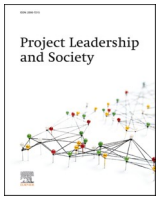
Project Leadership and Society 4 (2023) 100101

Contents lists available at ScienceDirect

Project Leadership and Society

journal homepage: www.sciencedirect.com/journal/project-leadership-and-society



Empirical Research Paper

Who is better in project planning?Generative artificial intelligence or project managers?☆

André Barcaui [a,*], André Monat [b]

[a] Universidade Federal do Rio de Janeiro (UFRJ), Pasteur Ave., 250, Urca, Rio de Janeiro, RJ, 21941-901, Brazil
[b] Universidade Estadual do Rio de Janeiro (UERJ), Passeio St., 80, Centro, Rio de Janeiro, RJ, 20031-040, Brazil

ARTICLE INFO

Keywords:
Generative
Artificial intelligence
Project management

ABSTRACT

This paper presents a comparative study of generative artificial intelligence (AI), specifically the GPT-4 model, and a human project manager in the context of a project plan development. The study's objective was to analyze the content and structure of a project plan prepared by this disruptive new technology and its human counterpart, focusing on the digital technology sector. Through a primarily qualitative methodology, the study scrutinizes critical aspects of each part of the project plan, including scope preparation, schedule development, cost estimation, resources evaluation, quality planning, stakeholder mapping, communication planning, and risk analysis. The results indicate unique strengths and weaknesses for both AI-generated and human-generated project plans, revealing them as complementary in the project planning process. It also emphasizes the continued importance of human expertise in refining AI outputs and harnessing the full potential of AI through the process known as prompt engineering. In conclusion, this study illustrates the potential synergy between human experience and AI in project planning, suggesting the careful integration of human and AI capabilities is key to developing robust and trustworthy project plans.

1. Introduction

Project management plays a crucial role in several domains, providing the structure and guidance necessary for successful outcomes. As technology continues to advance, there is a growing interest in leveraging generative artificial intelligence (AI) to enhance project management practices. Generative AI refers to a branch of AI that utilizes algorithms and machine learning techniques to generate new, creative solutions or optimize existing processes. The application of generative AI in project management holds the promise of automating repetitive tasks, optimizing resource allocation, and improving risk assessment, among other potential benefits (Taboada et al., 2023; Prifti, 2022; Auth & Wiecha, 2021; Kuster, 2021; Polonevych et al., 2020; Gil et al., 2020). However, although there are some studies comparing tasks performed by generative AI to the same tasks performed by humans (Haase& Hanel, 2023; Jakesch et al., 2022; Korteling et al., 2021), to the knowledge of the authors of this paper, there are no comparative studies of generative AI and human decision-making to understand the strengths and limitations of each approach related to project management.

Previous studies have highlighted the potential of AI to improve work performance, automate routine tasks, optimize resource allocation, and supplement decision-making processes (Salleh & Aziz, 2022; Davahli, 2020). For instance, data on the effects of AI on individuals and their jobs in the industrial and financial sectors of seven nations was gathered by the OECD in 2022. Although also bringing risks, the results demonstrate that using AI at work can benefit employees in terms of job satisfaction, health, and compensation (OECD, 2023).

But within the context of project management, a key aspect to explore is the content and structure of project plans. Project plans provide a blueprint for successful project execution, outlining deliverables, tasks, timelines, and resource allocation. This raises the question: how do project plans generated by AI compare to those created by a human project manager in terms of its content and structure? Through this comparative analysis, we aim to contribute to answering this question, shedding light on the benefits and limitations of each approach.

Therefore, by examining the anatomy of a specific project plan, we seek to understand the effectiveness of generative AI in project management, with the aim of contributing to the existing literature, by offering an in-depth exploration of the potentialities of its use in the macro

☆ This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
* Corresponding author.
E-mail addresses: barcaui@facc.ufrj.br (A. Barcaui), andresmonat@yahoo.com.br (A. Monat).

https://doi.org/10.1016/j.plas.2023.100101
Received 31 July 2023; Received in revised form 28 October 2023; Accepted 29 October 2023
Available online 4 November 2023

planning process of a project. Studies (Bang et al., 2022; Servranckx and Vanhoucke, 2021; Durmic, 2021) highlight the critical role of diligent planning in increasing the overall success of a project.

2. Literature review

Generative artificial intelligence (AI) has emerged as a powerful tool in several fields. Korzynski et al. (2023) suggest that some management theories and concepts need to be studied in the generative AI environment since it may influence managerial work at the strategic, functional, and administrative levels (Gyory et al., 2022). It would be naïve if not unrealistic to imagine that project management would not be affected as well. By harnessing algorithms and machine learning techniques, generative AI systems could generate novel ideas, optimize processes, and make data-driven decisions.

2.1. Advancements and applications of generative AI

One of the most prominent advancements within the domain of generative AI is the development of Large Language Models (LLMs). These models epitomize the ability of AI to understand, generate, and transform human language. Within the generative AI category, one that has gained considerable attention is the Generative Pre-trained Transformer (GPT), a language model developed by OpenAI (Radford et al., 2018). Rooted in the transformer architecture (Vaswani et al., 2017), the GPT series has exhibited a paradigm shift in natural language processing (NLP) capabilities, particularly in tasks such as text generation, translation, and question-answering.

LLMs, such as ChatGPT (versions GPT-3.5 and GPT-4), are trained on extensive text corpora and have showcased remarkable capabilities across numerous NLP tasks. Specifically, ChatGPT has proven its versatility in areas like education, healthcare, reasoning, text generation, human-computer interaction, and scientific inquiry.

More so, while the adaptation of large language models (LLM) to autonomous agents like Auto-GPT indicates their potential in achieving a degree of general intelligence, there are inherent challenges in directly utilizing LLMs in this capacity. The proposed agents operate through a sophisticated workflow, allowing the model to essentially communicate with itself without the need for human intervention (Yang et al., 2023).

Noy and Zhang (2023) demonstrate that the implementation of ChatGPT leads to significant improvements in productivity and output quality. The time taken for tasks decreases, and the quality of the produced work improves. Also, the use of ChatGPT reduces inequality among workers by benefiting those with lower abilities. Eloundou et al. (2023) corroborate these findings, when suggesting that with large language models (LLMs) like GPT, about 15% of all worker tasks could be completed significantly faster at the same level of quality. When incorporating software and tooling built on top of LLMs, this share could increase up to 56%.

2.2. Impacts on project management and human decision-making

In the realm of project management, generative AI can automate repetitive tasks, such as scheduling and resource allocation, freeing up human project managers to focus on higher-level strategic activities. Besides, generative AI can assist in risk assessment and mitigation by analyzing large datasets and identifying potential issues or bottlenecks. Polonevych et al. (2020) provide insights into the applications of artificial intelligence in project management, highlighting its potential to streamline processes and improve project outcomes.

While generative AI brings unique capabilities to project management, human decision-making remains integral to the success of projects. Human project managers possess a range of skills and qualities that are difficult to replicate with AI systems alone. Decision-making, problem-solving, creativity, and interpersonal skills are among the valuable attributes that human project managers bring to the table. These abilities are particularly crucial in complex and dynamic project environments where adaptability, intuition, and social intelligence play significant roles.

Choi et al. (2021) also emphasize the importance of human intelligence in sustainable management solutions for plant projects, highlighting how human project managers can navigate the complexities of project execution and foster effective collaboration among stakeholders. By understanding the contributions of human intelligence, we can gain a comprehensive perspective on the interplay between generative AI and human decision-making in project management.

Nieto-Rodriguez and Vargas (2023) reported that only 35% of projects today are completed successfully and one reason for this disappointing rate is the low level of maturity of technologies available for project management. The authors suggest that this is on the threshold of change as researchers, startups, and innovating organizations are beginning to apply AI, machine learning, and other advanced technologies to project management. The same idea is corroborated by Khatib and Falasi (2021) when affirming that AI applications enhance data quality and improve the speed and effectiveness of decision-making. Keeping those considerations into account, it would be natural to assume that the role of project managers is also about to change (Skinner, 2022).

2.3. Human-AI dynamics in project management

To gain a deeper understanding of the effectiveness of generative AI and human judgment in project management, comparative studies have been conducted. Gyory et al. (2021) presents a data-driven approach to real-time process management in complex engineering design, considering both AI and human involvement. Their study explores how generative AI systems can contribute to decision-making and process optimization in project management, while also acknowledging the unique strengths and insights brought by a human project manager.

Furthermore, Zurita et al. (2022) provide valuable data on an experiment that directly compares the performance of human and AI process managers. By examining the impact and effectiveness of both AI and human process managers, their findings elucidate the advantages and limitations of each approach. Through such comparative analyses, we can better understand the contexts in which generative AI or human expertise excels and identify potential synergies for effective project management practices.

