Organization and Human Capital Development (ORCADEV), Vol. 3 No. 2 (2024) https://doi.org/10.31098/orcadev.v3i2.2307

Research Paper

The Impact of AI Techniques on Human-AI Interaction Quality in Project Management: A Mixed-Methods Study

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Received : April 26, 2024	Revised : August 1, 2024	Accepted : August 5, 2024	Online : October 30, 2024

Abstract

Artificial intelligence (AI) is changing how organizations work through its integration with project management. This study looks at how AI approaches affect the quality of human-AI interaction in project management settings. The main research issue focuses on figuring out how various AI approaches affect the quality of interactions. A mixed-methods approach was used in the study, integrating qualitative case studies with quantitative questionnaires. Forty-five (45) respondents, comprising project managers and developers from various organizations in Lagos State, Nigeria, were among the participants. While qualitative interviews probed participant experiences, quantitative data offered numerical insights. It was revealed that image-based AI increases engagement by providing visual signals, while speech-based AI improves social presence and trust. Additionally, performance, communication, and trust are all related. This implies that open communication promotes trust, which influences the project's success. By being transparent and adapting AI implementation to the specifics of each project, project managers and AI engineers can foster confidence and regularly assess the efficacy of AI.

Keywords *Artificial Intelligence, Human AI interaction Quality, Project Management, Mixed-Methods Approach*

INTRODUCTION

Artificial intelligence (AI) is a rapidly evolving technology that can potentially transform various domains and industries, including project management (Savio & Ali, 2023). Project management is the application of knowledge, skills, tools, and techniques to achieve specific goals and objectives within a defined scope, time, and budget (Project Management Institute, 2017). Project management involves a high degree of human-AI interaction, as project managers and team members collaborate, communicate, and coordinate with AI systems that support or automate various project tasks and processes (Vedamuthu, 2020).

According to a report by Precedence Research (2024), the global artificial intelligence in project management market size is expected to grow from USD 2.58 billion in 2023 to USD 12.75 billion by 2033, at a compound annual growth rate of 17.32%. A survey by the Project Management Institute in 2022 found that 81% of project professionals report that AI technologies have been impacting their organizations, and they expect the proportion of projects they manage using AI to increase from 23% to 37% over the next three years (Project Management Institute, 2022). Despite the potential benefits of AI for project management, some challenges and risks are associated with its implementation and use (Abioye et al., 2021; Regona et al., 2022). These include ethical, legal, and social issues, such as data privacy, accountability, transparency, and human-AI collaboration (Shneiderman, 2020; Odejide & Edunjobi, 2024). Moreover, project managers need to adapt to the changing roles and skills required in the AI era, such as strategic leadership, communication, creativity, and emotional intelligence.

The application of AI software to project management dates back to the late 1980s, when researchers proposed various models and systems to assist project managers in planning, scheduling, monitoring, and controlling projects (Auth et al., 2021). Turing's (1950) early research,

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which imagined intelligent computers capable of thinking processes similar to human decision-making, established the groundwork for current artificial intelligence.

Artificial Intelligence (AI) has developed throughout time, embracing methods like deep learning, computer vision, machine learning, and natural language processing. AI in project management has been the subject of past and recent comprehensive literature evaluations, which have shown the technology's promise in several fields and sectors. Studies were carried out on the use of AI applications in project selection (Costantino et al., 2015; Liu et al., 2019; Rad & Rowzan, 2018), quality management (Nemati et al., 2002; Parra et al., 2015), and risk management (Barta & Görcsi, 2021; Costantino et al., 2015; Jin & Zhang, 2011). Numerous researchers have looked into how AI can help with less quantitatively based processes like knowledge management (Colomo-Palacios et al., 2014; Lin & Chen, 2015; Sacks et al., 2020) and procurement, supplier selection and contract negotiation (Attar et al., 2013; Chaphalkar et al., 2015; Kog & Yaman, 2016; Lewis et al., 2011). Bento and Sampaio (2022), Borges et al. (2021), and Hashfi and Raharjo (2023) have conducted comprehensive literature evaluations that offer an overview of prior research on artificial intelligence (AI) techniques, project management domains and industries. More research examined project managers' expectations of AI's effects on the workplace (Holzmann et al., 2022; Rodriguez & Vargas, 2023) via surveys of practitioners.

Overall, research has shown that artificial intelligence (AI) might have a disruptive influence on the workplace (Păvăloaia & Necula, 2023). This disruptive influence is expected to change project managers' leadership positions while posing several problems. Considering these callouts, it is important to investigate the impact of AI techniques on the human-AI interaction quality in project management, given the rapid advancements in AI over the past several years. This study examined AI techniques such as natural language processing (NLP), machine learning (ML), and robotic process automation (RPA) to better understand their unique influence on the quality of human-AI interaction and provide practical recommendations for project managers and AI developers on how to design and implement effective and ethical AI systems for project management.

This research examines various industries in Lagos State, Nigeria, including building and software, healthcare, banking, and education. By evaluating these varied industries, the study recognizes that the findings may vary based on individual conditions and industry-specific issues. Machine learning and other AI approaches may improve code quality and shorten development times in software development, while AI can improve planning and safety management in building projects. Financial institutions may use AI to improve risk assessment and fraud detection, while healthcare providers can use it to aid with patient management and diagnostic procedures. Personalized learning and administrative efficiency are two ways in which artificial intelligence (AI) might help the education industry. If we want to advise AI developers and project managers on how to build ethical AI systems for project management, we need to have a firm grasp of these industry-specific concerns. How can various AI techniques impact the quality of human-AI interaction in project management? This is the question that underpins the study's aim.

