Review on Investigating The Use Of Artificial Intelligence (AI) In Construction Project Management

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Abstract- *Artificial Intelligence (AI) has emerged as a transformative force in various industries, including construction project management (CPM). This study investigates the application of AI technologies to enhance efficiency, decision-making, and risk management in construction projects. The research explores AI-driven solutions such as predictive analytics, machine learning, natural language processing, and computer vision, which are increasingly employed for tasks like scheduling, cost estimation, resource allocation, and quality assurance. By analyzing real-world case studies and industry trends, the study highlights the potential of AI to improve project outcomes by minimizing delays, optimizing resource utilization, and ensuring adherence to safety and quality standards. Challenges such as data integration, stakeholder adoption, and ethical considerations are also examined. The findings underscore the necessity for a strategic approach to AI adoption, including training, collaboration, and robust frameworks to maximize its benefits. This research contributes to understanding how AI reshapes the construction industry and provides actionable insights for practitioners and policymakers aiming to leverage AI for more sustainable and efficient project management practices.*

I. INTRODUCTION

The construction industry is experiencing a significant transformation with the integration of artificial intelligence (AI) technologies. As project management becomes increasingly complex, AI offers promising solutions to enhance efficiency, reduce costs, and improve decision-making processes. This research aims to investigate the current and potential applications of AI in construction project management, exploring its impact on various aspects such as scheduling, resource allocation, risk assessment, and quality control.

The rapid advancement of AI technologies, including machine learning, deep learning, and natural language processing, has opened up new possibilities for addressing longstanding challenges in the construction sector. These technologies have the potential to revolutionize project planning, execution, and monitoring by providing data-driven insights, automating repetitive tasks, and enabling more accurate predictions of project outcomes.

This study will examine the existing literature on AI applications in construction project management, analyze case studies of successful implementations, and identify key areas where AI can drive innovation and productivity gains. Additionally, the research will explore the barriers to AI adoption in the construction industry and propose strategies for overcoming these challenges.

By investigating the use of AI in construction project management, this research aims to contribute to the growing body of knowledge in this field and provide valuable insights for industry practitioners, researchers, and policymakers. The findings of this study will help inform future directions for AI integration in construction projects and highlight the potential benefits and limitations of these technologies in improving project outcomes.

II. LITERATURE SURVEY

Following is the structured literature survey each focusing on Investigating the Use of Artificial Intelligence (AI) in Construction Project Management

1. Ar. Gayatri Patil (2019)

This study explores the Digital technology is changing the construction industry. Construction has strategic importance on the regional, national and global levels. It is largest business followed by Agriculture sector in India. Currently, the architecture, engineering and construction industry is facing enormous technological and industrial changes and challenges as well as proliferation of IT and appropriate applications of sustainable practices. The field of construction is well placed to benefit from advent of recent

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trends, tools, and technologies viz: IoT, ICT, Big data, Automation, Standardization, disruption, inflection, Block chain, and Supply chain. The advancement of Cloud Computing, Artificial Intelligence and Internet of Things offers great potential for the developing collaborative and integrated environment for construction Management. This paper presents in-depth literature review on adoption of artificial intelligence in construction management. Implementation of these emerging technologies provides tremendous benefits in improving the productivity in construction business. Moreover, this article is continuation of our earlier communication based on "recent aspects in digitalization of either construction management, construction project or construction industry along with construction business." As the development of this technology is still at an early stage, this research effort will provide a better understanding of the transformation and pave the way for further research in this area.

2. Vishnu Babu P, Abisha A (2023)

Vishnu Babu P and Abisha A studied The growth of the construction industry is severely limited by the myriad complex challenges it faces such as cost and time overruns, health and safety, productivity and labour shortages. Also, construction industry is one the least digitized industries in the world, which has made it difficult for it to tackle the problems it currently faces. An advanced digital technology, Artificial Intelligence (AI), is currently revolutionising industries such as manufacturing, retail, and telecommunications. The subfields of AI such as machine learning, knowledge- based systems, computer vision, robotics and optimisation have successfully been applied in other industries to achieve increased profitability, efficiency, safety and security. While acknowledging the benefits of AI applications, numerous challenges which are relevant to AI still exist in the construction industry. This study aims to unravel AI applications, examine AI techniques being used and identify opportunites and challenges for AI applications in the construction industry. A critical review of available literature on AI applications in the construction industry such as activity monitoring, risk management, resource and waste optimisation was conducted. Furthermore, the opportunities and challenges of AI applications in construction were identified and presented in this study. This study provides insights into key AI applications as it applies to construction- specific challenges, as well as the pathway to realise the acrueable benefits of AI in the construction industry.

