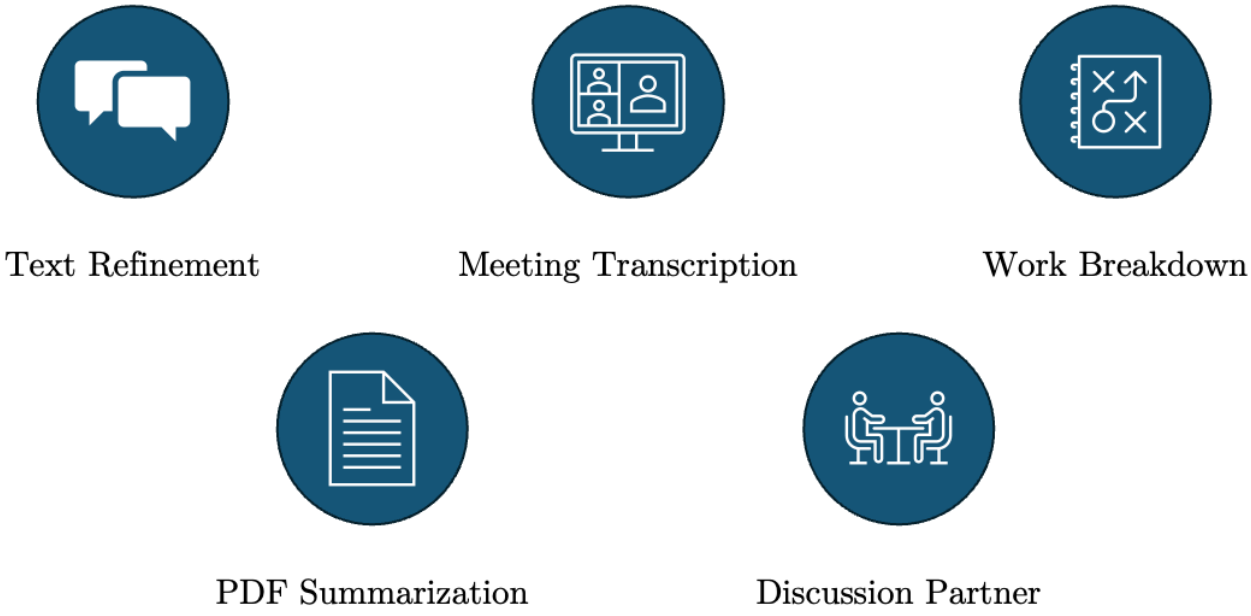

Figure 4.1: Overview of identified use cases

Subject	Text Refinement	Work Breakdown	Meeting Transcription	PDF Summary	Discussion Partner
S-1	X		X	X	X
S-2	X	X	X	X	X
S-3	X	X			X
S-4	X		X	X	X
S-5					
S-6	X	X	X	X	X
S-7			X		X
S-8	X		X		X
S-9	X	X	X	X	X
Sum	7	4	7	5	8

Table 4.2: Table over uses cases employed by each interviewee

4.2.1 Discussion Partner

89% of the project managers found LLMs to be valuable *discussion partners*. They utilized them not only for evaluating project planning strengths and weaknesses but also for various other purposes. For instance, our interviewees described using LLMs in conjunction with meeting transcriptions. This enabled project managers to promptly assess whether meetings proceeded as intended. By uploading the meeting transcription and engaging the LLM in debate, project managers could inquire about the resolution status of specific issues, task assignments, ongoing research, and more. The LLM could provide accurate feedback, facilitating critical thinking among project managers. For example, the LLM would pinpoint potential ambiguities and problems within the transcriptions between stakeholders or team members, and highlight possible future threats to the projects (or opportunities). This dynamic interaction with LLMs served as a valuable tool for decision-making and problem-solving in PM contexts. Moreover, the interaction was described as autonomous, enabling project managers to swiftly make informed decisions without the need for extensive inquiries or consultations.

This was done through prompt engineering, i.e., "stating a case" to an LLM, and asking for feedback. Project managers could do this ahead of meetings, asking for ways to conduct the meeting in a manner to resolve certain aspects or what tasks to prioritize. Several of the project managers were able to prompt engineer by employing simple key lists, which included interests (such as: organization, stakeholders, etc.), participants, goals (clarifying the roadmap), and expected outcomes (resolution of roadmap issues, mitigation of threats). Then, after generating an agenda, project managers could conduct the meeting and keep it concise. This saved them time and also required fewer resources. After the meeting, project managers also described using LLMs to generate action lists for the project based on the transcriptions from the meeting.

4.2.2 Text Refinement

The interviews revealed that a common application for AI tools was *text refinement*, with 78% of the interviewees regularly using AI tools for this task. The interviewees mentioned how their job has many dimensions, and they need to be able to communicate between different groups of interest. S-9 highlighted this:

> "...with so many departments, different areas of responsibility, and varying degrees of technicality, this tool [ChatGPT] can be very helpful."

Through our analysis, text refinement emerged as the second most frequently mentioned use case. The tools applied for this use case often included ChatGPT and its variations, internal SLMs, Gemini, or other forms of copiloting. Typically, the project managers would draft emails using AI tools. The project managers would usually tell the AI the intention of the email and include key points while describing the level of formality and technicality. The AI tool would then restructure and refine the contents of the mail.

Another common practice was to draft a brief email containing key points as a prompt for a language model to generate a more or less detailed response. Project managers could also customize these prompts, such as requesting the language model to use simple language (or other languages entirely). This customization resulted in concise emails of varying complexity, reducing the time spent on communication tasks.

4.2.3 Meeting Transcriptions

It was revealed through the interviews that the majority of project managers frequently participate in digital meetings. Most of the participants used Microsoft Teams to some degree, recognizing its inherent benefits for communication. One notable feature is its *meeting transcription* and recording function, which transcribes meetings. 78% of the participants utilized this feature regularly. These transcriptions typically include the speaker's name, timestamp, and message, providing clarity on who said what and when. This transcription feature eliminated the need for detailed meeting notes and was described as generally being quite accurate, helping to reduce ambiguity in communication. However, it is worth noting that several of the interviewees commented that during lengthy meetings, the transcription tool may struggle with languages other than English. Despite this limitation, project managers found it to be a significant time-saver. They emphasized that automatic transcription should be the default setting. Another drawback mentioned by an interviewee was that transcriptions sometimes lack context. Meetings often start with informal greetings and small talk, which are also transcribed, even though they may not be directly relevant to the meeting's agenda. This redundancy can clutter the transcription with unnecessary information.

4.2.4 PDF Summaries

Another use case was *PDF summaries*, with 56% of the participants using this regularly[1]. LLMs, in particular ChatGPT-4 and the internal SLMs of firms interviewed, are capable of creating summaries of uploaded files. The interviewees highlighted several benefits of using AI tools for this. First off, it was mentioned that this can be applied in many different contexts, including (but not limited to) technical documents, journal articles, or meeting transcriptions. The reason this is so powerful is because of its ability to condense information while retaining essential content. For example, instead of reading a 40-page manual of machine operation, a PDF summary can give the main points of interest. Additionally, users could upload the file and ask questions regarding their actual issue. As a result, the LLM became an efficient tool for project managers, reducing the time spent searching for information and receiving feedback quickly. Moreover, if the project managers are unsure of the implications of certain statements, they can ask for a simpler explanation from the LLM. For journal articles, it is practical to quickly assess whether the information contained is relevant. A person would not be able to condense information at the same rate or be likely to retain essential contents at the same speed or accuracy. Although PDF summarizing is not a perfect process, this allowed the project managers to save hours of research and reduce cognitive load. Even in small contexts, S-3 and S-9 said:

> "10 minutes here and 10 minutes there, in the long run, it adds up."

4.2.5 Work Breakdown

Using LLMs, project managers reported an improvement in their ability to break down complex issues. In 44% of the interviews, the participants emphasized their use of LLMs for this purpose. They described employing various techniques to break down intricate structures and tasks into more manageable components. The process was described by S-6 as:

> "I outline the high-level requirements and describe a problem. The AI then breaks it down and suggests straightforward, step-by-step tasks."

Another example of this is how the project managers used LLMs to break down large contracts with numerous requirements, enabling them to identify and address each requirement systematically. Likewise, when encountering technical difficulties, many project managers turned to LLMs to examine the issues and come up with efficient plans to address them. The ability to leverage LLMs for deconstructing complex problems enhanced their problem-solving capabilities and resulted in more efficient decision-making processes. This process of

[1]While we say "PDF summaries," it can be any (readable) file extension, such as Word or raw text. PDF happened to be the most common file type.

using LLMs could also be used to allocate project issues to team members. Although the process is not common among the interviewees, it was mentioned to help improve accountability within the team.

4.3 Summary

Through our analysis of the interviews, it was found that project managers employ a wide variety of AI tools for five distinct use cases. While the mentioned use cases are few, they are almost always utilized in conjunction with one another. This greatly influences the depth project managers are able to reach through AI tools. Moreover, these scenarios can help reduce mental strain for project managers by offering swift, pertinent information and expediting the decision-making process. Table 4.2 showcases which interviewee applied the different use cases.

5. Discussion

In this chapter, we will discuss our findings, aiming to put the identified use cases within the context of the PMBOK7 framework. With this, we are answering RQ2: How do AI tools affect PM using the PMBOK7 project performance domains of Planning, Uncertainty, and Team? The chapter will start by discussing the AI tools used by project managers. Continuing, the chapter will present the three chosen PDs and associate use cases found impacting the PD. An overview of how the use cases are associated with the PDs can be found in appendix IV. In addition, we will incorporate other relevant and similar cases from the literature. After this, we will look at the limitations found in AI adoption before we finally discuss our research process, limitations, and validity of the thesis.

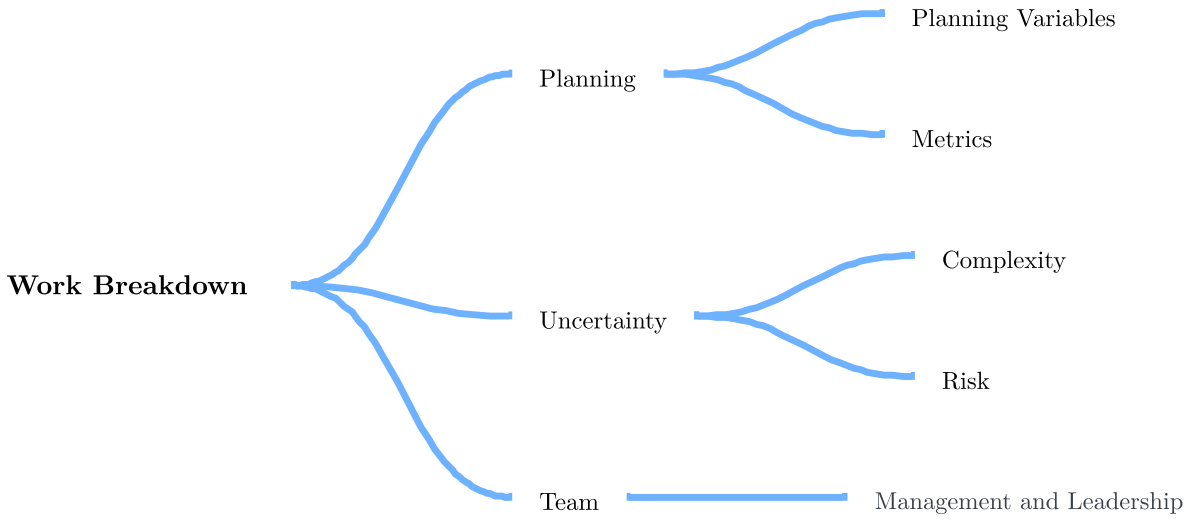

Figure 5.1: Example of how work breakdown associates with the chosen PDs.

5.1 AI tools

The AI tools predominantly used by project managers were ChatGPT in its latest version, 4.0. According to research by Vakilzadeh & Ghalejoogh (2023), version 4.0 has significantly improved accuracy and provided more features compared to its predecessor, version 3.5. Moreover, project managers deemed version 4.0's capability to connect to the internet an essential feature. This functionality conferred a competitive edge over other AI tools.

Although ChatGPT and Gemini are generic LLMs and not specialized for PM, they still have diverse applications that may benefit project managers. For example, comparing studies of GPT-3.5 and 4.0, conducted by Prieto et al. (2023), Barcaui & Monat (2023), and Vakilzadeh & Ghalejoogh (2023), collectively illustrate that the latter version significantly surpasses its predecessor in terms of performance and capabilities.

Within a span of less than a year, OpenAI managed to enhance the accuracy and capabilities of this technology, as evidenced by these studies. This underscores the rapid evolution of technology. The interviewees also emphasized this point, with many noting that version 4.0 is significantly more capable than version 3.5, which itself was considered more capable than any internal SLM they had used. SLMs were often employed for internal purposes, such as summarising contracts with NDAs or other related cases. Despite the language model used, project managers still emphasized the importance of corroborating answers.