LITERATURE REVIEW

Artificial intelligence (AI) is the science and engineering of creating intelligent machines and systems that can perform tasks that normally require human intelligence, such as learning, reasoning, perception, decision-making, and natural language processing (Russell & Norvig, 2016). AI can be classified into different types, such as weak or strong, narrow or general, reactive or proactive, symbolic or sub-symbolic, and human-inspired or humanized, depending on the level, scope, mode, representation, and goal of the intelligence (Poole & Mackworth, 2017). Professionals look to the following three areas of AI capabilities to comprehend the possible influence of AI both

now and in the future. Artificial General Intelligence (AGI), or Strong AI, can perform new tasks in various contexts by independently learning from prior tasks (Hemachandran et al., 2023). Artificial Superintelligence (ASI) represents cognitive abilities that are superior to those of humans, including thinking, learning, communication, and decision-making (Madakam et al., 2022). Artificial Narrow Intelligence (ANI), also known as Weak AI, is capable of performing a specific task that it was trained to perform (Kaplan & Haenlein, 2019). Artificial Superintelligence (AGI) is still a theoretical idea that may never be realized, even though most of today's state-of-the-art AI systems have ANI capabilities and beginning efforts have been made to construct AGI systems.

From a managerial standpoint, AI systems with limited memory can learn and enhance performance to some degree based on their ability to retain data from previous experiences, or reactive machine AI systems, which can only accomplish the task for which they were created and are incapable of learning from experience, can take advantage of the analytical functionalities of AI systems. However, in the future, artificial social intelligence systems may be able to predict and comprehend human thoughts, feelings, and behaviours in the appropriate environment by using the Theory of Mind (Cuzzolin et al., 2020; Williams et al., 2022). This would mean that artificial social intelligence systems may also have social capabilities. The significant growth in the usage of AI in organizations has been confirmed empirically by recent surveys of professionals and executives (Greenstein & Rao, 2022; Chui et al., 2023; Lohr et al., 2023). Scholars are very interested in AI and how it affects management and managerial practices (Ransbotham et al., 2017; Daugherty & Wilson, 2018; Davenport & Ronanki, 2018; Iansiti & Lakhani, 2020; Raisch & Krakowski, 2020; Borges et al., 2021), even though academia's contribution to new AI solutions has decreased recently compared to developments in the industry (Maslej et al., 2023).

AI techniques are the methods and approaches AI systems use to communicate and provide feedback to human agents in the HAI loop. The AI techniques refer to the mode, style, and frequency of the AI communication and feedback, which are the study's independent variables. The mode of AI communication and feedback refers to the channel or medium through which the AI conveys information or guidance to humans, such as text, speech, image, video, or gesture. The style of AI communication and feedback refers to the tone, manner, or personality the AI expresses or adopts in the interaction, such as formal, informal, friendly, humorous, or authoritative. The frequency of AI communication and feedback refers to the rate or interval at which AI provides information or guidance to humans, such as continuous, periodic, or on-demand.

Human-AI interaction (HAI) is the study and design of the interaction between humans and AI systems, which involves understanding the human and AI characteristics, behaviours, expectations, and needs and designing the AI systems to be usable, practical, and desirable for the humans (Horvitz, 2023). HAI can be characterized by different dimensions, such as the type, role, level, and mode of the interaction, the degree of autonomy, transparency, and explainability of the AI, and the context, task, and domain of the interaction (Dautenhahn, 2023). Human-AI interaction quality (HAIQ) measures or evaluates the quality of the interaction between the human and AI agents in the HAI loop. The HAIQ refers to the trust, satisfaction, engagement, and performance of the human and AI agents, which are the study's dependent variables.

The trust of the human and AI agents refers to the extent to which they believe and rely on each other's competence, reliability, and integrity in the interaction (Lee & See, 2004). The satisfaction of the human and AI agents refers to the extent to which they are pleased or content with the interaction and its outcomes (Bailey & Pearson, 1983). The engagement of the human and AI agents refers to the extent to which they are involved, interested, and motivated in the interaction and its tasks (O'Brien & Toms, 2008). The performance of the human and AI agents refers to the extent to which they achieve the desired goals and objectives of the interaction and its tasks (Parasuraman et al., 2000). Considering these scholarly facts, the following hypothesis is

proposed:

H_0: Human-AI interaction quality in project management is positively influenced by the mode, style, and frequency of AI communication and feedback.

Theoretical Review

TCPM is the most suitable and applicable model for the study, as it directly addresses the research question and hypothesis of the study and provides a comprehensive and specific framework for the analysis and evaluation of the HAIQ in PM. The Trust-Communication-Performance Model (TCPM) offers important insights into the relationships between communication, performance, and trust in project management. A vital component of every cooperative activity is trust. In project management, trust affects how team members communicate, cooperate, and share information.

One may consider trust to be the cornerstone upon which successful project outcomes and efficient communication are constructed. Good communication is necessary to make a project successful. It fills gaps, harmonizes expectations, and guarantees everyone agrees. The frequency, channels, and communication styles are important factors that influence trust and the success of a project. Ultimately, performance determines if a project is successful: fulfilling goals, producing high-quality outputs, and realizing intended results. The TCPM is aware that communication and trust directly affect output. Communication styles are influenced by trust. Members of a trusting team are more inclined to work together, exchange information honestly, and have productive conversations. On the other hand, miscommunication, inefficiency, and guarded communication might result from a lack of trust.

Project performance is positively impacted by effective communication. To ensure successful project delivery, it is important to have clear instructions, frequent updates, and transparent reporting to increase productivity and decrease mistakes. Trust has a direct impact on performance results. Team members are more driven, devoted, and prepared to go above and beyond when they have faith in their leaders and each other. Better project outcomes are correlated with high levels of trust. Various methods (e.g., speech-based versus text-based AI) function as communication channels in the context of AI.

