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AI APPLICATIONS IN PROJECT MANAGEMENT: TRENDS, CHALLENGES AND FUTURE PERSPECTIVES

Abstract

Efficient project planning and execution require to implement new methods and techniques instead of traditional ones. Artificial intelligence (AI) driven tools can allocate better project resources and perform project more efficient. The given study explores the role of the AI implementation in project management (PM). Bibliometric analysis is done using VOSviewer and CiteSpace software tools. The research has analyzed academic papers published 2010 to 2025 using Web of Science database. Results of research has shown a significant growth in publications on the topic of the use of AI in PM. AI tools are often used for resource optimization, risk prediction and cost estimation in PM. Keywords analyses have shown the growing importance of fields like machine learning, big data and neural networks. The study also highlights main benefits and challenges in the use of AI tools in PM and the growing interest of the scientific community in this topic.

Keywords: artificial intelligence (AI), bibliometric analyses, project management (PM), VOSviewer, Citespace.

Introduction

Due to rapid growth of scale and complexity of projects, traditional approaches in project management are not being effective anymore. As industries evolve, the limitations of traditional planning and conventional approaches become more evident, prompting project managers to seek more adaptive methodologies [1]. Artificial Intelligence (AI) provides huge opportunities which can be used for better project management [2]. Big potentials of AI applications in project management still requires careful analyses and research [3]. Various AI tools such as machine learning, robotics and neural networks can be used for resource optimization, cost estimation and risk prediction in project phases [4]. However, despite its big potentials, AI integration in project management faces some challenges like high costs, ethical issues and low skilled professionals. Particularly, companies may resist on using AI applications due to very high integration costs. Furthermore, use of AI tools in projects require professionals with the knowledge of machine learning and the skills to analyze the big data, which companies may not have [3].

Academic literature has lots of publications on Artificial Intelligence technologies and their integration in many industries [5]. However, the research in the field of AI integration in project management is not fully discovered. The study explores both benefits and challenges of using

AI applications by performing bibliometric analyses. According to academics, predictive project analytics is where artificial intelligence made a significant contribution to project management [6]. Predictive analytics refers to analyzing large amount of project data and predicting risks and cost estimations for the project. The information value of predictive project analytics has increased as the growth of big data has improved data collection capabilities. Similarly, AI-specific data analysis tools are expected to handle the increasing volume of project data.

The study presents bibliometric analysis of the topic due to the shortcomings of current literature assessments. Bibliometric analyses allow creating networking maps based on analyses of large data [7]. This facilitates the categorization of knowledge structures, the integration of previously acquired concepts, and the identification of new patterns in the field of research [8–10]. As a result, this method seems appropriate to complement current literature assessments by providing a more comprehensive and dynamic analysis.

The purpose of this study is to explore the role of AI application in project management and reveal trends, opportunities and barrier in the integration of AI applications.

Research work has following research questions:

1. How the literature on the topic of using AI applications in project management is organized?
2. What are the research trends on the topic?
3. What are the barriers in using AI applications in Project management?

The research findings are useful for both scientists and practitioners. For scientists, creating a conceptual framework for the subject matter makes it easier for researchers to understand the scientific field as a whole. The process improvements in PM that can be made possible with the help of AI are described in a separate section for practitioners. Possible advantages and challenges of using AI tools in particular industries are highlighted. The main contribution of this study is to better understand the trends in academic publications on the application of AI in project management based on the results of a comprehensive bibliometric analysis.

Additionally, recognizing evolving areas of the topic provides scholars with an organized and synchronized way to advance their academic research. Discussions on fundamental themes of emerging trends allow practitioners to better understand the current limitations of the technology [11]. In addition, businesses can enable intelligent systems by leveraging today's simulated intelligent systems. Finally, the benefits of keyword aggregation are primarily scientific. Scholars can understand structure of a research by mapping most relevant keywords. In addition, it helps scholars index and find relevant documents on a topic.

The three research questions will be examined using the quantitative method of bibliometric research. This study benefits from bibliometric research methods because they compare scientific works in a quantitative and organized manner and assess the productivity of the literature in a given field. Given analyses is beneficial for studying particular field such as AI in project management. Scientific articles in AI use in project management published between 2010–2025 years will be analyzed from Web of Science database.