Although some authors argue that AI cannot replace the human mind (Alshaikhi et al., 2021), trust and cooperation between AI systems and human project managers are critical for successful collaboration in project management. Zhang et al. (2022) investigate the effects of teammate identity and performance on trust and cooperation in Human-AI collaboration. Their study explored how the perception of AI as a teammate influences the willingness to cooperate and trust its decisions.

Despite the potential benefits of integrating AI into project management, challenges and obstacles remain (Gînguță et al., 2023; Regona et al., 2022). These include ethical and technical difficulties in implementing AI systems, lack of understanding and skills among project managers to effectively use AI, and resistance to change.

That's why understanding the dynamics of trust and cooperation between humans and AI in project management is essential for effective utilization of generative AI technologies. By examining the findings from this study, we can gain insights into how trust in AI systems can be fostered, and how the collaboration between humans and AI can be optimized to maximize project outcomes.

3. Methodology

3.1. Rationale

The objective of this study was to compare and evaluate the

effectiveness of a project plan prepared by a generative AI system like ChatGPT powered by its most capable model (GPT-4), with a project plan developed by a human project manager in terms of various project management parameters. We chose GPT-4 for this study due to its remarkable ability to generate coherent and contextually relevant text. With its large-scale language model trained on diverse internet text, it excels in delivering detailed and credible narratives, which aligns with our study's objective (OpenAI, 2023; Koubaa, 2023).

The evolution of the GPT models, from GPT-1 to GPT-4, has marked significant improvements in text generation capabilities, context understanding, and efficiency. While GPT-1 and GPT-2 already demonstrated powerful capabilities, GPT-3 made a giant leap in terms of producing human-like text that could potentially offer more nuanced and effective communication plans, better understanding of project requirements, and more accurate cost estimations. GPT-4, the model chosen for this study, builds upon the capabilities of GPT-3 but is even more robust and efficient, making it more equipped to handle complex project planning tasks (OpenAI, 2023).

3.2. Context

The proposal also aimed to align the practices proposed by the Project Management Institute (PMI). PMI's Project Management Body of Knowledge, also known as the PMBOK Guide (PMI, 2021) was utilized as it provides a framework for managing projects and is widely accepted in various industries globally (Amaro & Domingues, 2023; Takagi & Varajão, 2020). It contains rigorous and comprehensive standards for project management, making it an excellent point of comparison for our AI-based project management approach. Other researchers have already analyzed the potential of AI in project management knowledge areas (Fridgeirsson et al., 2021), but not necessarily through a comparative study between deliverables produced by generative AI and a human project manager.

Another critical component of this study's methodology was the selection of a suitable project type for comparison. The decision was to focus on a specific sector of growing relevance: the digital technology sector. More specifically, both the AI and the human project manager were given the task of planning an application development project.

This choice was motivated by several reasons. First, app development projects are commonplace in today's digital era, and their relevance extends across numerous industries, making our findings widely applicable. Second, app development is a complex process that encompasses a wide range of project management knowledge areas with a breadth that allows for a comprehensive evaluation of project planning.

3.3. Experiment set-up

In our study, we engaged both a human project manager and ChatGPT in planning the "Beauty Find App" project. The fundamental objective of this venture was to create an innovative mobile application that merges technology, security, and utility to provide users with a myriad of beauty and aesthetic services. This user-centric design was intended to facilitate quick, intuitive access to top-tier services offered by both businesses and independent contractors located in the user's vicinity.

The advanced features of the application encompass search, scheduling, communication, and rating for professionals and establishments in the beauty and aesthetic sectors. Such features would be invaluable to consumers who would primarily use the application for the convenience it offers, such as onsite attendance at their chosen location, time savings, detachment, privacy, 24-h scheduling, and the receipt of service confirmations via email, SMS, or WhatsApp. Moreover, it would allow customers to evaluate the services they've received, further enhancing the application's value proposition.

The "Beauty Find App" project was designed with a wide range of beauty services in mind, such as aesthetic procedures, a virtual beauty agenda, and recommendations on beauty and aesthetics. It is compatible with both iOS and Android platforms, making it a versatile tool for our comparative study. Professionals adhering to the application's guidelines would also reap benefits from the project. They would gain access to a clientele that values convenience and technology, receive fair commissions, and enjoy the flexibility to tailor their workdays to suit their preferences. Thus, the application promises to serve as a beneficial platform for both service providers and consumers.

It's relevant to clarify that when the plan was elaborated by the project manager, it was never meant for any kind of comparison, but for an actual business implementation. The plan was created and documented following the guidelines set out in PMI's planning artifacts (PMI, 2022) by a project manager with 10 years of experience in the field, independent consultant contracted for this project, who owns a Project Management Professional (PMP) certification by PMI. These authors provided the same project requirements and parameters as input to the GPT-4 model afterward.

For the purpose of a structured comparison, the project artifacts derived from both the AI-generated and human-generated plans were meticulously organized in accordance with the PMI Knowledge Management Areas. The analysis purposefully left out the project procurement part. This exclusion was motivated by the fact that project procurement involves critical decision-making processes such as make-or-buy decisions and supplier choices, which were beyond the scope of this particular study. One may argue that new technologies such as GPT agents and Auto-GPT could be used for procurement automation purposes. Nevertheless, although we acknowledge the potential of these recent technological advancements, it is crucial to recognize that these technologies are currently in the experimental open-source phase and have not yet been extensively validated for such ends.

A mind map (Fig. 1) is provided to visually illustrate each knowledge management area along with the corresponding research artifacts selected, serving to ensure a comprehensive understanding of the planning methodology deployed.

3.4. Data collection

This study employs a primarily qualitative methodology to analyze and compare the project plans developed by a generative AI model and a human project manager. The first phase involved the collection of project plans developed by the GPT-4 AI model and a human project manager. Both the AI model and the human project manager were provided with the same set of requirements and guidelines for structuring a project plan for mobile application development. The project manager built his plan first in approximately 3 weeks. The prompts for ChatGPT were later entered by these authors approximately 1 month after the human project plan was created but based on the same requirements as the project manager. For instance, the initial prompt for ChatGPT was:

> "Imagine that you are an experienced project manager with a PMP certification who is going to manage a team to develop an app called "Beauty Find". The app aims to offer its users beauty and aesthetic services aligning technology, safety, and convenience. In a short time, customers will be able to access a wide range of quality services, performed by the best freelance professionals and establishments in their location area. Could you prepare a detailed project plan with PMI standards for this project?"

From this prompt on, others had to be generated based on the answers presented by ChatGPT. Mainly by requesting more complete artifacts, such as resource plan, schedule, among others. The sequence of prompts/answers derived from this first prompt was approximately 15 rounds, among which, the one that most demanded clarification was the preparation of the schedule, since it was requested that it could be copied and pasted into MS-Project type software. Each round aimed to obtain answers as close as possible to the desired project management

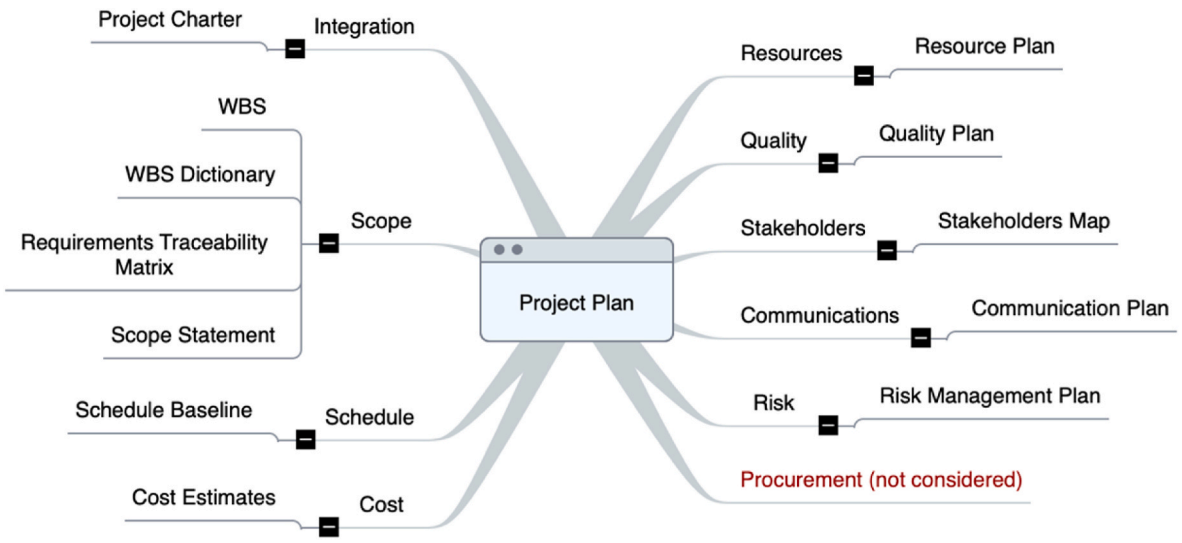


Fig. 1. Artifacts selected for this research considering each PM knowledge area, but procurement.

artifact standard, but always passing through the scrutiny of these authors. Regarding this analysis, it's relevant to mention that both have more than 15 years of experience in project management and a background in technology. One of them is a PMP-certified professional as well.