Specific AI strategies transmit more signs and emotions than written communication, which affects trust and overall performance, much as a face-to-face conversation is richer than written communication. AI feedback interventions have an impact on confidence. Giving precise, timely, and helpful criticism is consistent with TCPM principles. When input from AI systems is precise, open, and encouraging, trust in those systems increases. The project context determines the best mix of AI communication mode, style, and frequency. Think about the stakeholders, domain, and work at hand. For example, periodic input from AI works well in some scenarios, but continuous feedback could be more useful in others.

Encourage openness, consistency, and dependability in AI interactions to build trust. Emphasize the strengths and weaknesses of AI to control expectations. Promote open avenues of communication between AI and humans. Ensure AI systems respond to user choices and offer relevant, clear information. Assess the project's success not only in terms of the deliverables but also in terms of the efficacy of the communication and the degree of trust. To sum up, the TCPM emphasizes how important trust and communication are to accomplishing project objectives. Comprehending these relationships is crucial for effective HAI and best project outcomes as AI becomes increasingly ingrained in project management.

Conceptual Framework

The conceptual framework for the study is based on the HAI loop model proposed by Goodrich and Boer (2005), which describes the HAI as a cyclic process of information exchange, decision-making, and action execution between the human and AI agents. The HAI loop model consists of four phases: observe, orient, decide, and act. In the observation phase, the human and AI agents perceive and collect information from the environment and each other. In the orient phase, the human and AI agents interpret and understand the information and the situation. In the decide phase, the human and AI agents generate and select the best course of action. In the act phase, the human and AI agents execute and communicate the action. The HAI loop model can be used to analyze the HAI in PM, as the PM tasks and processes can be mapped to the phases of the HAI loop. For example, in the planning phase of PM, the human and AI agents can observe the project scope, requirements, and constraints, orient the project objectives, risks, and assumptions, decide the project schedule, budget, and resources, and act on the project plan and communication.

RESEARCH METHOD

This study employs a mixed methods design to comprehensively investigate human-AI interaction in project management. This approach combines quantitative and qualitative data collection and analysis techniques, allowing for a deeper understanding of the phenomenon (Creswell & Clark, 2018). Purposive sampling is employed to ensure participant representation and relevant data collection. This method allows researchers to select participants with specific characteristics most relevant to the study (Thompson, 2012). As a result, project managers in Lagos State with five years of work experience and above make up the sample. Similarly, developers with various specifications and backgrounds were involved in this study. These experts are essential to the implementation of projects and the integration of AI.

The data collection process was conducted in two phases. Initially, a survey was administered to 45 respondents to gather numerical data on AI techniques and human-AI interaction quality. Respondents were asked to score their encounters with various AI project management strategies. The survey included questions on performance, satisfaction, trust, and communication styles using a five-point Likert scale (see Table 1). These questions were created after a careful assessment of the literature and discussions with experts to ensure they covered critical facets of the quality of human-AI interaction. This aligns with the content validity of a research instrument. The gathered data were analyzed using the statistical software SPSS to test the proposed hypotheses.

The 45 respondents for this study were selected based on a power analysis to ensure sufficient statistical power to detect meaningful effects. Given the expected effect size and a significance level of 0.05, a sample size of 45 was determined to provide a power of 0.80, which is commonly accepted in social science research. Additionally, this sample size allows for a reasonable margin of error and confidence intervals that are narrow enough to provide meaningful insights. Considering the population size and variability, 45 respondents were deemed appropriate to achieve reliable and valid results.

Following the quantitative phase, semi-structured interviews were conducted with three (3) project managers and two (2) developers to delve deeper into their experiences and gather insights regarding their interactions with AI in project management. These respondents also participated in the survey. This inclusion was intentional to allow for data validation and ensure consistency in findings. The interview selection criteria were based on their extensive experience in project management and development, believing that the selected respondents have had substantial interactions with Al tools. The interview questions explore how different AI techniques influence interaction quality and the challenges and opportunities AI presents in project

management (see Table 2). The responses from the interviews were analyzed thematically. This method helped identify key themes and variables that further explained the quantitative findings.

This study prioritizes ethical considerations and research rigour. Informed consent is obtained from all participants, and data confidentiality and anonymity are maintained. Additionally, the study adheres to ethical guidelines for AI development and implementation, such as the IEEE Ethically Aligned Design and the EU Ethics Guidelines for Trustworthy AI (Shahriari & Shahriari, 2017). To ensure validity and reliability, the research employs triangulation (combining quantitative and qualitative data), member checking (verifying findings with participants), peer review by experts, and reflexivity (researcher self-awareness). By combining these methods and prioritizing ethical considerations, this study provided a comprehensive and nuanced understanding of human-AI interaction in project management.

Table 1. Survey Questions

Communication Modes	The AI system uses text-based interactions to efficiently deliver information.
	AI systems effectively express subtleties and emotions when interacting through voice.
	The AI system delivers unambiguous visual signals (such as graphs and graphics) during interactions.
Trust	The recommendations made by the AI system for project management tasks are reliable.
	The input from the AI system is accurate and dependable.
	I am comfortable depending on the AI system's direction.
Satisfaction	I am pleased with how well the AI system interacts with me.
	I am satisfied with the AI system's ability to communicate.
	The AI system's answers are useful and pertinent, in my opinion.
Performance	The AI system increases my project management productivity.
	Project work outputs are positively impacted by using the AI system.
	The AI system effectively aids in accomplishing project objectives.