Materials and methods

The Figure 1 demonstrates the evolution of use of AI in Project Management involves four stages. First phase is happened in 1983, when first automation programs were integrated. Later chatbot assistants have been used to manage meetings. The third phase began with the use of machine learning in project management for the purposes of providing accurate risk predictions, cost estimations and improving communications between stakeholders [12]. Using knowledge gained from project history, artificial intelligence (AI) allows real-time monitoring, adjusting resources and handling risks on real time [13].

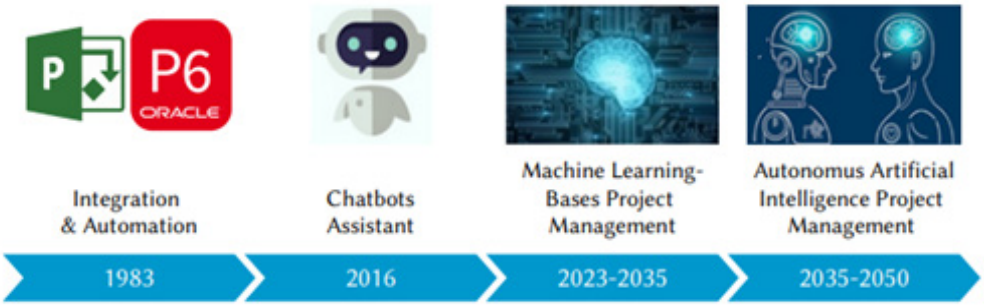

Figure 1 – Development of AI integration in Project Management

Note: compiled by Jayaram et al. [12]

Academicians consider that a new paradigm will be developed by reducing the risks associated with decision making. During the fourth stage, automotive AI system will be developed, which will take decisions itself [11]. The bots used in the different phases of project execution are another useful application of AI. These bots, which are natural language-based agents, improve human efficiency by helping users navigate project management software via chatbots. AI applications in project management are currently not fully integrated and its believed that AI tools can offer more potential benefits in the future [14].

Machine learning (ML) is defined as an AI tool that is able to learn from data and identify certain data patterns [15]. For example, machine-learning algorithms can estimate future budget requirements and timelines by analyzing historical data. Another powerful AI tool which uses machine learning techniques is Natural Language Processing (NLP) which can be efficiently implemented in routine tasks assisting the project team. NLP is mainly about how computers can understand human speech and respond back effectively. NLP can be applied in project management in several ways: NLP can be used for automotive tasks like organizing meetings, taking meeting notes, sending reports thus improving communication between stakeholders [12]. Furthermore, NLP-based applications can be utilized for analyzing project document texts and retrieving data for further cost estimation or risk prediction [16]. In overall, machine learning is used to create models for predictions based on analysis of historical information. Therefore, it can be concluded that ML is mainly used for creating prediction models. Narbaev et al. used Machine Learning for project cost prediction [17]. Authors develop XGBoost forecasting model which proved to work better than EVM and ML models. Lishner and Shtub utilized Artificial Neural Network to predict project duration, where authors propose a dynamic project duration prediction (DPDP) method that uses prediction model which tracks on time project characteristics and optimize it [18].

Robotic process automation (RPA) is AI tool which is used for doing automotive and repetitive tasks. Traditional approaches in project management included involvement of project managers in doing such tasks like preparing reports, putting data entries, tracking project timelines and etc. Integration of RPA in project management is totally changing the process: RPA bots are automatically used for report generation, data entries, tracking project timelines, distributing tasks, updating meeting notes and etc. [14]. Project managers in this case can concentrate on more important tasks and use RPA for better project monitoring and controlling.

Nowadays the scale of projects is increasing continuously, which leads to complexity of analyses of large project data. In this regard data analytics can be used for efficient data analyses. Data analytics involves analyzing large scale data and retrieving trends from the conducted analysis. Data analytics can be used for resource optimization, risk prediction or cost estimation. This in turns lead to better project management and reducing project costs [4]. Data analytics can also be used for real time performance monitoring of the projects. Data analytics can provide relevant data which may be further used by project managers to track the project progress and to respond to occurring

problems [19]. Data analytics identifies common patterns and trends in project data, that can further be used for identification of potential risks and problems. This helps project managers efficiently respond to challenges and improves project outcomes.

Hashimzai and Mohammadi presented a survey based on analyzing scientific articles from several databases [20]. Authors used keywords such as “AI in project management”, “risk management”, “prediction model”. The results of the study showed that the most trending areas in using AI in project management includes predictive analysis, automated scheduling and use of AI driven chatbots. According to the study the main issues companies face in integrating AI are high costs of implementation, data privacy issues and lack of professionals in AI.