3.5. Data analysis

In a second moment, the content and structure of the AI-generated and human-generated project plans were compared in detail by the authors of this research, including an examination of scope preparation, schedule development, cost estimation, resources evaluation, quality planning, stakeholder mapping, communication planning, and risk analysis.

Then a detailed analysis of the strengths and weaknesses of the AI-generated and human-generated project plans was done by these authors. This incorporates a discussion of the areas in which the AI model excels, the areas in which the human project manager excels, and the potential synergies between the two approaches.

3.6. Data interpretation and ethical framework

In the concluding segment of this research, the authors discussed the implications of the findings for project management practices. This includes recommendations for how project managers can leverage the strengths of AI models like GPT-4 while compensating for their weaknesses with human expertise.

The results of the study were organized and presented in a comparative format, as outlined in the phases above. This structured approach allows for a direct comparison of the performance of the generative AI model and the human project manager in each area of project plan development. By analyzing and presenting results in this way, this study was able to better understand the contexts in which generative AI or human experience excel and identify potential synergies for effective project management practices. The qualitative examination favors the collection of rich and detailed data, in addition to enabling the revelation of important new insights, in an exploratory research such as the one that was carried out.

The study ensured the anonymity of sensitive data while still offering important insights into the effectiveness of GPT-4 generated project plans compared to those created by human project managers adhering to PMBOK Guide standards. This was accomplished through the preservation of project company details for ethical reasons, adherence to the guidelines provided in PMI's PMBOK Guide, and the appropriate selection of evaluation metrics. The chosen methodology allowed for an unbiased evaluation while respecting confidentiality, making it suitable for answering the research question and maintaining ethical standards.

4. Results

In this section, we carry out a side-by-side comparison of project artifacts generated by the AI and those produced by an experienced human project manager. Each artifact was critically evaluated to assess its alignment with best practices, its completeness, its clarity, and its overall utility in achieving project objectives. Each knowledge area provides a unique lens through which to evaluate the effectiveness and accuracy of the AI-generated project plans in comparison to their human-developed counterparts.

4.1. Project integration

Even though the PMBOK Guide (PMI, 2021) considers the project charter an artifact that should be produced during the initiation macro-process (not of planning), we also considered this artifact for the purpose of this research since it represents a pre-version of the project plan itself.

Having made that initial disclaimer, the comparison between the AI-generated project charter and the human-generated project charter in the project integration area revealed distinct characteristics as presented

Table 1
Project Charter Aspects Comparison: AI-Generated x Human Project Manager.

Project Charter Aspects	AI-Generated Version	Human-Generated Version
Overview	Concise and clear	Detailed and contextualized
Objectives	Broad and general	Specific and measurable
Market Landscape	Not considered	Addressed with relevant information
Scope	Outlines key tasks	Includes additional considerations and details
Deliverables	Brief mention	Clearly identified and described
Key Success Factors	Mentioned	Detailed and measurable
User Satisfaction	Included as a goal	Emphasized with a specific rating target
Market Adoption	Mentioned as a goal	Specific user adoption targets
Constraints and Dependencies	Not mentioned	Addressed with relevant information

on Table 1.

The AI-generated version presented a concise and clear overview of the mobile application project, outlining its objectives, scope, and key success factors. On the other hand, the human-generated version offered a more detailed and contextualized overview, incorporating market research data and justifying the project based on the demand for beauty services and the availability of skilled professionals.

Additionally, the human-generated version included more specific and measurable objectives, along with a comprehensive scope that encompassed further considerations and details. The deliverables, key success factors, user satisfaction, market adoption, and constraints and dependencies were also compared, highlighting the variations between the two versions.

4.2. Project scope

For the purposes of this research paper, we considered four main artifacts produced by the project scope management knowledge area: the scope statement, work breakdown structure, WBS dictionary, and requirements traceability matrix (RTM). A summary of the findings can be found in Table 2.

The AI-generated scope statement provided a detailed overview of the project's aim - to develop and launch an innovative mobile app connecting users to a range of beauty and aesthetic services. SMART (specific, measurable, achievable, relevant, with a time bound) objectives were explicitly stated, giving a solid direction for the project. The AI also identified and elaborated on assumptions, constraints, benefits, and exclusions. However, it did not explicitly state all project constraints and exclusions. Despite these omissions, the AI-generated scope statement was comprehensive, providing a broad view of expected deliverables and outcomes.

In contrast, the human-generated scope statement included extra elements such as project name, refined objectives, assumptions, constraints, benefits, exclusions, and project phases. These additions offered more specificity that could be useful for project execution and control. Both scope statements met the requirements for an exhaustive scope statement.

Table 2
Project Scope Aspects Comparison: AI-Generated x Human Project Manager.

Project Scope Aspects	AI-Generated	Human-Generated
Scope Statement		
Project Objectives	Explicitly stated	More elaborated
Assumptions and Constraints	Identified and elaborated	Detailed and exhaustive
Project Exclusions	Partially mentioned	Clearly stated
Project Phases	Not explicitly mentioned	Delineated into five stages
Technological and Resource Limitations	Not explicitly stated	Included
Work Breakdown Structure (WBS)		
Number of Main Deliverable	13	6
Number of Sub-Deliverables (on average)	2.8	3.7
Coverage of Marketing and Publicity	Not explicit	Explicit
Emphasis on Project Management	Not explicit	Explicit
WBS Dictionary		
Number of Deliverables	More extensive	Slightly fewer
Coverage of Project Areas	Comprehensive	Comprehensive
Inclusion of Marketing Deliverables	Not explicit	Explicit
Level of Detail	More detailed	Detailed
Requirements Traceability Matrix		
Coverage of Functional and Non-Functional Requirements	Comprehensive	Balanced
Inclusion of Requirement Priorities	Not included	Included
Association with WBS IDs	Not included	Included
Categorization of Requirements	Not explicitly mentioned	Not explicitly differentiated

The AI-generated WBS featured a more extensive coverage of project deliverables, incorporating 13 main deliverables with 37 sub-deliverables. The tasks covered a range from project initiation to closure, addressing critical facets such as requirements analysis, design and development, database and infrastructure, implementation of various features, testing and quality assurance, deployment and launch, training and documentation. The human-generated WBS encompassed six main deliverables and 22 sub-deliverables. This WBS showed a greater emphasis on project management, monitoring, and control, with explicit mention of marketing and publicity.

The AI-generated WBS dictionary provided a detailed breakdown of project deliverables using a hierarchical structure. Each deliverable had a unique ID, description, and acceptance criteria. It demonstrated a comprehensive understanding of project deliverables and considerations, encompassing various project areas. The human-generated WBS dictionary followed a similar structure, providing a breakdown of project deliverables with unique IDs, names, descriptions, and acceptance criteria. It also reflected a comprehensive approach to project management, addressing various critical aspects of the project.

The AI-generated RTM provided a comprehensive breakdown of both functional and non-functional requirements for the project. The functional requirements encompassed user registration, service search and visualization, user-provider communication, payment processing, and more. The non-functional requirements focused on usability and security aspects. The matrix demonstrated a meticulous approach to requirement identification and description, ensuring clarity and comprehensiveness.

The human-generated RTM presented a structured and comprehensive overview of project requirements. It included requirement IDs, descriptions, priorities, related IDs, and WBS IDs associated with each requirement. The matrix captured a total of 10 requirements without explicitly differentiating between functional and non-functional aspects. While a "comprehensive" RTM ensures that every requirement is covered, a "balanced" RTM ensures that one type of requirement is not overemphasized at the expense of another. Both are critical, and the project manager's attention should be focused on both considerations.

4.3. Project schedule

The AI-generated schedule and the human-generated schedule exhibited significant disparities in terms of complexity and level of detail. While the AI-generated schedule proposed a total of 25 activities, the human-generated schedule consisted of a more intricate structure, comprising 175 activities. This stark contrast indicates that the human-generated schedule encompassed a more comprehensive breakdown of tasks and subtasks, resulting in a higher level of granularity.