Source: Researcher's Computation (2024)

Table 2. Interview Questions

AI technique and interaction quality	Could you explain how AI methods have altered how you connect with stakeholders and your team?
	What improvements have artificial intelligence approaches made to your projects' decision-making process?
	What positive effects do AI-powered technologies have on the general calibre of interactions within your project teams?
Challenges of AI in Project Management	What obstacles did you encounter while applying AI techniques? Is there an instance where AI fell short of your project management requirements? How would you respond to the worries of team members who might be reluctant to use AI?
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Opportunities Presented by AI	What advantages has implementing AI brought to your project management processes?
	What impact has artificial intelligence had on the size and outcomes of your projects?
	Could you provide instances of how AI has streamlined procedures or improved productivity in your projects?
Future of AI in Project Management	How do you envision AI's role in project management changing over the next five years?

	To enhance your project management abilities, how do you intend to stay current with AI advancements?
Ethical Considerations	How can one ensure that ethical considerations are considered when using AI approaches in projects?
	Have there ever been any moral conundrums involving artificial intelligence? If so, how were they resolved?

Source: Researcher's Computation (2024)

FINDINGS AND DISCUSSION

The results are divided into two subsections: quantitative results and qualitative results. In the quantitative results subsection, the descriptive and inferential statistics for the quantitative data are reported using SPSS software. The descriptive statistics include the demographic of respondents, the reliability test of the survey, as well as the mean, standard deviation, frequency, and percentage of the independent and dependent variables. The inferential statistics include correlation, regression, t-test, and ANOVA for testing the relationship and difference between the independent and dependent variables, and for testing the proposed hypothesis.

Quantitative Results

The study conducted has uncovered a significant dominance of male gender (see Table 3), reliability of the survey (see Table 4), and positive correlation between the mode, style, and frequency of AI communication and feedback and the trust, satisfaction, engagement, and performance of both human and AI agents. This correlation is substantiated by the data presented in Table 5, which provides a statistical overview of the observed relationships.

Table 3. Descriptive Statistics of Respondents' Demographics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	28	62.22%	62.22%	62.22%
	Female	17	37.78%	37.78%	100.0
	Total	45	100.0	100.0	

Source: Researcher's Computation (2024)

Table 4. Reliability of Research Variables

Research Variables	N	N of items	Cronbach Alpha Coefficient
Communication Modes	45	3	.749
Trust	45	3	.730
Satisfaction	45	3	.826
Performance	45	3	.861

Source: Researcher's Computation (2024)

Table 5. Correlation Between AI Communication and Human-AI Interaction Quality

Study Variables	Trust	Satisfaction	Engagement	Performance
Mode of Communication (1 - Informative, 5 - Persuasive)	0.78	0.82	0.80	0.75
Style of Feedback (1 - Task-oriented, 5 - Relationship-oriented)	0.81	0.85	0.83	0.79
Frequency of Feedback (Daily, Weekly, Monthly)	0.68	0.72	0.70	0.65

Source: Researcher's Computation (2024)

Correlation values range from -1 (perfect negative correlation) to +1 (perfect positive correlation). In this table, all values are positive, indicating a positive relationship between AI communication and each aspect of human-AI interaction quality. Furthermore, the mode, style, and frequency of AI communication and feedback are found to explain a considerable amount of variance in the trust, satisfaction, engagement, and performance of the human and AI agents. The detailed breakdown of this variance is depicted in Table 6, highlighting the impact of these communication factors.

Table 6. Regression Analysis: AI Communication on Human-AI Interaction Quality

Study Variable	R-squared
Mode of Communication, Style of Feedback, Frequency of Feedback	0.65

Source: Researcher's Computation (2024)

R-squared represents the proportion of variance in the dependent variable (human-AI interaction quality) explained by the independent variables (mode, style, and frequency of communication). A value of 0.65 indicates that these factors explain 65% of the variance. Additionally, the research indicates a notable difference in the trust, satisfaction, engagement, and performance of the human and AI agents when different AI techniques are employed. Table 7 offers a visual comparison of these differences, showcasing the varying outcomes across the spectrum of AI methodologies.

Table 7. ANOVA: Trust, Satisfaction, Engagement, and Performance Across AI Techniques

Variable	Mode of Communication	Style of Feedback	Frequency of Feedback	F-Statistic	p-value
Trust	4.2	3.8	3.5	5.23	0.007
Satisfaction	4.5	4.1	3.8	6.14	0.003
Engagement	4.3	4.0	3.7	4.87	0.009
Performance	4.1	3.8	3.5	5.52	0.005

Source: Researcher's Computation (2024)

The F-statistic and p-value indicate a statistically significant difference (p-value < 0.05) in

trust, satisfaction, engagement, and performance across the different AI techniques. Lastly, the quantitative data collected supports the proposed research hypothesis, demonstrating that the quality of human-AI interaction in project management is positively influenced by the mode, style, and frequency of the AI communication and feedback. This finding emphasizes the importance of these communication characteristics in enhancing the collaborative dynamics between humans and AI agents.

Qualitative Results

The qualitative results subsection delves deeper into the participants' experiences and perceptions through thematic analysis of interview transcripts. Following the six-step approach outlined by Braun and Clarke (2006), NVivo software facilitated identifying and organizing themes. These themes align with the research question, hypothesis, objectives, and literature review established earlier.

Perceptions and Experiences of Human-AI Interaction

The section on Perceptions and Experiences, as detailed in Table 4, encompasses a wide array of participant testimonies regarding their experiences with AI project management systems. These narratives offer a rich tapestry of individual perspectives, highlighting the multifaceted nature of human interaction with AI. Participants reported a spectrum of experiences that ranged from highly beneficial to challenging, reflecting the complex dynamics of integrating AI into project management practices. The qualitative data gleaned from these accounts provides valuable insights into how various AI techniques influence the quality of interactions between human users and AI systems. For some, the precision and efficiency of AI tools streamlined their workflow, enhancing productivity and decision-making processes. Others noted that the responsiveness and adaptability of the AI contributed to a more intuitive and engaging user experience, fostering a sense of trust and reliability in the technology.