Taboada et al. presents AI applications in project management performance and conducts survey to examine role of AI in emerging project management [21]. The results show that there has been a marked increase in number of scientific publications recently. It shows growing importance of AI integration in project management to improve project planning and controlling.

Bento et al. studied the potential and limitations of AI in project management through a literature survey, which allowed analysis and comparison of selected articles and the discovery of some trends and patterns [22]. The results of the study show that the main focus of the researchers is on construction and engineering, but recently they have shown a greater tendency to deviate into other areas that are more focused on artificial intelligence and certain sub-areas of project management that are particularly important, such as human resource management or decision support systems.

Research methodology involves bibliometric analyses which allow analysis of large number of scientific works in the field and revealing trends and gaps in the topic. Bibliometric analysis is performed by using software tools such as Bibliometrix, VOS viewer, CiteSpace and Gephi.

The research design is considered in the first step of the scientific mapping procedure, which also describes the bibliometric methods that address the research questions. In the second phase, data collection is performed. The final phase involves the use of the selected bibliometric software for data analysis, visualization, and interpretation (Figure 2).

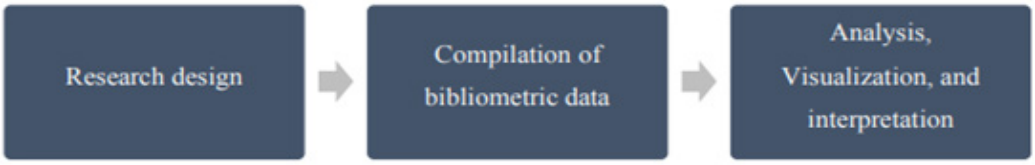

Figure 2 – Research workflow

Note: compiled by authors

Keywords are selected and searched in Web of Science. Identifying specific keywords is essential to this process in order to cover the entire research area.

In given work, two strings are used as input data. String 1 is identified with terms linked to Artificial Intelligence, while second column are keywords linked to Project Management (Table 1).

Table 1 – Keywords used in Web of Science

String 1	String 2
Artificial Intelligence	Project Management
AI	
AI applications	
AI tools	
Search line in Web of Science:	
TS= (‘Artificial Intelligence’ OR ‘AI’ OR ‘AI applications’ OR ‘AI tools’) AND TS=(‘Project Management’)	

The search by given keywords in Web of Science database resulted in 22,148 scientific works published in 1984–2024 years. The data provided by search of keywords in database can contain unrelated works. Therefore, identifying inclusion and exclusion criteria for filtering data is required. Inclusion criteria included publication type as a journal article or review article, publications only in English language and publications published in the period of 2010–2025 years (Table 2).

Table 2 – Inclusion criteria

№	Inclusion criteria
1	Publication date: 2010–2025
2	Type: journal article or review article
3	Language: English

Search string from Table 1 was inserted to Web of Science database search engine. It resulted in 22,148 scientific articles (Figure 6). At the step 2, publications from 2010–2025 were sorted (20,024 articles). At the step 3, journal and review articles were filtered which resulted in 13,252 works.

Furthermore, inclusion criteria 3 was applied and publications only in English language were selected (12,994 articles). At the next step articles related to technology but not to AI were excluded (4,585 articles). Finally, AI related articles but not in project management domain were excluded. It resulted in final 1,116 scientific articles. According to Rogers and Adams, the recommended number of articles for bibliometric analysis is 1,000 works [23]. Based on this criteria, 1,116 papers will be further analyzed.

Results and discussion

Descriptive analysis is provided in Table 4. Based on the search in Web of Science, we have 1,116 documents in database from the period of 2010–2025. 1,064 scientific works are journal articles, while 52 are review articles. Furthermore, sources of articles are 286, while the number of authors in general is 3,075. There are only 74 authors of single authored articles. In regarding co-authorship, there are 3 authors per article on average. This may be reasoned by the fact that AI in Project Management is quite broad topic and can be applied in many fields.

