From Agile to Autonomous: The Role of AI Agents in Software Project Management

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***Abstract*— Digital transformation and the development of Large Language Models (LLMs) are significantly impacting the way software projects are planned and managed, with agile methodologies and frameworks (e.g., Scrum, Kanban) still requiring a high level of manual human involvement in the planning, prioritization, risk assessment, and reporting processes. This paper aims to define the concept and framework of AIA-PM (AI Agent-Powered Project Management) and explore the possibilities of applying LLM agents in Autonomous Project Management (APM) processes, with a focus on the extent to which AI agents can take over management functions such as sprint planning, progress monitoring, risk analysis, decision-making and stakeholder communication. This paper will analyze which functions in agile project management are best suited for AI assistance or full autonomy, how LLM agents can contribute to the automation of planning, reporting, and risk assessment, and what the technical, ethical, and organizational challenges of introducing the AIA-PM approach are in real teams and industrial conditions. The results include a classification of functions suitable for the degree of autonomy, a presentation of potential benefits (efficiency, transparency, scalability) and limitations (ethics, security, accountability), as well as recommendations for the future development and application of such systems, with a proposal for a structured model/framework for practical implementation.**

Keywords—AI Agents, AI Agent-Powered Project Management, Large Language Models, Software Project Management

I. INTRODUCTION

Digital transformation has fundamentally reshaped the software development landscape, introducing new technologies and tools that significantly influence how projects are planned, executed, and controlled. Agile approaches and frameworks, such as Scrum and Kanban have become dominant in software project management due to their flexibility, iterative nature, and emphasis on customer value. However, despite their widespread adoption, agile frameworks still rely heavily on human involvement in key management activities, including sprint planning, backlog prioritization, risk assessment, progress monitoring, and stakeholder communication. These activities are often based on subjective judgment and experience, which can lead to inconsistencies, inefficiencies, and limited scalability, particularly in complex and fast-changing project environments.

Recent advances in artificial intelligence, particularly the development of Large Language Models (LLMs), have opened new possibilities for augmenting and transforming traditional project management practices. Unlike earlier automation tools, LLM-based AI agents are capable of understanding context, processing unstructured data, learning from historical project information, and supporting decision-making processes in real time. This evolution has led to the emergence of the concept of AI Agent-Powered Project Management (AIA-PM), which envisions a shift from human-centric management toward semi-autonomous and autonomous project management systems. Within this paradigm, AI agents can act as intelligent assistants or autonomous entities that analyze project data, predict risks and delays, generate reports, and support or execute managerial decisions.

By integrating data from project management tools (e.g., issue trackers, collaboration platforms), AI agents can generate real-time insights into project progress, detect deviations from plans, and predict potential risks related to scope, schedule, cost, or team capacity. This enables a transition from reactive project control toward proactive and predictive management, where potential issues are identified and addressed before they escalate. As the authors ìn [1] point out by leveraging LLMs, organizations can move toward more intelligent, adaptive, and proactive project management methodologies that align with Industry 5.0 values: human-AI collaboration, responsiveness, and personalization.

The aim of this paper is to define the concept and framework of AIA-PM and to explore the potential application of LLM agents in Autonomous Project Management (APM) processes. This scientific paper is based on a qualitative approach that includes a systematic review of scientific literature in the field of agile management and AI-assisted projects. The study focuses on identifying which agile project management functions are most suitable for AI assistance or full autonomy and examines how LLM agents can contribute to the automation of planning, reporting, risk assessment, and decision-making. Recent advances in Large Language Models have significantly expanded the scope of artificial intelligence applications in agile project management, moving beyond traditional automation and decision-support tools toward agent-based and collaborative systems. In this paper authors identify the key changes in competencies, processes, and organizational structure that arise from the introduction of AI agents into the life cycle of a software project.

The paper analyzes current research in this area. This approach enables the identification of key trends, advantages and limitations, as well as the formulation of recommendations for the future development and application of autonomous AI agents in software project management. This creates a complete theoretical and practical basis for understanding the transformation that leads from agile to fully autonomous project management.

