29th International Congress on Project Management and Engineering
Ferrol, 16th-17th July 2025

01-040 – Artificial intelligence agents for decision-making assistance in project management: a conceptual approach – Agentes de inteligencia artificial para la asistencia en la toma de decisiones en gestión de proyectos: un enfoque conceptual

Schulze González, Erik[1]; *Saldes Toledo, Nicole*[1]; *Lara Yergues, Eduardo*[1]
(1) Universidad de Valparaíso

Spanish Spanish

Project management faces growing challenges due to the complexity of strategic decision-making. This study proposes a conceptual framework for integrating artificial intelligence (AI) agents into project management decision-making, focusing on identifying key variables and designing a foundational architecture for implementation. Based on a literature review and an analysis of specific use cases, the essential elements for training an AI agent are defined, including resource allocation optimization, delay prediction, and task prioritization. This work establishes the theoretical foundations for the future implementation of AI systems in project management tools, highlighting their potential to improve efficiency and reduce uncertainty in project planning and execution.

Keywords: *Artificial intelligence; Project management; Decision-making; Intelligent agents; Conceptual modeling*

La gestión de proyectos enfrenta desafíos crecientes debido a la complejidad en la toma de decisiones estratégicas. El presente estudio propone un marco conceptual para la integración de agentes de inteligencia artificial (IA) en la toma de decisiones en gestión de proyectos, centrándose en la identificación de variables clave y el diseño de una arquitectura base para su implementación. A partir de una revisión de la literatura y el análisis de casos de uso específicos, se definen los elementos esenciales que se deben considerar para el entrenamiento de un agente de IA, como la optimización de asignación de recursos, la predicción de retrasos y la priorización de tareas críticas. Este trabajo establece las bases teóricas para la futura implementación de sistemas de IA en herramientas de gestión de proyectos, destacando su potencial para mejorar la eficiencia y reducir la incertidumbre en la planificación y ejecución de proyectos.

Palabras claves: *Inteligencia artificial; Gestión de proyectos; Toma de decisiones; Agentes inteligentes; Modelado conceptual*

1. Introduction

Modern project management faces significant challenges; despite methodological advances, project success rates remain low (Jupir et al., 2023). This is partly attributed to the increasing complexity of projects, uncertainty in dynamic environments, and limitations inherent in decisions based solely on human judgment. Traditional project management technology presents a gap that has not adequately addressed these challenges. Consequently, there is a disparity between the massive amount of information generated by projects, the human capacity to process it, and the ability to make optimal real-time decisions.

In this context, Artificial Intelligence (AI) has gained momentum across multiple industries and project management is no exception. AI emerges as an innovative alternative that enhances data-driven decision-making, enabling the analysis of vast amounts of historical and real-time information to identify patterns, forecast outcomes, and suggest optimal solutions. Recent studies highlight that integrating AI significantly improves managerial decision-making by automating tasks and enhancing analytical capabilities (Leyer & Schneider, 2021). Furthermore, AI has the potential to automate repetitive tasks, such as schedule updates and report generation, thereby reducing administrative burdens and minimizing human error.

Specifically, intelligent agents are projected to become key elements in supporting decision-making in project management. Thus, an AI agent could, for instance, act as a virtual advisor to the project manager, analyze performance indicators, and recommend adjustments in resource allocation or scheduling. It is important to note that this approach does not aim to replace human managers but rather to augment their capabilities, aligning with the notion that automation should enhance effectiveness rather than substitute for the managerial role. This balance is described in the literature as the "automation-augmentation paradox" (Raisch & Krakowski, 2021), emphasizing that the highest value is achieved when artificial and human intelligence collaborate, such as by acting as a virtual advisor to the project manager, analyzing performance indicators, and recommending resource allocation adjustments. Therefore, it is not surprising that future projections indicate that by 2030, AI adoption will cause significant changes in the project management industry, transforming risk management practices, resource allocation, and schedule optimization, thereby assuming a considerable share of project management tasks and activities (Nieto-Rodriguez & Maude, 2023).

Despite the promising potential of AI and intelligent agents in project management, knowledge gaps and methodological challenges persist and require a systematic approach to enhance understanding. Therefore, this study aims to address the following questions.

- What is the current state of knowledge about AI in project management?
- What are the key components to be integrated into a conceptual model to ensure effective decision-making support?
- Which specific mechanisms within an AI agent model can optimize resource allocation, predict delays, and prioritize tasks?

2. Objectives

Consistent with the above, the general objective of this study is to propose a conceptual design for an artificial intelligence agent architecture that assists decision-making in project management. The following objectives were defined to achieve this general purpose:

- To systematically review recent literature (2019–2024) on the application of AI in project management.
- Defining a conceptual framework integrating intelligent agents into project management.

- To identify and analyze potential theoretical impacts arising from the adoption of AI agents in projects.

3. Literature review and conceptual framework

To support the proposed design, a systematic review of the recent scientific literature related to AI and project management was conducted. For this purpose, three stages were established as pillars of the methodology. The first stage aimed to identify the relevant keywords and thesauri representing the concepts to be investigated using the Population, Intervention, Comparison, Outcome, Context approach (PICOC) (Frandsen et al., 2020) to delimit the scope, as illustrated in Table 1.

Table 1: Identification of Key Concepts Using the PICOC Framework.

Element	Keywords	Synonyms / Related Terms
Population	"project management"	"project-based organizations", "projects", "program management"
Intervention	"artificial intelligence agents", "AI agents", "intelligent agents"	"autonomous agents", "multi-agent systems", "AI decision support", "AI-based tools"
Comparison	"traditional project management"	"PMBOK", "PRINCE2", "Agile methods", "manual decision-making", "non-AI approaches"
Outcome	"decision-making", "project performance", "efficiency", "outcome improvement"	"cost control", "schedule adherence", "resource optimization", "success rate"
Context	"modern project management"	"VUCA", "agile environment", "digital transformation", "contemporary project settings"

The search strategy begins by determining the studies that are necessary and suitable for capturing the richness of the phenomenon under investigation. Once this determination was established, search strings were created in the selected databases Scopus and Web of Science (WoS). For the Web of Science (WoS) search, the "TS=" prefix (Table 2) directed our query across the title, abstract, author keywords, and Keywords Plus® fields. Table 2 lists the keywords and search strings used in this study.

