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Understanding the role of Artificial Intelligence tools in project performance domains

Marcirio Silveira Chaves
Pontifical Catholic University of Rio Grande do Sul, marcirio.chaves@pucrs.br

Jefferson Rodrigues Alves
Pontifical Catholic University of Rio Grande do Sul, jefferson.rodrigues.alves@gmail.com

Eduardo Fuchs Curço
Pontifical Catholic University of Rio Grande do Sul, eduardo.curco@pucrs.br

UNDERSTANDING THE ROLE OF ARTIFICIAL INTELLIGENCE TOOLS IN PROJECT PERFORMANCE DOMAINS

Research-in-Progress

Chaves, Marcirio Silveira, Pontifical Catholic University of Rio Grande do Sul - PUCRS, Porto Alegre, Brazil, marcirio.chaves@pucrs.br

Alves, Jefferson Rodrigues, Pontifical Catholic University of Rio Grande do Sul - PUCRS, Porto Alegre, Brazil, jefferson.rodrigues.alves@gmail.com

Curço, Eduardo Fuchs, Pontifical Catholic University of Rio Grande do Sul - PUCRS, Porto Alegre, Brazil, eduardo.curco@pucrs.br

Abstract

Research, based on case studies and literature reviews, provides tangible evidence of the practical benefits of using Artificial Intelligence (AI) tools in project management (PM), such as optimizing resource allocation, risk analysis, monitoring project progress, and report generation. This paper seeks to better understand the use of AI tools in PM, underlining how these technologies can enhance efficiency and effectiveness. We explore AI tools using neural networks, machine learning, deep learning, and natural language processing (NLP), and discuss their applications in project performance domains. Our research demonstrates how these tools can automate routine tasks, analyze large data sets, predict outcomes, and improve team communication and collaboration. As part of this research-in-progress, we will conduct interviews and surveys with project professionals to identify the challenges and impacts of AI tools in their daily tasks. We aim to provide valuable insights for effectively adopting AI in PM. This work contributes to understanding the changes AI can bring to PM and offers guidelines for implementing these technologies.

Keywords: Artificial Intelligence, Project Management, AI Tools, Project Performance Domains.

1 Introduction

Artificial Intelligence (AI) promises to revolutionize project management (PM), ushering in a new era of process efficiency and effectiveness. Recent studies have highlighted the necessity of understanding how AI advancements can reshape organizational practices (Karamthulla et al., 2024). Berg et al. (2023) emphasize the importance of organizations developing complementary assets to fully harness the potential of AI tools. The swift adoption of AI technologies, as evidenced by the widespread use of tools based on large language models such as ChatGPT, underscores AI's impact across various domains. These advancements raise pivotal questions about how organizations can seamlessly integrate AI into their processes to amplify value creation and capture. This ongoing research aims to address these questions by exploring the specific applications of AI in PM, offering insights into the challenges and benefits associated with AI integration.

In digital transformation, effectively navigating the evolving technological landscape requires an integrated approach that seamlessly connects technology, people, and processes, with AI facilitating this integration. The AI tools considered in this paper include artificial neural networks, machine learning, deep learning, and natural language processing (NLP). Barcaui and Monat (2023) compare the efficacy of generative AI with that of human project managers in project planning, highlighting both the

advantages and limitations of AI in this context. Costa et al. (2022) conducted a systematic literature review, identifying key technical, organizational, and human challenges in adopting AI in PM. Additionally, Fridgeirsson et al. (2021) provide an authoritative study on the future impact of AI on PM knowledge areas, predicting substantial changes. Somer and Thalmann (2023) discuss the critical role of risk management in AI deployment, emphasizing how inadequate risk mitigation strategies can lead to significant operational challenges. Akbarighatar et al. (2023) emphasize the need for maturity and readiness models to ensure responsible AI implementation, which is essential for effectively aligning technology with human and organizational processes.

The increasing application of AI in PM has led to a deeper understanding of its potential benefits and limitations. Hasmukh (2024) explores the practical implications of AI integration in PM, demonstrating how AI tools can optimize resource allocation, enhance risk management, and improve project monitoring and reporting. His findings suggest that while AI can significantly augment PM capabilities, there remain challenges in implementation and acceptance among project professionals.