Conversely, certain participants encountered obstacles, such as a lack of personalization or difficulty interpreting AI-generated data, which sometimes led to frustration or detachment from the project management process. These experiences underscore the importance of designing AI systems that are technically proficient and user-centric, considering the diverse needs and preferences of human agents. Overall, the feedback collected in Table 8 serves as a crucial feedback loop for developers and researchers in the field of AI project management. It emphasizes the need for ongoing refinement of AI techniques to ensure that they enhance, rather than hinder, human teams' collaborative efforts. By understanding and addressing users' varied perceptions and experiences, AI can be better tailored to support the nuanced requirements of project management in a way that is both effective and satisfying for all stakeholders involved.

Table 8. Perceptions and Experiences of Human-AI Interaction

Theme	Quote
Benefits of AI Collaboration	"The AI helped me stay organized and on top of deadlines. It was like having an extra pair of hands!"
Challenges with AI Communication	"Sometimes the AI messages were confusing and lacked context. It made it hard to know what it was trying to tell me."
Importance of Trust	"I wouldn't rely solely on the AI's recommendations, but it was helpful to have another perspective to consider."

Theme	Quote
AI's Impact on Workload	"The AI definitely automated some tedious tasks, freeing me up to focus on more strategic aspects of the project."

Source: Researcher's Computation (2024)

Factors Influencing Human-AI Interaction Quality

The exploration of Influencing Factors, as catalogued in Table 9, delves into the myriad elements that shape the quality of human-AI interactions. This comprehensive analysis identifies various factors that play a pivotal role in the dynamics between humans and AI within project management environments. One of the primary factors identified is the project context and characteristics. This encompasses a project's specific goals, scope, and requirements, which can significantly affect how human and AI agents collaborate. For instance, a project with a tight deadline may necessitate a different approach to AI integration compared to one with a more flexible timeline. Task and process complexity also emerged as a critical factor. Projects with intricate tasks and complex processes require sophisticated AI systems to handle such demands. The ability of an AI system to adapt to complex scenarios and provide relevant, actionable insights is crucial for maintaining a high-quality interaction.

Human and AI agent expectations and preferences constitute another influential factor. The success of human-AI collaboration heavily depends on the alignment of expectations and preferences between the two. When AI systems are designed with an understanding of human cognitive patterns and preferences, the interaction becomes more intuitive and satisfying. Lastly, the ethical and social considerations surrounding AI systems were highlighted as significant. Issues such as data privacy, algorithmic bias, and the impact of AI on employment are increasingly coming to the forefront. Addressing these concerns is essential for fostering trust and acceptance of AI systems among users.

In summary, the factors influencing human-AI interaction quality are multifaceted and interdependent. A nuanced understanding of these factors is essential for designing AI systems that are not only technically advanced but also aligned with human needs and societal values. By considering these factors, developers and researchers can enhance the efficacy and ethicality of AI systems, thereby improving the overall quality of human-AI interactions in project management and beyond.

Table 9. Factors Influencing Human-AI Interaction Quality

Theme	Description
Project Context & Characteristics	Project size, industry, and maturity level can influence the suitability and effectiveness of AI integration.
Project Task & Process Complexity	The complexity of tasks and processes can influence the level of human oversight and interaction required with the AI.
Human & AI Agent Expectations & Preferences	Understanding expectations and preferences regarding communication styles, decision-making roles, and levels of autonomy is crucial for smooth interaction.
Ethical & Social Implications	Considerations around bias, transparency, and job displacement need to be addressed to ensure responsible AI implementation.

Source: Researcher's Computation (2024)

Recommendations for Improving Human-AI Interaction Quality

The section on recommendations for improvement, as outlined in Table 10, encapsulates a collection of insightful suggestions put forth by participants to elevate the quality of human-AI interactions within the sphere of project management. These recommendations are the culmination of practical experience and reflect a consensus on the need for advancements in AI systems to better serve their human counterparts. A key theme that emerged from the feedback is the call for AI systems that are both adaptive and personalized. Participants expressed a desire for AI tools that not only respond to changing project dynamics but also cater to individual user preferences and working styles. This level of customization would enable AI systems to more effectively complement human skills and preferences, leading to a more seamless integration into the project management process. Clear communication protocols were also highlighted as a vital area for improvement. Participants noted that establishing well-defined guidelines for interactions with AI systems can significantly reduce misunderstandings and streamline collaborative efforts. This includes setting expectations for response times, the format of AI-generated insights, and the channels through which AI systems provide feedback.

Enhanced transparency and explainability of AI decisions and processes were identified as crucial for building trust. There is a growing need for AI systems to not only make decisions but also to provide clear rationales for those decisions. This level of clarity allows human users to understand and trust the AI's contributions, leading to more informed decision-making and a stronger partnership. Lastly, fostering collaboration and trust between humans and AI agents was essential. Participants suggested that efforts should be made to create environments where AI is viewed as a reliable partner rather than replacing human expertise. This involves designing AI systems that are approachable, user-friendly, and capable of working alongside humans to achieve common goals. The recommendations provided by participants advocate for a human-centric approach to AI development in project management. By focusing on adaptability, clear communication, transparency, and collaboration, AI systems can be refined to not only perform tasks efficiently but also to enhance the overall project management experience for human users.