Table 2: Search Strings Constructed Using the PICOC Framework for Scopus and WoS.

Scopus	TITLE-ABS-KEY (“project management" AND ("artificial intelligence" OR "AI") AND ("decision-making" OR "decision support") AND ("agile" OR "traditional"))
Web of Science (WoS)	TS = ("project management" AND ("artificial intelligence" OR "AI") AND ("decision-making" OR "decision support") AND ("agile" OR "traditional"))

To refine and select documents that accurately represented the phenomenon of the study addressed in this research, the initial sample was screened, and the quality of the final sample was ensured. To accomplish this, inclusion and exclusion criteria were applied, as described in Table 3.

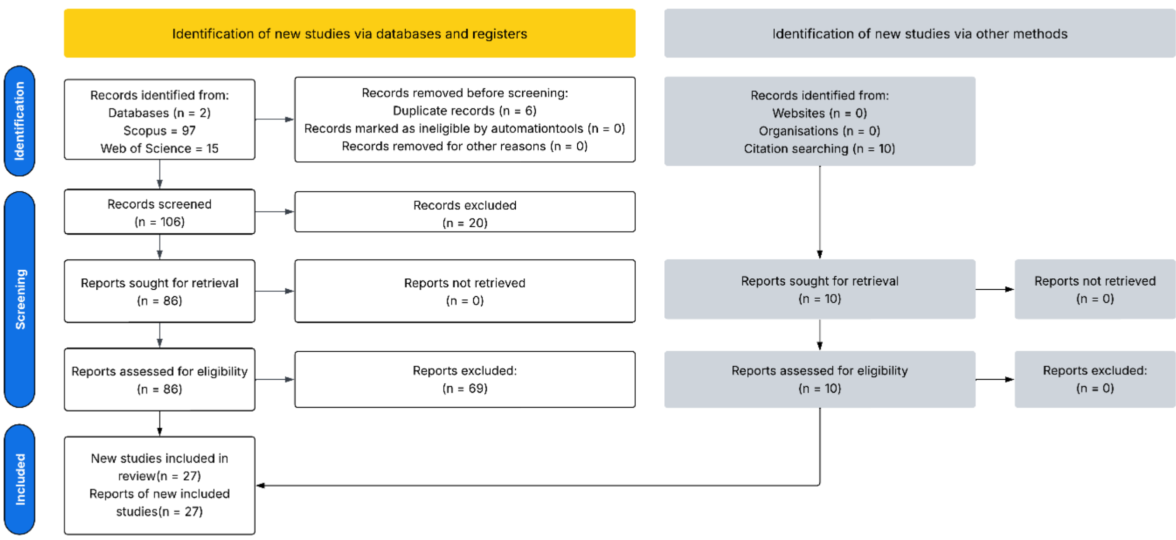
Table 3: Inclusion and Exclusion Criteria Based on the PICOC Framework.

Dimension	Inclusion Criteria	Exclusion Criteria
Population	Studies involving real-world projects across sectors (e.g., industry, healthcare, construction, IT) with a clear focus on project management processes.	Studies unrelated to project management, or purely theoretical works without practical project-based applications.

Intervention	Applications of artificial intelligence, specifically intelligent agents (reactive, deliberative, multi-agent, etc.) used for decision support in projects.	Studies discussing generic AI approaches without specific application to project decision-making or management processes.
Comparison	Comparisons with traditional project management approaches (e.g., PMBOK, PRINCE2, waterfall or agile methods without AI).	Comparisons limited to AI-based methods without referencing traditional or human-based project management approaches.
Outcomes	Demonstrated improvements in decision-making, resource optimization, cost/time/scope performance, or project efficiency.	Articles lacking measurable outcomes related to project decision-making or performance improvements.
Context	Modern project management environments (digital, agile, dynamic, uncertain) or validated simulations reflecting real project scenarios.	Artificial or purely academic settings disconnected from real-world project environments, or studies with insufficient contextual information.

Finally, in pursuit of rigor, transparency, and replicability, this study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). Additionally, the snowballing technique was employed to identify key articles and to include significant works that were not captured in the initial search. Figure 1 illustrates the PRISMA flowchart of the methodological phase.

Figure 1: PRISMA Flowchart for the Study Selection Process.



As a result of this review, the conceptual framework was structured around two main axes:

(a) AI applications in project management reported in the literature, and (b) Types of intelligent agents and architectures

Additionally, at the methodological level, the following axes were considered for context-specific applications in project management:

(c) Relevant variables for decision-making in projects that AI can help improve, and (d) Findings from recent studies that inform the proposed conceptual design.

3.1 Applications of AI in Project Management

Based on the reviewed literature, it is evident that there is a growing increase in AI applications across various areas of project management. For instance, (Müller et al., 2024) provide an empirical overview indicating that project-related research is still emerging but accelerating, and propose a future agenda for its effective implementation in practice.

Among the documented concrete applications, several studies highlight how AI-driven tools are revolutionizing the way risks are identified, analyzed, and mitigated throughout the project lifecycle (Manu, 2024). This enables a proactive approach to risk, where an AI agent can alert the project manager early about "weak signals" indicating an increasing risk, thus facilitating timely preventive actions rather than reactive responses.

In the domain of planning and scheduling, AI has also demonstrated its value. For example, (Turkyilmaz & Polat, 2025) argue that AI tools can provide more accurate time and cost estimates by accounting for multiple variables and historical data. Comparative studies have shown that AI-based methods outperform traditional techniques in predicting a project's final duration, integrating complex factors such as scope changes or team performance, which are often difficult to quantify. Consistently, (Ünsal-Altuncan & Vanhoucke, 2024) compared AI methods with traditional ones for predicting project duration and found significant improvements in accuracy.