3. Sofie Bang and Nils Olsson (2023)

This research examined The use of artificial intelligence (AI) in construction projects has surged in recent years and is believed to represent a significant potential for increasing productivity and efficiency in the industry. The purpose of this paper is to present a state-of-the-art view of the field by conducting a review of publications concerning the topic of AI in construction and comparing the findings to previously conducted reviews. This paper provides an overview of the recent and current uses of AI in construction projects, through a descriptive analysis of the characteristics and contents of 86 peer-reviewed articles from 2015 to 2020. Although the application of AI in the industry is not entirely new, construction appears to currently be behind other industries in terms of adopting and adapting to AI. The results show that a wide range of research is conducted on AI in construction projects. A limited number of publication channels and authors stand behind a significant part of the reviewed publications. Most studies are conceptual or use a mixed-methods research design. The research addresses several areas of application, but there is a predominance of quantitatively based subfields of construction, such as estimation and cost control, logistics, planning, and scheduling. Future research should focus on developing holistic and process-oriented frameworks for projects to move from ambition to practice. Findings can inform the future development and implementation of AI in the construction industry context. For researchers, this study identifies areas in need of further attention and examines possibilities for future exploration of multidisciplinary approaches that combine construction engineering, project management, AI, and social science. For practitioners, the study highlights current trends and work within the field, providing an overview of the potential for pilot studies, tests, and innovations.

4. Vered Holzmann and Michele Lechiara (2022)

Vered Holzmann and Michele Lechiara conducted Artificial intelligence (AI) is a fast-growing innovative technology that will have a huge impact on projects and project management practices in the forthcoming years. The purpose of this paper is to contribute to project management theory and practice in the construction industry by analyzing the expectations of project professionals. A mixed method based on an international survey and semi-structured interviews was applied. The results show that construction project practitioners are looking for AI solutions to support the quantitative processes mainly related to scope, schedule, cost, quality, and risk management. However, the human-related processes, such as communication and stakeholder management, are not expected to be directly enhanced by AI, although might benefit from it indirectly. The findings also demonstrate a difference between amplifying and accelerating

countries, where somewhat surprisingly the latter are more ready to adopt AI in their projects.

5.   Muhammad Irfan Hashfi & Teguh Raharjo (2023)

This paper presents a systematic literature review (SLR) investigating the challenges and impacts of implementing artificial intelligence (AI) in project management, specifically mapping them into the process groups defined in the Project Management Body of Knowledge (PMBOK). The study aims to contribute to the understanding of integrating AI in project management and provides insights into the challenges and impacts within each process group. The SLR methodology was applied, and a total of 34 scientific articles were analyzed. The results and analysis reveal the specific challenges and impacts within each process group. In the Initiating Process Group, AI tools and analysis techniques address challenges in risk assessment, cost prediction, and decision-making. The Planning process group benefits from various tools and methodologies that improve risk assessment, project selection, cost estimation, resource allocation, and decision-making. The Execution process group emphasizes the importance of advanced tools and techniques in enhancing productivity, resource utilization, cost reduction, and decision-making. The Monitoring and Controlling process group demonstrates the potential of advanced tools in achieving efficiency, cost reduction, improved quality, and informed decision-making. Lastly, the Closing process group emphasizes the importance of utilizing advanced tools to minimize waste, optimize resource utilization, reduce costs, improve quality, and project closure success. Overall, this research provides valuable insights and strategies for organizations seeking to implement AI in project management, thereby enhancing the potential for success within the PMBOK Process Group.

