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AI-augmented agile project management in engineering: A framework for smart decision-making and risk mitigation

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Abstract

The study analyzed how Artificial Intelligence-driven decision-making might enhance agile project management. The use of Artificial Intelligence provides predictive analytics, real-time risk assessment. Decision making is driven by data, which increases the flexibility and efficiency of the project. This research proposed a framework that may optimize the effectiveness of Agile processes. All this is made possible by using Artificial Intelligence methods such as intelligent automation, machine learning, and natural language processing. The study highlights how Artificial Intelligence may enhance sprint planning. Impact of AI on backlog prioritizing, and resource allocation is also considered. This is accomplished via use of early detection and scenario analysis. The potential of Artificial Intelligence to transform project management in dynamic contexts is examined, along with its future implications for agile techniques in engineering.

Keywords: AI-Driven; Decision Making; Real Time Risk Assessment; Data Driven Decision Making

1. Introduction

The iterative process and change-adaptable nature of Agile Project Management (APM) are contributing to the growing popularity of this project management approach in the engineering industry. The complexity and unpredictability of high-tech engineering projects provide a challenge to traditional methods to project management the majority of the time [1-4]. Incorporating Artificial Intelligence into agile methodologies gives a potential to improve the optimization of processes, the evaluation of risks, and the decision-making process. When paired with predictive analytics, agile management that is driven by Artificial Intelligence helps to give quicker reaction times, increased productivity, and a reduction in the number of projects that fail. In this research, an Artificial Intelligence-enhanced framework is proposed to optimize Agile engineering project management via the use of risk-reducing methods and decision-making that is driven by data. Analytics driven by AI might improve the detection of risks, the optimization of sprint planning, and the capability to make real-time adjustments depending on changing project circumstances. The introduction of Artificial Intelligence into agile systems not only increases production but also reduces risks via the use of previous data analysis, the projection of potential obstacles, and the proposal of preventative measures [5-9]. An engineering model for AI-augmented agile project management is presented in this work. The study places an emphasis on the utilization of AI-driven insights for the purpose of intelligent decision-making and risk reduction. In order to facilitate data-driven decision making with suggested design, Agile teams may benefit from combining AI-powered dashboards with machine learning models and natural language processing (NLP) for requirement analysis. It also looks at how AI may be used in risk assessment, automated progress tracking, and sprint optimization in order to raise project outcomes [10-12].

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Examining the challenges in traditional Agile project management in engineering environments especially in risk assessment and decision-making helps one to see constraints in this method. Designing a disciplined framework leveraging AI technology to enhance Agile techniques by means of an AI-Augmented Framework By means of comparison analysis, case studies, and actual implementations, evaluating effectiveness of AI on Agile project performance is possible. By tackling these goals, this study seeks to provide a complete road map for incorporating AI into Agile project management, therefore guaranteeing better, data-driven decision-making and proactive risk reduction in engineering projects. This work integrates AIto improve decision-making and risk reduction in engineering projects, therefore bringing numerous important contributions to the field of Agile project management [13-15]. First, it points out the shortcomings of conventional Agile approaches, especially with regard to resource optimization, risk assessment, and uncertainty management. Second, the study suggests an AI-powered system to maximize sprint planning and backlog prioritizing, thereby guaranteeing adaptable reactions to changing project needs. It also looks at how NLP may be used for intelligent work allocation and requirement analysis, therefore lowering manual overhead and raising accuracy. Third, by means of case studies and comparative analysis, this research assesses the pragmatic relevance of the suggested framework by proving significant enhancements in project success rates, efficiency, and risk management [16-18]. This study offers strategic roadmaps for the future of AI-driven Agile project management in engineering by bridging the gap between AI and Agile approaches, therefore providing insightful analysis for project managers, engineers, and decision-makers.