Other AI tools, such as Microsoft Copilot, were mentioned positively, although none of the interviewees had hands-on experience with them. Interviewees believed businesses leveraging Microsoft Office were likely to benefit most from integrating Microsoft Copilot. 56% of the interviewees stated that the tool could significantly improve communication quality and highlight missed e-mails. There could be a decrease in poor communication, optimizing time management, and reducing uncertainty. Most mentioned that the tool had not been implemented due to organizational restrictions regarding costs, privacy, and GDPR (further described in Section 5.6). Additionally, interviewees asserted that integrating AI tools into software development significantly enhances efficiency. For instance, S-9 stated, "Our productivity would significantly decrease overnight if we ceased using ChatGPT." According to the interviewees, stopping the use of AI tools would result in losing a valuable partner that provides diverse insights, perspectives, and access to extensive information.

Nevertheless, project managers who have had the opportunity to utilize AI tools do not perceive them as flawless; rather, they acknowledge their ability to substantially enhance productivity. This, in turn, boosted their morale and motivation, which is linked to better project performance.

5.2 Planning PD

The Planning PD stands out as the largest, with significant influence on other PDs. Referencing Barcaui & Monat (2023), wherein ChatGPT-4 orchestrated an entire application development project vs. a human project manager, the results showed that both entities exhibited inaccuracies. Additionally, Prieto et al. (2023) also show promising results of using ChatGPT in planning. In accordance with literature, our research indicates that project managers utilizing AI tools as collaborative partners gained more insights into potential challenges and received better suggestions for effective planning strategies. AI tools can significantly affect the planning process for both future and current project managers.

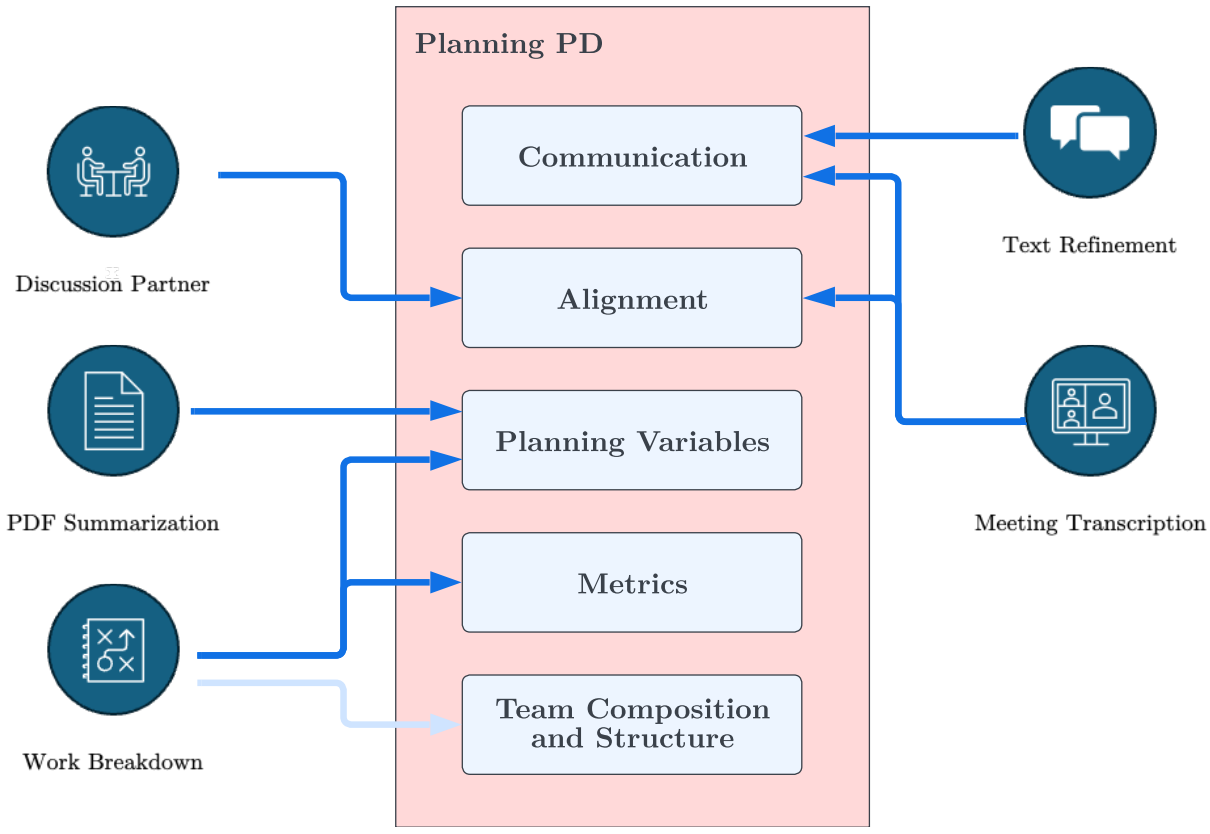

Figure 5.2: Connection between Planning PD and use cases. Note the light-blue as it is indirect. No significant connection to procurement, physical resources or changes was found.

5.2.1 Communication

The use of AI tools can be seen in the subdomain of communication. The PMBOK7 presents the 6 “W’s” (Section 3.5.1) for planning communication in a project. Many interviewees emphasized the potential benefits of using LLMs such as Gemini, Microsoft Copilot, or ChatGPT to improve communication. They were also clear in communicating these tools’ current limitations.

The use case that was most mentioned for enhancing communication in the planning PD was meeting transcription, which 78% of the interviewees had used. One of the main benefits, according to project managers, was the improved clarity regarding who required information, what information was needed, and who possessed the necessary information.

They would gain clarity about the meeting’s contents by using the meeting transcription use case. Four of the project managers also used the PDF summary in conjunction with the transcriptions to condense long transcripts into short, actionable points that highlighted who needed what and when the tasks needed to be completed. When asked about this, the project managers who used this process did not encounter any obvious drawbacks and described great benefits in terms of time savings. The only downside mentioned was that meetings typically start informally, which leads transcription and AI tools to mistake this informal conversation as part of the meeting. The summary mentioned that important topics for discussion could include "the birthday party of my child" and "the nice weather on Saturday." The issue was resolved by initiating transcription at the beginning of the actual meeting. Otherwise, these findings coincide with the suggestions of Abbas et al. (2023).

Text refinement is the second use case that ties in with the subdomain. Project managers utilized AI tools to modify text for a specific situation or context, mirroring the use cases highlighted by Abbas et al. This usage is closely connected to the question of "what is the best way to provide information?" (PMI, 2021, p. 64). A direct benefit is that project managers using the tools reported spending less time worrying about communication structure and wording. This was especially apparent when project managers needed to communicate from a technical to a more business-oriented context. S-9 highlights this:

> “When a developer needs to communicate with a non-technical business person, [AI tools] help bridge the gap.”

Despite the optimism of several of the interviewees, there were some limitations to the text refinement. This was primarily attributed to contextual constraints, and all interviewees emphasized the significance of verifying the AI tools’ output. AI tools sometimes misinterpret the context of some sentences during text refinement, reversing them and conveying a different meaning than intended.

In summary, AI tools can assist in several aspects of planning communication, which corresponds with the exploratory study of Abbas et al. (2023). Several use cases were identified as

relevant for the subdomain, but not without limitations. Especially data limitations resulting in unclear context definitions were often the most mentioned limitation. This limitation aligns with broader observations outlined by Brock & Von Wangenheim (2019) and Prieto et al. (2023).

5.2.2 Alignment

When inquired about their day, interviewees emphasized that they had to ensure that project tasks aligned with the project goals and anticipated outcomes for project success. Typically, regular workdays followed a similar pattern, and when questioned, S-5 encapsulated it by stating:

> "It is hard to define. Although every day varies, coordination is often the overarching theme."

In the analysis of alignment, we found the use of AI tools as discussion partners to be most frequent in this subdomain. Using various prompts and information from project documents (PDF summaries), AI tools could identify and emphasize the essential variables to maintain project alignment. The interviewees observed that while the use case provided advantages, it was mainly used as an extra resource for brainstorming in the project's initial planning stage, aligning with Abbas et al.'s (2023) recommendations.

Meeting transcription also assisted in this subdomain, but in a more indirect way. By having meeting transcripts coupled with PDF summaries, the interviewees reported that they found it easier to allocate resources and convey information to stakeholders.

5.2.3 Planning Variables

Planning variables cover a wide range of factors, such as development approaches, deliverables, and regulatory constraints, among others, essentially involving the planning for project execution. Our research analysis indicates that some interviewees effectively utilized AI to break down complex tasks into manageable steps, echoing the insights of Barcaui & Monat (2023) and Prieto et al. (2023)[1]. PMBOK7 describes five distinct variables that influence planning variables, as described in section 3.5.

The first use case that assisted with planning variables was work breakdown. The process allowed project managers to break down potential projects, yielding insight into possible future outcomes, estimations regarding time and cost, and resources needed related to the project, similar to the use cases outlined by Abbas et al. (2023) and findings of Barcaui &

[1]As articulated by one interviewee, these studies represents merely the "planning" aspect, emphasizing that AI cannot currently execute or replicate the full scope of a project manager's responsibilities.

Monat (2023). Many of the benefits from the applications of AI tools include assisting in the development approach variable as well as project deliverables.

The PDF summary emerged as the second use case to assist project managers. When it came to altered project deliverables, organizational requirements, or new legal and regulatory constraints, this use case proved invaluable. It condensed information so that project managers swiftly understood the practical implications. Similar to the work breakdown aiding the development approach, the PDF summary also assisted in this aspect. As a result, the interviewees stated to have saved time.

In summary, the planning variables subdomain can in many ways be assisted by the use of AI tools. Project managers commonly focus on planning variables, and the work breakdown and PDF summary facilitate planning in this context. The use cases often, despite their value, suffered from many of the same pitfalls as described by Brock & Von Wangenheim (2019), namely a lack of (D) quality data and (I) intelligence.

5.2.4 Metrics

The category of metrics acts as the natural linkage between planning, delivering, and the measurement of work, as described in Section 3.5.4. This establishes whether project work is ahead of, on, or behind schedule. In order to employ AI tools effectively in this subdomain, proper data management is vital[2]. This notion was unanimously agreed upon by the interviewees, as they believed quality data was important. The current usage of AI tools for metrics primarily revolves around work breakdown.

Through work breakdown, the interviewee S-6 said, "I can get it [AI tools] to suggest which task to prioritize, including cost and other important measurables." One could view this as a direct link to metrics. Although metrics were often defined in the planning phase, the issues and tasks assigned in the execution phase were often not detailed enough to accurately assess the progress of metrics. Using 'work breakdown', it was easier to track the advancement of tasks, therefore making the assessment of metrics more accurate. Nonetheless, using AI tools to define metrics was deemed less valuable due to the generic nature of the suggested metrics. The AI suggestions often failed to offer significant value or new insights into the project.

5.2.5 Team Composition and Structure

It was found that AI tools may not directly help with team composition and structure in planning, but work breakdown can provide indirect support in this area. This is because the use case can aid in generating a WBS that potentially highlights skill sets that the project

[2]Data management in this context is closely related the 'D' from DIGITAL (Brock & Von Wangenheim, 2019)

team does not possess. Utilizing AI tools for WBS creation (shown by Barcaui & Monat (2023)) and as discussion partners allows project managers to receive valuable feedback.

When a project lacks the necessary skill sets, encountering problems can lead to schedule and cost overruns due to this bottleneck. Project managers may need to either hire experts, which incur additional expenses or assign responsibilities to team members who must acquire the necessary expertise. In either scenario, a poor assessment of project needs can prove time-consuming and costly. Depending on the scale of the project and other interdependencies, this can prove costly for organizations.

5.3 Uncertainty PD

The uncertainty PD revolves around the inherent uncertainty within all projects. Projects can have differing degrees of uncertainty, making it difficult to accurately predict and provide mitigation strategies. However, several of our findings indicate that AI tools can improve how project managers plan for and deal with uncertainty. The most common use case of AI tools to manage uncertainty was to employ them as discussion partners or "teachers."

Our findings also coincide with Barcaui & Monat's (2023) findings, implying that AI tools can break down uncertainty more thoroughly than project managers alone. A common application of AI tools was to provide risk assessments, risk mitigation strategies, and suggestions on possible risk scenarios. The findings indicate that AI tools are effective for project managers in uncertainty evaluation. When project managers utilize AI tools to assess risks, the evaluation seems more thorough and precise.

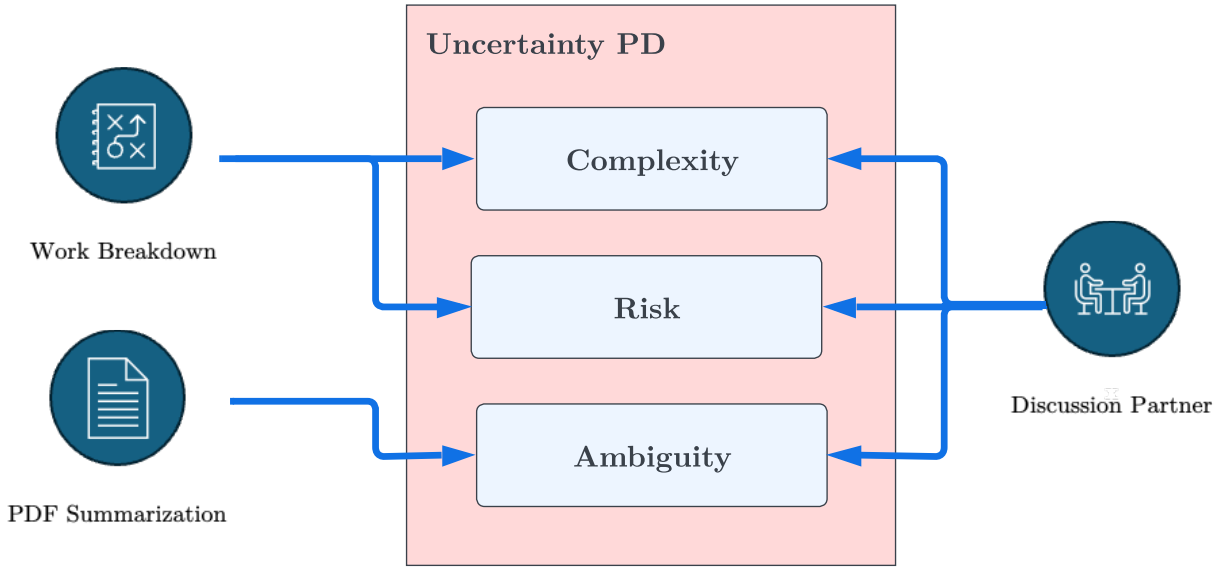

Figure 5.3: Connection between Uncertainty PD and use cases. No significant connection to volatility was found.