Table 10. Recommendations for Improving Human-AI Interaction Quality

Theme	Description
Adaptive and Personalized AI	AI systems that adapt to individual user preferences and project contexts can enhance interaction quality.
Clear & Consistent Communication Protocols	Establishing clear communication protocols for AI interaction ensures timely, relevant, and transparent information exchange.
Enhanced Transparency & Explainability	Improving the explainability of AI decisions fosters trust and allows human agents to understand the AI's rationale.
Collaboration & Trust Building	Promoting collaborative working relationships and trust between humans and AI agents is key to successful human-AI interaction.

Source: Researcher's Computation (2024)

Discussion of Results

The discussion unfolds across four key areas: comparison of findings, strengths and limitations, implications and contributions, and future directions. The first area, comparison of findings, meticulously compares the quantitative and qualitative results with the existing scholarly discourse. This comparison aims to identify both alignments and discrepancies with previous studies, highlighting areas of confirmation and novel insights. This research complements and expands upon the findings of Project Management Institute (2023) and Rodriguez and Vargas

(2023). The research by Rodriguez and Vargas (2023) highlights how AI is revolutionizing project management. This is supported by discovered findings, especially when it comes to integrating AI for real-time monitoring, prioritization, and project selection. The study's findings align with Project Management Institute (2023) emphasis on AI-driven project selection and prioritization. This study highlights the value of artificial intelligence (AI) systems for handling massive data sets, removing biases, and assisting in decision-making.

CONCLUSIONS

The above discussion has led to several important conclusions that underscore the significance of AI in the realm of project management. The study corroborates the expanding influence of AI, which aligns with the literature findings. It is evident that the quality of human-AI interaction is a decisive factor in achieving success in the rapidly evolving field of project management. Moreover, the research supports the notion that human-AI interaction is cyclical. This process is shaped by factors such as communication, trust, and performance, which are essential for a harmonious and productive collaboration between humans and AI. Additionally, the study offers a unique perspective on how various AI techniques can affect the quality of human-AI interactions, highlighting that the most effective approach is contingent upon the specific context and characteristics of the project. Project managers can realistically apply these insights to improve the interaction between humans and AI in their projects.

Recommendations

From these conclusions, the study derives several recommendations. One such recommendation is the implementation of AI systems that are tailored to the unique demands of each project. The effectiveness of AI is influenced by the context of the project, suggesting that future initiatives should concentrate on creating adaptable AI systems that can be customized to meet the specific needs of different projects. Another recommendation emphasizes the importance of establishing clear communication protocols and building trust between humans and AI agents. Successful human-AI collaboration will require future research and development to prioritize these aspects. The project team can foster a more effective and efficient partnership between humans and AI in project management by focusing on clear communication and trust-building.

LIMITATION & FURTHER RESEARCH

This study enhanced the understanding of how various AI techniques affect the quality of human-AI interaction in project management through a mixed-methods approach. Despite the insights gained, it is acknowledged that the study may not capture the complete picture. One significant limitation of this study is the potential for incomplete or biased responses during the semi-structured interviews. However, every effort was made to ensure participants felt comfortable and open in sharing their experiences. This limitation could affect the depth and accuracy of the qualitative data collected.

Additionally, the sample size of 45 respondents, while determined to be statistically sufficient, may still limit the generalizability of the findings to broader populations or different project management contexts. Another limitation is the rapid evolution of AI technologies. As AI techniques and their applications in project management continue to advance, the findings of this study may quickly become outdated. The study captures a snapshot in time, and future developments in AI could significantly alter the dynamics of human-AI interaction in ways not anticipated by this research. Moreover, the study focused on specific AI techniques currently in use, potentially overlooking emerging methods that could substantially impact project management practices.

Future research should address these limitations by expanding the sample size and diversity of participants to include a broader range of industries and project management contexts. Longitudinal studies would be beneficial to observe how the interaction quality evolves over time as AI technologies develop. Additionally, future studies should explore new and emerging AI techniques to understand their potential impact on human-AI interaction in project management. Incorporating perspectives from a more comprehensive array of stakeholders, including end-users and clients, could provide a more comprehensive understanding of the ethical implications and practical challenges of integrating AI into project management. By addressing these areas, future research can build on the foundation laid by this study and continue to advance the field of human-AI interaction in project management.

REFERENCES

Abioye, S. O., Oyedele, L. O., Akanbi, L., Ajayi, A., Delgado, J. M. D., Bilal, M., ... & Ahmed, A. (2021). Artificial intelligence in the construction industry: A review of present status, opportunities and future challenges. *Journal of Building Engineering*, *44*, 103299. https://doi.org/10.1016/j.jobe.2021.103299

Attar, S., & Zandieh, M. (2013). A new model for supplier selection using artificial intelligence techniques. *International Journal of Production Research*, 51(10), 2986-3000. https://doi.org/10.1080/00207543.2012.709314

Auth, G., Jöhnk, J., & Wiecha, D. A. (2021, September). A conceptual framework for applying artificial intelligence in project management. In *2021 IEEE 23rd Conference on Business Informatics (CBI)* (Vol. 1, pp. 161-170). IEEE. https://doi.org/10.1109/CBI52690.2021.00027

Bailey, J. E., & Pearson, S. W. (1983). Development of a tool for measuring and analyzing computer user satisfaction. *Management Science*, *29*(5), 530–545.

Barta, M., & Görcsi, M. (2021). AI in project risk management: A systematic review. *International Journal of Project Management*, 39(4), 357-373. https://doi.org/10.1016/j.ijproman.2021.02.002

Bento, P., & Sampaio, P. (2022). A systematic review of AI techniques in project management. *Project Management Journal*, 53(4), 345-358. https://doi.org/10.1177/87569728211019423

Borges, A. F. S., Laurindo, F. J. B., Spínola, M. M., Gonçalves, R. F., & Mattos, C. A. (2021). The strategic use of artificial intelligence in the digital era: Systematic literature review and future research directions. *International Journal of Information Management, 57*, 102225. https://doi.org/10.1016/j.ijinfomgt.2020.102225

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa.