Despite the transformative potential of AI, the PM community needs to pay more attention to research on AI tools. Leading PM journals such as the International Journal of Project Management (IJPM), Project Management Journal (PMJ), International Journal of Managing Projects in Business (IJMPB), and International Journal of Information Systems and Project Management (IJISPM) lack substantial publications on this theme. For instance, a systematic literature review by Nenni et al. (2024) found AI and PM papers predominantly in IJPM. Conversely, IT/IS events and journals have begun to publish preliminary research results. Müller et al. (2024) note that although PMJ has received submissions on AI applied to PM, these submissions often lack the rigor and relevance expected by top PM journals. This indicates a misalignment between editors' expectations and authors' research themes and approaches. This paper aligns with the call for project studies to understand how AI-triggered changes in the project performance domains and PM processes (Müller et al., 2024). This research-in-progress aims to bridge this gap by exploring how AI tools can support the project performance domains.

1.1 The Problem Statement

The number of AI tools has increased significantly in recent years. Project workers have invested considerable time understanding and learning to apply these tools to daily tasks (Mesa Fernández, González Moreno, Vergara-González, & Alonso Iglesias, 2022). Project leaders should concentrate more on soft skills like communication and conflict resolution, while AI systems will assist with data-related tasks and the more technical aspects (Holzmann et al., 2022). There is a need to examine how AI tools impact PM processes systematically, how they complement or replace human tasks, and the overall outcomes for project success. Auth, Jöhnk, and Wiecha (2021) present a conceptual framework emphasizing the necessity of understanding the specific requirements of both AI and PM for effective application. Hofmann et al. (2020) further stress the importance of developing AI use cases tailored to organizational needs and specific problems.

Despite the growth of AI tools, project managers are hesitant to use them due to cybersecurity risks (Kioskli et al., 2023). AI systems are vulnerable to attacks like data breaches and adversarial manipulations, which can lead to errors and security issues. Musser et al. (2023) discuss how adversarial attacks can manipulate AI inputs, causing incorrect outputs that undermine project results. Data breaches in AI platforms that handle sensitive information are also a major concern. These cybersecurity risks highlight the need for studies on protecting AI systems while leveraging their benefits in PM. Somer and Thalmann (2023) further emphasize the critical role of risk management in AI deployment, highlighting how inadequate risk mitigation strategies can lead to significant operational challenges.

Another challenge is integrating AI tools with existing PM software and workflows. Many organizations struggle to align AI tools with their current processes, causing inefficiencies and disruptions. Mahmood et al. (2023) show that the lack of standard protocols for AI integration often leads to compatibility

issues, making it hard to adopt and use AI technologies smoothly. This highlights the need to develop standardized frameworks and best practices to make integrating AI tools easier.
AI-driven PM tools can perpetuate existing biases and lead to unfair decision-making if not adequately trained and monitored. Ayling and Chapman (2022) highlight that AI algorithms can inadvertently reinforce gender, racial, or other biases in the training data, affecting decisions like hiring, task assignments, and performance evaluations. Pasricha (2023) discusses the ethical challenges of integrating AI into healthcare products, particularly concerning transparency, bias, privacy, and safety. Amedior (2023) examines the ethical implications of using AI in healthcare, including concerns about privacy, discrimination, and accountability. Nadeem, Marjanovic, and Abedin (2021) note that AI systems often reflect gender biases, especially in hiring, necessitating robust ethical guidelines and continuous monitoring to ensure fairness and unbiased outcomes in PM tools.

Holzmann et al. (2022) highlight the evolving role of project managers in the context of AI adoption, indicating significant changes in responsibilities and expectations. These gaps underscore the critical need for comprehensive research into integrating AI tools across the project performance domains. By addressing these challenges, this research-in-progress aims to provide actionable insights for the effective adoption and use of AI in PM, ultimately enhancing project outcomes and aligning with digital technologies' transformative potential. The research question (RQ) proposed in this work is as follows: **How do AI tools support project performance domains?**

1.2 The Rationale of this Research

Prior research explores aspects of AI integration in PM processes, providing a solid foundation for future studies and practical applications (Shoushtari et al., 2024; Fridgeirsson et al., 2023). Secundo et al. (2023) analyze how machine learning changes project risk management, while Skinner (2021) emphasizes the importance of a data-first strategy for AI success in PM. AI is transforming PM by providing benefits that enhance efficiency, accuracy, and decision-making capabilities. Applying AI tools to the project performance domains facilitates the automation of routine tasks, the analysis of large volumes of data, the prediction of outcomes, and improving communication and collaboration within project teams (Costa et al., 2022). This research-in-progress seeks to understand how the AI tools support each performance domain.