II. THEORETICAL BACKGROUND

Traditional project management approaches based on linear planning, manual processes and human judgment have proven to be insufficiently flexible to meet the needs of modern organizations, particularly in the IT sector, which are increasingly characterized by rapid changes in requirements, growing software system complexity, and strong pressure to enhance quality and delivery speed [2], [3].

Contemporary software projects take place in a dynamic and complex environment where traditional management approaches no longer provide sufficient flexibility, speed and efficiency. Agile frameworks, especially Scrum and Kanban, have significantly improved the way software solutions are planned, coordinated and delivered. However, with the accelerated development of artificial intelligence and the emergence of advanced AI agents, software project management is entering a new development phase [4], [5].

Over the past decade, artificial intelligence has evolved from systems based on predefined rules toward adaptive and autonomous solutions capable of decision-making in dynamic environments. In this context, AI agents represent one of the key concepts of contemporary artificial intelligence. In literature an AI agent is defined as a software-based or hybrid entity that autonomously collects data from its environment, interprets it using artificial intelligence algorithms, and executes actions to achieve predefined goals. Modern AI agents rely on advanced machine learning models, enabling them to adapt and continuously improve their performance over time. Artificial Intelligence denotes the emulation of human intelligence in machines, incorporating technologies such as machine learning, natural language processing, robotics, and expert systems. These technologies are revolutionizing multiple domains by allowing machines to execute tasks that conventionally necessitate human intelligence, including visual perception, speech recognition, decision-making, and language translation [6].

The concept of AI Agent-Powered Project Management (AIA-PM) represents a natural evolution of AI-supported decision-making toward more autonomous and intelligent project management systems. Unlike traditional project management tools that primarily assist with reporting or scheduling, AIA-PM introduces AI agents as active participants in management processes. These agents are capable of perceiving project states, interpreting structured and unstructured data, reasoning over multiple constraints, and executing or recommending actions aligned with predefined project goals. Within agile environments, this shift is particularly relevant due to the iterative nature of work, frequent requirement changes, and continuous decision-making demands.

A key aspect of AIA-PM is the classification of agile project management functions according to their suitability for different levels of AI autonomy. Functions such as progress monitoring, performance reporting, metric analysis, and anomaly detection are well suited for high levels of automation due to their reliance on quantitative data and clearly defined outputs. Sprint planning support, backlog refinement, and risk assessment typically benefit from partial autonomy, where AI agents provide recommendations, scenario simulations, and prioritization suggestions while human managers retain decision authority [7]. More strategic and context-sensitive functions-such as stakeholder negotiation, value-based prioritization, and ethical judgment-currently require strong human oversight, highlighting the importance of hybrid human–AI collaboration models.

The introduction of AIA-PM also implies a redefinition of traditional agile roles. Project managers, Scrum Masters, and Product Owners increasingly shift from operational coordination toward supervisory, strategic, and governance-oriented responsibilities [8]. AI agents assume responsibility for routine analytical tasks, continuous monitoring, and optimization, while human actors focus on vision, alignment, and decision validation. This redistribution of responsibilities has the potential to reduce cognitive overload, improve consistency, and increase scalability across multiple projects and teams.

Existing research papers indicates that artificial intelligence has been increasingly explored as a means to enhance project planning, monitoring, and decision support, particularly through predictive analytics for schedule delays, cost estimation, resource allocation, and risk forecasting [9], [10], [11]. The application of AI-driven predictive analytics, optimized resource planning, automated risk identification, and adaptive scheduling enables project managers to enhance overall project performance, operational efficiency, and stakeholder satisfaction. Systematic and review-based studies generally conclude that AI can strengthen project management performance by improving visibility, early warning capabilities, and decision consistency, while simultaneously introducing challenges related to data quality, tool integration, and organizational readiness. AI-supported project management constitutes a substantial improvement in decision-making processes and predictive capabilities.

Machine learning enables project management systems to learn from historical data and improve predictions over time without being explicitly programmed [12]. Through the use of algorithms that detect patterns and trends in datasets, ML models can forecast project outcomes, predict resource requirements, and identify potential risks with a level of precision far surpassing human capacity. Natural language processing (NLP) extends the capabilities of AI in project management by enabling systems to process and analyze human language. This is particularly relevant in communication-intensive projects, where the systematic tracking of project progress and the accurate interpretation of contextual information derived from stakeholders' reports, email exchanges, and other communication channels are critical for effective and informed decision-making.