Another key application lies in resource and schedule management. Intelligent systems have been shown to continuously seek the optimal allocation of human and material resources, while respecting constraints and multiple objectives (e.g., minimizing costs, meeting deadlines, balancing workloads), as proposed by (Wang et al., 2021). In this regard, AI techniques such as genetic algorithms and fuzzy logic have been used to improve scheduling and the dynamic adjustment of project timelines. Along the same lines, (Uddin et al., 2025) conducted a review of machine learning and deep learning methods in project analytics, identifying successful applications in scheduling and resource optimization through predictive models that recommend plan adjustments when circumstances change. Similarly, in agile contexts, AI has been used to predict team velocity during sprints and to reassign sequences, thereby enhancing iterative value delivery (Pérez Castillo et al., 2024).

There is also evidence of AI applications in cost estimation. Neural networks trained on previous project data have been shown to generate more reliable budget forecasts, accounting for risks and complexities that often elude traditional parametric techniques (Liu et al., 2024).

In terms of communication and knowledge management, AI has been documented in the use of intelligent chatbots to assist in project communications. These bots can answer frequently asked questions from team members regarding project status, upcoming tasks, or procedures, thereby freeing up managerial time and ensuring immediate, consistent responses, as discussed by (Ramaul et al., 2024). (Kaplan & Haenlein, 2019) note that such chatbots are revolutionizing team interaction by offering 24/7 availability and minimizing misunderstandings. In the same vein, researchers such as (Geraldi et al., 2024), considering the rise of generative AI, have explored tools like ChatGPT to support report writing, knowledge management, and even creative project planning.

(Felicetti et al., 2024) examined how project managers are adopting generative chatbots and found that these tools can improve team collaboration and provide new ideas for problem-solving. While they caution that proper management is needed to avoid overreliance or the spread of misinformation, the literature overall shows that AI applications in project management are diverse and span nearly all knowledge areas defined in the PMBOK (Felicetti et al., 2024).

3.2 Types of Intelligent Agents and Architectures

The concept of intelligent agents is broad, ranging from simple reactive programs to complex autonomous systems. In the project management literature, various types of agents have been explored for different functions. In this context, an agent is defined as a software entity capable of perceiving the project's state, processing that information using AI techniques, and acting or recommending actions in response—either autonomously or semi-autonomously—toward specific goals (Hintze & Dunn, 2022).

Among the most frequently mentioned types are monitoring and alert agents, which continuously track project metrics and notify the project manager when deviations or risks are detected. Other agents serve as recommendation or decision-support agents, which not only alert about problems but also suggest courses of action. There are also scheduling or planning agents, designed to automatically recalculate schedules in response to changes or to iteratively replan for optimization. These agents apply heuristic search algorithms or combinatorial optimization methods to identify task sequences and resource allocations that minimize project duration or cost, while respecting constraints (Zhang et al., 2024).

In multi-project environments, researchers such as (Fu & Zhou, 2021) have proposed multi-agent systems in which different agents represent each project or shared resource, negotiating resource allocation and execution priorities among themselves. This distributed approach is useful where centralized control is limited or when robustness and flexibility are desired, as agents can dynamically reorganize work in response to disruptions.

Regarding agent architectures, two primary approaches are identified: reactive agents and cognitive (or deliberative) agents. Reactive agents operate on simple condition-action rules, responding directly to events in the project environment. While they are fast and robust, they lack a complex internal representation of the project world (Palanca et al., 2023). In contrast, deliberative or cognitive agents use internal models, perform more sophisticated inferences, and plan their actions (Karaduman et al., 2023). A common paradigm is the BDI model (Belief-Desire-Intention), where the agent maintains beliefs (information about the project state), desires or goals (e.g., successful project completion), and intentions (committed action plans). Although the BDI model originates from general AI research, it has been proposed for project management agents capable of replanning their intentions when their beliefs indicate that a desire is at risk (Parizi et al., 2021). These agents can support complex decisions, such as recommending project cancellation when business indicators suggest that continuation is no longer justified—something a purely reactive agent would not do without explicit instructions (Strand et al., 2022).

Studies also distinguish between simple agents and collaborative agents. Simple agents operate autonomously in a specific task, while multi-agent systems (MAS) involve multiple agents interacting. In project management, a MAS could include a planning agent, a risk agent, and a communication agent—each specialized, but coordinated to improve overall project outcomes. Recent research suggests that this modular architecture can be mapped to the knowledge areas of project management. For example, (Perera et al., 2022) propose a modular multi-agent system where specialized agents are assigned to functions equivalent to areas such as communication, planning, and knowledge management. This facilitates the understanding of interdependencies and project processes. These agents may share a common knowledge base, fed by historical project data and domain ontologies, enabling them to understand interrelationships.

In terms of technological architecture, agent integration in practice is typically implemented as additional layers on top of existing project information systems. Specifically, an agent connects to tools such as MS Project, Primavera P6, Jira, or others via APIs, extracting data and processing it in its AI module before returning suggested or automated actions to the system. An example of this is presented by (Ninpan et al., 2024), who demonstrated that integrating agents into the project management system enabled real-time updates and direct recommendations within the platform used by the manager. Similarly, research by (Cinkusz et al., 2024) describes cases where organizations developed intelligent dashboards with agents that analyze key metrics and display color-coded alerts or recommended actions—thus achieving a more intuitive human–machine interaction for the project manager. These approaches illustrate the diversity of architectures, yet all share the vision of intelligent agents as extensions of the project management system, endowing it with advanced analytical and autonomous response capabilities.

4. Conceptual Design Methodology

Based on the findings of the literature review, an architectural proposal was developed to incorporate AI agents into project management. This design methodology is conceptual in nature and grounded in the integration of functional components identified in the literature, adapted to the practical needs of project managers. Key variables such as resource optimization, delay prediction, and task prioritization were considered as the central focus of the design. Furthermore, efforts were made to ensure compatibility and integration with the project management software tools currently used in professional settings.