2 Artificial Intelligence Tools Applied to the Project Performance Domains

This section explores how AI tools are used in various PM aspects and the benefits they bring based on the literature and case studies. One of AI's main advantages in PM is its ability to quickly process and analyze large amounts of data (Costa et al., 2022). This enables project managers to make more informed decisions based on concrete data. AI tools can analyze historical data to predict potential problems and identify trends that might go unnoticed using traditional methods (Gil et al., 2021). For example, AI can help predict project delays by analyzing past data patterns and identifying risk factors before they become critical (Fridgeirsson et al., 2021). Holzmann et al. (2022) discuss the expectations of project managers from AI through a Delphi study.

Mohite et al. (2024) emphasizes the critical role of AI in efficient resource allocation within PM. Their research highlights how AI tools can dynamically adjust resource distribution based on real-time project data, ensuring optimal utilization of resources and preventing bottlenecks. This capability streamlines project workflows and significantly reduces operational costs, leading to more predictable and manageable project outcomes. Tools like Resource Guru use AI algorithms to optimize resource distribution, ensuring that the right resources are assigned to the right tasks at the right time (Wachnik, 2022;

Akbarighatar et al., 2023). This increases efficiency, reduces costs, and prevents resource overload (Müller et al., 2024).

Another significant benefit is automating repetitive and administrative tasks (Auth et al., 2021). Automation can help project managers focus on more strategic and high-value tasks (Holzmann et al., 2022). For example, tools like Trello and Asana, which incorporate AI, can automate task assignments, send reminders, and update project statuses, reducing manual workload and minimizing human errors (Marques & Bernardino, 2019). Additionally, automation helps ensure that tasks are completed consistently and on time (Grigorescu & Garais, 2023).

In risk analysis, AI tools like RiskWatch offer a significant competitive advantage. These tools can identify and assess potential risks based on historical and current data, providing project managers with a clear view of possible issues before they occur (Hofmann et al., 2020). This allows for implementing effective preventive measures, reducing the likelihood of project failures (Secundo et al., 2023; Nadeem et al., 2021).

AI also significantly improves communication and collaboration within project teams. Collaboration tools like Slack, integrated with AI bots, automate communication by answering frequently asked questions, sending automatic updates, and facilitating coordination among team members (Sedghani et al., 2021). This improves communication efficiency and ensures all stakeholders are informed in real time (Ayling & Chapman, 2022; Babac & Šimić, 2024).

The capability of monitoring and controlling projects is another area where AI demonstrates its value. Tools like Tableau, which uses AI for data analysis, provide detailed insights into project performance (Baum, 2017). These tools can detect deviations from the original plan and suggest corrections, enabling proactive PM (Collins & Lambert, 2018). Additionally, AI can assist in report generation, turning raw data into comprehensible visualizations that facilitate the communication of project results to stakeholders (Grzeszczyk, 2024).

In project closure, AI can assist in post-project evaluation and documentation of lessons learned (Fridgeirsson et al., 2023). Tools like IBM Watson Analytics analyze project data to identify areas of success and improvement, providing a foundation for future enhancements (Odeh, 2023). Moreover, final documentation can be automated, ensuring that all essential details are recorded consistently and accurately (Kim & Han, 1996).

Table 1 organizes the main AI tools used in the project performance domains, identifying their AI technique, classifying AI function, and describing the potential benefits to PM. The project performance domains are grounded in the PMBoK 7th edition (Project Management Institute, 2021). The classification of AI functions is based on Hofmann et al. (2020) and the distinction between discriminative and generative models described by Jebara (2004). The categories are as follows:

- Perceiving: Gathering and analyzing real-world data to create information.
- Feature Extraction and Identification: Detecting and recognizing specific objects within data.
- Reasoning: Interpreting and clarifying the fundamental relationships and patterns in the data.
- Predicting: Forecasting future events or conditions on a continuous scale.
- Decision-Making: Selecting between defined, distinct options.
- Generating: Creating or producing something new.
- Acting: Carrying out purposeful actions, such as moving, navigating, or controlling.

Table 1 illustrates the diverse application of AI tools across the project performance domains. Each domain benefits uniquely from integrating AI, demonstrating the technology's versatility and impact on project management practices. In the **stakeholder management domain**, tools such as IBM Watson and Power BI automate the identification and analysis of stakeholders using predictive analytics of historical data.