5.3.1 Complexity

Complexity is inherent in projects and is difficult to manage on a large scale, and even more so in public projects. An example is the Fornebubanen project (NRK, 2024), which encountered challenges partly because of its complexity and the scarcity of comparable projects.

Since complexity is inherently difficult to handle, a key role of project managers is to manage it properly. The interviews revealed that AI tools are valuable assets in this regard, capable of breaking down complex issues into manageable components. Work breakdown can be linked to various approaches outlined in PMBOK7 for handling complexity, especially system-based and reframing complexity (Section 3.4.3).

The PMBOK7 presents two ways of dealing with system-based complexity: through decoupling and simulations. The utilization of AI-powered work breakdown methods facilitates both of these strategies, often being less time-consuming than traditional methods. Most interviewees described that work breakdown assisted with decoupling and was also a common use of AI tools. It was seen as a simple way to reduce system-based complexity. Based on our analysis, simulation was less mentioned but was often an indirect gain from the use of the AI tools. As AI tools such as ChatGPT are trained on extensive datasets, this enables them to identify connections and relationships between different scenarios that would not typically be associated with a specific project. AI tools could potentially generate forecasting and historical data from similar projects, broadening the scope of reframing strategies.

Reframing complexity typically involves brainstorming or leveraging balancing data. We identified the AI-driven work breakdown process and collaborative discussions as central to assisting with managing this type of complexity. Interviewees described these use cases as facilitating solo brainstorming sessions, resembling Delphi-like cycles, wherein prompts were refined iteratively. This could also serve as a foundation for collaborative brainstorming in a team environment, describing important project parts or providing a basis for possible project solutions. These types of brainstorming sessions mirror the use cases showcased by Abbas et al. (2023) and coincide with the findings of Weng (2023).

Although this approach offers rapid insights, it may lack the diversity of human perspectives, underscoring the importance of weighing its advantages and drawbacks. This limitation was also mentioned in the literature overview by Vakilzadeh & Ghalejoogh (2023), Barcaui & Monat (2023) and Abbas et al. (2023).

In summary, the interviewees indicated that AI tools can effectively assist project managers in navigating project complexity. Our analysis highlights two primary use cases through which AI aids in complexity reduction, namely work breakdown and discussion partner. Nevertheless, there are concerns about AI for work breakdown, the worries regarding the use case concise with the limitations found by Brock and Von Wagenheim (2019) especially related to *Be integral*.

5.3.2 Ambiguity

Ambiguity is divided into both conceptual and situational ambiguities. There exist situations where differing understandings of the project, such as requirements or technical or legal jargon, provide ambiguous situations for project managers. A lack of ambiguity resolution will result in problems between different groups because of differing expectations. An illustrative case is the NASA Mars Climate Rover project in 1999, where two engineering departments failed to clarify the units for their calculations, resulting in a costly 125 million $ failure (Sauser et al., 2009). PMBOK7 identifies three methods for addressing ambiguity, and the findings suggest that AI tools can assist these methods.

The first way of dealing with ambiguity is through progressive elaboration. There are similarities between how project managers apply PDF summaries and how PMBOK7 outlines the progressive elaboration method. Project managers can obtain a summary of larger documents by using the PDF summary; both meeting transcriptions and longer technical documents were mentioned for this. S-6 mentioned how this was at times a progressive process for larger documents. This was due to constraints on the length of text in the PDF summary tools.

A discussion partner also assisted in achieving this progressive elaboration. Using discussion partners allowed for a dynamic exchange wherein clarity was gradually achieved through dialogue. Despite the potential insight this resulted in, the interviewees tended to supplement AI tools with traditional methods and human discussion partners, indicating a degree of uncertainty regarding AI-generated responses.

However, direct experimentation and prototyping using AI tools appeared underutilized, primarily due to concerns regarding the time and cost required to produce accurate prototypes, which may outweigh potential benefits. S-5 echoed this sentiment, highlighting the potential cost implications and suggesting that savings might not offset expenses associated with AI tools.

S-5 highlighted this by saying:

> "The potential savings might be overshadowed by the potential costs."

These cost concerns related to AI tools were a common theme in the interviews. While some of the project managers were convinced the cost would be higher than the gains, others debated that the gains would far overshadow the cost. The "truth" may differ from one company to another, with no certainty that either claim is correct.

The last use case to reduce ambiguity does not align directly with the strategies outlined in PMBOK7. Several interviewees reported improved clarity regarding meeting discussions and assignments through meeting transcription. This was due to them reporting attendees being more immersed since they did not need to take detailed notes, improving the meet-

ing quality. Furthermore, meeting transcriptions with PDF summaries allowed the AI to create action lists, reducing the need for manual and subjective viewpoints, which in turn minimized ambiguity post-meeting. Due to the project manager participating in the meetings, they already had a decent idea of the action list and could easily edit it if they found inconsistencies.

In summary, AI tools offer promise for mitigating ambiguity through PDF summaries, discussion partners, and meeting transcription. Nonetheless, concerns about the reliability of the AI tools' outputs remain.

5.3.3 Risk

Risks, whether beneficial (opportunities) or negative (threats), are of high importance for project managers. Within the domain of uncertainty, a majority of the subjects interviewed discussed their application of AI, primarily to navigate through risks, mostly aiming at the threat side of risk.

Numerous instances where the absence of robust risk management led to detrimental consequences, including fatalities, underscore the significance of risk assessment. The Dalian oil spill accident in China in 2010 serves as a stark example, where two crude oil pipelines ruptured and exploded, resulting in extensive environmental contamination (Zhang et al., 2013). Similarly, the Jiangsu chemical plant explosion, which involved the detonation equivalent of 708 metric tons of TNT, resulted in 78 fatalities and 617 injuries (Yang et al., 2020). This underscores the consequences of inadequate security measures and poor risk assessment.

Based on the interviews, mitigation and avoidance emerged as the most commonly used strategies against threats. Utilizing AI tools, particularly through the work breakdown and discussion partner use cases, project managers could anticipate and circumvent common project pitfalls. This was advantageous because the project managers could get a quick overview of potential risks with minimal effort. However, interviewees noted limitations, particularly regarding the specificity of project contexts, which sometimes rendered AI-generated risk assessments too general to yield significant benefits. Similarly, AI tools often provide limited insights into mitigation strategies due to constraints in the available project data.

Coinciding with our findings, some AI tools (ChatGPT-4 in particular) are already able to assess scenarios given to them. As Barcaui & Monat (2023) found, AI tools assess risks and recommend risk mitigation strategies more extensively than humans. Nonetheless, project managers were aware of certain limitations and contextual factors, including the inability to simulate the "real" situation because of IP, sensitive data, and NDAs. The 'opportunities' aspect of risk is equally significant, where uncertainty can potentially yield substantial benefits. While risk management is predominantly focused on mitigating threats, the potential for AI tools to identify and capitalize on opportunities remained unexplored in the inter-

views. Regardless, opportunities for AI tools have risen in other sectors. An example of this is predicting outcomes related to COVID-19, where ML algorithms can accurately forecast mortality rates and identify significant risk factors such as age and predictors from previous medical history, achieving nearly 90% accuracy (Pourhomayoun & Shakibi, 2021).

In summary, our findings indicate that certain AI tools can reduce and elucidate risk, mainly by suggesting mitigation and avoidance strategies. It was also highlighted by many of the project managers that the ability of AI tools to perform was largely dependent on and limited by the data provided.

5.4 Team PD

The Team PD encompasses various factors, predominantly centered around the individuals performing the work of the project to reach the intended outcomes (PMI, 2021, p. 16). While the discussion primarily addresses project managers, it is important to recognize that each team member plays a role in completing projects. Project managers are responsible for defining accountability among team members.

Our research, supplemented by existing literature, emphasizes the importance of autonomy in cultivating high-performing teams. Ideally, teams should function effectively even in the absence of direct supervision by a project manager. As a result, the interview guide was tailored to offer practical insights into the broader utilization of AI tools at the team level.

Identifying AI tools aimed at improving team PD may increase project value and project success.

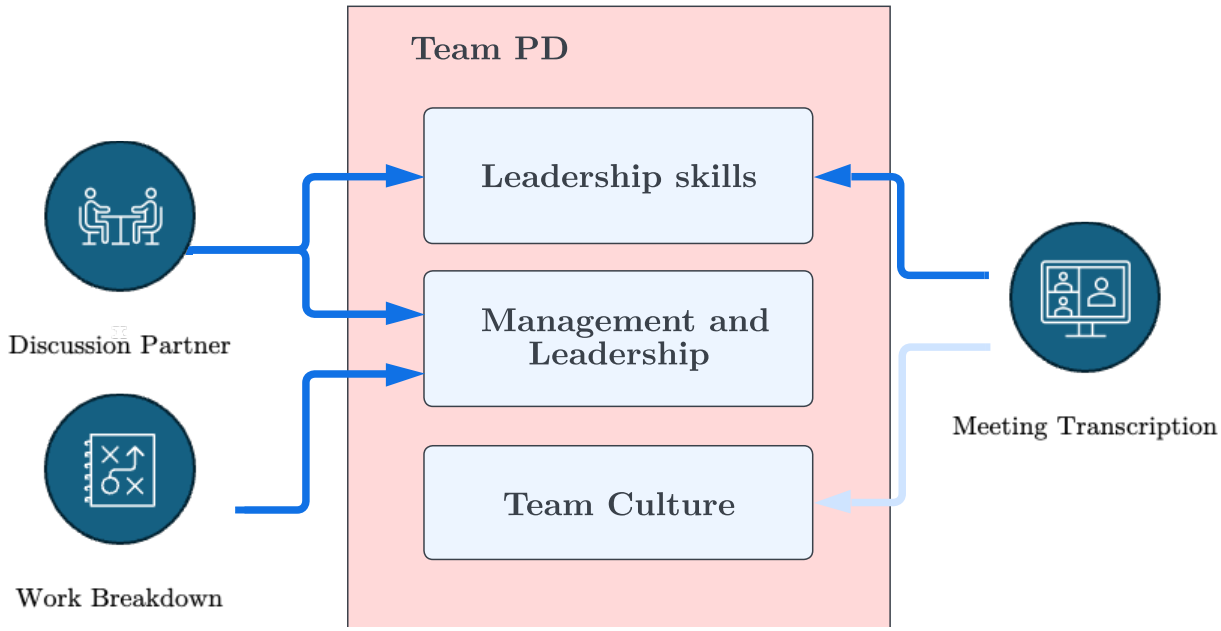

Figure 5.4: Connection between Team PD and use cases. No significant connection to leadership styles was found.

5.4.1 Leadership Skills

According to our research, AI tools improve critical thinking and make it easier to build and maintain vision in the category of leadership skills. According to section 3.6.1, the subdomain refers to four traits and activities associated with leadership: establishing and maintaining vision, critical thinking, motivation, and interpersonal skills. The interviews showed that AI tools can assist in mainly two of these traits, namely establishing and maintaining vision and critical thinking.

Critical thinking was highlighted as a trait that could benefit from the assistance of AI tools. The primary advantage of AI tools in enhancing this skill lies in their objective approach to analysis (section 3.8.2). Through the employment of an AI discussion partner, several of the interviewees reported this strength as assisting with critical thinking. S-4 presents this strength through a case where they needed to hire a new team member.

> "I uploaded all the CVs and applications to a language model and asked it for a table output with name, education, experiences, a summary of the application, and to score their suitability from 0 to 100."

Though this was a singular use case, it is clear that the unbiased nature of AI tools assisted. Especially in the applicant scoring, the AI tool highlighted an unbiased way of thinking. The project manager also reported saving a significant amount of time using this process.

There are similarities between subdomain alignment and the leadership trait of "establishing and maintaining vision," albeit the latter on a smaller scale than alignment. Examining the relationship between AI tools used for assisting alignment and establishing and maintaining vision also reveals parallels. Both of them are often associated with the discussion partner and meeting transcript use cases, which support the functions within this subdomain and exhibit similar applications, as described in section 5.2.2.

Lastly, the study did not find any data related to the other traits. The human-centered trait of leadership skills, including motivation and interpersonal skills, may present a limitation for AI tools.