The core aspects of project decision making are addressed by specifically addressing these variables within the architecture. In addition, the architecture is designed to be flexible, allowing the incorporation of additional modules to address other variables, considering the diversity of projects and execution contexts. Nevertheless, the proposed set of core agents encompasses a broad spectrum, ranging from strategic planning and monitoring to the tactical daily execution of projects. In this sense, the configuration represents an ecosystem of agents that comprehensively support the project manager.

4.1 Proposed Conceptual Architecture of AI Agents

The proposed conceptual architecture is illustrated in Figure 2, which shows that it consists of several components or agent modules organized into layers that interact with one another.

The first layer is called **the Data and Environment**, and it serves as the foundation of the architecture, where interaction with the real-world project environment occurs. This layer hosts the project's data sources, including project management software (e.g., MS Project, Primavera, Jira), performance databases (historical KPIs, earned value metrics), relevant corporate systems (ERP for costs, HR systems for staff availability), and external sources (such as market data or weather conditions in construction projects). The sensor agents in this layer continuously extract up-to-date data through API integration or connectors. For example, a connector to the Project Management Information System (PMIS) allows the agent to read the current schedule, task completion percentages, registered risks, and so on. Additionally, this layer can include manual input streams, where the project team provides data to feed the system from the perspective of project participants.

The second layer is **Perception and Preprocessing**, in which raw data must be processed before decisions are made. In this layer, AI modules perform tasks such as data cleaning, aggregation, and descriptive analytics on incoming data. For instance, derived indicators such as the Schedule Performance Index (SPI) and Cost Performance Index (CPI) are calculated from earned value data, progress time series are generated to feed predictive models, or natural language processing algorithms are applied if textual data are present. The goal is for higher-level agents to work with relevant and standardized information. This layer may also include a sub-agent specialized in filtering noisy data; for example, if some reports arrive late or have errors, the agent detects them and either prevents them from affecting calculations or requests user confirmation.

The next layer corresponds to the **Decision Agents**, which are positioned at the core of the system, where three main agents are located, each associated with the key variables identified.

These agents interact with one another. First, a **Resource Optimization Agent** is introduced. It employs artificial intelligence (AI) techniques to determine the best resource-to-task allocation. This agent takes the current schedule status, resource availability, and project objectives as inputs, and then proposes adjustments. For example, if a critical resource is assigned to multiple concurrent tasks, it reorders those assignments or recommends delegating certain tasks to other team members. Similarly, if idle periods are identified in some teams, this suggests reallocating these hours to delayed tasks. This agent may run Monte Carlo simulations or what-if analyses to evaluate the different allocation options before recommending an action. Its *beliefs* include knowledge of each resource's capabilities, costs, and constraints; its *goals* are to meet target deadlines while using resources efficiently; and its *plans* involve reassignments or leveling actions.

Second, a **Schedule Prediction and Control Agent** are presented. This agent incorporates predictive models such as LSTM-type recurrent neural networks trained on data from similar projects or decision tree models to estimate task and project completion dates and evaluate schedule-related risks. It continuously updates the probability of delay for each milestone, and calculates the schedule risk metrics (e.g., the required buffer in the critical path). If the probability of missing a given milestone exceeds a threshold, the agent generates an alert and sends an "intention" to the resource or task agent to take corrective action. It also monitors the fulfillment of intermediate milestones in real time. If a deadline is missed, it immediately recalculates the remaining schedule probabilistically. This agent used supervised machine learning trained on hundreds of projects. Its *beliefs* are the trained model and current project data, and its *goal* is to keep the SPI close to 1. Its *plans* include issuing alerts or triggering rescheduling requests.

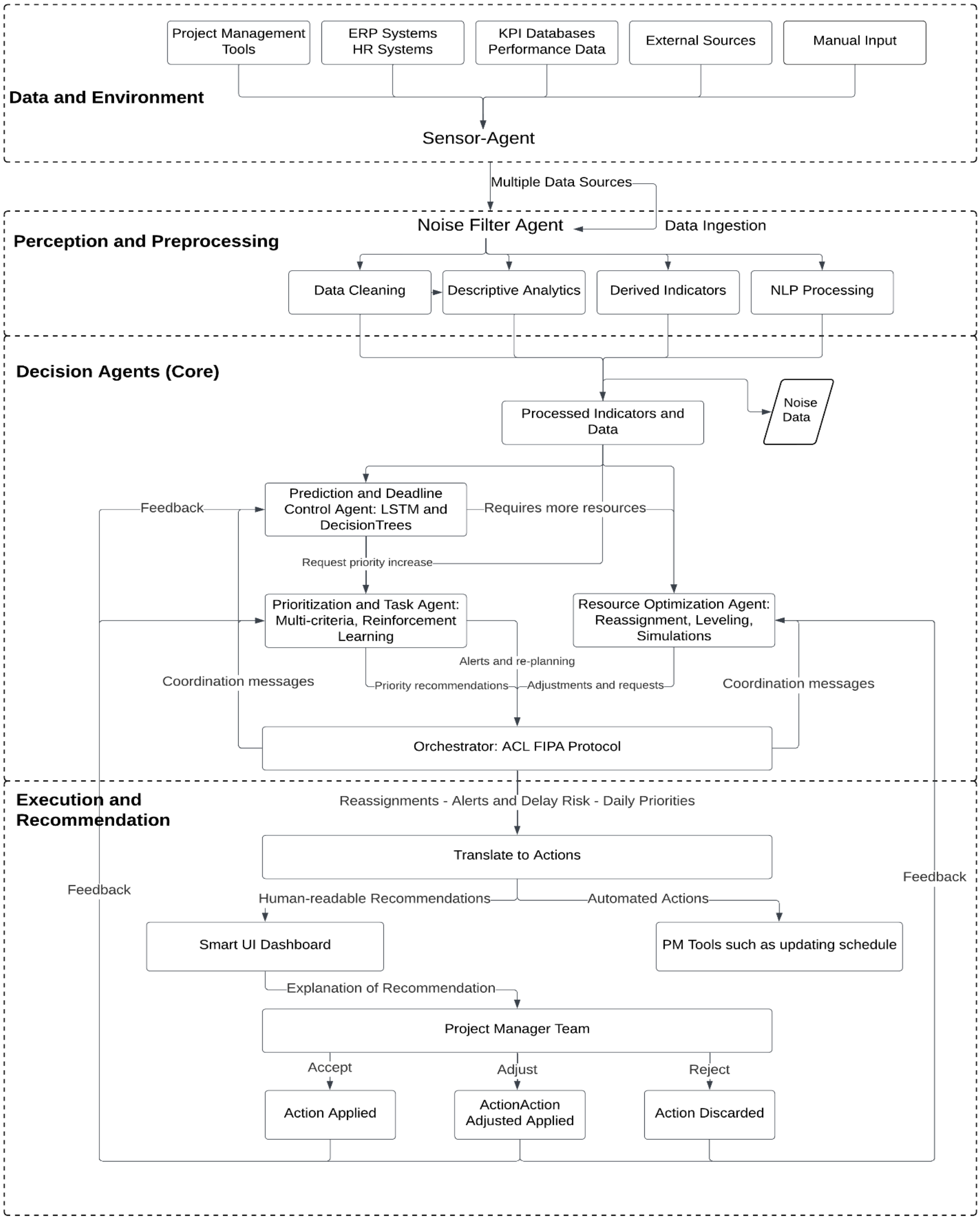
Finally, a **Task Prioritization Agent** was introduced. This agent focuses on ordering and assigning priorities to the project tasks and pending items. It employs dynamically weighted multicriteria, including urgency, impact, associated risks, and dependencies. Reinforcement learning algorithms can be used to learn which prioritizations lead to better outcomes in the past, minimizing risk proactively. This agent generates recommended worklists for each team member at the beginning of each period, suggesting the tasks to focus on first. It also assists the project manager during daily or weekly meetings by highlighting issues that require the most attention. Its *beliefs* include the status of all tasks and their position within the precedence network, with the goal of maximizing the value delivered per unit of time and minimizing bottlenecks. Its *plans* include reordering task sequences or proposing to defer or modify the scope of less critical tasks if resources are insufficient.