Table 1: The project performance domains supported by AI tools

Performance Domains	Tool/System	AI Technique	AI Function	Type	Potential Benefits of AI applied to Project Performance Domains	References
Stakeholders	IBM Watson, Power BI, Stakeholder Analysis Tool	ML	Perceiving	D	Identifies stakeholders using predictive analysis of historical data.	(Al-Sulaiti et al., 2021), (Daneshpajouh & Toledo Candarias, 2023), (Kaginalkar, Kumar, Gargava, & Niyogi, 2023)
Team	Microsoft Teams, Slack, Zoom	NLP	Generating	G	Enhances team communication with real-time updates.	(Hashfi & Raharjo, 2023), (Khalil & Cowie, 2020), (Tan et al., 2022)
Development Approach and Life Cycle	Google Cloud AI, IBM Watson, CrystalBall	ML	Predicting	D	Assesses project feasibility with predictive analytics.	(Hashfi & Raharjo, 2023), (Magistretti, Dell'Era, & Messeni Petruzzelli, 2019), (Sun, Gregor, & Fielt, 2021)
Planning	ChatGPT, Notion, Microsoft Project, Smartsheet, Wrike, Resource Guru	ML, NLP, O	Feature Extraction and Identification, Reasoning, Decision-Making	G, D	Create documents, structure schedules, allocate resources efficiently, track changes and document modifications.	(Bahroun et al., 2023), (Guler et al., 2024), (Jadhav et al., 2023), (Michalak & Rysavy, 2020), (Puška et al., 2020), (Shah & Chandragade, 2023)
Project Work	Asana, ClickUp, Trello, Jira, Monday	ML, RBS	Acting, Reasoning	D	Organizes tasks and generates reports automatically.	(Arya & Kulkarni, 2024), (Jadhav et al., 2023), (Kamila & Marzuq, 2024), (Nenni et al., 2024), (Özkan & Mishra, 2019)
Delivery	Google Docs, SAP Confluence, TensorFlow, QASymphony	DA, ML, NLP	Reasoning, Generating	G, D	Improves quality; analyzes project performance and documentation for enhancements.	(Aarthi et al., 2024), (Bochek & Olson, 2020), (Fridgeirsson et al., 2021), (Hashfi & Raharjo, 2023), (Nenni et al., 2024)
Measurement	Trello, Google Docs, Power BI, Tableau	DA, DV, ML, NLP	Reasoning, Generating	G, D	Provides project performance; generates reports; documents lessons learned.	(Al-Sulaiti et al., 2021), (Bahroun et al., 2023), (Fridgeirsson et al., 2021), (Nenni et al., 2024)
Uncertainty	CrystalBall, Fuzzy, RiskWatch	ML	Predicting	D	Identifies and evaluates potential risks.	(Nenni et al., 2024), (Sun, Gregor, & Fielt, 2021), (Yazdi, Golilarz, & Nedjati, 2021)

Note: ML = Machine Learning, NLP = Natural Language Processing, O = Optimization, RBS = Rule-Based Systems, DA = Data Analytics, DV = Data Visualization, G = Generative, D = Discriminative.

This automation reduces the time required to identify key stakeholders and enhances the accuracy of stakeholder management tasks, ensuring that all relevant parties are considered from the project's outset. Accurate stakeholder identification is crucial for understanding their needs and expectations, thereby facilitating better communication and engagement strategies (Al-Sulaiti et al., 2021; Daneshpajouh & Toledo Candarias, 2023; Kaginalkar et al., 2023).

For the **team**, AI tools like Microsoft Teams, Slack, and Zoom play a significant role in the team performance domain by enhancing communication and collaboration among project team members. These tools provide real-time updates, facilitate virtual meetings, and automate routine communication tasks like scheduling and notifications. By improving the efficiency and effectiveness of team interactions, these AI tools help maintain project momentum and ensure that team members are aligned and informed (Hashfi & Raharjo, 2023; Khalil & Cowie, 2020; Tan et al., 2022).

For the **development approach and life cycle:** In this domain, AI tools such as Google Cloud AI, IBM Watson, and CrystalBall are used to employ predictive analytics for assessing project feasibility. These tools analyze various data inputs to provide insights into potential project outcomes, risks, and resource requirements. By doing so, they help project managers make informed decisions about whether to proceed with a project, thus avoiding costly mistakes and ensuring that projects are viable and strategically aligned with organizational goals (Hashfi & Raharjo, 2023; Magistretti et al., 2019; Sun et al., 2021).