Table 3 – Descriptive analysis

Description	Results
Main information about data	
Time period	2010–2025
Article sources	286
Articles	1,116
Annual growth rate %	14,3 %
Document average age	4,51
Average citations per article	15.75
References	13,957
Article contents	
Keywords	4,768
Authors keywords	3013
Authors	

Continuation of table 3

Authors	3,075
Authors of single-authored articles	74
Authors collaboration	
Single authored articles	79
Co-authors per article	2.99
International co-authorships %	25.71
Article type	
Journal article	1,064
Review article	52

Average growth rate is equal to 14,3%. From the graphs provided in Figure 3, we can see that the number of publications in given topic significantly has increased from 2019. The highest number of articles are in 2021 and 2024. Few numbers of publications by 2025 can be explained with the fact that the data contains only first three months of the year.

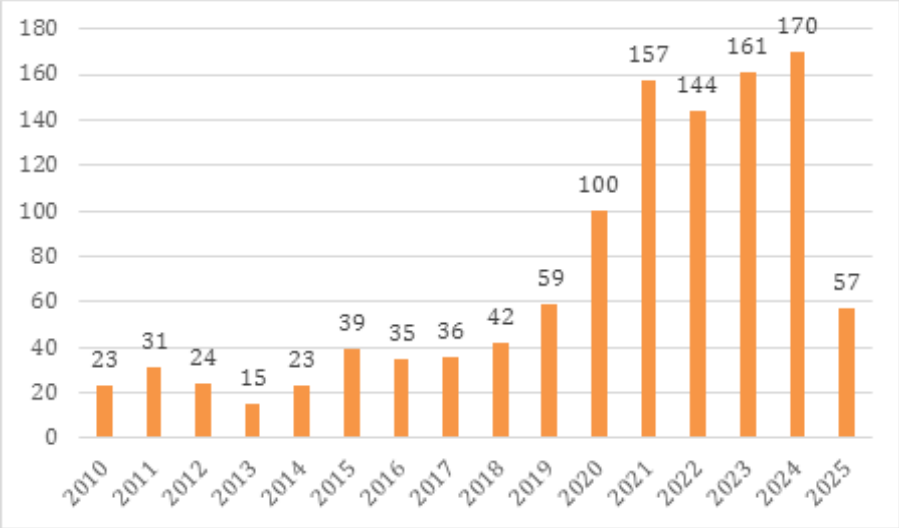

Figure 3 – Annual publication trend 2010–2025

Note: compiled by authors

In Figure 4, network of collaboration of countries with six clusters is presented, where top 10 countries published in field of use of artificial intelligence in Project Management. China, USA and India have most published documents. Regarding total citations received per country, China, USA and Italy are the countries with most total citations in the field. It can be seen that co-authorship rate is low. The reason behind it is the difficulty of research in AI integration in project management. Different countries may have different capabilities to perform research in a given field.

Co-occurrence analyses of keywords are shown in the Figure 5. From the figure, it can be seen that most used keywords are artificial intelligence, management, machine learning and model.