In summary, several of the traits and activities described in the leadership skills subdomain make it evident that AI tools can assist project managers with leadership skills. However, there are still some leadership skills that project managers will need to acquire through practical experience, especially soft skills such as understanding motivation and interpersonal relationships.

5.4.2 Management and Leadership

The management and leadership category involves a variety of tasks, including administrative duties common in management and the necessary leadership skills for empowering and guiding a project team. The interviewees, with a median of 15 years of experience in PM, mentioned that they had their own well-defined leadership style. When discussing AI tools, it became clear that the primary role of AI tools was in management rather than leadership.

However, one interviewee, S-8, suggested that AI might be more useful for inexperienced project managers in terms of leadership. In response to the dynamic sub-question, "Do you believe AI tools might assist future project managers and compensate for a lack of experience?" S-8 replied, "It would make it easier for us to hire people who are great leaders but have less technical knowledge." This implies that AI tools may, in the future, have a role to play in leadership, particularly for those with less experience.

On the other hand, there were several mentions of management being enhanced with AI tools. The findings are primarily related to the work breakdown and discussion partner use cases. We found similar gains for the work breakdown, focusing on the guidance aspect of a project, as described in Section 3.5.2. The use cases, specifically coupled with meeting transcripts, let the project managers more clearly guide their teams.

5.4.3 Team Culture and High-Performing Project Teams

Effective project teams display numerous characteristics, such as transparent communication, trust, collective responsibility, and other qualities. Reaching top performance levels depends on the specific characteristics of each project. Both human and technical factors impact a project manager's ability to effectively evaluate and develop a high-performing team.

While none of the interviewees described using AI tools to create higher-performing teams, many mentioned sharing insights about AI tools with other team members. Our findings highlighted the time-saving benefits of AI tools. By sharing the specific use cases with other team members, more people on the team took advantage of these gains, resulting in saving even more time. S-1 mentioned how they shared the meeting transcription use case with PDF-summaries with other managers in his department, and they were positively surprised by its utility. The impact was small at the team level, but S-1 believed it would enhance efficiency at the organizational level as additional teams adopted the feature.

5.5 Method & Interviews

The following sections will discuss how the research in this thesis was conducted. The section will mainly focus on the data collection methods, as shown in Figure 2.1.

5.5.1 Data Gathering

Conducting semi-structured interviews requires extensive preparation. The interviews were both resource-intensive and time-consuming. According to Saunders et al. (2007, p. 336), it is advised not to conduct more than three interviews in a day due to cognitive load, which is advice that was followed. It is important to note that none of the interviews conducted exhibit a high level of reproducibility, which limits the generalizability of the findings. Additionally, more interviews could be conducted to reduce subjectivity.

The one-hour time limit required careful management to ensure that interviewees adhere to the structure and avoid straying off-topic. It was essential to avoid interrupting the interviewees mid-sentence. If an interviewee began to ramble, the usual approach was to politely redirect the conversation with a prompt similar to, "That's interesting. You mentioned X earlier. Could you elaborate further on that?" If the answer was insufficient, the next approach was either dynamic sub-questions or the next question in the interview guide. Additionally, small cues or interesting information missed by either interviewer could be asked by the other interviewer without disturbing the flow of the interview.

Furthermore, the interview process became smoother throughout the process. This improvement was partly attributed to translating the questions into Norwegian, the language in which the interviews were conducted. This reduced the complexity and ambiguity of the guide. Moreover, we ensured that the questions were more pertinent and focused on the research area with each refinement. Throughout the interviews, we were able to draw upon cases from previous interviews as anecdotes while maintaining anonymity. We also set a professional tone (even considering our appearance) at the very beginning of the interview, which can significantly impact the outcome, as stated by Saunders et al (2007, p. 322).

5.5.2 Digital Interviews

All interviews were conducted using Microsoft Teams, leveraging its transcription and recording features. There is speculation that digital interviews may be perceived as inferior due to their digital nature. Some literature suggests that digital interviews cannot replace face-to-face interactions (Lo Iacono et al., 2016), while others argue that they are a highly effective alternative (Thunberg & Arnell, 2022). Given the recent pandemic and its impact on the general perception of physical gatherings, it is reasonable to speculate that individuals have become more accustomed to digital interviews and meetings. There was no evidence indi-

cating that the digital format of the interviews influenced the interviewees, suggesting that it had a minimal impact on the interview dynamics compared to face-to-face interactions.

Moreover, conducting interviews in person might have discouraged potential subjects. Initially, there were 12 interviewees; however, 3 withdrew. Among the remaining 9 interviewees, only one anticipated a physical interview. This reinforced the notion that digital interviews were the preferable option, aligning the expectations of interviewees with our own. It is also possible that the initial communication effectively conveyed the process, resulting in aligned expectations.

5.5.3 Surveys

The pre-interview survey was designed to delve into the epistemology of each participant, aiming to gain an understanding and insight into their perspectives. This approach was intended to identify potential biases and complement the interview process. There was a final optional field that the respondents could answer regarding specific PM topics they had used AI for, which facilitated open discussions during the interviews. Understanding the background of each participant was deemed important as it could enhance the interview process.

One notable limitation of the survey was its length, resulting in limited data acquisition. However, this limitation was anticipated and justified due to not wanting to "waste" the time of possible interviewees. We aimed to spend most of the time exploring the AI tools, and this would be achieved through the interview; hence, *keep the survey concise*. Moreover, Saunders et al. (2007, p. 316) state that managers are usually more interested in interviews than surveys, further reinforcing the belief that the surveys should be short.

The post-interview survey was created to verify whether our findings were considered true amongst the interviewees, as well as any change of heart they may have had since or because of the interview. This survey was conducted to validate the discoveries by verifying if they matched the opinions of the interviewees. Similar to the pre-interview survey, some of the questions and statements left the participants split. Inquiring about how project managers view their capacity to embrace and utilize new AI tools and technologies was considered intriguing. The survey revealed that 78% of respondents agreed to some extent that they felt informed about both existing AI technologies and new and emerging ones that could impact their PM practices.

5.5.4 Interviewees

It is important to note that all interviewees either worked in or had backgrounds in the IT sector, and this fact is most likely reflected in the research findings. However, not every interviewee's primary education was in IT. Notably, S-1 is an electrical engineer, S-7 holds

a master's degree in industrial cybernetics, and S-4 has an education in geomatics.

The interviewee's demographic can be considered both a weakness and a strength. The prevailing sentiment among the interviewees was that the IT sector exhibits a greater propensity for embracing and experimenting with new AI technologies than other industries. Consequently, in the area of AI, they are often perceived as being "ahead of the curve" in terms of both utilization and comprehension of AI's potential. The consultants concurred with this viewpoint, frequently advising firms with diverse levels of PMTQ[3]. It is plausible that the majority of interviewees were at the forefront of integrating and embracing new AI technology, displaying a keen interest in its advancements.

5.6 Hindrances for AI tools

In the interviews, each participant was asked about their impression of their firm's PMTQ. While the interviewees were individuals who worked with IT and software in various industries, where new technologies emerge constantly, we wanted to pinpoint the factors that hinder AI tools for PM. Given the capabilities and impact of LLMs released in the past two years, existing PM literature has not yet researched the current applications of AI. On the other hand, firms have likely had time to adopt and test these new technologies. The interviewees claimed that this was particularly true for consulting firms, where early adoption of new technology is a competitive advantage. The thesis also looked at whether the factors and barriers of technology adoption have changed. AI and technology adoption barriers to technology adoption have changed. AI and technology adoption barriers have been extensively researched, and it would prove interesting whether our study has similar conclusions as existing literature, such as DIGITAL (Brock & Von Wangenheim, 2019).

5.6.1 Organizational Level

When discussing how well different parts of an organization adopt AI technologies, the interviewees believed that there was an "age gap," i.e., that the younger colleagues were better at utilization and adoption compared to their older colleagues. There are also other factors that contribute to adoption barriers; however, these factors differ across organizational levels. For example, on a team level, there was no belief in the significant organizational impact of which technologies to employ, i.e., teams had relative autonomy over which AI tools they employed. On the other hand, the project managers believed that the firm strategies significantly influenced the organizational utilization of AI for PM. Referencing the post-interview survey, some expected barriers were addressed, anticipating that the strategic vision and objectives of the firm would influence AI adoption. For instance, a firm with a strong emphasis on innovation and efficiency may prioritize the adoption of AI tools to streamline

[3]PMTQ = the ability to effectively integrate new technologies (Taboada et al., 2023).

PM processes, leading to more agile and responsive PM practices. On the other hand, organizations with conservative strategies or risk-averse cultures may approach AI adoption more cautiously, thus being "laggards" (Brock & Von Wangenheim, 2019). These firms are focusing on incremental changes or piloting AI initiatives in specific areas before broader implementation. These viewpoints were agreed upon by the interviewees, especially when comparing the answers from the consulting firms vs. other firms.

It was found that the project managers found their firms risk-averse in the adoption of LLMs and were given strict guidelines to follow if they were to use them. The primary barrier was data sensitivity, as organizations were uncertain about the data inputs and outputs of using online and open-access LLMs.

Companies placing a high value on IP as a means to maintain a competitive advantage in the market were particularly cautious about adopting tools from external suppliers. Instead, they opted to develop their own AI tools to retain control over the flow of data. Additionally, certain specialized aspects of a firm might be so unique that existing AI tools fail to provide sufficient insights to justify the costs. This specialization could render externally sourced tools useless for addressing specific needs.

The key limiting organizational traits discovered were similar to the ones presented by Brock & Von Wangenheim (2019), especially considering (D) data, (I) intelligence, and (A) agile.

5.7 Thesis Limitations

This thesis is subject to several limitations, primarily stemming from the methodological approach, the characteristics of the interviewees, and the analysis of the results.

While qualitative methods offer depth that surpasses other approaches, they are not without shortcomings. However, given the exploratory nature of this research, a quantitative or authoritative approach was deemed unlikely to provide the necessary depth. Furthermore, a similar study utilizing an authoritative method was conducted by Fridgeirsson et al. (2021). As a result, employing a similar methodology would likely not contribute novelty to the literature or achieve the depth required for the main inquiry of this thesis.

An additional limitation pertains to the generalizability of findings across different industries. The interviewees' backgrounds suggest that they are very familiar with the practical application of AI. In industries such as software and IT where automation is already prevalent, AI applications may reach their saturation point and efficiency improvements stagnate. Researching if the use cases can be applied in other industries could lead to more significant findings. However, these industries remain uncertain. For instance, while healthcare could derive substantial benefits from AI, the sector's extensive sensitive data might hinder its effective utilization of AI tools in PM.

6. Conclusions

The purpose of this thesis was to get a better understanding of how project managers apply AI tools in PM practices. The focus of this thesis was to answer the following inquiry:

"How do AI tools influence project management?"

The research revealed a widespread utilization of AI tools in project management. The tools included ChatGPT-4, ChatGPT-3.5, Googles Gemini, Custom SLMs and custom GPTs. ChatGPT and its variants were identified as the most commonly employed AI tools. The tools themselves provide a platform for a variety of different use cases. Through categorization, five distinct ways of using AI tools emerged. These use cases were not defined by a certain tool but rather emerged from similarities in how the tools were utilized, as mentioned by the interviewees. These five use cases were found, presented from most to least frequent:

- Discussion partner
- Meeting transcription
- Text refinement
- PDF summary
- Work breakdown

These five use cases were how project managers would mainly employ AI tools and provided several advantages in PM-related tasks. Using the PMBOK7 framework, we categorized how the AI tools directly influenced PM within the PDs of Planning, Uncertainty, and Team.

Planning

Within the planning performance domain, our research shows that several of the identified use cases can assist with planning-related activities. The analysis across the sub-domains of communication, alignment, planning variables, metrics, and team composition has revealed that meeting transcription, PDF summary, text refinement, discussion partner and work breakdown assist project managers in this PD.

However, the utility of these use cases depends heavily on the quality and quantity of the provided data, as repeatedly emphasized by project managers during interviews.

Furthermore, while AI tools assist in several of the subdomains of planning PD, they cannot replace the nuanced decision-making and interpersonal skills of human project managers.

Instead, AI tools should be viewed as complementary resources that can assist project managers.

Uncertainty

In the exploration of the uncertainty performance domain, several use cases were found to assist project managers. Within the subdomains of complexity, ambiguity, and risk, the research revealed several different means of utilizing AI tools to reduce uncertainty. The use cases of work breakdown, discussion partner, and meeting transcription were shown to assist project managers in the uncertainty domain. AI's ability to more extensively plan for potential risks was found beneficial. In addition, the discussion partner provided project managers with platforms to confirm their own suspicions about risks related to a project.

Despite their clear strengths, it remains evident that AI tools are not perfect. One such limitation was the generic nature of the output from current AI tools. The interviewees reported that without extensive contextualization, the outputs from AI tools would at times be too generic and provide little value.

There are clear benefits to the wide application of current AI tools, but the interviewees commented that the outputs from the AI tools would often be too generic to provide any substantial value in a specific project context.

Team

Findings from the Team Performance domain uncovered that AI tools can play a significant role in enhancing various aspects of teams. The analysis showed that while AI tools are predominantly beneficial in administrative and analytical tasks, they also hold the potential for supporting leadership functions, particularly for less experienced managers.

The research highlighted AI's capacity to improve critical thinking due to the unbiased nature of AI tools (when used correctly). An illustration of this is when AI tools were used to select candidates in a hiring process, resulting in less bias. The process highlighted the effectiveness of AI tools in saving time and improving fairness in decision-making.