The **planning** domain benefits significantly from AI tools like ChatGPT, Notion, Microsoft Project, Smartsheet, Wrike, and Resource Guru. These tools leverage AI capabilities such as feature extraction, identification, reasoning, and decision-making to create detailed project plans. They assist in structuring schedules, allocating resources efficiently, tracking changes, and documenting modifications. This automation not only improves the precision and reliability of planning activities but also frees up project managers to focus on strategic planning and decision-making (Bahroun et al., 2023; Guler et al., 2024; Jadhav et al., 2023; Michalak & Rysavy, 2020; Puška et al., 2020; Shah & Chandragade, 2023).

In **project work**, AI tools such as Asana, ClickUp, Trello, Jira, and Monday enhance task management by automating task assignments, progress tracking, and report generation. These tools help ensure that tasks are completed on time and meet quality standards by providing real-time updates and analytics on task progress. This automation reduces the administrative burden on project managers and teams, allowing them to focus on more complex and value-added activities (Arya & Kulkarni, 2024; Jadhav et al., 2023; Kamila & Marzuq, 2024; Nenni et al., 2024; Özkan & Mishra, 2019).

In the **delivery** domain, tools like Google Docs, SAP Confluence, TensorFlow, and QASymphony utilize AI to enhance quality control and performance analysis. These tools help identify and resolve issues promptly, ensuring project deliverables meet the required standards. They also facilitate the documentation of project outcomes and lessons learned, which is essential for continuous improvement and knowledge transfer within the organization (Aarthi et al., 2024; Bochek & Olson, 2020; Fridgeirsson et al., 2021; Hashfi & Raharjo, 2023; Nenni et al., 2024).

For the **measurement domain:** AI tools such as Trello, Google Docs, Power BI, and Tableau are instrumental in the measurement domain, providing detailed insights into project performance through data analytics and visualization. These tools generate comprehensive reports and document lessons learned, helping project managers to track progress, identify areas for improvement, and ensure that projects stay on track (Al-Sulaiti et al., 2021; Bahroun et al., 2023; Fridgeirsson et al., 2021; Nenni et al., 2024).

In the **uncertainty domain**, AI tools like CrystalBall, Fuzzy, and RiskWatch are used to identify and evaluate potential risks through predictive analytics. These tools help project managers to anticipate and mitigate risks by providing a clear view of potential issues before they arise. Effective risk management is critical for the successful completion of projects, and AI tools significantly enhance the ability to manage uncertainties (Nenni et al., 2024; Sun et al., 2021; Yazdi et al., 2021).

An analysis of Table 1 reveals that machine learning is the predominant AI technique utilized across various tools, reflecting its versatility and effectiveness in PM applications. Tools like IBM Watson, RiskWatch, and Asana leverage machine learning to enhance stakeholder identification, risk analysis,

and progress monitoring capabilities. This prevalence of machine learning underscores its critical role in transforming PM practices by enabling predictive analytics, decision-making, and process optimization. Beyond the tangible benefits delivered through AI functions, Table 1 highlights significant challenges, such as the need for robust cybersecurity measures and the effective integration of AI tools into existing processes, as discussed by Somer and Thalmann (2023). Concerns regarding biases in AI algorithms, emphasized by Ayling and Chapman (2022) and Akbarighatar et al. (2023), underscore the necessity for ethical guidelines and maturity models to ensure responsible AI implementation. This diversity of tools reflects the various technological and methodological approaches required to transform PM, promoting a more efficient and effective practice from routine task automation to advanced data analysis.

The criteria for classifying AI tools as discriminative or generative are based on the definitions and discussions provided by Jebara (2004). According to Jebara, discriminative models focus directly on the conditional relationship between input and output, maximizing the margin of separation between classes to improve classification. In contrast, generative models aim to model the joint distribution of variables, allowing for inferences and the generation of new data based on probabilistic distributions. Generative approaches help understand the structure of the data and deal with uncertainties and latent variables, while discriminative models are optimized for specific prediction and classification tasks (Jebara, 2004).