Chaphalkar, A., & Shankar, R. (2015). Supplier selection using a hybrid model of fuzzy analytic hierarchy process and genetic algorithm. *International Journal of Production Research*, 53(19), 5753-5772. https://doi.org/10.1080/00207543.2014.959762

Chui, M., Yee, L., Hall, B., & Singla, A. (2023). *The state of AI in 2023: Generative AI's breakout year*. McKinsey & Company. https://www.mckinsey.com/capabilities/quantumblack/our-insights/ the-state-of-ai-in-2023-generative-ais-breakout-year.

Colomo-Palacios, R., & García-Crespo, A. (2014). Artificial intelligence techniques for knowledge management in software engineering: A systematic review. *Knowledge-Based Systems*, 56, 1-14. https://doi.org/10.1016/j.knosys.2013.11.010

Costantino, N., Di Gravio, G., & Nonino, F. (2015). Project selection in project portfolio management: A literature review. *International Journal of Project Management*, 33(5), 1135-1145. https://doi.org/10.1016/j.ijproman.2015.02.002

Creswell, J. W., & Clark, V. L. P. (2018). *Designing and conducting mixed methods research* (3rd ed.). SAGE Publications. https://toc.library.ethz.ch/objects/pdf/z01_978-1-4129-7517-9_01.pdf

Cuzzolin, F., Morelli, A., Cirstea, B., & Sahakian, B. J. (2020). Knowing me, knowing you: Theory of mind in AI. *Psychological Medicine, 50*(7), 1057–1061. https://doi.org/10.1017/S0033291720000835

Daugherty, P. R., & Wilson, H. J. (2018). *Human + machine: Reimagining work in the age of AI*. Harvard Business Press.

Dautenhahn, K. (2023). Human-AI interaction: Dimensions and issues. In M. G. Helander, T. K. Landauer, & P. V. Prabhu (Eds.), *Handbook of human-computer interaction* (3rd ed., pp. 49–72). Elsevier.

Davenport, T. H., & Ronanki, R. (2018). Artificial intelligence for the real world. *Harvard Business Review, 96*(1), 108–116. https://blockqai.com/wp-content/uploads/2021/01/analytics-hbr-ai-for-the-real-world.pdf.

Goodrich, M. A. & Boer, E. R. (2005). Designing human-centered automation: Trade-offs in collision avoidance system design. *IEEE Transactions on Intelligent Transportation Systems*, *1*(1), 40-54.

Greenstein, B., & Rao, A. (2022). *AI business survey*. https://www.pwc.com/us/en/tech-effect/ai-analytics/ai-business-survey.html

Hashfi, A., & Raharjo, H. (2023). AI-driven project management: A comprehensive literature review. *Journal of Business Research*, 143, 170-183. https://doi.org/10.1016/j.jbusres.2022.12.018

Hemachandran, K., Rodriguez, R. V., Subramaniam, U., & Balas, V. E. (2023). *Artificial intelligence and knowledge processing: Improved decision-making and prediction (1st ed.)*. CRC Press. https://doi.org/10.1201/9781003328414.

Holzmann, M., & Gerhard, L. (2022). Exploring project managers' expectations of AI's impact in the workplace. *International Journal of Project Management*, 40(7), 734-743. https://doi.org/10.1016/j.ijproman.2022.06.002

Horvitz, E. (2023). Human-AI interaction: A personal perspective. In M. G. Helander, T. K. Landauer, & P. V. Prabhu (Eds.), *Handbook of human-computer interaction* (3rd ed., pp. 23–48). Elsevier.

Iansiti, M., & Lakhani, K. R. (2020). *Competing in the age of AI: Strategy and leadership when algorithms and networks run the world*. Harvard Business Press.

Jin, R., & Zhang, Y. (2011). A framework for risk management in engineering projects based on intelligent agents. *Advanced Engineering Informatics*, 25(4), 581-590. https://doi.org/10.1016/j.aei.2011.07.002

Kaplan, A., & Haenlein, M. (2019). Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. *Business Horizons, 62*(1), 15–25. https://doi.org/10.1016/j.bushor.2018.08.004

Kog, Y. C., & Yaman, H. (2016). A decision support system for supplier selection using multi-criteria decision-making methods. *Journal of Supply Chain Management*, 52(3), 31-45. https://doi.org/10.1111/jscm.12116

Lee, J. D., & See, K. A. (2004). Trust in automation: Designing for appropriate reliance. *Human Factors*, *46*(1), 50–80.

Lewis, J. P., & Walker, R. (2011). Negotiation in project management: A strategic approach. *International Journal of Project Management*, 29(6), 733-740. https://doi.org/10.1016/j.ijproman.2010.10.001

Lin, C. P., & Chen, M. (2015). The impact of artificial intelligence on knowledge management in organizations. *Journal of Knowledge Management*, 19(2), 232-247.

https://doi.org/10.1108/JKM-01-2015-0047

Liu, Y., Wang, J., & Zhang, R. (2019). Research on intelligent project selection based on machine learning. *Journal of Intelligent & Fuzzy Systems*, 37(5), 6281-6290. https://doi.org/10.3233/JIFS-179566

Lohr, T., Brook, E., Chase, S., Krishna, S., Shank, M., Edin, P., McGowan, B., & Frolick, E. (2023). *Generative AI: From buzz to business value*. https://kpmg.com/kpmg-us/content/dam/kpmg/pdf/2023/generative-ai- survey.pdf.

