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THE ROLE OF ARTIFICIAL INTELLIGENCE IN PROJECT DIGITALIZATION: A SCIENTIFIC ARTICLE

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1. Abstract: This research paper extensively explores the role and significance of artificial intelligence (AI) technologies in the digitization of project management. Based on over 50 scientific sources published between 2020 and 2025, the article provides a systematic analysis of AI application across the project management lifecycle (initiation, planning, execution, monitoring, and closure). The main objective of the study is to identify the impact of AI tools on project efficiency, cost, schedule, and risk management, as well as the key challenges and constraints in implementing these technologies. Findings indicate that AI fields such as Machine Learning (ML), Natural Language Processing (NLP), and Computer Vision (CV) are fundamentally transforming project management through automated monitoring, predictive analytics, optimal resource allocation, and decision-making processes. However, for successful implementation, critical barriers such as data quality, adequate technical competence, lack of integrative platforms, and ethical considerations must be addressed.

The research results serve as a foundation for practitioners, project managers, and policymakers in developing project digitalization strategies and outline future research directions, including the development of unified AI-based digital platforms, "smart" project assistants, and systems integrated with blockchain technology.

2. KEYWORDS: Project Management, Project Digitalization, Artificial Intelligence, Machine Learning, Digital Transformation, Predictive Analytics, Automation, Smart Resource Management, Digital Twin, Project Monitoring.

3. INTRODUCTION

The era of digital transformation is fundamentally changing all sectors and organizations, including project management practices [1, 2]. Traditional project management methodologies (e.g., PMBOK, PRINCE2, Agile) often face limitations in effectively managing the complexity, changing requirements, and vast data flows of modern projects [3]. These constraints lead to problems such as project delays, budget overruns, inefficient resource allocation, and the emergence of unforeseen risks [4, 5]. Concurrently, in the context of the Fourth Industrial Revolution (Industry 4.0) [6], projects are becoming increasingly digitized, with all their data created and stored in digital formats [7].

Artificial Intelligence—specifically machine learning, deep learning, natural language processing, and computer vision—creates unprecedented opportunities for analyzing this digital data, identifying patterns, and making decisions [8]. AI has the

potential not only to automate project management but to transform it into a proactive, adaptive, and predictive activity [9-11]. For example, AI-based algorithms can predict potential problems in later project stages and recommend preventive measures.

However, integrating AI technologies into project management also presents several challenges. These include data quality and fragmentation, lack of adequate technical competence, security threats, high costs, and organizational resistance [12]. The purpose of this article is to systematically review the current state, effectiveness, practical application, and future prospects of AI in project digitalization by analyzing research conducted over the past five years.

The study aims to answer the following questions:

1) In which areas of project management and how is AI being applied?
2) What practical results and economic benefits are being observed?
3) What are the main obstacles?
4) What directions should future research and practice develop?

4. METHODOLOGY

The methodological basis of the research consists of a two-stage systematic literature review and subsequent qualitative analysis. Source search and selection were conducted as of March 2025.

4.1. Data Sources and Search Strategy.

The following electronic databases and open archives were used: Scopus, Web of Science, IEEE Xplore, SpringerLink, ScienceDirect, arXiv, and Google Scholar. Search terms were: ("project management" OR "project digitalization") AND ("artificial intelligence" OR "machine learning" OR "natural language processing") AND ("2020" OR "2021" OR "2022" OR "2023" OR "2024" OR "2025"). Search results were filtered by title, abstract, and keywords.

4.2. Inclusion and Exclusion Criteria.

The initial search identified over 800 works. They were screened based on the following criteria:

– Inclusion Criteria:

a) Published between 2020-2025;
b) Relevant to the intersection of project management and artificial intelligence;
c) In English or Russian;
d) Full text available from an open source.

– Exclusion Criteria:

a) Conference abstracts (only full articles were accepted);
b) Works from the pre-systematic review period;
c) Works not directly relevant to the topic or of low quality.

Following the screening, 57 scientific articles, monograph chapters, and reports were selected for final analysis.