In project management, LLMs are increasingly employed for tasks such as automated documentation generation, real-time stakeholder communication, and intelligent decision support [13]. Owing to their advanced natural language processing capabilities, LLMs can effectively summarize project updates, analyze unstructured project data, and identify patterns derived from historical project records [14]. Furthermore, these models are able to predict potential risks and recommend appropriate actions by contextualizing information across diverse data sources, thereby enhancing situational awareness and supporting more informed and timely decision-making processes [15].

Within agile contexts, early research demonstrates how language-model-driven approaches can support or simplify agile project planning and execution, indicating feasibility for partial automation of Scrum-oriented workflows [5]. Moreover, research that explicitly targets agile project

management tasks (e.g., reporting, requirements generation, and scope coverage) suggests that LLMs can reduce manual effort and improve consistency, particularly in documentation-heavy PM activities. These findings motivate the AIA-PM concept by positioning LLM agents not merely as assistants that draft text, but as systems capable of "closing the loop" by analyzing project signals and generating actionable management outputs.

LLM-based agents play a central role due to their ability to process natural language artifacts such as user stories, sprint goals, risk descriptions, and stakeholder communications. Recent advances in Large Language Models have led to the rise of LLM-based agents, which extend beyond text generation by incorporating planning, memory, tool use, and interaction with external systems. This "agentic" capability is especially relevant for project management because PM work heavily depends on combining structured signals (metrics, timelines, budgets) with unstructured artifacts (requirements, stakeholder feedback, meeting notes, risks, decisions). A comprehensive overview of LLM-based agents in software engineering emphasizes that agents can execute multi-step tasks by perceiving context, invoking tools, and iteratively refining outcomes-capabilities that align well with planning, reporting, and coordination functions in agile environments.

The literature increasingly explores AI and LLMs across specific agile functions such as backlog management, requirements quality, and sprint-level coordination [16]. Research on using LLMs for backlog management emphasizes improving user story quality and structuring agile artifacts, which directly affects prioritization and sprint planning effectiveness. Complementary work highlights the potential of integrating LLM-powered cognitive agents into agile project management frameworks to enhance execution, coordination, and decision support-supporting the assumption that agile processes can be augmented by agentic systems beyond classic analytics.

Moving from AI assistance to autonomy requires reliable human–agent collaboration models, especially when multiple agents coordinate across planning, monitoring, and communication tasks. Research on trustworthy human-agent collaboration in LLM-based multi-agent autonomous systems emphasizes that autonomy introduces new coordination and oversight challenges, including allocation of responsibilities, conflict resolution, and ensuring consistent behavior across agents. This supports the need for AIA-PM frameworks that define not only which PM functions are automated, but also how agents interact with humans and other systems (issue trackers, CI/CD, documentation, dashboards), and where oversight boundaries are placed [17].

III. APPLICATION OF LARGE LANGUAGE MODELS IN AGILE AND AGENT-BASED PROJECT MANAGEMENT

The Tab. 1 provides a systematized overview of relevant scientific papers dealing with the application of large language models (LLMs) and AI agents in agile software project management. The presented papers were analyzed through four key dimensions: the focus of application, the type of model used, the primary role of LLM and the level of autonomy of the system. This structure enables a comparative analysis of different approaches, from the assistive use of generative AI to highly autonomous multi-agent systems, thus clearly illustrating the evolution of the role of AI in agile project management.

Analysis of Tab. 1 shows that LLMs and AI agents have been applied in a wide range of agile functions, including sprint planning, backlog management, effort estimation, progress monitoring, risk prediction, as well as improving the quality of user stories. Earlier and human-centric papers (e.g. [5], [18], [17]) focused on assistive support to existing Scrum practices, while more recent works (e.g. [16], [19], [20]) introduce partially autonomous agents that take on specific operational tasks. Thus, the table clearly shows how AI application is moving from support to active participation in project processes.