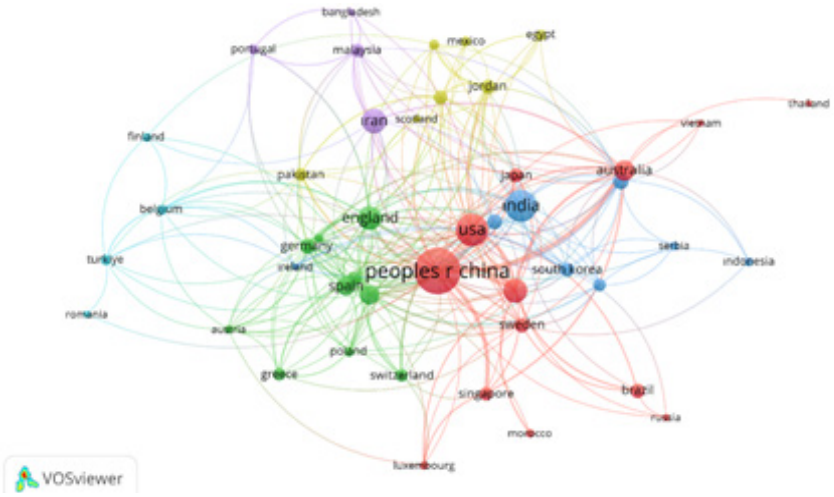

Figure 4 – Collaboration of countries in research field

Note: compiled by authors

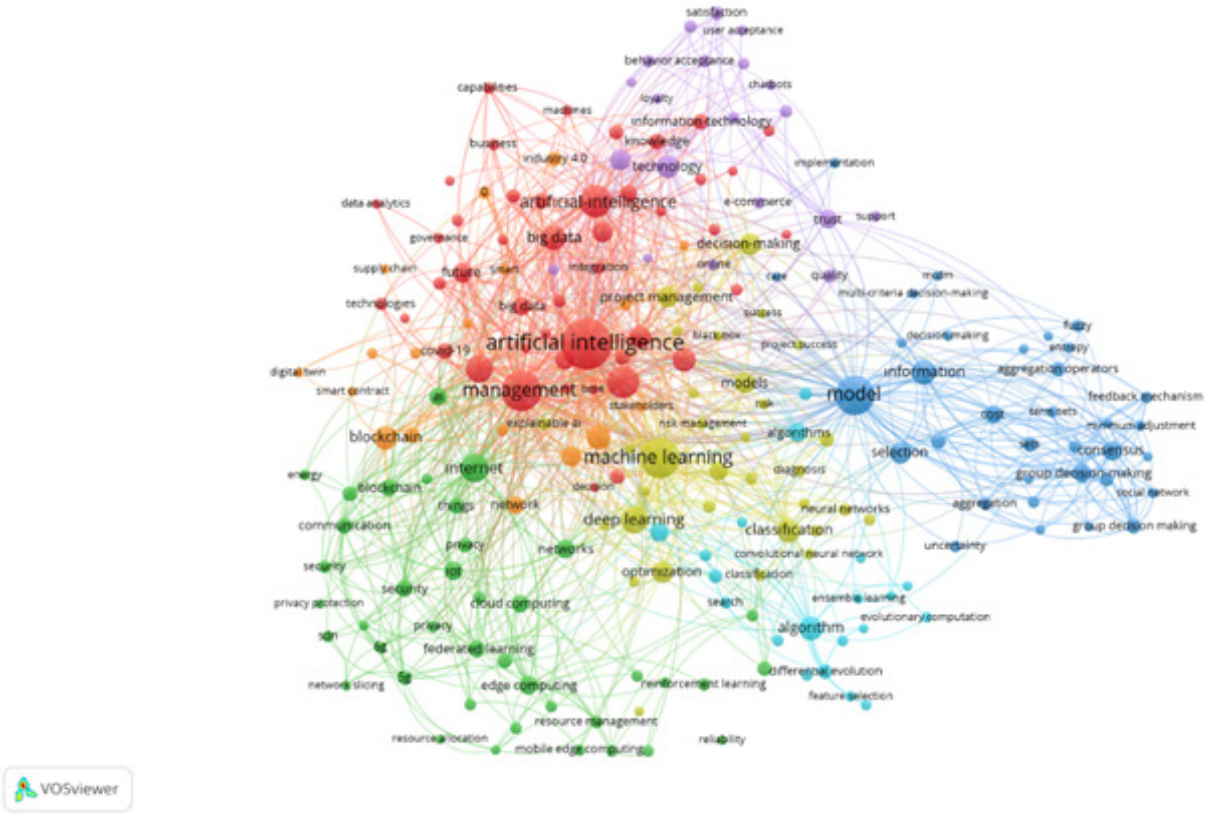

Figure 5 – Co-occurrence of keywords

Note: compiled by authors

Most used keywords are provided in Figure 6. The dominant themes in the research field are artificial intelligence (134 times) and management (83 times). It follows up with following themes machine learning (82), model (78).