Besides the differences in the number of activities, the two schedules displayed variations in terms of predecessors, dependencies, and project duration. The AI-generated schedule provided a limited number of explicit predecessors, primarily focusing on the immediate sequential relationships between activities. On the other hand, the human-generated schedule incorporated a more intricate web of dependencies, considering both immediate and indirect relationships between activities. This comprehensive approach in the human-generated schedule allowed for a more detailed understanding of the project's flow and interdependencies. Also, the total project duration showed a slight 3-month forecast variance between the AI-generated version (12 months) and the human project manager version (15 months).

The sequencing and order of activities differed between the two schedules. The AI-generated schedule often suggested parallel execution of certain tasks, assuming that they could be performed simultaneously without dependencies or conflicts. In contrast, the human-generated schedule demonstrated a more sequential and phased approach, reflecting a deeper understanding of the project's requirements and interdependencies.

The human-generated schedule also provided further details and

considerations that were not present in the AI-generated schedule. For instance, it included specific milestones, deliverables, and quality control checkpoints, ensuring that the project progressed according to predefined criteria. These additional elements in the human-generated schedule contributed to a more comprehensive and structured project plan. Also, it incorporated a more comprehensive resource allocation plan, considering factors such as personnel, equipment, and budgetary constraints. It accounted for specific resource requirements and availability, enabling a more realistic assessment of project timelines and potential bottlenecks. In contrast, the AI-generated schedule lacked detailed resource allocation considerations, potentially overlooking critical constraints and feasibility issues.

The AI-generated schedule's simplicity and limited number of activities may offer advantages in terms of ease of understanding and quick initial planning. However, the human-generated schedule's complexity and attention to detail provide a more robust foundation for project execution, enabling comprehensive monitoring, control, and risk management throughout the project lifecycle. Table 3 summarizes the comparison between the two approaches.

4.4. Project costs

The AI-generated cost estimates for the project provided a monthly breakdown of planned costs and resources based on the initial plans. The estimates ranged from $20,000 in the first month to $14,000 in the twelfth month, covering various development, testing, and implementation activities. The AI emphasized the importance of regular monitoring and adjustments to ensure alignment with actual expenditures, recognizing the dynamic nature of project costs. The total estimated cost for the project amounted to $105,000 over the twelve-month duration. These comprehensive estimates serve as a valuable tool for financial planning, resource allocation, and cost control throughout the project lifecycle.

In contrast, the human-generated cost estimates took a meticulous approach, considering direct, indirect, fixed, and variable costs for each resource involved in the project. The detailed breakdown allowed for precise financial planning and control. The human-generated estimates totaled $258,606, providing stakeholders with a complete understanding of the project's financial scope and impact. This total served as a benchmark for budget allocation, decision-making, and ongoing cost monitoring. Table 4 offers an overview of the two approaches main aspects.

4.5. Project resources

The AI-generated resource plan for the project encompassed various roles, material resources, and other related expenses. The plan provided a breakdown of the hourly rates and market costs for each resource, as well as average monthly costs. It included key project management personnel, such as the Project Manager, Backend Developers, Frontend Developers, and Interface Designers were also accounted for, each with their respective hourly rates and monthly costs. The plan recognized the importance of specialized roles, including a Database Specialist, Testers, and a Data Security Specialist, each with their own hourly rates and monthly costs.

Apart from human resources, the AI-generated plan considered material resources required for the project. This included Servers and Infrastructure, Software Licenses, Equipment and Mobile Devices. The estimated costs for these resources were based on market averages. The plan also acknowledged the need for external services, such as Data Security Consultancy, and allocated a budget for such services. Besides, training and capacity-building were recognized as important elements of resource planning, with a designated budget to cover associated costs.

On the other hand, the human-generated resource plan involved a more specific allocation of roles and responsibilities compared to the AI-generated plan. The plan identified key resources essential for project success, including a Project Manager, a Requirements Analyst, Android Developers, iOS Developers, a Test Analyst, and a Web Designer specializing in User Experience (UX). Each resource played a distinct role in the project, contributing their expertise to different aspects of development, testing, and design. Table 5 shows the main differences between both approaches.

In addition to outlining the roles, the human-generated plan included a RACI Matrix to clarify the responsibilities and involvement of each resource. The matrix identified who should be Responsible, Accountable, Consulted, and Informed for each project task or deliverable. This level of detail enhanced communication, accountability, and coordination among team members, ensuring that everyone understood their roles and responsibilities within the project. The plan also emphasized the importance of considering the desirable profile for each resource. By specifying the desired characteristics, skills, and qualifications for each role, the plan aimed to ensure the selection of the most suitable individuals to fulfill the project's requirements. This consideration of resource profiles can contribute to the effectiveness and

Table 3
Project Schedule Aspects Comparison: AI-Generated x Human Project Manager.

Project Schedule Aspects	AI-Generated Schedule	Human-Generated Schedule
Project Duration	12 months	15 months
Number of Activities	25	175
Predecessors and Dependencies	Limited and immediate	Comprehensive and varied
Breakdown of Activities	Less detailed	More granular
Sequencing of Activities	Parallel execution	Sequential and phased
Specific Milestones and Deliverables	Absent	Included
Resource Allocation	Limited considerations	Detailed and realistic
Complexity and Level of Detail	Lower	Higher
Project Control and Risk Management	Limited monitoring	Comprehensive oversight

Table 4
Project Cost Aspects Comparison: AI-Generated x Human Project Manager.

Project Cost Aspects	AI-Generated Estimates	Human-Generated Estimates
Level of Detail	Monthly breakdown of costs and resources utilized	Comprehensive breakdown of costs by resource
Total Amount	$105,000	$258,606
Cost Components	Not specified	Direct, indirect, fixed, and variable costs considered
Resource Considerations	Resources involved and rationale for cost estimation	Detailed analysis of each resource's costs
Financial Planning	Acknowledged the need for regular monitoring and adjustments	Meticulous approach allowing precise financial planning
Transparency and Accountability	Lack of explicit total amount	Specific total amount for financial evaluation

Table 5
Project Resources Aspects Comparison: AI-Generated x Human Project Manager.

Resources Aspect	AI-Generated Resource Plan	Human-Generated Resource Plan
Resource Types	Listed resource types with hourly rates and monthly costs	Well-defined team structure with specific roles
Roles and Responsibilities	Roles defined, but not responsibilities (RACI)	Defined roles and responsibilities in a RACI matrix
Qualifications and Profiles	Not specified	Desirable profiles and qualifications for each resource
Equipment Considerations	Included equipment considerations	No equipment considerations mentioned

efficiency of the project team, as it helps to align the skill sets of the resources with the specific demands of the project.

4.6. Project quality

The AI-generated quality plan aims to ensure the delivery of a functional, high-quality, and error-free application by emphasizing user expectations in terms of usability, performance, and security. The strategy outlined in the plan includes comprehensive testing approaches, agile development practices, code reviews, quality metrics, and clear acceptance criteria. Specific quality activities such as unit testing, integration testing, system testing, user acceptance testing, performance testing, security testing, and code reviews are described. The plan assigns responsibilities to project stakeholders, highlights the need for appropriate tools and resources, and emphasizes the integration of quality activities into the project schedule. While the AI-generated plan provides valuable insights into quality management, it lacks certain elements such as auditing, nonconformity treatment, and comprehensive performance monitoring.

In contrast, the human-generated quality plan takes a more all-encompassing approach by incorporating not only testing activities but also auditing, nonconformity treatment, performance monitoring, and a comprehensive tests plan. It provides a detailed breakdown of activities necessary to achieve quality requirements, along with responsible individuals and their frequency. The plan also incorporates various control tools such as cause-and-effect diagrams and histograms. It places a strong focus on compliance, continuous improvement, and effective monitoring of project performance. Table 6 below reflects both approaches (see Table 7).

4.7. Project stakeholders

The comparison between the AI-generated and human-generated stakeholder plans reveals the importance of identifying and involving diverse stakeholders in project management. The AI-generated plan successfully identified and categorized various stakeholders for the application project, including end-users, development and testing teams, company managers and directors, investors and shareholders, beauty service providers, regulatory and governmental bodies, market competitors, strategic partners, and collaborators. The plan aimed to establish effective communication and engagement strategies tailored to each stakeholder group, taking into consideration their power and interest in the project.

Table 6
Project Quality Aspects Comparison: AI-Generated x Human Project Manager.

Quality Aspects	AI-Generated Quality Plan	Human-Generated Quality Plan
Focus	Functional, high-quality, and error-free application	Compliance, continuous improvement, and performance monitoring
Strategy	Testing, agile development, code reviews, quality metrics	Testing, auditing, nonconformity treatment, performance monitoring
Activities	Unit testing, integration testing, system testing, user acceptance testing, performance testing, security testing, code reviews	Testing activities, auditing activities, nonconformity treatment, performance monitoring
Responsibilities	Project manager, development team, end users	Responsible individuals for each activity
Acceptance Criteria	Suggestions based on its understanding of the project scope	Clear acceptance criteria
Tools and Resources	Testing and defect tracking tools	Control tools (cause-and-effect diagrams, histograms, etc.)
Integration with Project Schedule	Integration into project schedule mentioned	Integration with project schedule could be clearer
Quality Metrics and Benchmarks	Mentioned need for quality metrics, but not specified	Not specified
Additional Elements	Not mentioned	Auditing plan, nonconformity treatment, performance monitoring

Table 7
Project Stakeholders Aspects Comparison: AI-Generated x Human Project Manager.