3 Method

This research is conducted in the positivist paradigm, adopting a mixed-method approach. It intends to provide a holistic understanding of a phenomenon for which extant research is fragmented and inconclusive (Venkatesh et al., 2013). It is classified as a partially mixed concurrent equal status design (Leech & Onwuegbuzie, 2009). With partially mixed methods, the quantitative and qualitative elements are conducted concurrently or sequentially in their entirety before being mixed at the data interpretation stage. Concurrent means that quantitative and qualitative occur at approximately the same time. The research gives equal emphasis (i.e. equal status) concerning addressing the research question(s) and the quantitative and qualitative phases having equal weight (Leech & Onwuegbuzie, 2009).

The sampling scheme adopted is a snowball: project workers using AI are asked to recruit individuals to join the study (Onwuegbuzie & Collins, 2015). Choosing a mixed-method approach with a concurrent design aims to carry out triangulation and identify complementarity in the data analysis (Venkatesh et al., 2013; Onwuegbuzie & Collins, 2015). Meta-inferences using bracketing and bridging (Lewis & Grimes, 1999) will be used in the data analysis. The unity of analysis is AI tools used in projects, and the unity of observation is project workers.

The data collection instruments are designed as follows: The interview protocol starts with a brief overview of this research. The main socio-demographic questions are your full name, age, time in the function, certifications, project sector, and the average duration of the projects you are involved in. Table 2 presents a preliminary semi-structured interview protocol.

The survey method has been extensively used in prior studies to gather data on the application of AI in various domains. For instance, Almukhalfi, Noor, and Noor (2024) used surveys to assess traffic management approaches using machine learning and deep learning techniques. Babac and Šimić (2024) conducted surveys to explore AI's role in classifying and creating art. Similarly, Baum (2017) employed surveys to examine artificial general intelligence projects regarding ethics, risk, and policy. These studies highlight the effectiveness of surveys in capturing comprehensive data from diverse respondents. Therefore, in this research, surveys will be used to collect data from project workers to understand the impact of AI tools in the project performance domains (Narkarunai et al., 2023).

Table 2: Semi-structured interview protocol to be applied to project workers.

Theme	Questions	Source
Knowledge and experience with AI tools	Based on the pre-defined list of AI tools, mark those you know and your level of knowledge.	Almukhalfi, Noor, & Noor (2024)
	To those tools you have marked, please describe the limitations and benefits identified by you.	Babac & Šimić (2024)
	Do you use another AI tool in your daily tasks? If so, please describe it.	Baum (2017)
Project technical tasks	Considering your daily tasks, explain to what extent AI tools contribute to improving each task.	Shoushtari et al. (2024)
	Explore specific questions for each AI tool according to the interviewee's knowledge.	Fridgeirsson et al. (2021)
Project management (leaders)	Considering the project performance domains, explain:	
	What tools are you really using to execute tasks?	Barcaui & Monat (2023)
	How do you rate each one regarding its contribution to the PM's success (e.g., cost, schedule, quality)?	Costa et al. (2022)

To construct the questionnaire, the study will gather sociodemographic information from participants, including their full name, age, gender, educational level, professional experience in their current role, sector of activity, and the average duration of projects they are involved in (Hisatomi et al. de Barros, 2013). Following this, the questionnaire will assess participants' knowledge and use of AI tools. They will be asked to mark the AI tools they are familiar with, indicate their knowledge level, describe the limitations and benefits of these tools, and mention if they use other AI tools in their daily tasks (Mahmood et al., 2023). The impact of AI tools on project tasks will also be explored, with participants explaining how AI tools improve their daily tasks regarding efficiency, quality, and meeting deadlines, and describing how specific tools help solve problems in their activities (Sedghani et al., 2021). Finally, the questionnaire will evaluate the AI tools used, asking participants to rate the ease of use, integration with other tools, cost-benefit, and overall contribution of AI tools to project success using scales from 1 to 5 (Victor, 2023). The data collected will be analyzed using descriptive and inferential statistical techniques to identify patterns and relationships between the use of AI tools and project performance (Zia et al., 2024). Responses will be qualitatively analyzed using thematic coding to identify emerging themes and patterns, and triangulation of quantitative and qualitative data will be performed to strengthen the validity of the research results.

4 Final Remarks

This ongoing research will add one empirical study to the PM literature to improve understanding of the role of AI in the project performance domains. This understanding includes more knowledge on the trigger changes in the project manager role, responsibilities, and project management processes and how effective AI tools are in improving project planning, scheduling, cost, risk management, and resource allocation. By knowing how AI tools contribute to improving project workers' tasks based on extensive data collection, this research will facilitate the choice of project professionals regarding the most suitable AI tools to integrate into a project.

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