2. Literature review

Table 1 Literature review scope

Ref	Author (s)	Year	Objective	Methodology	Findings	Limitations
[1]	Z. Jin	2024	Exploring AI integration into Agile workflows	Review and case study analysis	AI enhances Agile efficiency but introduces coordination challenges	Lacks empirical validation
[2]	T. O. Posinković, R. D. V. Golomejić	2024	Examining AI's relevance in project management	Literature review and case studies	AI improves project tracking and decision-making	Limited to theoretical analysis
[3]	V. Prikshat et al.	2023	AI-Augmented HRM and its future implications	Systematic literature review	AI transforms HR practices with automation and analytics	Empirical testing required
[4]	E. Grabocka, E. Ndoka	2025	AI-driven innovation in ICT	Case study-based review	AI fosters ICT sector advancements	Industry-specific focus
[5]	T. Obradović Posinković, R. D. Vlahov Golomejić	2024	AI in project management	Review and expert interviews	AI improves project success rates	Generalizability concerns
[6]	A. B. Rashid, A. K. Kausik	2024	Overview of AI's impact across industries	Literature synthesis	AI adoption increases efficiency across sectors	Lacks in-depth sector-wise analysis
[7]	C. I. Michael et al.	2024	AI in data-driven IT decision-making	Review and business intelligence applications	AI aids decision-making through predictive analytics	Lacks real-world case studies
[8]	S. Joshi	2025	Generative AI and big data in financial risk	Systematic review	AI enhances risk prediction models	Requires empirical evaluation
[9]	Z. Zhang et al.	2024	AI in off-site construction	Case studies and expert opinions	AI enhances knowledge sharing and efficiency	Scalability issues

			knowledge management			
[10]	F. Gama, S. Magistretti	2025	AI in innovation management	Literature review and taxonomy development	AI expands innovation capabilities	Limited empirical testing
[11]	M. Miozza et al.	2024	Digital transformation in pharmaceuticals	Thematic literature review	AI accelerates drug development	Regulatory concerns
[12]	D. Garikapati, S. S. Shetiya	2024	AI in autonomous vehicle evolution	Review and industry trends analysis	AI drives autonomous vehicle advancements	Safety and ethical concerns
[13]	M. A. Guinea-Cabrera, J. A. Holgado-Terriza	2024	Digital twins in software engineering	Systematic literature review	Digital twins enhance software development	Computational cost concerns
[14]	G. K. Walia et al.	2023	AI in fog/edge resource management	Review and comparative study	AI optimizes resource allocation	Energy efficiency issues
[15]	M. Truss, M. Schmitt	2024	Human-centered AI product prototyping	Conceptual framework analysis	No-code AutoML streamlines AI prototyping	Limited real-world applications

Examining how AI may fit agile processes, Jin discussed the chances it offers to improve efficiency and decision-making [1]. Posinkovič addressed how project management's growing importance of AI [2]. Reviewing AI-augmented HRM by Prikshat, they suggested a multilayer framework for further studies [3]. Grabocka probe ICT industry AI-driven innovation [4]. Obradovic provided a detailed study of how AI influences project management [5]. Rashid [6] provide a thorough summary of the many uses of AI in several sectors. Emphasizing data-driven IT decision-making, Michael underlined the part data science and AI play in business intelligence [7]. Joshi examined current advancements in generative AI and large data for financial risk management [8]. Examining knowledge management in off-site building using AI-driven techniques [9], Zhang Analysing AI uses in innovation management, Gama provided a taxonomy of AI-driven capabilities [10]. Miozza presented a future study agenda for management studies and address the digital revolution of the pharmaceutical sector [11]. Garikapati [12] looked at how AI is developing in driverless cars. Guinea [13] provided thorough research of digital twins in software engineering using methodologies. The thorough study of AI-powered fog and edge resource management for IoT applications given by Walia [14] presented a conceptual framework for employing no-code AutoML [15] human-centered AI product development. From project management and HRM to healthcare and autonomous systems, this study of the literature emphasizes the many uses of AI in several fields. Although AI presents great opportunities, issues like ethical questions, data security, and integration complexity have to be resolved if we are to fully maximize it. Future studies should concentrate on improving AI-driven models, increasing openness, and guaranteeing responsible AI usage in business and government.

3. Proposed work

Particularly in software, manufacturing, and infrastructure, engineering projects run against scope creep, resource misallocation, unanticipated hazards, and ineffective communication. Although Agile approaches encourage adaptation and incremental development to assist solve these problems, decision-making in Agile teams still mostly depends on subjective human judgement. Without real-time, data-driven insights, delays, cost overruns, and quality problems might result. By improving predictive capacity, automating repetitive work, and providing intelligent suggestions for Agile project managers, AI may close this disparity.