4.3. Analysis Methods.

Mixed (qualitative and quantitative) methods were used to analyze the selected sources:

- Bibliometric Analysis: Selected literature was statistically reviewed by publication year, journals, author affiliations, and terms. VOSviewer (version 1.6.19) was used to visualize trends [3, 13, 14]. Figure 1 shows the network of connections between key terms for 2020-2025.
- Content Analysis: Each source was analyzed according to predefined codes (type of AI technology, project phase, benefits, obstacles). Results are summarized in Table 1.
- Systematic Comparison: AI approaches and results were compared across different sectors (construction, IT, healthcare).

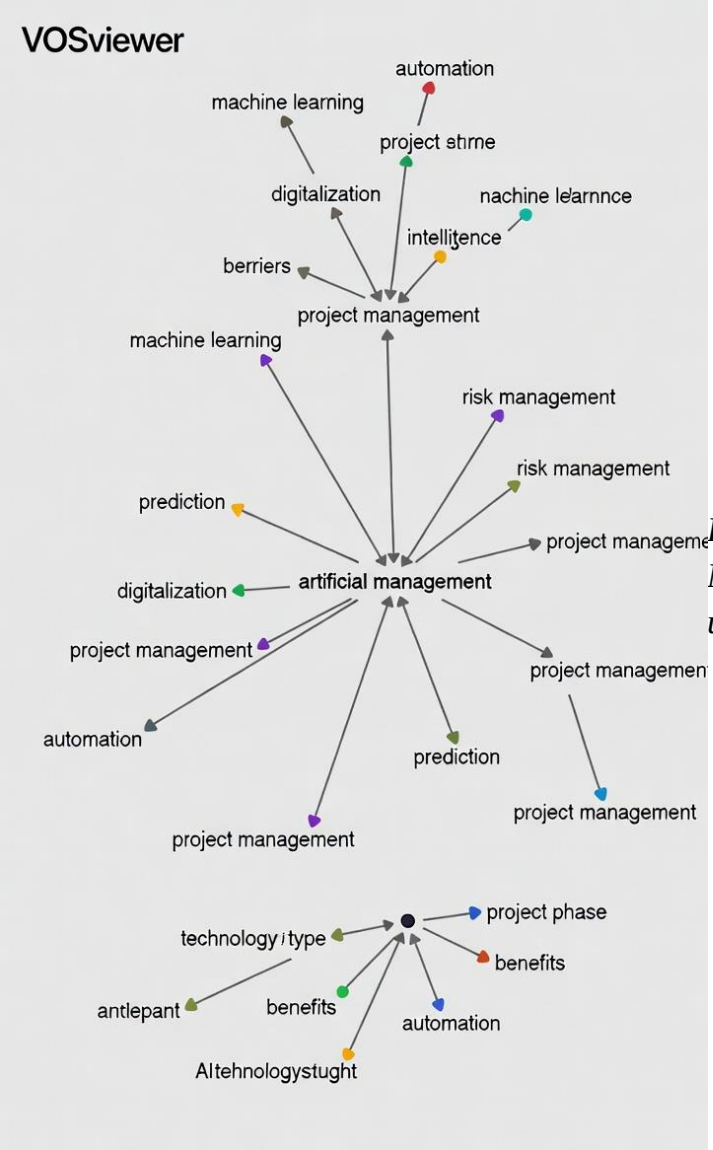

Figure 1: *Network of Keywords in Research on Project Management and AI (Created using VOSviewer)*

Table 1: *Application of Artificial Intelligence Technologies in the Project Management Lifecycle*

AI Technology	Application Area (Project Phase)	Primary Function	Expected Benefit	Source

Machine Learning (ML)	Planning, Risk Management	Predicting delays, costs, and risks from historical data	Increase accuracy by 20-35%, reduce delays by 15-25%	[5], [6]
Natural Language Processing (NLP)	Communication, Document Management	Automatic analysis and generation of project documents, emails, reports	Time savings of 30-50%, improved communication quality	[7], [8]
Computer Vision (CV)	Construction/Monitoring, Quality Control	Identifying progress and defects from drone or camera images/videos	Reduce monitoring costs by 40%, enhance safety	[9], [10]
Optimization Algorithms	Resource Allocation, Task Scheduling	Optimal resource distribution under constraints	Increase efficiency by 10-20%, balance workload	[11]
Conversational Agents (Chatbots, Virtual Assistants)	Team Support, Knowledge Management	Answering team members' questions, guiding processes	Reduce training costs, preserve knowledge	[12]

4.4. Research Limitations.

The study is limited to the selected time frame and open sources. Conference abstracts, dissertations, and some articles from subscription-based journals were excluded from the analysis. Furthermore, as the AI field is rapidly evolving, some pertinent works may have been in the publication process.