However, it is evident that AI tools have limitations, particularly in cultivating leadership traits such as encouragement and interpersonal skills. These areas still heavily rely on personal experience and real-life interactions. Despite AI tools not directly contributing to creating high-performing teams, they did make management practices more efficient. By simplifying processes and sharing the gains from the use of AI tools, it indirectly supported the enhancement of team performance at an organizational level. For instance, the adoption of AI-generated meeting transcriptions and summaries within teams highlighted both time-saving benefits and improved organizational efficiency as more teams embraced and became aware of this technology.

6.1 Future Research

Future research on AI tools in project management holds significant promise. A more comprehensive study of how project managers apply AI tools, contextualizing findings across all domains, could provide valuable insight into the broader context of PM.

Conducting experiments to quantify the measurable productivity gains derived from widespread AI tool usage presents another compelling avenue for further research. Organizational experiments, where AI is utilized in one scenario and not in another, followed by a comparison of metrics, could offer valuable empirical data. All our interviewees mentioned how Microsoft's copilot AI could potentially provide great benefits, due to the Microsoft platform already being so closely integrated into most project managers' work. Using the Microsoft platform to compare differences between those using copilot and those who do not, could provide interesting insights into the measurable benefits of AI.

Such research endeavors are particularly pertinent across various industries, with the software and IT sectors likely to exhibit more maturity in AI integration. However, integrating AI into project management practices across industries, such as construction, could yield equally insightful results.

Another interesting approach for future research is delving deeper into the aspects of accountability and ethics surrounding the utilization of AI. A wider study on the effects of AI-enhanced decision-making may reveal ethical aspects of AI-driven project management.

Finally, the importance of the nature of future research cannot be overstated. As mentioned previously, PMJ emphasizes the importance of steering clear of speculative, forecasting, and atheoretical manuscripts and maintaining a clear focus on AI for PM (Müller et al., 2024). Future studies should concentrate on the mentioned areas or offer guidelines for optimal usage. Other future research aspects of AI in PM can be found in Müller et al. (2024).

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I. Interview Guide

1. As a Project Manager, in what areas do you perceive AI could offer substantial value in project management?

2. What types of AI do you use, and for what purpose?

3. What measurable outcomes have you achieved or improved upon? For example:

- ML in manufacturing/risk/cost/time estimates?
- ChatGPT to suggest team-building activities?

4. The term "PM Technology Quotient" (PMTQ) refers to a person/team/organization's ability to integrate and adapt to new technologies. Does your organization create a solid foundation to increase PMTQ and create an agile and adaptable environment? If yes, how? If no, what do you believe you need?

5. How does your team leverage data analytics or AI-driven insights to inform project decision-making and improve overall project outcomes?

6. How does your team utilize AI-driven insights from data analytics to identify and mitigate potential risks?

7. Can you share examples where AI applications have been instrumental in ensuring data accuracy and integrity throughout a project's life cycle?

8. What ways do you see AI tools enhancing team communication and cooperation?

9. Can you provide examples where AI-supported collaboration has positively impacted project outcomes, particularly in cross-functional or geographically dispersed teams?

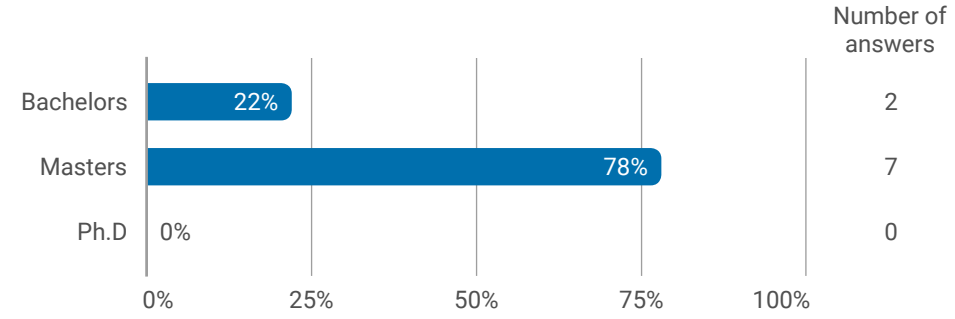
10. How does your organization ensure that project planning and execution consistently align with the overall strategic goals?

11. In what ways have AI technologies been employed to prioritize tasks and deliver value? Any examples?

12. Are there any questions or themes you feel we should discuss?

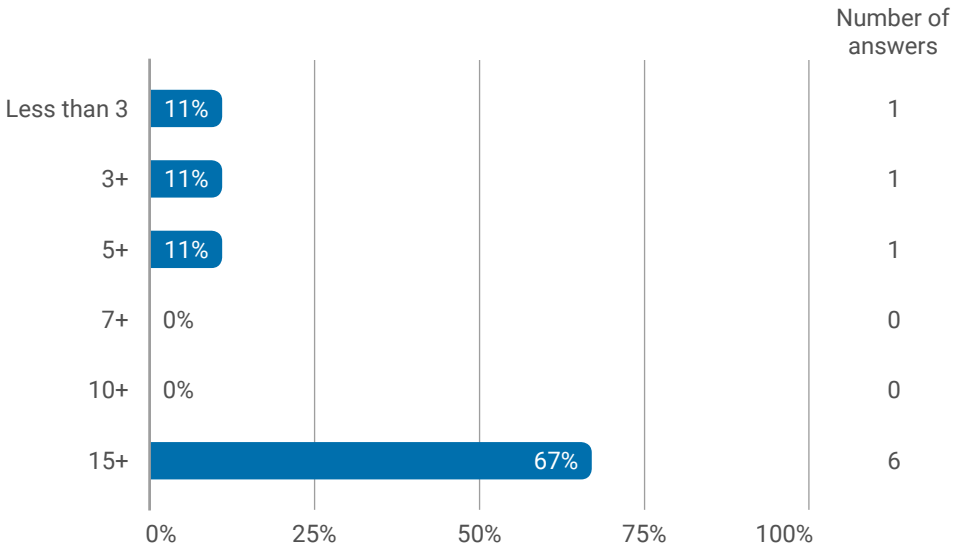
II. Pre-Survey

What is your highest level of completed education?

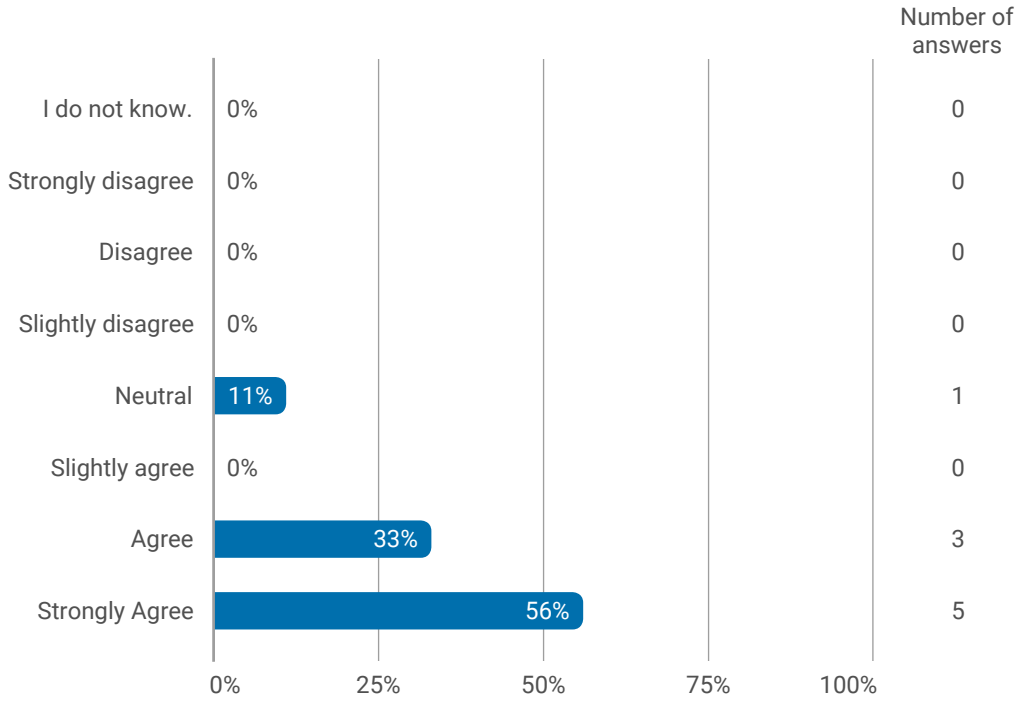


What is your profession or occupation?
Senior Engineering Manager
Project manager and consultant
Project Manager
Project Manager
Manager - Zone Management Technology
Manager - Projects department
Information technology management
IT consultant, Project Manager
Developer

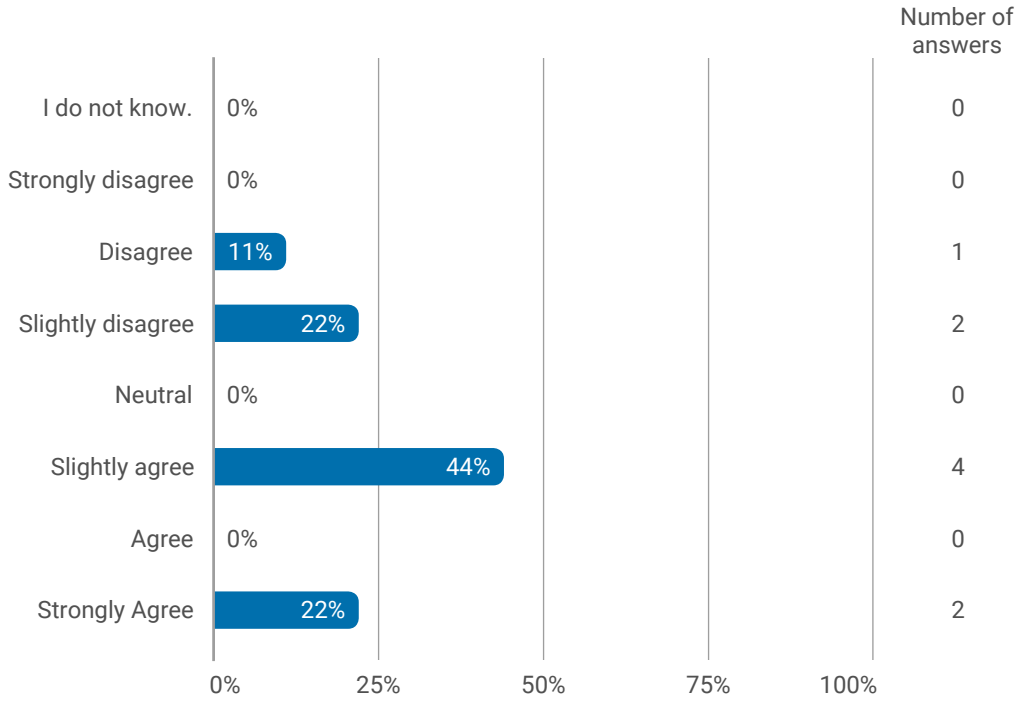
How many years of relevant work experience (engineering, project management) do you have?



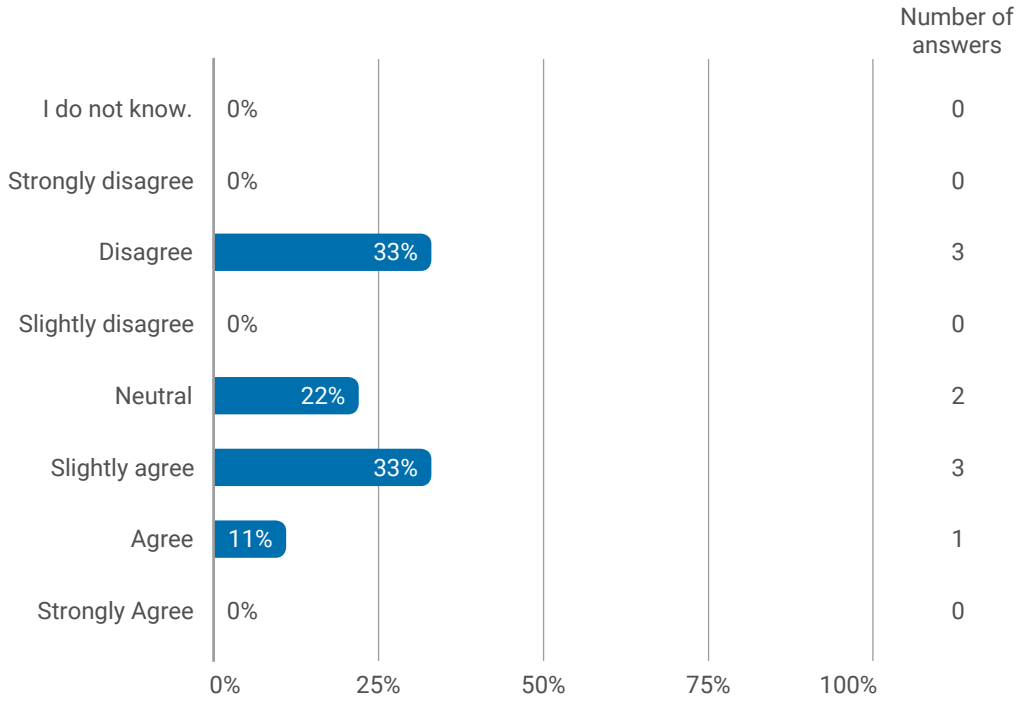
To what extent do you strongly disagree or agree with the statement, "I believe AI can be applied to enhance my project management skills"?