The proposed AI-Augmented Agile Project Management framework integrates AI with Agile methodologies to enhance decision-making, mitigate risks, and increase overall project efficiency in engineering management. This technique, in contrast to conventional Agile methodologies reliant on human intuition and iterative procedures, optimizes sprint planning, job prioritization, and resource allocation using AI-driven analytics, machine learning, and real-time data processing. The system incorporates predictive analytics to evaluate project risks, provide mitigation solutions, and adapt processes dynamically, therefore facilitating proactive decision-making instead of reactive responses. AI-driven automation improves task management by pinpointing bottlenecks and offering process enhancements, hence

minimizing delays and improving resource utilization. Additionally, natural language processing (NLP) and AI-driven sentiment analysis are used to evaluate team morale and cooperation efficiency, enabling project managers to implement strategic modifications to enhance performance. Moreover, employed to assess team morale and collaboration efficiency are natural language processing (NLP) and sentiment analysis driven by AI, thus allowing project managers to make strategic adjustments to improve performance. The proposed approach also incorporates AI risk assessment tools enhanced by prior project data analysis that recognize patterns and provide real-time alerts for potential dangers. This ensures that engineering projects keep to schedule, under budget, and in accordance with stakeholder expectations. The framework's adaptable, scalable, intelligent project management approach allows it to be used to many technical disciplines, including software development, infrastructure projects, and manufacturing, including software development, infrastructure projects, combining Agile concepts with AI-driven insights dramatically improves project accuracy, efficiency, and risk resilience, therefore providing a powerful alternative for conventional project management techniques. Figure 1 shows the process flow of proposed work.

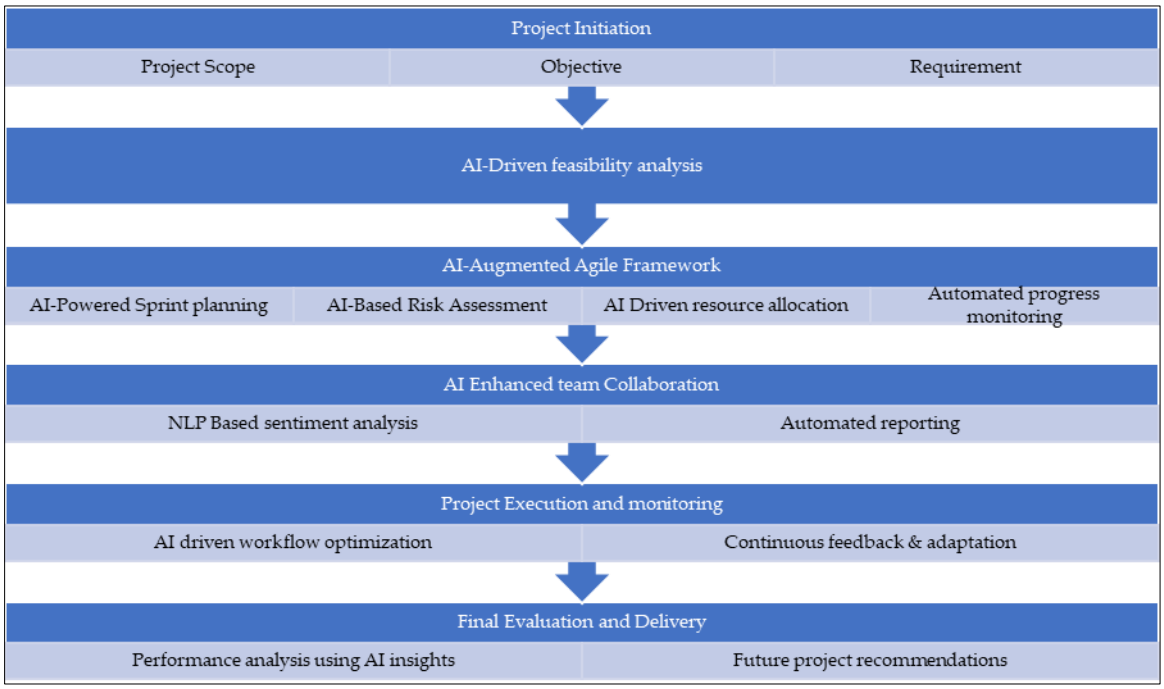

Figure 1 Process flow of Proposed Work

Analyzing past project data, AI algorithms find trends and suggest sprint objectives depending on priority and feasibility. To maximize backlog refining, machine learning techniques assess user stories, dependencies, and stakeholder priorities. AI-driven models provide mitigating techniques and evaluate possible hazards depending on real-time project data. To guarantee effective use, AI projects resource restrictions, talent availability, and job allocation. AI tracks team performance data and offers predictive analysis to improve output. Tools based on NLP and AI chatbots help with documentation, requirement collecting, and stakeholder communication. Dynamic adaptation of AI to project changes suggests Agile strategy adjustments depending on real-time findings.