Based on the analysis of the papers, it can be concluded that the literature clearly indicates the gradual evolution of the role of AI systems in agile project management. While earlier approaches treat LLMs as documentation automation and decision support tools, more contemporary works introduce AI agents that actively participate in the planning, coordination and execution of agile activities. This transition from AI-assisted to semi-autonomous and autonomous systems represents a key trend in the development of the AIA-PM paradigm.

Contemporary research papers increasingly explore the use of LLMs to support or automate core agile functions such as sprint planning, effort estimation, backlog management, and team coordination. This paper highlights a shift from isolated AI assistance toward integrated, agent-driven approaches that redefine how project management activities are executed in agile environments.

The studies summarized in Tab. 1 demonstrate a clear evolution in both the technical maturity and functional scope of LLM applications within agile project management. The special value of the table is reflected in the classification of the level of autonomy, which enables the differentiation between AI-assisted, semi-autonomous and highly autonomous systems. Works such as [21] and [22] represent a shift towards multi-agent architectures with a high degree of autonomy, where AI agents cooperate with each other and perform tasks with minimal human supervision. In contrast, most of the literature still relies on low-to-medium autonomous systems, indicating that full autonomy in agile project management is still in the research and experimental application phase.

Earlier papers primarily employ GPT-3 and GPT-3.5 models to assist with planning, estimation, and reporting tasks, positioning LLMs as supportive tools that enhance human decision-making. More recent contributions increasingly adopt GPT-4-based and multi-agent architectures, enabling higher levels of autonomy in functions such as collaborative planning, requirements prioritization, sprint management, and

developer behavior simulation [23]. Key functionalities are human-like conversational responsiveness, natural language translation, and automated text summarization, which collectively enhance communication and information processing in project environments. By assuming responsibility for a range of repetitive and time-intensive tasks, such as documentation preparation, information synthesis, and preliminary risk assessment the system, enables project managers to focus on higher-level strategic and coordination activities.

TABLE I. OVERVIEW OF LARGE LANGUAGE MODELS USED IN AGILE PROJECT MANAGEMENT AND AGENT-BASED SYSTEMS

Reference	Application Focus	LLM / Model Type Used	Primary Role of LLM	Level of Autonomy
[16]	Agile project planning	GPT-3.5	Sprint planning, user story generation, task breakdown, effort estimation	Semi-autonomous
[24]	Tool selection and manipulation by LLM-based agents	GPT-4.0	Tool-aware reasoning and autonomous task execution	Medium-High (semi-autonomous)
[25]	Evaluation of general reasoning and planning capabilities relevant to autonomous agents	GPT-4 (large-scale transformer-based LLM)	General-purpose reasoning, abstraction, and multi-step planning	Medium-High (foundational cognitive autonomy)
[26]	Open-ended autonomous agent with continual learning and planning	Transformer-based LLMs integrated with planning, memory, and tool execution	Autonomous reasoning, planning, skill generation, and tool use	High (autonomous)
[27]	Agile effort estimation via multi-agent coordination	Large Language Models (LLMs) integrated into a multi-agent framework (referred to as SEEAgent)	Multi-agent estimation, consensus building, Generates and justifies effort estimates; interacts with agents and humans	Semi-autonomous
[28]	Generative AI for optimizing Agile product management (task coordination, backlog refinement, sprint planning, team efficiency)	Generative models (GPT-4 Plus, Gemini AI, Blackbox AI) integrated across workflow	Automating backlog refinement, sprint planning, resource allocation, predictive analytics	AI-assisted
[21]	Multi-agent AI collaboration in agile software development	Transformer-based LLMs in a multi-agent framework	Collaborative reasoning, coordination, and interaction between agents and humans	High (semi-autonomous → autonomous)
[5]	AI integration into Scrum practices (planning, backlog refinement, reporting)	Transformer-based LLMs used as supportive AI tools	Assistive generation, refinement, and communication support	Low-Medium (AI-assisted)
[19]	Automated enhancement of user story quality in agile backlogs	Transformer-based LLM agents (model-agnostic)	Autonomous analysis and refinement of user stories	Medium (semi-autonomous)
[20]	Requirements and backlog prioritization using LLMs	Transformer-based LLMs (model-agnostic)	Analytical decision support for requirement ranking	Low-Medium (assistive decision support)
[22]	Multi-agent collaboration for agile software development and task execution	Transformer-based LLMs in a dynamic multi-agent system	Autonomous coordination and execution of agile development tasks	High (semi-autonomous → autonomous)
[29]	AI-enhanced sprint management and velocity prediction	ML-based predictive models (LLM-agnostic)	Sprint velocity forecasting and planning support	Low-Medium (predictive decision support)
[18]	AI integration into agile workflows (planning, execution, communication, monitoring)	Model-agnostic LLM-based and generative AI techniques	Assistive automation and workflow optimization	Low-Medium (assistive)
[30]	Impact of generative AI on agile role evolution and backlog-driven coordination	Model-agnostic LLM-based generative AI tools	Role augmentation and redistribution of agile responsibilities	Low-Medium (assistive)
[17]	Human-centric AI integration into agile methodologies	LLMs and ML-based AI tools (model-agnostic)	Assistive support for communication, coordination, and decision-making	Low-Medium (human-centric assistive)