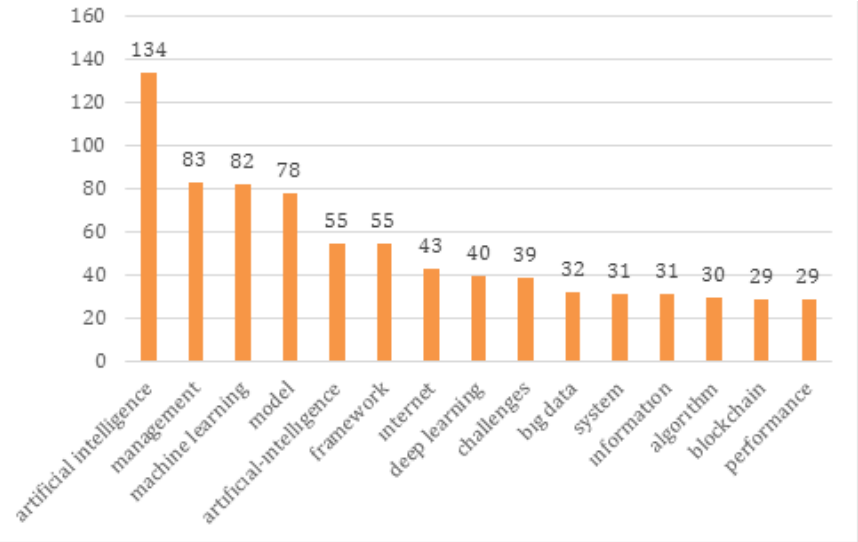

Figure 6 – Most occurred keywords

Note: compiled by authors

Citation burst analyses show the frequency of keywords cited in the literature over a given time period, indicating rapidly developing topics or topics related to citations. CiteSpace was used to conduct the citation analysis. The dataset contained 54 keywords. Figure 7 presents the top 25 keywords with the highest citation bursts.

Top 25 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2011 - 2025
artificial intelligence	2013	18.57	2022	2025	
machine learning	2014	8.5	2022	2025	
challenges	2022	6.66	2022	2023	
internet	2020	6.51	2020	2023	
big data	2016	4.91	2021	2023	
framework	2012	4.49	2021	2023	
management	2016	2.72	2020	2022	
system	2012	1.89	2012	2015	
ethics	2019	1.86	2019	2020	
hybrid	2012	1.71	2012	2013	
genetic algorithm	2012	1.58	2012	2014	
selection	2013	1.26	2013	2014	
fuzzy logic	2011	1.25	2011	2012	
regression	2011	1.25	2011	2012	
terminal assignment problem	2012	1.2	2012	2013	
swarm intelligence	2012	1.2	2012	2013	
support vector machines	2012	1.2	2012	2013	
terminal assignment problems	2012	1.2	2012	2013	
tabu search	2012	1.2	2012	2013	
optimization	2012	1.19	2014	2015	
design	2012	1.14	2012	2013	
algorithms	2018	1.12	2018	2019	
artificial bee colony algorithm	2015	1.12	2015	2016	
efficient	2015	1.12	2015	2016	
nature-inspired algorithms	2017	1.12	2017	2018	

Figure 7 – Citation bursts

Note: compiled by authors

Artificial intelligence has the strongest citation burst in 2022–2025, explaining significant growth of publications in the given period. Machine learning, challenges, big data and management have high citation bursts in the period of 2020–2025, indicating high influence of given topics in the research field.

CiteSpace also allows creating clusters. Figure 8 presents 8 major clusters with high citations.

As it can be seen, artificial intelligence, deep learning big data and communications are largest clusters in literature.