Stakeholders Aspects	AI-Generated Plan	Human-Generated Plan
Stakeholder Identification	Users, development team, managers, investors, beauty service providers, regulatory bodies, competitors, strategic partners, collaborators	Clients, sponsors, project team, service providers, beauty salons, pharmaceutical companies, families of project team members, communities, development and maintenance team, marketing company, NGOs, regulatory bodies, press, providers of digital media channels, opinion leaders, unions
Stakeholder Categorization	High Power and High Interest: Users, managers, investors High Power and Low Interest: Regulatory bodies, competitors Low Power and High Interest: Beauty service providers, strategic partners, collaborators Low Power and Low Interest: Some internal stakeholders and less impacted public	Not specified, but includes a wide range of stakeholders beyond the project scope
Stakeholder Engagement Approach	Provide information, seek participation, monitor for potential impacts	Maintain communication, meet needs, seek involvement and feedback

Similarly, the human-generated stakeholder plan provided a comprehensive list of stakeholders to consider for the project. The stakeholders encompassed clients or users of the application, sponsors and investors, the project team, independent service providers, beauty salons, pharmaceutical companies, employees' family members, communities, development and maintenance team, marketing campaign company, non-governmental organizations (NGOs), regulatory bodies, competitors, press, digital media channels, opinion leaders, and unions. By including stakeholders from various domains, the plan recognized the broader impact and interconnections between the project and its stakeholders, emphasizing the importance of effective engagement and communication with each group.

Both the AI-generated and human-generated stakeholder plans recognized the importance of identifying and involving diverse stakeholders in project management. The AI-generated plan demonstrated a structured method for stakeholder identification and involvement, utilizing a power-interest matrix to classify stakeholders based on their influence and interest in the project. This approach provided valuable insights into the appropriate level of participation for each stakeholder group. Conversely, the human-generated plan exhibited a comprehensive list of stakeholders that extended beyond the immediate project scope, acknowledging the potential impacts and interconnections between the project and various organizations. Table 7 highlights elements from both approaches.

4.8. Project communications

The AI-generated communications plan prioritized clear and consistent communication throughout the project lifecycle. It aimed to keep stakeholders well-informed about project progress, milestones, and

updates while addressing their concerns promptly. The plan utilized various communication channels, including team meetings, email updates, in-app notifications, stakeholder workshops, and community engagement events. Key messages focused on project updates, the benefits of the application, and guidelines for freelance professionals and establishments. The plan also established a communication schedule, specifying the timing of different communication activities. Responsibilities for communication were assigned to specific roles, such as the project sponsor, project manager, project team members, and marketing and communications team.

The human-generated communications plan encompassed a range of communication methods, including a monitoring newsletter, website, correspondence, company presentations, quality reports, and institutional videos. Its objectives were to provide general information about the company, promote the brand, and update stakeholders on service quality. The newsletter served as a comprehensive source of information regarding the quantity of services provided and registered service providers. The website aimed to promote the brand and inform interested individuals about the services offered. Correspondence was structured to address specific topics with clear indexing. Company presentations showcased the overall situation of the organization, while quality reports updated stakeholders on the quality of services. Institutional videos were developed to enhance brand visibility and highlight the services offered. Table 8 below emphasizes aspects of both approaches (see Table 9).

4.9. Project risks

The AI-generated risk plan demonstrated a comprehensive approach to risk management, encompassing all stages from identification to response planning. Risk identification was thorough, covering a range of potential threats and opportunities. Risks were further qualified by categorizing them into specific domains such as legal/regulatory, technology, market/users, and finance. This allowed for a more focused understanding of the areas that posed the greatest risks. Furthermore, the AI-generated plan went beyond mere identification by qualitatively and quantitatively assessing risks. Probability and impact were evaluated, providing a more objective basis for risk prioritization. The inclusion of both threats and opportunities highlighted the plan's holistic approach to risk management.

In terms of response planning, the AI-generated plan provided specific strategies tailored to each identified risk. Response actions were defined, emphasizing proactive measures to mitigate potential negative impacts and capitalize on opportunities. Also, contingencies were planned, as part of the risk response plan, but no management reserves were considered. Some mitigation actions as well as contingency values were not updated on the costs plan.

Table 8
Project Communications Aspects Comparison: AI-Generated x Human Project Manager.

Communications Aspects	AI-Generated Communications Plan	Human-Generated Communications Plan
Objectives	Ensured clear and consistent communication	Promoted general information and brand visibility
Channels	Team meetings, email updates, in-app notifications	Newsletter, website, correspondence, presentations, videos
Key Messages	Project updates, application benefits, guidelines	Company information, service quality updates
Schedule	Weekly team meetings, monthly email updates	No specific schedule
Responsibilities	Defined roles for project sponsor, manager, team, and marketing	No specific role assignments
Stakeholder Engagement	Emphasized collaboration and engagement	Focused on providing information

Table 9
Project Risks Aspects Comparison: AI-Generated x Human Project Manager.

Risk Aspects	AI-Generated Risk Plan	Human-Generated Risk Plan
Risk Identification	Comprehensive identification of both threats and opportunities	Partial identification of risks
Risk Qualification	Categorization into specific domains	No categorization
Risk Quantification	Quantitative assessment of probability and impact	No quantitative assessment
Risk Response Planning	Specific response strategies tailored to each risk	No specific response strategies
Coverage	Encompassed a wide range of risks and opportunities	Focused on threats without considering opportunities

This comprehensive risk response planning ensured that the project team was well-prepared to address challenges as they arose. The plan's consideration of risk quantification facilitated resource allocation and decision-making, enabling the team to prioritize their efforts effectively. In general, the AI-generated risk plan demonstrated a rigorous and structured approach to risk management, enhancing the project's chances of success.

On the other hand, the human-generated risk plan focused primarily on risk identification without a comprehensive approach to risk management. Risks were listed without clear categorization or qualitative and quantitative assessment. This limited the plan's ability to prioritize risks and allocate appropriate resources. On top of that, the absence of risk response strategies hindered the project team's preparedness to address potential challenges. The human-generated plan also neglected to consider potential opportunities that could arise during the project, failing to capture the full spectrum of risks and rewards. Table 9, underscores features of each approach.

5. Discussion

The analysis sought to explore the strengths and limitations of both approaches, highlighting the potential synergies and trade-offs that emerge when combining artificial intelligence with human expertise in project management. By examining each knowledge area in detail valuable insights were gained into the contrasting characteristics and performance of the AI-generated and human-generated plans. The investigation also shed light on the critical role of human insights in interpreting and refining AI-generated outputs, refining prompt engineering, and leveraging domain knowledge to optimize project outcomes.

5.1. Knowledge contribution

Beginning with the project charter, the comparison between the AI-generated and human-generated project charters revealed important distinctions, raising several points for consideration. It became apparent that the level of information and contextual awareness differed significantly between the AI-generated and human-generated versions. While the AI-generated version provided a clear and concise outline of the project, it lacked the depth and uniqueness found in the human-generated version. The incorporation of market research data, such as the demand for beauty services and the potential pool of freelancing workers, strengthened the project's justification in the human-generated charter.

In terms of objectives, both versions shared the common goal of developing and launching the application within a specified timeframe while ensuring a user-friendly interface, database, and security. However, the human-generated version presented more precise and measurable targets, enabling easier project tracking and evaluation. Moreover, the human-generated version recognized the significance of

user adoption and customer satisfaction, emphasizing the importance of meeting user expectations and achieving success in the market.

The scope of the project showcased notable differences between the two versions. The AI-generated version provided a comprehensive understanding of the tasks involved in creating the application, implementing features, and launching a marketing campaign. In contrast, the human-generated version included crucial points such as prohibiting physical alterations to locations and mandating professional background checks. By addressing legal and practical considerations, these extra features ensured a more realistic scope.

The human-generated project scope version offered a more in-depth and contextualized understanding of the project compared to the AI-generated version, which primarily provided just a summary. The inclusion of market research, precise targets, and scope considerations in the human-generated charter enhanced the project's justification, clarity, and alignment with market needs. Consequently, the human-generated version provides a stronger foundation for successful project planning and execution, as it demonstrates a deeper awareness of the context and objectives.