Each of the described agents operates semi-independently, but in coordination. This coordination is achieved through an orchestration module or direct agent-to-agent communication. For example, the schedule agent, upon predicting a delay, can send a message to the resource agent ("I need more resources for Task A to prevent a delay") and to the Task A agent ("increase the priority of Task A"). Agents may use a standard communication protocol (such as Foundation for Intelligent Physical) to exchange status information and negotiate solutions. This interaction ensures that agent decisions are globally aligned with overall project objectives and do not conflict with one another.

Finally, the **execution and recommendation layers** were presented. This is where the outputs of the decision agents are translated into actions in a real project environment. In some cases, actions can be automated and executed directly by the system using project management tools. For example, the resource agent may automatically rebalance assignments in the scheduling software if the project manager grants sufficient trust. In other cases, actions take the form of recommendations to the manager and the team, requiring human approval or intervention. These recommendations are delivered through an Intelligent User Interface, which may be a visual dashboard or system of notifications. The project manager receives the recommendation along with options to apply, adjust, or reject it.

Importantly, the interface should explain, at least at a basic level, the rationale behind each recommendation to foster user trust. This layer also handles feedback; if the manager accepts, modifies, or rejects a recommendation, that information is fed back to the agents to learn from human preferences and refine future suggestions.

Figure 2 Conceptual Architecture of the Multi-Agent System for Project Management Decision Support.



4.2 Integration with Current Project Management Tools

A fundamental pillar of conceptual design is the feasibility of its integration into real-world environments. The successful adoption of AI agents in projects requires their coexistence with established tools and processes, complementing them without disruption. Therefore, the proposed architecture was conceived as a modular add-on that connects to the most common project management software platform.

As mentioned earlier, the data layer includes connectors to existing tools. In practice, this means developing API-based integrations or plugins with software such as Microsoft Project, Primavera P6, Jira, Trello, and Asana, as well as ERP systems such as SAP. Based on these integrations, the AI agent can operate using the same information that the project manager handles daily, avoiding data duplication and the need for parallel platforms. This fosters trust and ease of use, as project managers would not need to migrate to unfamiliar software but would instead perceive AI as a new functionality embedded within their existing tools. Another integration pathway involves conversational interfaces or embedded virtual assistants. In the proposed architecture, such natural interaction allows the agent to integrate into the team's communication workflow, thereby increasing user acceptance.

Regarding technical implementation, it is anticipated that many modern PMIS platforms will already offer robust APIs (Micale et al., 2021). Therefore, the initial development effort involves connecting each agent module to the relevant endpoints. There are also standardization initiatives, such as the Project Management XML exchange format (PMXML) or standards, such as IPMA ICB, which could facilitate data interpretation by agents from different sources. In enterprise environments using legacy or ad hoc tools, custom development may be required to extract data, for instance, by connecting directly to the database of an in-house system. The proposed modular architecture supports this scenario, as each connector is independent, meaning that if a tool is replaced, only the connector module needs to be substituted without altering the internal logic of the agents.

Another aspect of integration involves alignment with organizational project management processes. The introduction of AI agents must not override existing control mechanisms and approval workflow. This aligns with the principle of keeping humans in a loop, ensuring that critical decisions follow the appropriate formal path. Simultaneously, for routine and low-impact decisions, the organization may configure the agent with greater autonomy. This configurability makes the solution adaptable to different organizational cultures, ranging from highly controlled environments to those that promote greater system autonomy.

It is important to consider that the integrated user interface should also include manual control of the project manager. The manager should be able to easily override agent decisions when qualitative factors not captured by AI are deemed relevant. Ideally, the integration presents recommendations alongside relevant contextual information, allowing managers to adjust them as needed. This human-machine collaboration is a core aspect of the design, as the intention is not to have an agent operating in isolation, but rather one that interacts continuously with the project team, incorporating human input whenever available.