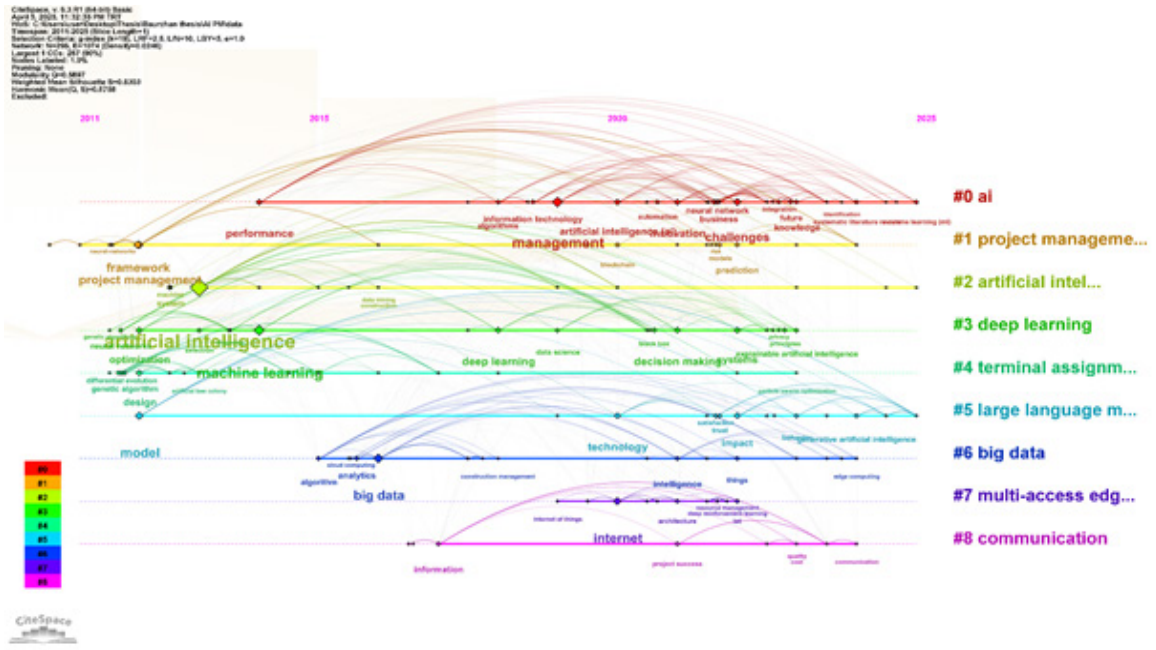

Figure 8 – Clustering structure

Note: compiled by authors

Table 11 provides a structured analyses of key trends in the use of artificial intelligence (AI) tools in project management (PM) across industries. It categorizes nine major AI tools such as machine learning (ML), natural language processing (NLP), computer vision, robotic process automation (RPA), and others, based on four key dimensions.

Table 4 – Cross-Sectoral Analysis of AI Tools and Their Applications in Project Management

No.	AI tool	Application in Project Management	Industry	Opportunities	Barriers
1.	Machine Learning (ML)	Used for resource optimization, risk prediction and cost estimation	IT, Construction Management, Engineering	Improves prediction accuracy, provides effective data driven decisions	Large data sets required; model interpretability
2.	Natural Language Processing (NLP)	Used mainly for documentation automation, report generation and sentiment analysis	IT, Legal, Marketing	Saves time on administrative tasks; analyzes stakeholder feedback in real time	Domain-specific language understanding issues

Continuation of table 4

3.	Optimization Algorithms	Used for resource optimization, resource allocation, scheduling, logistics optimization	IT, Construction, Engineering and Logistics	Provides efficient resource allocation and cost &time savings	Difficulties with integration to existing systems
4.	Predictive Analytics	Used for risk prediction, forecasting project outcomes	Construction, Manufacturing, Engineering Healthcare	Improves project outcomes	Historical data required, prediction accuracy depends on quality of data
5.	Computer Vision	Used in site monitoring, observing safety regulations and tracking progress	Construction, Manufacturing, Energy	Provides real-time visual information; hazard detection	High hardware costs, image quality is affected by weather and lighting conditions
6.	Decision Support Systems	Used in multi-criteria decision making	IT, Strategic Planning, Government	Provides efficient decision making	Difficulties in modelling scenarios
7.	Robotic Process Automation (RPA)	Used in repetitive task automation	IT, Finance, Human Relations, Telecommuni-cations	Increases efficiency, reduces manual errors.	Lack of adaptability; limited to rule-based processes
8.	Chatbots and Virtual Assistants	Used in communications with stakeholders, task reminders	IT, Customer Service, Finance, Education	Response time reduction, real time availability	Issues in understanding complex queries
9.	Digital Twins	Used for modeling project performance in real time	Engineering, Construction, Manufacturing	Real-time monitoring; preventive maintenance	High costs, integration issues

The use of AI tools in PM includes cost estimation, planning, risk prediction, and stakeholder engagement. The main areas of using artificial intelligence applications are stated as construction industry, engineering, IT, finance and education. Key advantages of using AI applications in project management involve automation, improving predictive analytics, efficient resource allocation, optimization and improved project outcomes [6]. Barriers for AI integration in project management are firstly high integration costs, need for high quality historical data which companies usually are unable to provide, data privacy issues and other difficulties with adapting and integration [24].

Analyses show that research work in the area of use of AI applications in project management was low until 2010. Starting from 2015, significant increase in publications show the research interest on a given topic. Rapid development in machine learning and artificial intelligence evoked the interest of scientists on the topic. Increasing complexity of projects and requirement for big data analyses made artificial intelligence as essential tool in project management.

With the increase of research interest on the topic, cooperation between researchers from different countries has also increased. Authors from countries like China, USA and India have more collaboration works on the topic.

Research analyses has showed that most cited keywords in given topic were machine learning, project management and artificial intelligence. The trend topics in research field are artificial intelligence (cited 134 times) and management (cited correspondingly 83 times) followed by machine learning (cited 82 times) and model (cited 78 times).

Conclusion

Artificial Intelligence has been revolutionizing many industries. Project management has also been transformed with integration of AI tools. AI applications such as machine learning and robotic process automation helps to analyze large amounts of data and automates repetitive tasks, thus improving and accelerating project management processes. Different AI-driven tools are also being used for predictive analytics, resource allocation and risk management. Beside advantages AI can provide, the main challenges of its integration in project management are high costs and data privacy issues.