In the scope part of the plan, both the human project manager and the AI made use (and sometimes a mix) of work packages representing deliverables with others representing activities, even though the PMI recommendation (PMI, 2022) is to work with products at the WBS level. The inclusion of project stages in the document created by the human project manager added more specificity that might be useful for project execution and control, even though both scope statements met the requirements for an exhaustive scope statement.

Average sub-deliverables per main deliverable were higher for the human project manager's WBS (3.7) than for the AI's WBS (2.8). This shows that, despite the AI's wider scope, the human project manager went a little bit deeper into each significant project phase. Neither approach is inherently superior. The effectiveness of a WBS depends on how well it fits the project's context and the team's working style. A more detailed WBS might be suitable for complex projects where precision is crucial. A broader WBS might be better for projects that require flexibility and team autonomy. In the case of this specific project, both WBS structures seemed comprehensive in covering the scope, considering the initial planned features.

The fundamental goal of both WBSs was to divide the project into distinct jobs. The human project manager's WBS displayed a stronger concentration within each main deliverable and highlighted the importance of project management, marketing, and publicity deliverables, whereas the AI-generated WBS presented a broader view with more work packages. Depending on the requirements and settings of a given project, any approach's effectiveness may change.

The project was successfully divided into manageable deliverables using both the AI-generated and human-generated WBS dictionaries. The WBS lexicon created by AI offered a more thorough breakdown, covering a wider range of project categories and deliverables. It showed a deeper comprehension of the goals and constraints of the project, but the definition of each deliverable's acceptance criteria was just an AI suggestion based on its understanding of the project scope.

The human-generated WBS lexicon, on the other hand, displayed a slightly narrower focus, highlighting the project scope (rather than just the product scope) and important project management elements including scope declaration, budget, schedule, and marketing. It also includes precise deliverables for the validation of prototypes, a description of the architecture, and lessons learned. The specific definition of each deliverable's acceptance criteria provided clear rules for assessing the accomplishment and success of the deliverables.

In respect to the RTM, the AI version made evident how requirements relate to certain WBS IDs, allowing for efficient project planning and control. The human-generated matrix did not explicitly divide the requirements into functional and non-functional components, in contrast to the AI-generated matrix, which would have made it easier to distinguish between various project demands.

Overall, each strategy has advantages and disadvantages. The human-generated matrix offered a structured and quantitative foundation, whereas the AI-generated matrix showed the possibility for creating comprehensive requirements. The project's traceability and requirement management might be improved by combining the advantages of the two methodologies, resulting in a thorough understanding of the project's requirements and effective prioritization.

The differences observed between the AI-generated and human-generated schedules can be attributed to the different strengths and weaknesses inherent in the two methods. The AI-generated schedule leverages machine learning and algorithmic techniques to create a basic timeline based on the given input. While this approach offers simplicity and quick initial planning, it may lack the necessary level of specificity and project context that could be further developed through more refined prompts or inputs. On the other hand, the human-generated schedule benefits from the project manager's experience and domain knowledge, allowing for a more thorough and customized approach. Although both displayed each activity with its respective duration, resources, and costs on a MS-Project format (as demanded on the ChatGPT prompt), the human-generated schedule provided a more accurate and realistic depiction of the project's complexities by considering its unique requirements, resource limitations, and interdependencies.

In addition, the human-generated schedule demonstrated more in-depth project control and risk management considerations. By incorporating specific milestones, deliverables, and quality control checkpoints, it established clear points of evaluation and ensured adherence to predetermined criteria. This comprehensive oversight facilitates efficient project management, enabling the identification and mitigation of risks. In contrast, the AI-generated schedule lacked such thorough monitoring systems, which can lead to increased uncertainty and limitations in control.

While the AI-generated schedule can serve as a useful starting point for initial planning, it is crucial to recognize its limitations and the need for human participation and refinement. With its greater complexity and attention to detail, the human-generated schedule provides a more solid foundation for project execution, enabling thorough monitoring, control, and risk management throughout the project lifecycle. The choice between the two schedules should be based on the specific needs of the project, available resources, and the desired level of granularity. Careful consideration of the trade-offs between simplicity and complexity is necessary to ensure the suitability of the chosen schedule for the project at hand.

The disparity between the AI-generated and human-generated cost estimates is notable in terms of the level of detail and accuracy. The AI-generated estimates offered insights into monthly cost projections and resource utilization, which can be useful for initial planning and high-level cost monitoring. However, it lacked a specific total amount for the overall project, limiting its effectiveness in comprehensive financial planning and evaluation.

In contrast, the human-generated cost estimates excelled in providing a comprehensive breakdown and considering various cost elements. The inclusion of specific cost components, such as direct, indirect, fixed, and variable costs, improve financial transparency and accountability. This level of detail enabled accurate budgeting, resource allocation, and cost control throughout the project lifecycle. The human-generated estimates provided stakeholders with a clear understanding of the project's financial scope and impact. This specific total amount serves as a valuable reference for financial evaluation and decision-making.

It is also important to link the project cost estimates with the earlier findings in the scope and schedule areas. The comprehensive breakdown of costs by resource in the human-generated estimates aligns with the detailed breakdown of activities and dependencies in the human-generated schedule. The meticulous consideration of direct, indirect, fixed, and variable costs demonstrates a holistic approach to project planning, ensuring that all cost elements are accounted for. This linkage

boosts the reliability and accuracy of the project plan, facilitating informed decision-making and effective cost management.

The human-generated cost estimates also contribute to the financial planning and control aspects discussed in the scope and schedule sections. By providing stakeholders with a complete understanding of the project's financial implications, the human-generated estimates enable more informed budget allocation and resource management. The specific total amount of $258,606 serves as a benchmark for financial evaluation and ongoing cost monitoring, ensuring that the project remains within budgetary constraints.

Nevertheless, given the sensitivity of the cost variable in the context of project management, it would have been interesting, in addition to being a good practice, to prepare a cost baseline, to follow the project budget. Furthermore, both the artificial intelligence (AI)-generated, and human-generated versions of the project plan failed to integrate the contingency and mitigation values derived from the risk plan into the overall project cost plan.

Regarding the resource plan, it is important to note that the human-generated version did not specifically take equipment requirements into account. Even considering that the project was about the development of an application and that computing resources can be part of the procurement process (if the option is to outsource the services), considering only the human resources of the project can be a disadvantage. This was the typical case where we understood that further refinement of the generative AI prompt could make all the difference. One may or may not assume that the organization will supply or have access to the essential equipment. In any case, for the purpose of correctly allocating costs and carrying out project activities effectively, it would be important to consider the adequacy and availability of equipment.

The resource plan generated by the project manager displayed a higher level of precision and consideration of individual roles and responsibilities in comparison to the AI-generated plan. The project team's accountability and clarity were improved with the addition of the RACI Matrix but to ensure smooth work execution, supplemental equipment considerations could be incorporated into the human-generated plan.

The AI-generated version of the quality plan placed a strong emphasis on thorough testing strategies, agile development techniques, and the creation of quality measures to deliver a functional and high-quality application. While early defect identification and automation expedite the quality assurance process, the plan lacks certain components such as auditing, nonconformity handling, and thorough performance monitoring. In contrast, the human-generated quality plan utilized a more comprehensive strategy that considered performance monitoring, nonconformity handling, and auditing, besides testing operations. It recognized the value of compliance, ongoing development, and the application of control measures, resulting in a solid quality management structure that ensured standard compliance and promotes continual improvement. Neither party considered the inclusion of good-known quality assurance practices such as retrospectives or lessons learned.

Selecting between the two quality plans requires consideration of the individual requirements and circumstances of the project. While the human-generated plan offers a wider variety of quality control elements, the AI-generated plan provides advantages in terms of efficiency and automation. Combining the strengths of both approaches can lead to an improved quality management strategy that effectively utilizes AI for testing and automation, while incorporating components from the human-generated plan to ensure compliance and promote continual improvement.

While the AI-generated plan offered a systematic approach to stakeholder identification and engagement, it may have lacked the depth and detail present in the human-generated plan. The human-generated plan demonstrated a clear concern on the part of the project manager for meeting the expectations of various stakeholders, likely drawing from past project experiences. It encompassed specific stakeholders such as employees' families, NGOs, unions, and opinion leaders, recognizing their potential influence on the project. Additionally, the human-generated plan acknowledged stakeholders outside the immediate project scope, emphasizing the broader social and environmental repercussions of the project. Both plans did not consider the costs and resource impacts of stakeholder engagement in integrating the project plan.

Effective communication in project management was recognized as essential in both the AI-generated and human-generated communications plans. The AI-generated plan demonstrated a more concrete and organized approach, with well-defined objectives, channels, messages, schedules, and roles. It utilized contemporary communication methods, such as in-app notifications and community engagement events, to encourage stakeholder interaction and collaboration. In contrast, the human-generated plan employed more traditional strategies, relying on techniques like newsletters, websites, correspondence, presentations, and videos. While these strategies have their merits, they may not fully leverage the capabilities of digital communication platforms and emerging technologies.