Madakam, S., Uchiya, T., Mark, S., & Lurie, Y. (2022). Artificial intelligence, machine learning and deep learning (Literature: Review and Metrics). *Asia-Pacific Journal of Management Research and Innovation, 18*(1–2), 7–23. https://doi.org/10.1177/2319510X221136682

Maslej, N., Fattorini, L., Brynjolfsson, E., Etchemendy, J., Ligett, K., Lyons, T., Manyika, J., Ngo, H., Niebles, J. C., & Parli, V. (2023). *The AI index 2023 annual report. AI index steering committee*. Institute for Human-Centered AI, Stanford University.

Nemati, H. R., & Fard, A. M. (2002). Using artificial intelligence for quality management. *Total Quality Management*, 13(2), 203-217. https://doi.org/10.1080/09544120120125014

O'Brien, H. L., & Toms, E. G. (2008). What is user engagement? A conceptual framework for defining user engagement with technology. *Journal of the American Society for Information Science and Technology*, *59*(6), 938–955. https://doi.org/10.1002/asi.20801

Odejide, O. A., & Edunjobi, T. E. (2024). AI in project management: Exploring theoretical models for decision-making and risk management. *Engineering Science & Technology Journal*, *5*(3), 1072-1085. https://doi.org/10.51594/estj.v5i3.959

Parasuraman, R., Sheridan, T. B., & Wickens, C. D. (2000). A model for types and levels of human interaction with automation. *IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans*, *30*(3), 286–297. https://doi.org/10.1109/3468.844354

Parra, J., Rojas, J., & Mardones, R. (2015). Artificial intelligence in quality management: A systematic literature review. *Journal of Quality in Maintenance Engineering*, 21(2), 174-189. https://doi.org/10.1108/JQME-12-2013-0053

Păvăloaia, V. D., & Necula, S. C. (2023). Artificial intelligence as a disruptive technology—a systematic literature review. *Electronics*, *12*(5), 1102. https://doi.org/10.3390/electronics12051102

Poole, D., & Mackworth, A. (2017). *Artificial intelligence: Foundations of computational agents* (2nd ed.). Cambridge University Press.

Precedence Research. (2024, June). *AI in Project Management Market Size to Hit USD 12.75 Bn by 2033*. Www.precedenceresearch.com. https://www.precedenceresearch.com/ai-in-project-management-market

Project Management Institute. (2017). *A guide to the project management body of knowledge (PMBOK guide)* (6th ed.). Project Management Institute.

Project Management Institute. (2022, March 9). *AI Implications on Project Management and has the Pandemic sped up the adoption?* Pmi-Se.org. https://www.pmi-se.org/Kompetens-Projektledning/Artiklar/AI-Implications-on-Project-Management-and-has-the-Pandemic-sped-up-the-adoption_

Project Management Institute. (2023, October). *Shaping the future of project management with AI* Pmi-Se.org. https://www.pmi.org/learning/thought-leadership/ai-impact/shaping-the-future-of-project-management-with-ai

Rad, P. F., & Rowzan, M. (2018). A machine learning approach for project selection. *International Journal of Project Management*, 36(6), 844-853. https://doi.org/10.1016/j.ijproman.2018.03.002

Raisch, S., & Krakowski, S. (2020). Artificial intelligence and management: The automation-

augmentation paradox. *Academy of Management Review, 46*(1), 192–210. https://doi.org/10.5465/amr.2018.0072

Ransbotham, S., Kiron, D., Gerbert, P., & Reeves, M. (2017). Reshaping business with artificial intelligence: Closing the gap between ambition and action. *MIT Sloan Management Review, 59*(1), 1–17.

Regona, M., Yigitcanlar, T., Xia, B., & Li, R. Y. M. (2022). Opportunities and adoption challenges of AI in the construction industry: A PRISMA review. *Journal of Open Innovation: Technology, Market, and Complexity*, *8*(1), 45. https://doi.org/10.3390/joitmc8010045

Rodriguez, J., & Vargas, J. (2023). The influence of artificial intelligence on project management practices: A practitioner survey. *Journal of Project Management*, 31(1), 54-67. https://doi.org/10.1007/s41600-022-00091-y

Russell, S. J., & Norvig, P. (2016). *Artificial intelligence: A modern approach* (4th ed.). Pearson.

Sacks, R., & Goldin, G. (2020). Artificial intelligence in construction: Implications for project management. *Automation in Construction*, 113, 103109. https://doi.org/10.1016/j.autcon.2020.103109

Savio, R. D., & Ali, J. M. (2023). Artificial Intelligence in Project Management & Its Future. *Saudi Journal of Engineering and Technology*, *8*(10), 244-248. https://doi.org/10.36348/sjet.2023.v08i10.002

Shahriari. K. & Shahriari, M. (2019). Ethically aligned design: A vision for prioritizing human well-being with autonomous and intelligent systems. *2017 IEEE Canada International Humanitarian Technology Conference (IHTC).* https://doi.org/10.1109/IHTC.2017.8058187

Shneiderman, B. (2020). Bridging the gap between ethics and practice: guidelines for reliable, safe, and trustworthy human-centered AI systems. *ACM Transactions on Interactive Intelligent Systems (TiiS)*, *10*(4), 1-31. https://doi.org/10.1145/3419764

Thompson, S. K. (2012). *Sampling*. Wiley. https://doi.org/10.1002/9781118352568

Turing, A. M. (1950). Computing machinery and intelligence. *Mind, 59*(236), 433-460. https://doi.org/10.1093/mind/LIX.236.433

Vedamuthu, T. (2020). *Artificial intelligence and human collaboration in project decision-making* [Master's thesis, The College of St. Scholastica].

Williams, J., Fiore, S. M., & Jentsch, F. (2022). Supporting artificial social intelligence with theory of mind. *Frontiers in Artificial Intelligence, 5*, 750763. https://doi.org/10.3389/frai.2022.750763