The given study explored trends in the use of AI applications in project management based on conducted bibliometric analysis for the scientific publications published in last 15 years. Dataset is retrieved from Web of Science database, thereafter VOSviewer and CiteSpace bibliometric tools were used for data analyses.

The results of the study revealed the significant increase of publications on the usage of AI applications in project management. Published scientific papers on given topic has showed tendency to increase during last 10 years. Countries like China, USA and India have owned most published papers on this topic. Regarding total citations received per country, China, USA and Italy are the countries with most total citations in the field. Keywords analyses have shown that the most occurring keywords on the topic involved artificial intelligence, machine learning, big data and hybrid models.

Limitation of given study is that authors consider only publications in English, excluding non-English publications about the related topic. Results of the study may have particular research gaps such as the use for analysis one scientific database, which may not include important results from other research papers. Future research may continue to analyze scientific papers on the application of AI tools in specific areas of project management, particularly where AGILE and SCRUM techniques are used.

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ЖАСАНДЫ ИНТЕЛЛЕКТТІ ЖОБА БАСҚАРУДА ҚОЛДАНУ: ТЕНДЕНЦИЯЛАР, ҚИЫНДЫҚТАР ЖӘНЕ БОЛАШАҚ

Аңдатпа

Жобаны тиімді жоспарлау және жүзеге асыру дәстүрлі әдістердің орнына жаңа тәсілдер мен технологияларды енгізуді талап етеді. Жасанды интеллект (ЖИ) негізіндегі құралдар жоба ресурстарын тиімді бөлуге және оны табысты орындауға мүмкіндік береді. Бұл зерттеу жобаны басқаруда (ЖБ) ЖИ енгізудің рөлін қарастырады. Библиометриялық талдау VOSviewer және CiteSpace бағдарламалық құралдарының көмегімен жүзеге асырылды. Зерттеу Web of Science деректер базасындағы 2010–2025 жж. аралығында жарияланған ғылыми мақалаларды қамтыды. Нәтижелер РМ саласында ЖИ қолдану тақырыбы бойынша жарияланымдар санының айтарлықтай артқанын көрсетті. ЖИ құралдары ресурстарды оңтайландыру, тәуекелдерді болжау және шығындарды бағалау үшін жиі пайдаланылады. Түйінді сөздерге жасалған талдау машиналық оқыту, үлкен деректер және нейрондық желілер салаларының маңыздылығының артып келе жатқанын айқындады. Сонымен қатар, зерттеу ЖБ-да ЖИ құралдарын пайдаланудың негізгі артықшылықтары мен қиындықтарын көрсетіп, ғылыми қоғамдастықтың бұл тақырыпқа деген қызығушылығының арта түскенін дәлелдейді.

Тірек сөздер: жасанды интеллект (ЖИ), библиометриялық талдау, жобаны басқару (ЖБ), VOSviewer, Citespace.

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ПРИМЕНЕНИЕ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В УПРАВЛЕНИИ ПРОЕКТАМИ: ТЕНДЕНЦИИ, ВЫЗОВЫ И ПЕРСПЕКТИВЫ

Аннотация

Эффективное планирование и реализация проектов требуют внедрения новых методов и технологий вместо традиционных. Инструменты на основе искусственного интеллекта (ИИ) позволяют более эффек-

тивно распределять ресурсы проекта и выполнять его более эффективно. В данном исследовании изучается роль внедрения ИИ в управление проектами (УП). Библиометрический анализ проводится с использованием программных инструментов VOSviewer и CiteSpace. В ходе исследования были проанализированы научные статьи, опубликованные в период с 2010 по 2025 гг., с использованием базы данных Web of Science. Результаты исследования показали значительный рост числа публикаций на тему использования ИИ в УП. Инструменты ИИ часто используются для оптимизации ресурсов, прогнозирования рисков и оценки затрат в УП. Анализ ключевых слов показал растущую важность таких областей, как машинное обучение, большие данные и нейронные сети. В исследовании также освещаются основные преимущества и проблемы использования инструментов ИИ в УП, а также растущий интерес научного сообщества к этой теме.

Ключевые слова: искусственный интеллект (ИИ), библиометрический анализ, управление проектами (УП), VOSviewer, Citespace.

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