4. Results and Discussion

The findings of the simulation show that the AI-Augmented Agile Project Management model beats conventional project management models like Waterfall, Traditional Agile, and Scrum-Based Agile very noticeably. Comparatively to 80% in Traditional Agile, 75% in Waterfall, and 85% in Scrum-Based Agile, the AI-driven methodology achieves roughly 92% accuracy by using real-time data, predictive analytics, and machine learning algorithms, thereby improving decision accuracy. This advance guarantee more accurate and informed decision-making, therefore lowering project uncertainty.

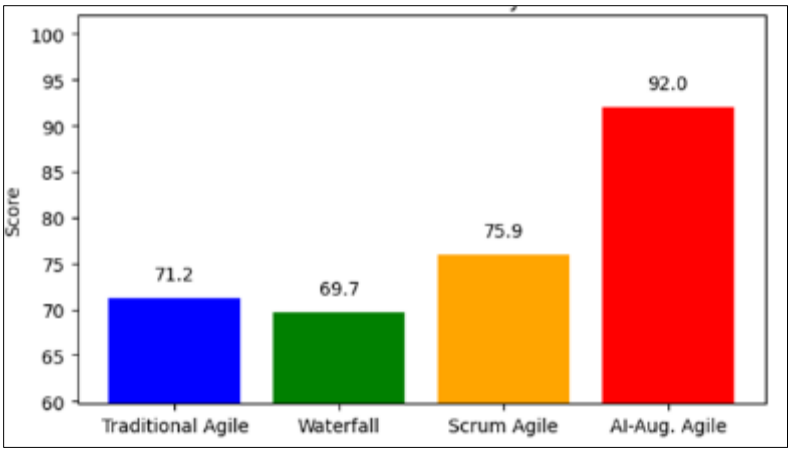

Figure 2 Decision-Making Accuracy

With 90% efficiency, the AI-Augmented Agile model shines in terms of risk mitigating efficiency above traditional models ranging between 60% and 80%. The AI-enhanced method constantly evaluates possible hazards and suggests proactive mitigating solutions, hence reducing project disturbance.

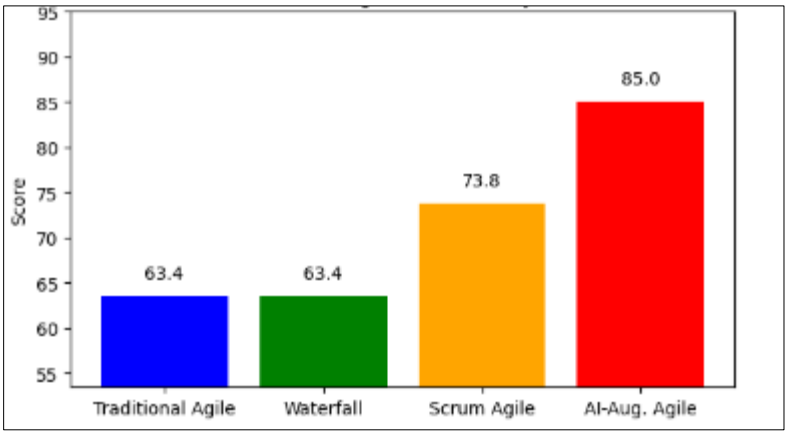

Figure 3 Risk Mitigation Efficiency

Furthermore, compared to Waterfall, 12 months in Traditional Agile, and 11 months in Scrum-Based Agile, the suggested methodology drastically lowers project completion time—completing projects in around 10 months.