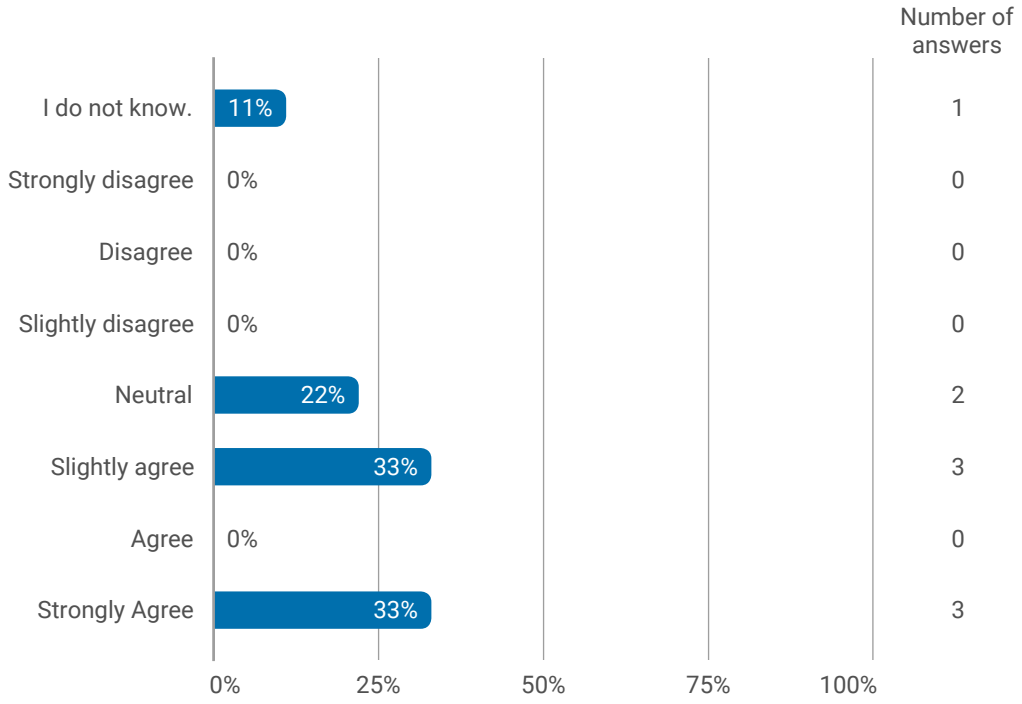
Do you believe that your organization possesses the necessary resources and capabilities to navigate the advancements in AI?



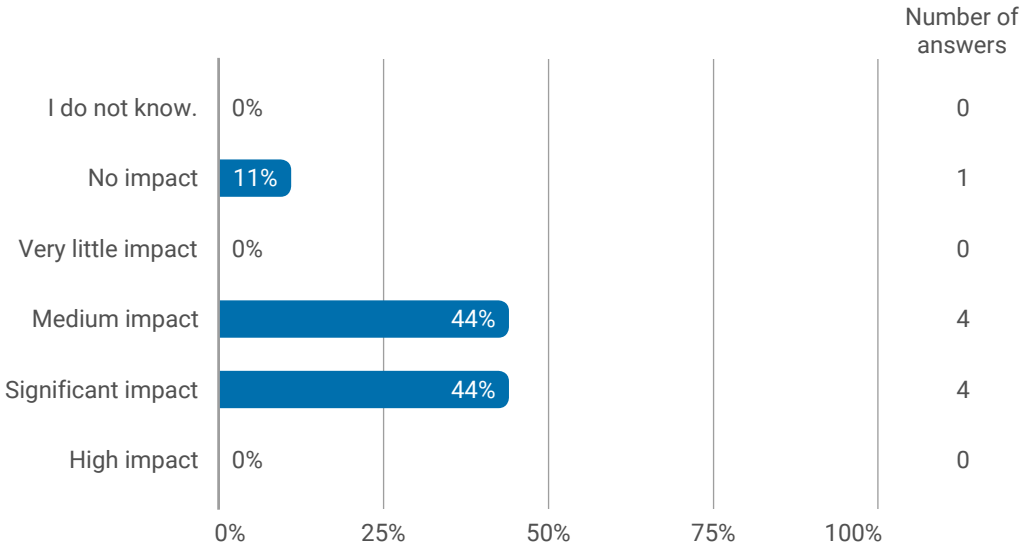
How would you rate your perception of AI's contribution to the advancement of project management capabilities within your organization?



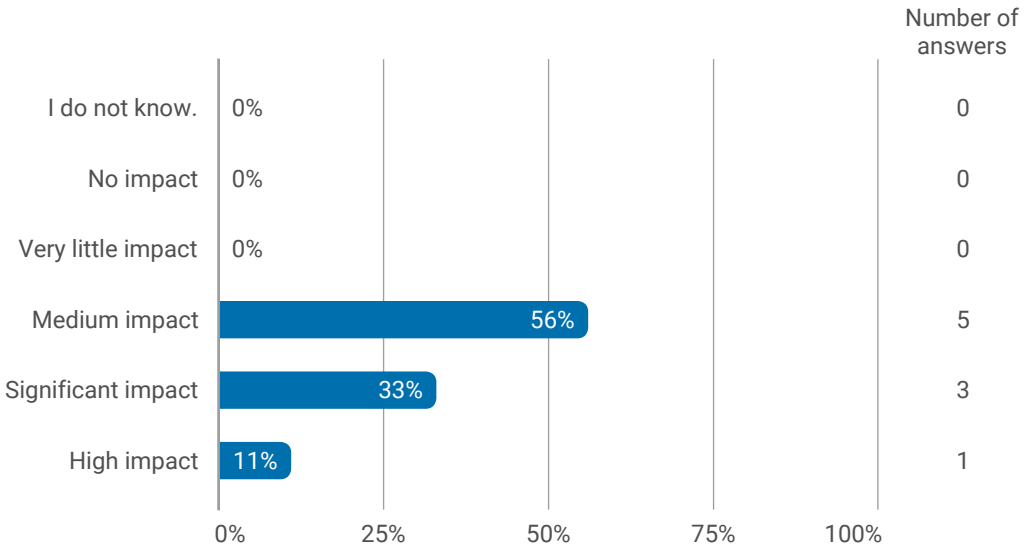
How closely do your beliefs align with the notion that specific resources and capabilities are vital for navigating AI advancements in organizational settings?



How big of an impact do you believe AI has on advancing project management capabilities within your organization?



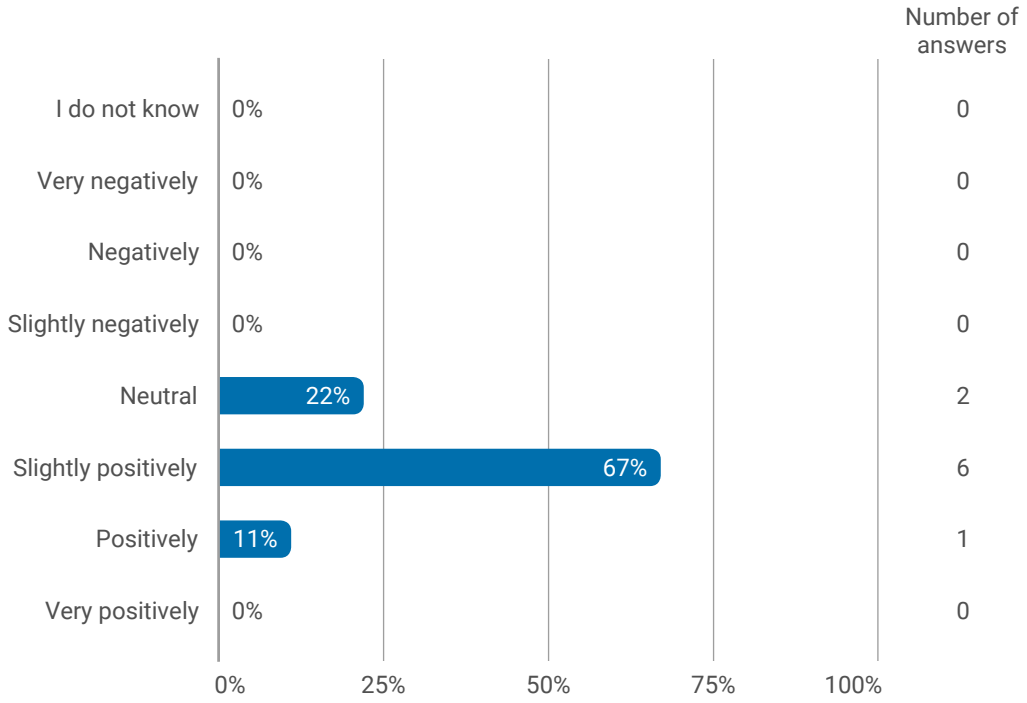
How big on impact do you think AI could have on the overall efficiency of project management processes?



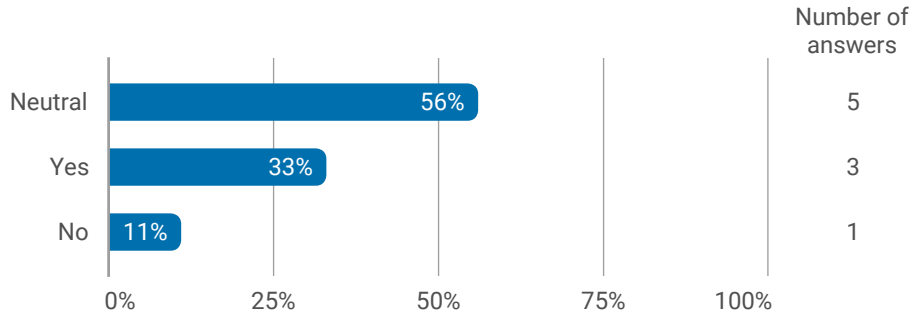
(Optional) Are there any parts of PM you believe AI can improve significantly?
scope clarification, risk areas, communication
To make the first draft, to summarize big documents
Planning workshops, transcribe meetings and create summaries, explain new topics, brainstorm ideas
Management and refining the planning aspects, also communication and coordination. Probably some other manually labor task such as writing and so on..
Complying with contract, standards, rules and regulations
Communication and risk management
Administrative tasks, communication

III. Post-Survey

How has our interview influenced your current perception of the possible role of AI in project management?

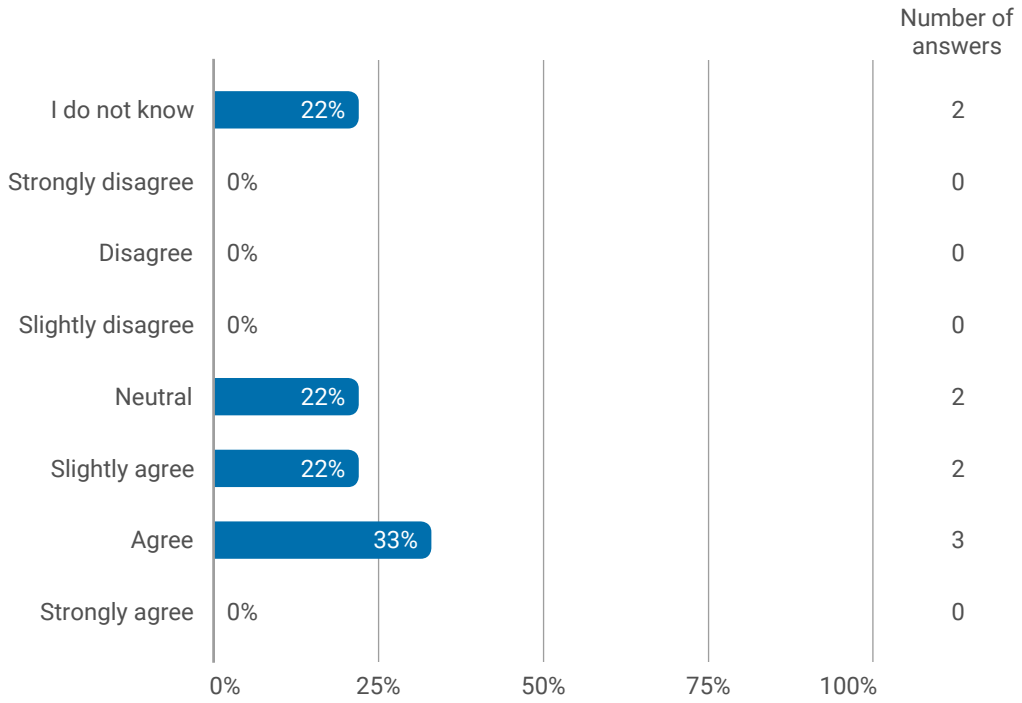


Have you gotten curious about new or existing AI-technologies since or because of our interview?