Finally, in terms of organizational-level integration, it is important to note that the introduction of AI into project management requires adjustments to traditional roles. Some authors suggest the emergence of new roles such as "Project Data Analyst" or "AI Project Assistant," whose responsibilities include overseeing AI systems, ensuring the quality of project data, and assisting in the interpretation of results (Holmström, 2022). In the proposed conceptual architecture, it is anticipated that system oversight may fall under the responsibility of a specialized individual or team. Therefore, integration also involves training project managers and PMOs in the use of these agents, and potentially incorporating data specialists into project teams. This aligns with broader trends in the digital transformation of the project management profession, where data and AI-related skills are gaining increasing relevance (Holmström, 2022).

5. Discussion of Results and Theoretical Analysis

5.1 Potential Impact of AI Agents on Project Management

Adoption of intelligent agents in project decision-making promises significant benefits. First, a substantial improvement in the accuracy of estimates and forecasts is expected. Various authors have shown that AI-based approaches can reduce errors in project duration and cost estimations by detecting complex patterns that are invisible to traditional methods (Nenni et al., 2024; Prasetyo et al., 2025). With a predictive agent continuously monitoring project performance, potential deviations can be identified before they materialize, enabling early corrective actions. This could result in a higher rate of projects being delivered on time and within budget.

Indeed, (Nenni et al., 2024) argue that AI-driven methodologies will revolutionize project risk management throughout the entire lifecycle, increasing the ability to mitigate risks before escalating. Similarly, (Müller et al., 2024) proposed that AI has transformative effects on the forecasting accuracy and risk management, which aligns with the function of our schedule-prediction agent. In essence, this points toward a more proactive and less reactive project management approach in which projects operate with an anticipatory radar that minimizes unexpected disruptions.

Another anticipated impact is the optimization of resource utilization and, consequently, greater operational efficiency. By automating resource allocation and leveling, agents can eliminate idle time and unproductive overloads, thereby increasing team productivity and reducing the opportunity costs associated with the misallocation of talent. (Raisch & Krakowski, 2021) argued that when properly implemented, AI can significantly enhance efficiency without eliminating human roles, emphasizing a capacity-augmentation model.

This suggests that project managers supported by AI agents could manage larger or more numerous projects with the same team size, as routine tasks related to monitoring and rescheduling would be handled by these agents. In theory, a project manager could focus their time on strategic and leadership aspects while delegating daily microplanning and metric tracking to a virtual assistant. In this way, AI acts as a force multiplier for the manager, raising the ceiling of complexity or project volume that can be effectively managed.

With regard to decision quality, it was inferred that this would also benefit from the use of AI agents. By providing analyses based on data and empirical evidence, agents help ensure that decisions are more objective and well founded. This reduces reliance on intuition or managerial biases, which while valuable through experience, may fail when confronted with novel patterns or a large number of variables. (Haefner et al., 2021) emphasize that AI tools can identify opportunities and threats beyond human search routines, thereby complementing the manager's perspective. The combination of expert intuition and AI-based analysis tends to outperform either alone, according to the decision support literature.

Team collaboration and communication were expected to have a positive impact. With agents monitoring and disseminating key information, all team members are better informed in real time about the project's status and focal points. This can lead to greater alignment of efforts, reduced misunderstandings, and an improved interpersonal climate. (Felicetti et al., 2024) observed that generative chatbots integrated into project management could revolutionize interactions, facilitating continuous communication and shared creativity. In this way, an AI agent can foster interdisciplinary collaboration by presenting information in an accessible format for all, creating a shared understanding, and adapting to the linguistic codes specific to different disciplinary communities.

Finally, there is potential for strategic and organizational impact regarding alignment with business objectives and sustainability goals. By improving project success rates and optimizing resource utilization, organizations can achieve a better return on investment for their initiatives. Moreover, the implementation of AI agents in project management can contribute to innovation and sustainable efficiency objectives aligned with the Sustainable Development Goals (SDGs).

5.2 Limitations and Technical Challenges

Despite the positive outlook, it is essential to acknowledge the limitations and technical challenges associated with this conceptual approach. First, reliance on relevant historical data can be a significant constraint. AI algorithms—particularly those based on supervised learning—require large, high-quality datasets to train predictive models. Many organizations may lack a sufficient number of consistently documented historical projects to train a high-performing agent. This is especially true for small organizations or highly innovative projects where there is little comparable history. If the agent is trained using data from another industry or context, it may make errors by transferring inappropriate knowledge. This challenge of insufficient data is highlighted in the literature as one of the barriers to AI adoption in project management (Zahaib Nabeel, 2024). As a mitigation strategy, techniques such as transfer learning could be employed, or models could be initialized with publicly available industry data and then refined using the organization's specific context. Nevertheless, early implementations may show limited accuracy until more local data is accumulated.

Another limitation is the technical complexity of development and integration. While the agent modules have been conceptually outlined, implementing them in a real-world environment entails overcoming numerous engineering challenges: integrating multiple heterogeneous data sources, ensuring scalability, handling exceptions and edge cases, and more. In critical settings, an inaccurate prediction can lead to poor decisions; therefore, development teams must incorporate robust validation mechanisms and conduct exhaustive testing before deploying agents in high-stakes projects.

At a technical level, an additional challenge relates to ensuring compatibility with legacy systems. Some organizations still manage project plans using Excel spreadsheets or outdated applications without modern APIs. Connecting an AI agent to these sources may require custom-built solutions, which complicates real-time updates. Integration with legacy systems—and across multiple platforms simultaneously—adds considerable complexity. If the integration is not seamless, the agent's value diminishes (Xu & Guo, 2025).

Implementation and maintenance costs are also a limiting factor. Although long-term cost savings are expected due to increased efficiency, the initial investment required to develop or acquire such a system can be substantial. Moreover, keeping models updated demands continuous work by data experts. Some organizations may choose commercial cloud-based solutions that offer these agents as a service; however, this raises concerns regarding vendor lock-in and data confidentiality.