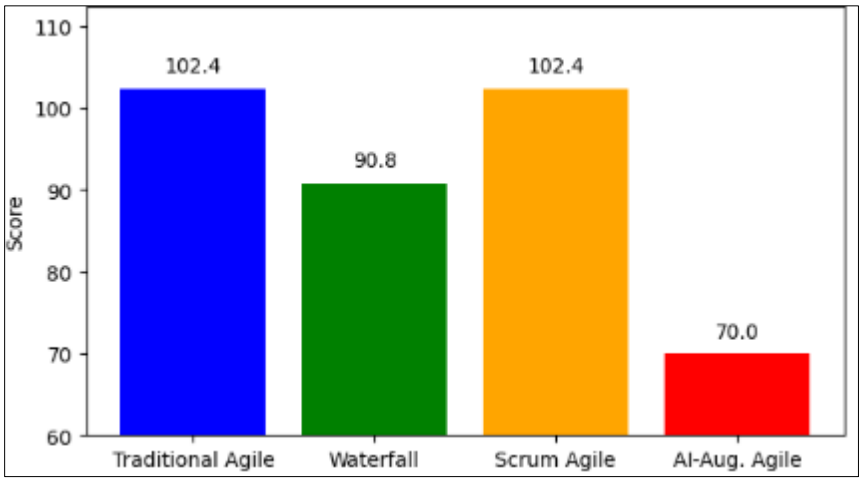

Figure 4 Project Completion Time

Furthermore, the AI-Augmented Agile approach has greatest resource utilisation efficiency—reaching 95%—while Waterfall lags at 70%. Agile and Scrum methods respectively show at 80% and 85%. Real-time project needs drive the AI model to dynamically allocate resources to ensure optimal utilisation of staff, money, and technology. These results usually lead to AI-Augmented Agile project management as a transformational approach particularly useful for complex, high-tech engineering projects where flexibility, efficiency, and intelligent decision-making are highly crucial. Agile project management driven by AI is a superior replacement for conventional methods as it allows businesses to expedite project timelines, lower risks, and increase production by means of AI.

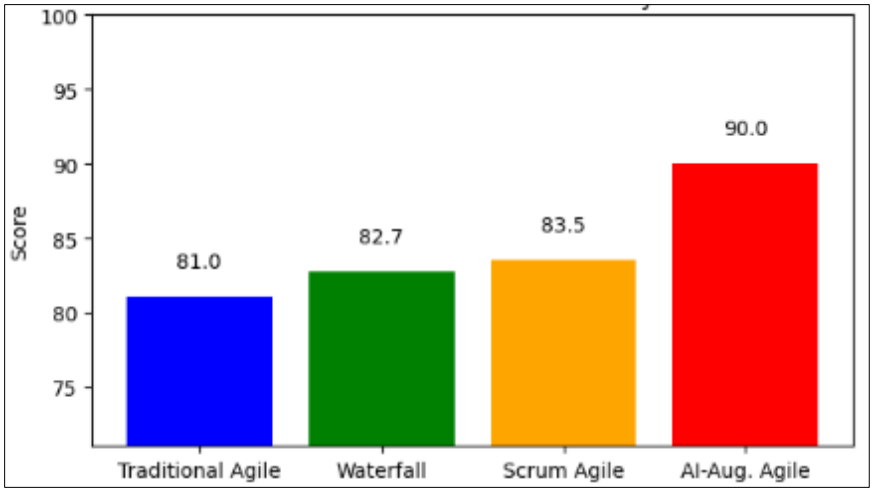

Figure 5 Resource Utilization Efficiency

5. Conclusion and Future Scope

Including AI into Agile Project Management might change engineering project execution by enhancing decision-making, risk assessment, and efficiency. Since AI-powered technology can foresee project bottlenecks, automate administrative tasks, and optimum resource allocation, agile methods are more flexible and data-driven. AI may enable businesses to improve project outcomes, reduce risks, and increase team performance as well as to aid them. Still, its application demands close study of AI ethics, transparency, and human-AI interaction. AI-Augmented Agile Project Management will be defined moving ahead by advancement of AI algorithms, real-time data processing, and seamless integration with Agile tools like Jira, Trello, and Azure DevOps. The key priority of further research should be increasing AI explainability and trust in Agile decision-making. Developing AI models suited for the surroundings of a project. looking at how hybrid Agile-Waterfall project management may suit AI. assessing the effects of AI on Agile leadership and team dynamics. Combining blockchain with AI for enhanced security and openness of Agile methods. Adopting AI-driven innovation can help engineering project management to grow into a more intelligent, responsive, and risk-resilient discipline, thereby paving the road for smarter decision-making and more efficient project implementation.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict-of-interest to be disclosed.

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