The AI-generated plan excelled in its comprehensive and systematic approach to stakeholder engagement. It ensured accountability and coordination by clearly defining roles and responsibilities. Regular team meetings and stakeholder workshops provided forums for open discussions and feedback. Although less specific in terms of roles and coordination, the human-generated plan acknowledged the value of diverse communication channels for disseminating information and engaging stakeholders. It placed a particular focus on communication through newsletters, website updates, letters, and presentations, aiming to inform and update stakeholders on the company's operations and customer service levels.

Conversely, the AI-generated communications strategy, with its diverse channels and well-defined roles, offered a more thorough and disciplined approach to project communication. It aimed to inform stakeholders, address their concerns, and foster collaboration. On the other hand, the human-generated plan seemed to prioritize conventional communication techniques. Therefore, combining elements from both plans could potentially yield benefits for project planning, incorporating the advantages of contemporary and traditional communication approaches.

In terms of project risks, the advantages of a systematic and thorough approach to risk management were highlighted by the comparison of the AI-generated and human-generated risk plans. The AI-generated risk plan demonstrated a comprehensive framework that encompassed all stages of risk management, from identification to response planning. It effectively identified a wide range of potential risks and opportunities, categorizing them into specific domains such as legal/regulatory, technology, market/users, and finance. This classification allowed for a focused understanding of the areas that posed the greatest risks to the project. Moreover, the plan employed qualitative and quantitative assessment to evaluate the probability and impact of risks, facilitating an objective basis for risk prioritization. By considering both threats and opportunities, the AI-generated plan showcased a holistic approach to risk management.

On the other hand, the human-generated risk plan focused primarily on risk identification without a comprehensive approach to risk management. While the project manager's experience contributed to identifying risks, the plan lacked the categorization, qualitative and quantitative assessment, and specific response strategies present in the AI-generated plan. The absence of risk response planning hindered the project team's preparedness to address potential challenges, limiting their ability to mitigate negative impacts effectively. On top of that, the human-generated plan failed to consider potential opportunities that could arise during the project, neglecting to capture the full spectrum of risks and rewards.

The contrast between the two plans highlights the advantages of an AI-generated approach to risk management, especially in complex projects. The AI-generated plan demonstrated a rigorous and structured

framework that integrated risk identification, qualification, quantification, and response planning. This comprehensive approach empowered the project team to effectively understand and address risks, while capitalizing on potential opportunities. The inclusion of risk quantification in the AI-generated plan further improved decision-making and resource allocation, ultimately enhancing project outcomes.

5.2. Practical implications

While the human-generated plan may have been limited in some parts of its planning approach (e.g.: risks), it is important to consider that the reasons behind its shortcomings were not investigated in this study. Factors such as time constraints or limited resources may have impacted the project manager's ability to develop a more formalized risk management process. However, the comparison underscores the potential advantages of utilizing an AI-generated strategy as a starting point for project planning, providing a solid foundation and saving time for the project manager to conduct a more in-depth analysis and refinement of the overall plan. These findings suggest that the combination of AI-generated insights with human expertise can create a powerful synergy in planning for a project, ultimately improving the project's chances of success.

Another research finding that could be observed during the project plan development was that the iterative process of refining the AI-generated project plan has demonstrated its effectiveness in improving results across various project management expertise areas. Gradually adjusting and clarifying the AI system's instructions enhances the standard and applicability of the outputs produced. The initial prompt serves as a starting point that can be continuously assessed and optimized through later iterations. Project managers can leverage the AI system's ability to create precise and customized project plans by continuously adjusting the input instructions.

Research studies by Ekin (2023) and Song et al., 2021 support the notion that providing detailed and explicit information to AI models enhances their capacity to understand desired outcomes and produce results that align with intended requirements. Project managers can ensure that the created project plan includes the necessary elements and fulfills the main project requirements by providing the AI system with detailed input. This all-encompassing approach leads to project plans that are better suited to the project's objectives and constraints, fostering a more productive partnership between human expertise and AI capabilities.

5.3. Societal implications

The distinct strengths and weaknesses of AI-generated and human-generated project plans suggest a synergistic approach, combining AI and human input, may optimize the project planning process. For instance, AI models like GPT-4 could rapidly generate a project plan's initial draft, subsequently refined, and customized by a human project manager, thereby enhancing efficiency while ensuring comprehensive consideration of all critical project aspects. Concurrently, the rise of AI in project management demands the development of robust policies and guidelines by organizations and governing bodies, addressing key issues such as data privacy, ethical AI use, and responsible AI application.

Societally, the increasing capabilities of AI models pose potential challenges, including job displacement in the project management field. However, this study underscores the complementary nature of the strengths and weaknesses of AI and human project managers, suggesting a collaborative rather than replacement-based approach may be most effective. This has far-reaching implications for the education and training of future project managers, necessitating a curriculum that equips them to collaborate effectively with AI.

6. Research limitations and future considerations

The research offers valuable insights into the realm of project management, effectively juxtaposing human expertise with AI capabilities. The study approached data handling with due diligence, laying the foundation for a nuanced understanding of project planning in the age of AI. As with any pioneering research, there are avenues that present opportunities for deeper exploration in future iterations. A more detailed exposition on data governance, integrity, and management within project frameworks can further enhance the discourse.

Also, while the goal of this study was to compare project plans made by human project managers and those made by AI, it is vital to recognize some limitations that may restrict the applicability and scope of the results. For instance, using a single project plan limits the capacity to draw general conclusions about the effectiveness of project plans created by humans or artificial intelligence (AI) in a variety of circumstances and contexts. The findings may be influenced by the unique characteristics of the selected project, the expertise of the human project manager, and the specific training and data utilized by the AI system. Besides, due to the small sample size, care must be taken when extrapolating the findings to populations other than the project chosen and research subjects. Also, the unique circumstances, project requirements, and characteristics of the human project manager may not be representative of other project management scenarios, industries, and organizational settings. The choice of a particular project plan and a human project manager may have also unintentionally introduced biases that may have impacted the findings of the investigation.

Future research should aim to overcome these limitations by including a larger sample size of project plans. A broader range of projects and diverse human project managers should be considered to provide more robust and generalizable insights into the comparison between AI-generated project plans and those created by human project managers.

It's also important to note that the rapidly evolving capabilities of generative AI models suggest that they will become increasingly valuable in the project planning process, potentially altering the comparative strengths and weaknesses identified in this study. Therefore, while this study presents a comprehensive comparison between a human project manager and the GPT-4 model, the findings could quickly become outdated as newer, more advanced models are developed.

Another limitation to highlight within our research methodology concerns the depth of our evaluation of AI-generated responses. While we did consider multiple responses from the AI system and experimented with various prompts, our analysis primarily centered on a select response for each prompt. It's widely recognized in the realm of generative AI that these systems can yield a spectrum of responses to a single prompt. Such outputs can sometimes bear resemblance, but there are instances where they substantially differ, leading to alternative perspectives or interpretations. Although our study incorporated a range of responses and prompt variations, a more exhaustive exploration might reveal further nuances in the AI's outputs.

Additionally, while the study touched upon auditing and monitoring, an in-depth exploration of the associated ethical implications, especially considering AI's growing role and the interests of diverse stakeholders, could add another layer of depth. These considerations, particularly from an ethical standpoint, are essential as we navigate the complexities of integrating AI in project outcomes and their implications for various stakeholders. As the field evolves, subsequent research endeavors can build upon these foundations, continuing the quest for a holistic understanding of the synergy between human and AI in project management.

7. Conclusion

In examining the comparison between an AI-generated and a human-created project plan, this study found that both have unique strengths

and weaknesses, suggesting a collaborative approach may be optimal.

AI-generated plans serve as efficient starting points, often introducing novel insights, especially in areas like risk management. However, they should not be viewed as final deliverables. Human expertise remains vital for validating and refining these AI outputs. A human project manager's domain knowledge, understanding of industry standards, and best practices make them uniquely qualified to provide context and address potential gaps in AI-generated plans.

While AI, particularly generative models like GPT-4, can rapidly produce initial drafts, human oversight ensures alignment with organizational goals, stakeholder expectations, and project constraints. The "human in the loop" approach effectively bridges the nuances of project planning with AI outputs, underscoring the complementary nature of AI and human capabilities in this domain.

Prompt engineering emerged as a critical factor in optimizing AI's utility. By refining prompts, human project managers can guide AI outputs to be more contextually relevant and precise. However, overreliance on AI introduces risks. Technically, AI models can produce outputs that might not be contextually appropriate or may overlook industry-specific nuances. Moreover, solely AI-centric project management might neglect vital human-centric aspects like team leadership and alignment with organizational values.