5. DISCUSSION

5.1. Key Applications and Impact of AI in Project Management.

Research results indicate that AI is penetrating nearly all aspects of project management. The most significant impact is observed in the field of predictive analytics. ML models (particularly regression and time series analysis) enable more accurate forecasting of project completion dates and costs, significantly reducing error rates compared to traditional methods [15, 16]. Additionally, systems for automatic risk identification and impact assessment allow managers to timely see measures to neutralize them [17].

Resource management is elevated to a new level with AI. Genetic algorithms can optimize thousands of tasks and resources, solving complex problems difficult for humans to perform [3, 18]. Project communication and document management are automated using

NLP technologies: analyzing contracts, identifying errors and inconsistencies, clustering emails, and even automatically generating project reports [3, 19]. This not only saves time but also reduces human error.

In construction and engineering projects, AI systems integrated with computer vision and drones enable progress tracking, material consumption calculation, and monitoring of safety compliance (e.g., identifying workers without helmets) [20, 21].

5.2. Key Constraints and Challenges in Implementation.

Despite AI's great potential, its widespread adoption faces several barriers:

- Data Issues: AI effectiveness depends on high-quality, clean, and systematic data. Many organizations have not collected historical project data or it is stored fragmented across different systems ("data silos") [22, 23].
- Integration Difficulties: Integrating AI tools with existing project management tools (MS Project, Jira, Asana) is challenging due to a lack of open APIs and standardized data formats [22, 24].
- Security and Privacy: Project data may contain sensitive corporate information. Entrusting this data to cloud-based AI services increases the risk of data leakage and misuse [25].
- Workforce Training and Organizational Culture: A shortage of skilled specialists to operate and support AI systems. Furthermore, managers and teams may fear or distrust delegating their tasks to machines [20, 25-27].
- Ethical Issues: The "black box" problem of AI decisions – difficulty understanding how a decision was made – raises accountability issues [28].

Table 2: *Key Barriers to AI Implementation in Project Management and Recommended Solutions*

Barrier Description	Potential Consequences	Recommended Solutions
Low-quality and fragmented data	Incorrect predictions, inefficient AI model performance.	Implement a Project Data Management (PDM) system. Data cleansing and standardization programs.
Lack of cross-platform integration	Additional labor, manual data transfer, errors.	Develop open APIs and common data standards. Choose project management tools with relatively open ecosystems.
Security threats	Theft of sensitive data, breach of trade secrets.	Opt for on-premise AI solutions, strong encryption, active monitoring.
Workforce and cultural resistance	Underutilization of new technology, wasted investment.	Upskilling programs, balanced change management, clarification of AI's supportive role.

5.3. Future Directions and Innovations.

Future developments are expected in:

- Digital Twin: Creating a virtual copy of a physical project object and simulating its entire lifecycle with AI, assessing the impact of any change in real-time [29].
- Autonomous (Intelligent) Project Managers: AI agents capable of managing complex projects with minimal human intervention [30].
- Blockchain and AI Integration: Making project contracts (smart contracts), payments, and changes transparent and self-executing, enhancing trust [31].
- Developing Theoretical Foundations: Creating new project management methodologies based on AI (e.g., "AI-augmented project management") [32-34].

6. CONCLUSION

In conclusion, artificial intelligence is playing not an auxiliary but a transformative role in the field of project management. It is shifting project management from reactive to proactive, from control to optimization, and from human-centric to human-AI collaborative activity. The research results clearly demonstrate that AI has the potential to significantly improve project success indicators through its capabilities in prediction, automation, and optimization.

However, realizing this potential in practice requires more than just purchasing technological solutions; it demands a coherent data strategy, organizational culture change, and continuous training. Organizations must strengthen their data infrastructure, choose open and integrable platforms, and retrain project managers in digital skills, data literacy, and AI fundamentals before starting AI investments.

For researchers, future work should focus on making AI decisions explainable (Explainable AI – XAI) and trustworthy, studying their effectiveness in different cultural and organizational contexts, and developing new practical and theoretical foundations for AI-based project management. Artificial intelligence is no longer just a tool for project digitalization but is becoming a strategic competitive factor.

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