6. Conclusions

Project management is currently at an inflection point due to advances in artificial intelligence. This article has conceptually explored how intelligent AI agents can be integrated as decision-making assistants in project management, addressing pressing issues such as uncertainty, complexity, and the need for more agile and data-driven responses. Through a systematic review of recent literature (2019–2024), the main applications of AI in projects were identified, and the critical variables where AI contributions appear most promising were highlighted.

Based on this review, a conceptual architecture was proposed for an intelligent multi-agent system designed to support the project manager. This system includes specialized agents that, using machine learning techniques, predictive analytics, and decision rules, collaborate to monitor the project in real time, anticipate issues, and suggest optimal actions. The architecture emphasizes seamless integration with existing project management software tools and the preservation of the project manager's central role as the ultimate supervisor and decision-maker. It is proposed that the implementation of such agents could lead to substantial improvements: more punctual and efficient projects, more informed and objective decisions, increased adaptability to change, and more sustainable use of resources. In addition, the practical implications of this approach were analyzed, highlighting the need for proper management of organizational change, data quality, and staff training to ensure effective adoption.

From a theoretical perspective, this proposal aligns with the vision of project management empowered by data and intelligence tools (Project Management 4.0), in which AI serves as a decision-enabling factor. Far from replacing the project manager, AI agents would take on supportive tasks that free the manager's time and attention for strategic and leadership activities, promoting a human–machine collaboration model. Nevertheless, limitations and challenges are acknowledged: the technology is neither infallible nor autonomous in complex contexts without human oversight, and its success will depend on how well it is integrated into the organizational processes and human dynamics.

As future work, there is a clear need to develop prototypes and pilot implementations that allow for empirical validation of these agents' performance in real-world projects, quantifying benefits and refining implementation methodologies. It would also be valuable to explore AI methods that enhance the transparency of recommendations and investigate how these agents could learn from accumulated organizational experience to become "wiser" with each completed project (continuous learning).

In conclusion, the incorporation of artificial intelligence agents into project management represents a transformative opportunity for the discipline. If approached with technical rigor and appropriate change management, it can significantly enhance project delivery capabilities, strengthen decision-making processes, and contribute to more innovative and sustainable project management practices. Project managers in the near future will likely rely on intelligent virtual assistants as indispensable allies in achieving their project goals.

7. References

Manu, B. A. (2024). Leveraging Artificial Intelligence for optimized project management and risk mitigation in construction industry. *World Journal of Advanced Research and Reviews*, *24*(3), 2924–2940. https://doi.org/10.30574/wjarr.2024.24.3.4026

Cinkusz, K., Chudziak, J. A., & Niewiadomska-Szynkiewicz, E. (2024). Cognitive Agents Powered by Large Language Models for Agile Software Project Management. *Electronics*, *14*(1), 87. https://doi.org/10.3390/electronics14010087

Felicetti, A. M., Cimino, A., Mazzoleni, A., & Ammirato, S. (2024). Artificial intelligence and project management: An empirical investigation on the appropriation of generative Chatbots by project managers. *Journal of Innovation & Knowledge*, *9*(3), 100545. https://doi.org/10.1016/j.jik.2024.100545

Frandsen, T. F., Bruun Nielsen, M. F., Lindhardt, C. L., & Eriksen, M. B. (2020). Using the full PICO model as a search tool for systematic reviews resulted in lower recall for some PICO elements. *Journal of Clinical Epidemiology*, *127*, 69–75. https://doi.org/10.1016/j.jclinepi.2020.07.005

Fu, F., & Zhou, H. (2021). A combined multi-agent system for distributed multi-project scheduling problems. *Applied Soft Computing*, *107*, 107402. https://doi.org/10.1016/j.asoc.2021.107402

Geraldi, J., Locatelli, G., Dei, G., Söderlund, J., & Clegg, S. (2024). AI for Management and Organization Research: Examples and Reflections from Project Studies. *Project Management Journal*, *55*(4), 339–351. https://doi.org/10.1177/87569728241266938

Haefner, N., Wincent, J., Parida, V., & Gassmann, O. (2021). Artificial intelligence and innovation management: A review, framework, and research agenda☆. *Technological Forecasting and Social Change*, *162*, 120392. https://doi.org/10.1016/j.techfore.2020.120392

Hintze, A., & Dunn, P. T. (2022). Whose interests will AI serve? Autonomous agents in infrastructure use. *Journal of Mega Infrastructure & Sustainable Development*, *2*(sup1), 21–36. https://doi.org/10.1080/24724718.2022.2131092

Holmström, J. (2022). From AI to digital transformation: The AI readiness framework. *Business Horizons*, *65*(3), 329–339. https://doi.org/10.1016/j.bushor.2021.03.006

Jupir, J., Ab. Aziz, K., & Hassan, H. (2023). Determinants of Successful Collaborative Project Management: Insights From Malaysian Construction Industry. *International Journal of Technology*, *14*(6), 1344. https://doi.org/10.14716/ijtech.v14i6.6651

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

Karaduman, B., Tezel, B. T., & Challenger, M. (2023). Rational software agents with the BDI reasoning model for Cyber–Physical Systems. *Engineering Applications of Artificial Intelligence*, *123*, 106478. https://doi.org/10.1016/j.engappai.2023.106478

Turkyilmaz, A. H., & Polat, G. (2025). Risk-based completion cost prediction approach in construction projects utilizing machine learning. *Journal of Information Technology in Construction*, *30*, 375–396. https://doi.org/10.36680/j.itcon.2025.016

Leyer, M., & Schneider, S. (2021). Decision augmentation and automation with artificial intelligence: Threat or opportunity for managers? *Business Horizons*, *64*(5), 711–724. https://doi.org/10.1016/j.bushor.2021.02.026