In summary, while AI has immense potential to augment project planning, the pivotal role of human expertise remains undeniable. A balanced integration of both AI and human capabilities ensures efficient, comprehensive, and nuanced project plans. Organizations and stakeholders must recognize and harness this synergy for effective project management.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

References

Alshaikhi, A., Khayyat, M., 2021. An investigation into the impact of artificial intelligence on the future of project management. In: Proceedings of the 2021 International Conference of Women in Data Science at Taif University (WiDSTaif). March 30-31.

Amaro, F., Domingues, L., 2023. PMBOK 6th meets 7th: how to link both guides in order to support project tailoring? Procedia Comput. Sci. 219, 1877–1884.

Auth, G., Johnk, J., Wiecha, D.A., 2021. A conceptual framework for applying artificial intelligence in project management. In: Proceedings of the 2021 IEEE 23rd Conference on Business Informatics, CBI 2021—Main Papers. IEEE, Bolzano, Italy, pp. 161–170.

Bang, S., Aarvold, M., Hartvig, W., Olsson, N., Rauzy, A., 2022. Application of machine learning to limited datasets: prediction of project success. J. Inf. Technol. Construct. https://doi.org/10.36680/j.itcon.2022.036.

Choi, S., Lee, E., Kim, J., 2021. The engineering machine-learning automation platform (EMAP): a big-data-driven AI tool for contractors' sustainable management solutions for plant projects. Sustainability 13 (18), 10384. https://doi.org/10.3390/su131810384.

Davahli, M.R., 2020. The Last State of Artificial Intelligence in Project Management arXiv preprint arXiv:2012.12262.

Durmic, N., 2021. The process aspect of project success: an empirical test. Int. J. Inf. Technol. Proj Manag. https://doi.org/10.4018/IJITPM.2021040104.

Ekin, Sabit, 2023. Prompt engineering for ChatGPT: a quick guide to techniques, tips, and best practices. TechRxiv. Preprint. https://doi.org/10.36227/techrxiv.22683919.v2.

Eloundou, T., Manning, S., Mishkin, P., Rock, D., 2023. GPTs are GPTs: an early look at the labor market impact potential of Large Language Models. https://doi.org/10.48550/arXiv.2303.10130. Working Paper.

Fridgeirsson, T.V., Ingason, H.T., Jónasson, H.I., Jónsdóttir, H., 2021. An authoritative study on the near future effect of artificial intelligence on project management knowledge areas. Sustainability 13, 2345.

Gil, Jesús, Martínez Torres, Javier, González-Crespo, Rubén, 2020. The application of artificial intelligence in project management research: a review. International Journal of Interactive Multimedia and Artificial Intelligence 6–6, 54–66. https://doi.org/10.9781/ijimai.2020.12.003.

Gînguță, A., Ștefea, P., Noja, G.G., Munteanu, V.P., 2023. Ethical impacts, risks and challenges of artificial intelligence technologies in business consulting: a new modelling approach based on structural equations. Electronics 12, 1462. https://doi.org/10.3390/electronics12061462.

Gyory, J., Zurita, N., Martin, J., Balon, C., McComb, C., Kotovsky, K., Cagan, J., 2021. Human versus artificial intelligence: a data-driven approach to real-time process management during complex engineering design. J. Mech. Des. FEBRUARY2022, Vol.144 /021405-1.

Gyory, J.T., Kotovsky, K., Cagan, J., 2022. Is it human or is it artificial intelligence? Discerning the impact and effectiveness of process managers based on the manager's identity. Proceedings of the Design Society 2, 1579–1588.

Haase, J., Hanel, P.H., 2023. Artificial Muses: Generative Artificial Intelligence Chatbots Have Risen to Human-Level Creativity. ArXiv./abs/2303.12003.

Jakesch, M., Hancock, J., Naaman, M., 2022. Human Heuristics for AI-Generated Language Are Flawed. ARXiV.

Khatib, M., Falasi, A., 2021. Effects of artificial intelligence on decision making in project management. Am. J. Ind. Bus. Manag. https://doi.org/10.4236/AJIBM.2021.113016.

Korteling, J.E.(H.), van de Boer-Visschedijk, G.C., Blankendaal, R.A.M., Boonekamp, R. C., Eikelboom, A.R., 2021. Human versus artificial intelligence. Frontiers of Artificial Intelligence. https://doi.org/10.3389/frai.2021.622364.

Korzynski, P., Mazurek, G., Altmann, A., Ejdys, J., Kazlauskaite, R., Paliszkiewicz, J., Wach, K., Ziemba, E., 2023. Generative artificial intelligence as a new context for management theories: analysis of ChatGPT. Central European Management Journal 31–1, 3–13. https://doi.org/10.1108/CEMJ-02-2023-0091.

Koubaa, A., 2023. GPT-4 vs. GPT-3.5: A Concise Showdown.

Kuster, L., 2021. The Current State and Trends of Artificial Intelligence in Project Management: A Bibliometric Analysis. Master's Thesis. Escola de Administração de Empresas de São Paulo, São Paulo, Brazil.

Nieto-Rodriguez, A., Vargas, R.V., 2023. How AI will transform project management. Harv. Bus. Rev. Retrieved from https://hbr.org/2023/02/how-ai-will-transform-project-management.

Noy, Shakked, Zhang, Whitney, 2023. Experimental evidence on the productivity effects of generative artificial intelligence. https://doi.org/10.2139/ssrn.4375283. Working Paper.

OECD, 2023. OECD Employment Outlook 2023: Artificial Intelligence and the Labour Market. OECD Publishing, Paris. https://doi.org/10.1787/08785bba-en.

OpenAI, 2023. GPT-4 Technical Report arXiv preprint. arXiv:submit/4812508.

Polonevych, O., Sribna, I., Mykolaychuk, V., Tkalenko, O., Shkapa, V., 2020. Artificial Intelligence Applications for Project Management. Connectivity.

Prifti, Valma, 2022. Optimizing project management using artificial intelligence. European Journal of Formal Sciences and Engineering 5 (1), 29–37.

Project Management Institute, 2021. PMBOK Guide. Project Management Institute, Newtown Square, PA, USA.

Project Management Institute, 2022. Process Groups: A Practice Guide. Project Management Institute, Newtown Square, PA, USA.

Radford, A., Narasimhan, K., Salimans, T., Sutskever, I., 2018. Improving Language Understanding by Generative Pre-training. OpenAI Blog.

Regona, M., Yigitcanlar, T., Xia, B., Li, R.Y.M., 2022. Opportunities and adoption challenges of AI in the construction industry: a prisma review. J. Open Innov. Technol. Mark. Complex 8, 45. https://doi.org/10.3390/joitmc8010045.

Salleh, M.H., Aziz, K.A., 2022. Artificial intelligence augmented project management. In: International Conference on Technology and Innovation Management (ICTIM 2022). Atlantis Press, pp. 274–284.

Servranckx, T., Vanhoucke, M., 2021. Essential skills for data-driven project management: a classroom teaching experiment. The Journal of Modern Project Management. https://doi.org/10.19255/JMPM02609.

Skinner, L.J., 2022. How will AI transform project management? Itnow 64 (2), 14–15.

Song, B., Zurita, N., Nolte, H., Singh, H., Cagan, J., McComb, C., 2021. Addressing challenges to problem complexity: effectiveness of AI assistance during the design process. In: 33rd International Conference on Design Theory and Methodology (DTM), vol. 6.

Soria Zurita, N.F., Gyory, J.T., Balon, C., Martin, J., Kotovsky, K., Cagan, J., McComb, C., 2022. Data on the Human versus artificial intelligence process management experiment. Data Brief 41.

Taboada, I., Daneshpajouh, A., Toledo, N., de Vass, T., 2023. Artificial intelligence enabled project management: a systematic literature review. Appl. Sci. 13 (8), 5014. https://doi.org/10.3390/app13085014. MDPI AG. Retrieved from.

Takagi, N., Varajão, J., 2020. Success Management and the Project Management Body of Knowledge (PMBOK): an Integrated Perspective.

Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A., Kaiser, L., Polosukhin, I., 2017. Attention is All You Need. https://doi.org/10.48550/arXiv.1706.03762. Retrieved from:

Yang, H., Yue, S., He, Y., 2023. Auto-GPTfor Online Decision Making: Benchmarks and Additional Opinions. Retrieved from. https://arxiv.org/abs/2306.02224.

Zhang, G., Chong, L., Kotovsky, K., Cagan, J., 2022. Trust in an AI versus a Human teammate: the effects of teammate identity and performance on Human-AI cooperation. Comput. Hum. Behav. 139, 107536.