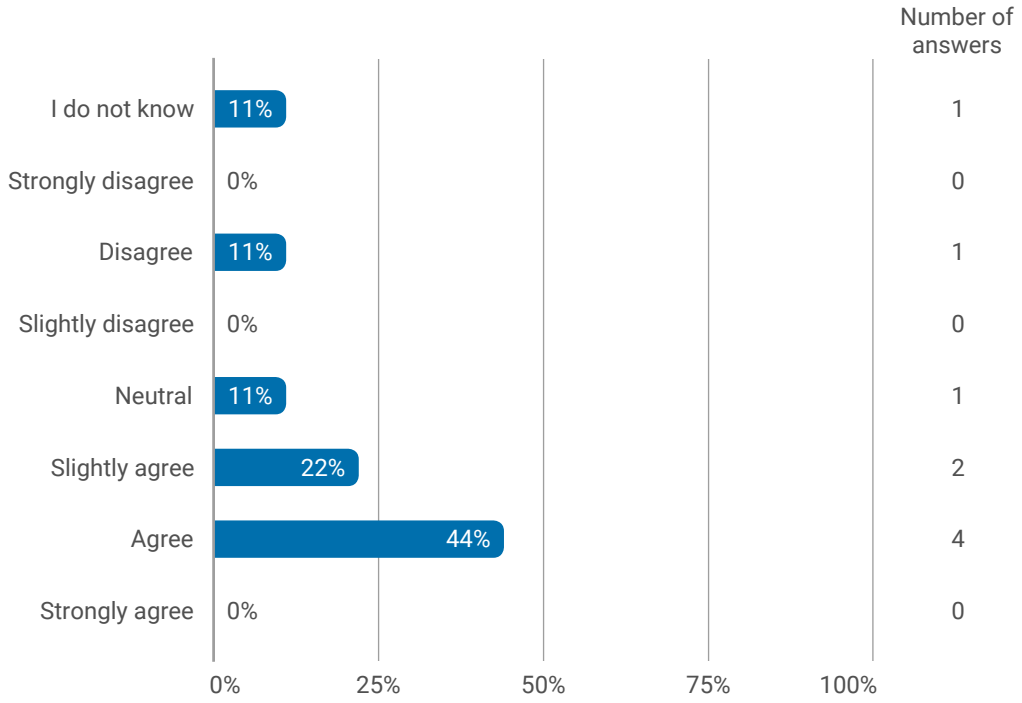


Have you discovered additional use cases or utilized AI technologies more extensively in PM practices since our interview? (If yes, please briefly describe the application or how you experimented with it.)
tested out MOM generation and documentation generating
no
no
Yes, more for handling administration of the PM tasks
Not new use cases, but raised awareness a bit
No
I have read the book "maskiner som tenker" by Inga Strumke.
Experimented with it for text generation.

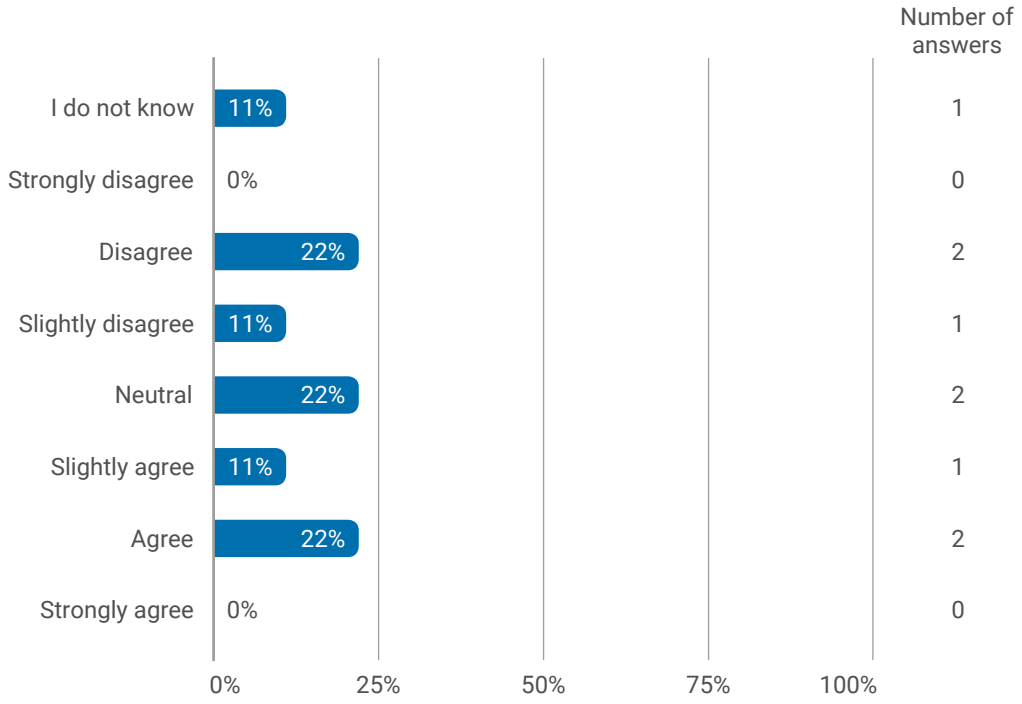
Firm strategies significantly influences my adoption of AI technologies in project risk management.



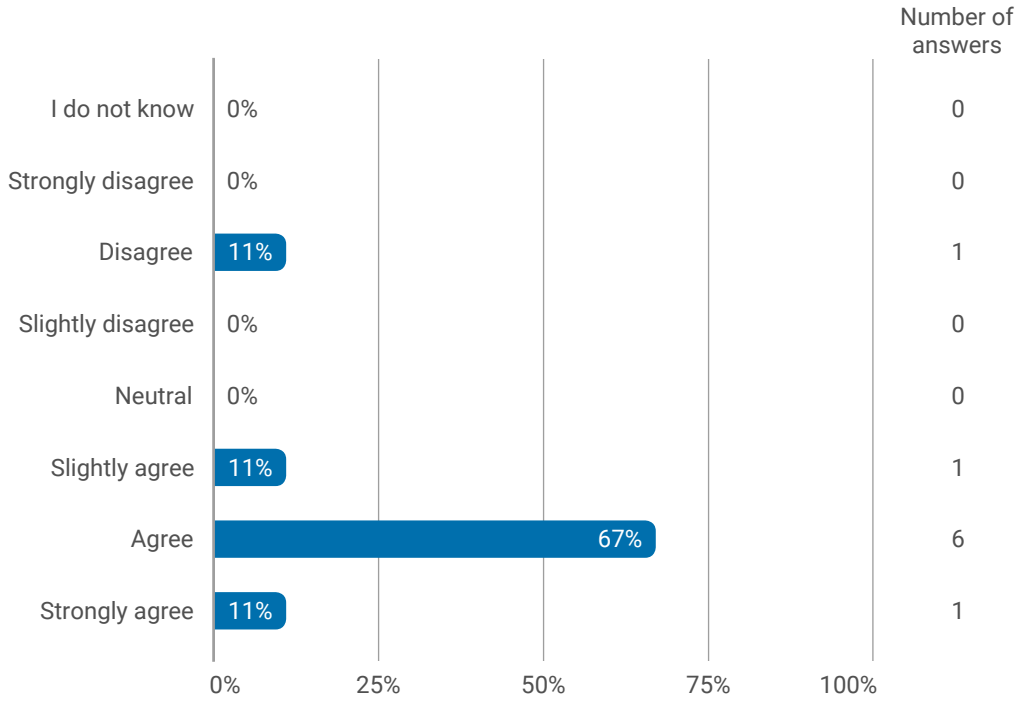
Firm strategies significantly influences my adoption of AI technologies in project planning.



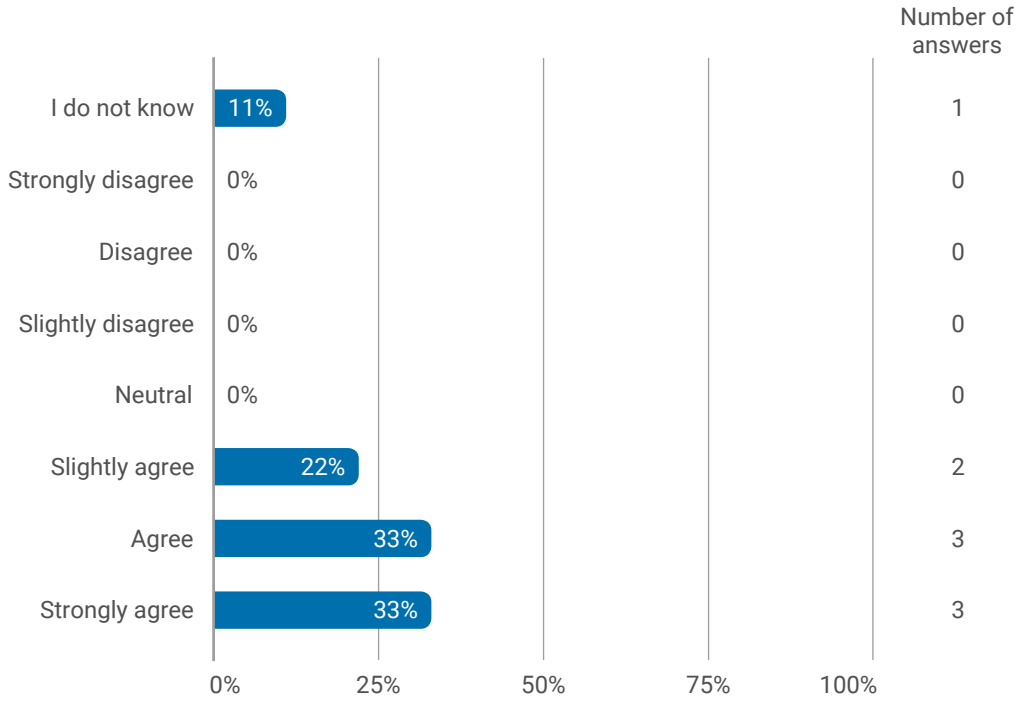
Firm strategies significantly influences my adoption of AI technologies within team settings and dynamics.



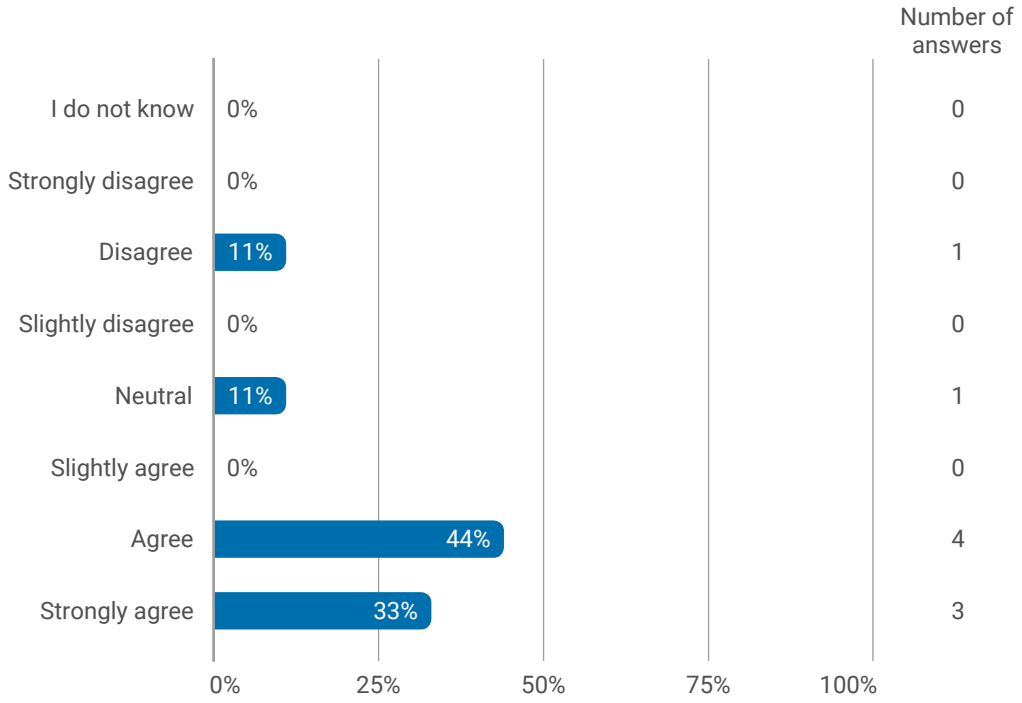
Organizational culture and hierarchy affects my ability to effectively integrate AI-technology in my PM practices.