Liu, H., Cheng, J. C. P., & Anumba, C. J. (2024). A Graph Neural Network Approach to Conceptual Cost Estimation. *Proceedings of the International Symposium on Automation and Robotics in Construction*, 815–821. https://doi.org/10.22260/ISARC2024/0106

Micale, R., La Fata, C. M., Lombardo, A., & La Scalia, G. (2021). Project Management Information Systems (PMISs): A Statistical-Based Analysis for the Evaluation of Software Packages Features. *Applied Sciences*, *11*(23), 11233. https://doi.org/10.3390/app112311233

Müller, R., Locatelli, G., Holzmann, V., Nilsson, M., & Sagay, T. (2024). Artificial Intelligence and Project Management: Empirical Overview, State of the Art, and Guidelines for Future Research. *Project Management Journal*, *55*(1), 9–15. https://doi.org/10.1177/87569728231225198

Nenni, M. E., De Felice, F., De Luca, C., & Forcina, A. (2024). How artificial intelligence will transform project management in the age of digitization: A systematic literature review. *Management Review Quarterly*. https://doi.org/10.1007/s11301-024-00418-z

Nieto-Rodriguez, A., & Maude, R. (2023). How AI Will Transform Project Management. *Harvard Business Review*. https://hbr.org/2023/02/how-ai-will-transform-project-management

Ninpan, K., Huang, S., Vitillo, F., Assaad, M. A., Benmiloud Bechet, L., & Plana, R. (2024). Mitigating Co-Activity Conflicts and Resource Overallocation in Construction Projects: A

Modular Heuristic Scheduling Approach with Primavera P6 EPPM Integration. *Algorithms*, *17*(6), 230. https://doi.org/10.3390/a17060230

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Alonso-Fernández, S. (2021). Declaración PRISMA 2020: una guía actualizada para la publicación de revisiones sistemáticas. *Revista Española de Cardiología*, *74*(9), 790–799. https://doi.org/10.1016/j.recesp.2021.06.016

Palanca, J., Rincon, J. A., Carrascosa, C., Julian, V. J., & Terrasa, A. (2023). Flexible Agent Architecture: Mixing Reactive and Deliberative Behaviors in SPADE. *Electronics*, *12*(3), 659. https://doi.org/10.3390/electronics12030659

Parizi, M. M., Sileno, G., & van Engers, T. (2021). Declarative Preferences in Reactive BDI Agents. In T. Uchiya, Q. Bai, & I. Marsá Maestre (Eds.), *Lecture Notes in Computer Science* (Vol. 12568, pp. 215–230). Springer. https://doi.org/10.1007/978-3-030-69322-0_14

Perera, H., Azadnia, A. H., & Ghadimi, P. (2022). Development of a Multi-Agent System to Tackle Communication Fragmentation and Information Exchange in the Construction Industry. *IFAC-PapersOnLine*, *55*(10), 335–340. https://doi.org/10.1016/J.IFACOL.2022.09.409

Pérez Castillo, Y. J., Orantes Jiménez, S. D., & Letelier Torres, P. O. (2024). Sprint Management in Agile Approach: Progress and Velocity Evaluation Applying Machine Learning. *Information*, *15*(11), 726. https://doi.org/10.3390/info15110726

Prasetyo, M. L., Peranginangin, R. A., Martinovic, N., Ichsan, M., & Wicaksono, H. (2025). Artificial intelligence in open innovation project management: A systematic literature review on technologies, applications, and integration requirements. *Journal of Open Innovation: Technology, Market, and Complexity*, *11*(1), 100445. https://doi.org/10.1016/j.joitmc.2024.100445

Raisch, S., & Krakowski, S. (2021). Artificial Intelligence and Management: The Automation–Augmentation Paradox. *Academy of Management Review*, *46*(1), 192–210. https://doi.org/10.5465/amr.2018.0072

Ramaul, L., Ritala, P., & Ruokonen, M. (2024). Creational and conversational AI affordances: How the new breed of chatbots is revolutionizing knowledge industries. *Business Horizons*, *67*(5), 615–627. https://doi.org/10.1016/j.bushor.2024.05.006

Strand, O., Reilstad, D. S., Wu, Z., Da Silva, B. C., Torresen, J., & Ellefsen, K. O. (2022). RADAR: Reactive and Deliberative Adaptive Reasoning - Learning When to Think Fast and When to Think Slow. *2022 IEEE International Conference on Development and Learning, ICDL 2022*, 184–189. https://doi.org/10.1109/ICDL53763.2022.9962202

Uddin, S., Yan, S., & Lu, H. (2025). Machine learning and deep learning in project analytics: methods, applications and research trends. *Production Planning & Control*, *36*(7), 873–892. https://doi.org/10.1080/09537287.2024.2320790

Ünsal-Altuncan, I., & Vanhoucke, M. (2024). A hybrid forecasting model to predict the duration and cost performance of projects with Bayesian Networks. *European Journal of Operational Research*, *315*(2), 511–527. https://doi.org/10.1016/j.ejor.2023.12.029

Wang, J., Hu, X., Demeulemeester, E., & Zhao, Y. (2021). A bi-objective robust resource allocation model for the RCPSP considering resource transfer costs. *International Journal of Production Research*, *59*(2), 367–387. https://doi.org/10.1080/00207543.2019.1695168

Xu, G., & Guo, T. (2025). Advances in AI-powered civil engineering throughout the entire lifecycle. *Advances in Structural Engineering*. https://doi.org/10.1177/13694332241307721

Zahaib Nabeel, M. (2024). Big Data Analytics-Driven Project Management Strategies. *Journal of Science & Technology*, *5*(1), 117–163. https://doi.org/10.55662/JST.2024.5104

Zhang, Y., Li, X., Teng, Y., Shen, G. Q., & Bai, S. (2024). A heuristic rule adaptive selection approach for multi-work package project scheduling problem. *Expert Systems with Applications*, *238*, 122092. https://doi.org/10.1016/j.eswa.2023.122092

Use of Generative Artificial Intelligence

No generative artificial intelligence was used in the preparation of this work.

Communication Aligned with the Sustainable Development Goals