Moreover, ChatGPT facilitates comprehensive risk analysis and, due to its advanced linguistic competencies, can function as an intermediary during meetings with stakeholders who may lack familiarity with technical or domain-specific terminology. In this way, the system contributes to improved clarity, inclusiveness, and efficiency in project communication processes. Despite these advances, the literature remains fragmented, with limited consensus on autonomy boundaries, governance mechanisms, and the systematic integration of LLM agents into end-to-end project management frameworks.

IV. CONCLUSION

In recent years, the application of artificial intelligence in project management has emerged as a prominent research domain, particularly focusing on the automation of routine tasks, decision-support, and the transformation of the roles of project managers and team members.

This paper explored the emerging concept of AI Agent-Powered Project Management (AIA-PM) and its potential to transform traditional and agile project management practices through the application of Large Language Model-based AI agents. The analysis demonstrated that many core functions of agile project management-such as sprint planning, progress monitoring, risk analysis, reporting, and stakeholder communication-are well suited for AI assistance and, in certain cases, partial or full autonomy. By leveraging real-time data analysis, predictive capabilities, and continuous learning, AI agents can significantly enhance efficiency, transparency, and scalability in project management processes.

Overall, the evidence presented in Table 1. underscores the ongoing transition from AI-assisted agile project management

toward AI Agent-Powered and partially autonomous management paradigms. While LLM-based agents demonstrate strong potential to improve efficiency, consistency, and scalability across multiple agile functions, their adoption also raises important organizational, ethical, and governance-related challenges. These findings reinforce the need for structured frameworks, such as the proposed AIA-PM model, that classify project management functions by autonomy level and define clear human-AI collaboration and oversight mechanisms. By synthesizing existing research through the lens of autonomy and agent-based design, this study contributes to a more coherent understanding of how LLMs can be responsibly integrated into future agile project management systems. The table also shows that most research papers still favors hybrid models in which AI agents supplement, but do not completely replace, human roles. The Scrum Master, Product Owner, and Project Manager remain the key bearers of responsibility, while AI systems take over analytical, repetitive, and data-intensive tasks. This approach confirms that issues of trust, transparency and accountability remain central to the design of AI-supported agile systems.

The transition toward Autonomous Project Management introduces important challenges that must be carefully addressed. Technical limitations related to data quality, system integration, and model reliability, as well as ethical concerns regarding accountability, decision transparency, and trust, represent critical barriers to widespread adoption. Organizational readiness, including cultural acceptance and the redefinition of human roles, is equally important for successful implementation. Based on these findings, the paper proposed a structured framework for classifying project management functions according to their suitability for different levels of AI autonomy and provided recommendations for the future development and practical application of AIA-PM systems.

Overall, the results suggest that AI agents should not be viewed as replacements for human project managers but rather as powerful collaborators that augment human capabilities and enable more informed, proactive, and adaptive project management. Future research should focus on empirical validation of AIA-PM frameworks in real industrial environments, the development of governance models for autonomous decision-making, and the exploration of hybrid human-AI management structures that balance autonomy with human oversight.

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