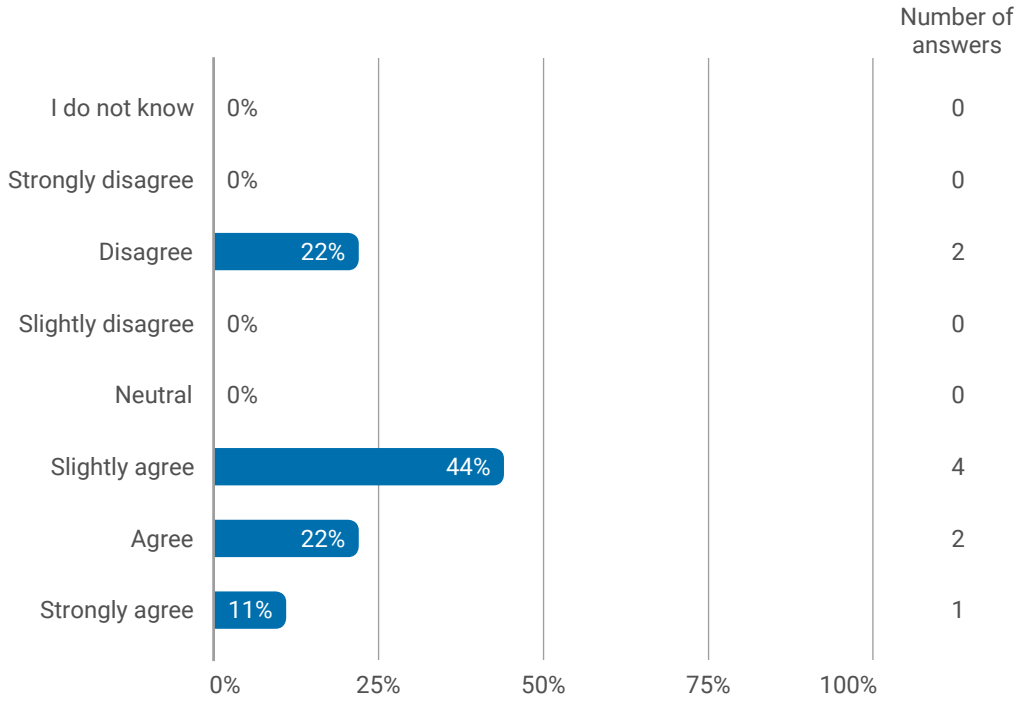
Firm strategies strongly influence my organizations ability, culture and will to integrate new AI-technologies.



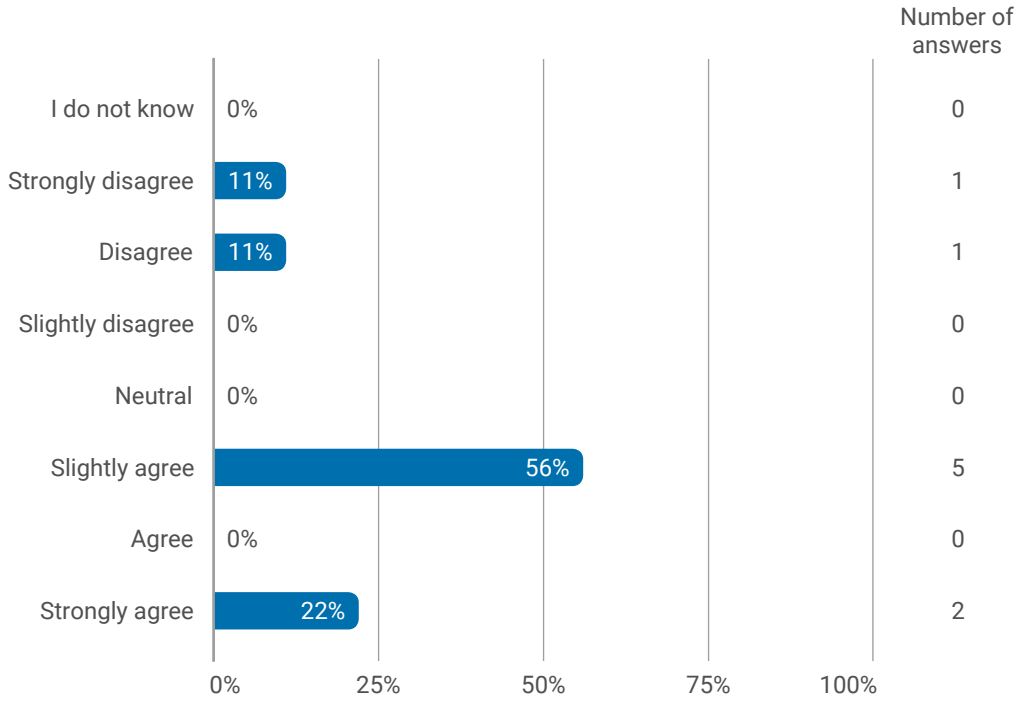
If I employ AI technologies and use the result, I hold full accountability for the outcome, particularly if circumstances take a negative turn.



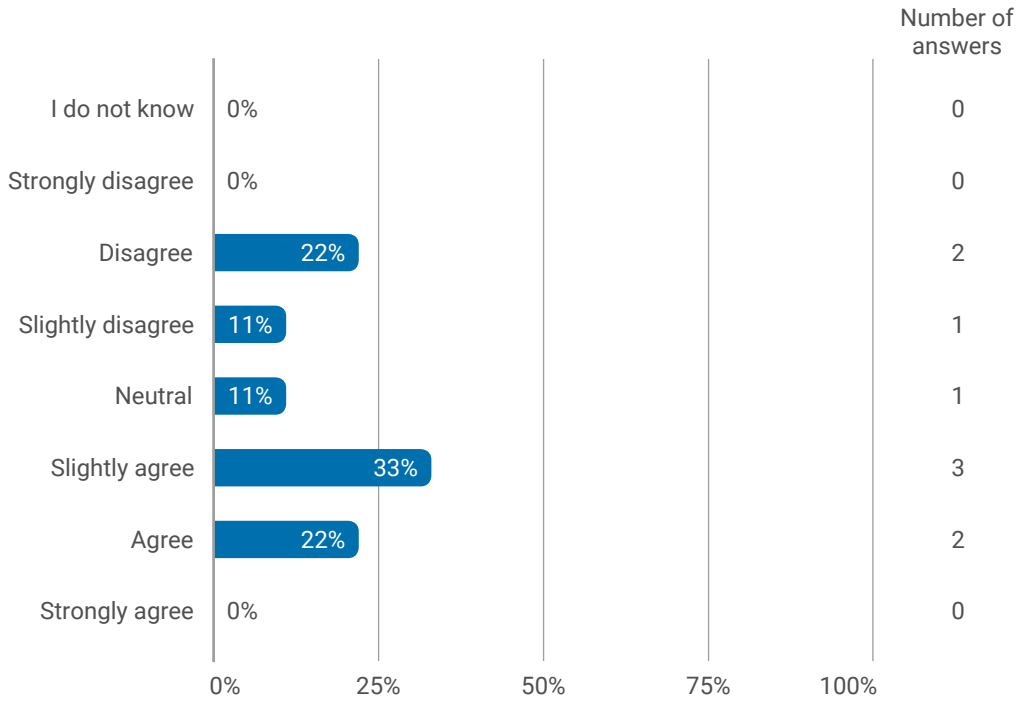
I am sufficiently up to date with existing AI technologies that can influence my PM practices.



I am sufficiently up to date with new emerging AI technologies that can influence my PM practices.



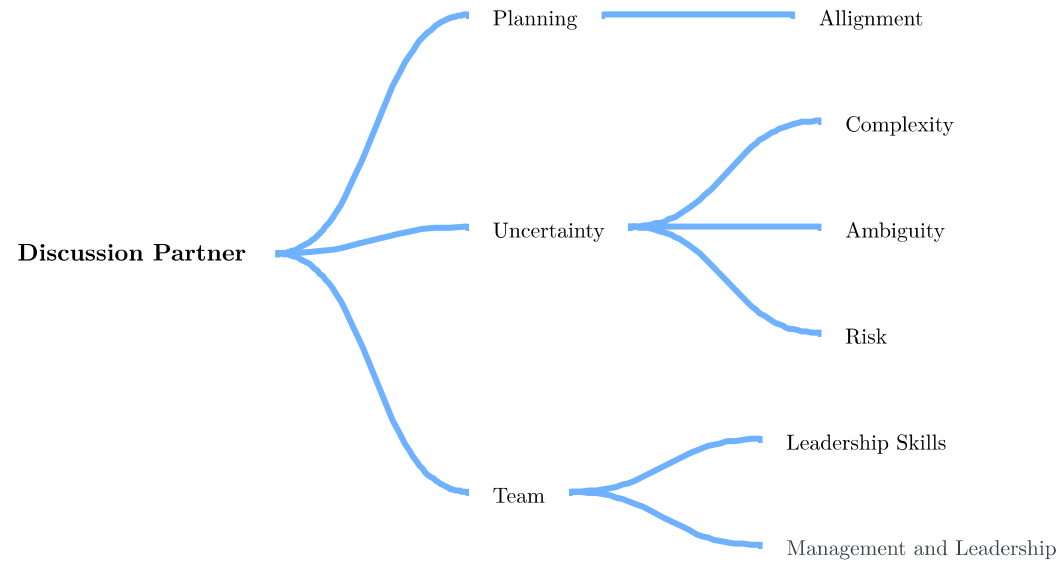
My organization is helping me sufficiently to stay up to date with new AI-technologies, and keep me up to date with new technologies that may help my PM practices.

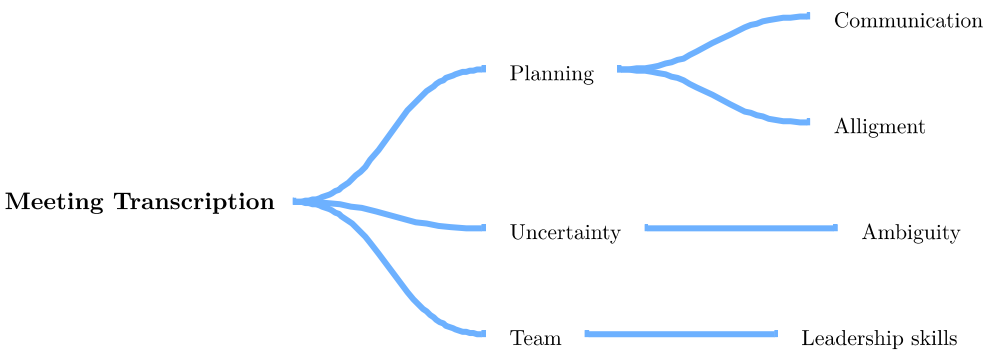


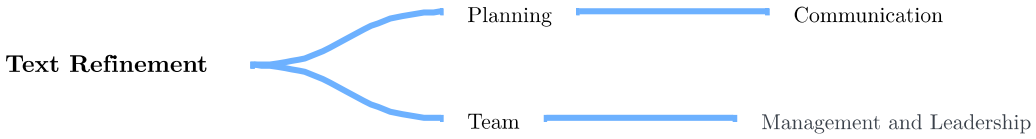
(Optional) Do you think there are additional specific aspects of project management where AI could bring about substantial improvements?
connecting silos and various PM systems
Repetetive tasks, suggestion for ideas, solution etc.
Agents are a hot topic these days. I am sure there are ways to utilize agents to help assist me in PM activities.

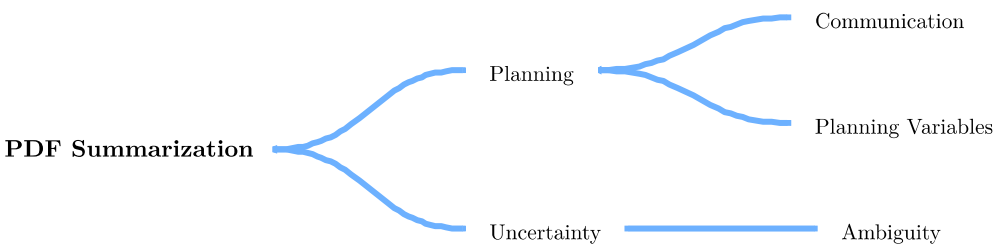
(Optional) Is there any feedback you have for us?
Good luck!

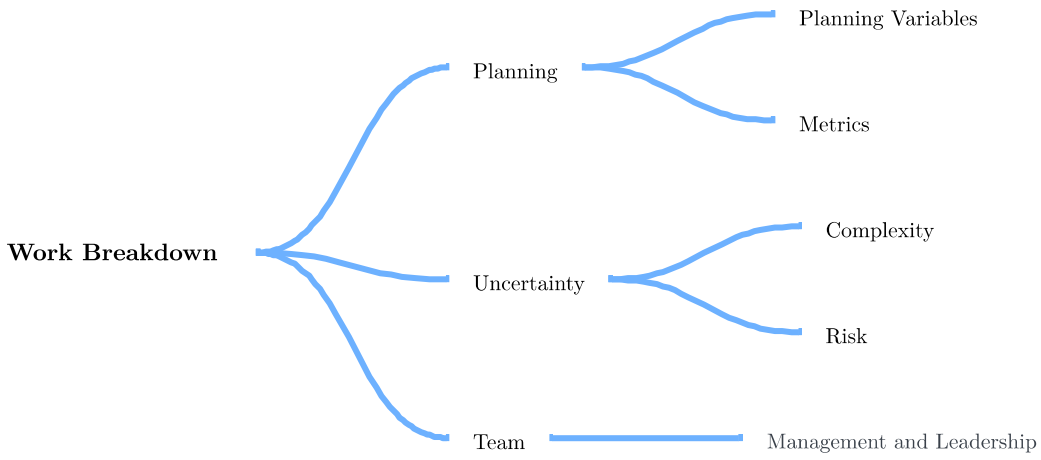
IV. Use Cases


Discussion Partner
Planning
Allignment
Uncertainty
Complexity
Ambiguity
Risk
Team
Leadership Skills
Management and Leadership


Meeting Transcription
Planning
Communication
Alligment
Uncertainty
Ambiguity
Team
Leadership skills


Text Refinement
Planning
Communication
Team
Management and Leadership


PDF Summarization
Planning
Communication
Planning Variables
Uncertainty
Ambiguity


Work Breakdown
Planning
Planning Variables
Metrics
Uncertainty
Complexity
Risk
Team
Management and Leadership