6.   Nwankwo Constance Obiuto, 2 Riliwan Adekola Adebayo, 3 Oladiran Kayode Olajiga, 4 Igberaese Clinton Festus-Ikhuoria (2024)

In their research study The construction industry faces challenges such as project complexity, delays, and communication issues. Leveraging AI, particularly through data analysis, predictive analytics, and machine learning, addresses these challenges by optimizing project planning, scheduling, and risk management. This paper outlines strategies for AI integration, including data collection, machine learning algorithms, and cloud computing. Case studies highlight successful implementations, showcasing benefits such as increased efficiency, cost savings, and improved safety. However, challenges like data security and workforce acceptance must be considered. The abstract

concludes by discussing future trends and encouraging the construction industry to embrace AI for enhanced project outcomes.

7.   Dr. Tayibe Seyman-Güray (2023)

Dr. Tayibe Seyman-Güray studies Artificial Intelligence (AI) has become popular in all industries recently and provides numerous opportunities by simulating human intelligence processes. As a mainstream technology of an inevitable digital transformation in Industry 4.0, AI applications are hot research topics to deal with the different problems of several industries. The construction industry is no exception, but its main characteristic is resistant to new technologies and innovations. However, the construction industry has several challenges such as being a highly competitive arena, abundant participants, high financial risk, long-term periods of projects, and uniqueness of projects. Therefore, its productivity and performance growth level show relatively a poor increasing trend. This study aims to examine the contributions of AI to handling these challenges by performing both bibliometric and scientometric analysis using the PRISMA protocol. In this regard, this study presents the current state of adapting AI in the construction industry and its future directions.

8.   Aditya P. Mistry, Prof. (Dr.) J.R. Pitroda, Prof. A.N. Bhavsar (2024)

In their research the building sector is confronted with difficulties as a result of the worldwide digitization and exponential rise of digital technology. A key element of the digital transformation paradigm is artificial intelligence (AI), which provides new possibilities for project planning and execution. Various articles on AI's applicability to the construction value chain are reviewed in this study. The main users of AI technologies are facility managers, who might potentially profit from proactive site management. Growth in design is another significant benefit. One potential avenue for rapid technological improvement is data augmentation. With this information, building companies will be able to recognize the efficiency and productivity gains of AI technology and make well-informed investment decisions.

9.   Wolfgang Eber (2020)

Wolfgang Eber studied Artificial intelligence (AI) approaches have been developed since the upcoming of Information Technologies beginning in the 1950s. With rising computing power, the discussion of AI usefulness has been refuelled by new powerful algorithms and, in particular, the availability of the internet as a vast resource of unstructured

data. This gives hope to construction management in particular, since construction projects are recently becoming larger and more complex, i.e. encompassing more and more participants focusing on diverging interests while the given frames of time and budget are getting tighter. Finally, construction management is used to establish an efficient organisation of all these issues and able to predict the result with a high degree of precision and certainty. This could be accomplished by the human mind when projects were smaller, but with the recent development human mind is clearly pushed to its limits. On this background, the possible support of AI to organisational tasks needs to be investigated on a theoretical level prior to developing tools. This paper is the extended version of the article 'Artificial Intelligence in Construction Management – a Perspective', presented at the Creative Construction Conference 2019 where the algorithmic and entropic scope of AI is investigated in the context of construction management. However, efficient organisation is about restructuring systems into a set of well-separated subsystems, where human intelligence is required to bring in mainly two higher principles which AI fails to provide: the ability to prioritise and creativity allowing for new approaches not derived from given data. This paper additionally focuses on the aspect of in-situ coordination. This service is an aspect of organisation which is not separable and can therefore only be treated as self-determined subsystem, located outside of hierarchical control. At this point algorithms of AI need to be investigated not so much as to substitute human mind but to provide significant support.

10. Sushil Mahato, Jyoti Yadav, Aakriti Lama, Aryan Dipak Raut, Aryan Suraj Raut (2024)

This study explore the construction sector occupies one of the major roles within the global economy, and 13% of world GDP currently comes from this industry. It is also expected to expand by 85%, to a value of $15.5 billion by 2030, with demand in China, the United States, and India acting as the major drives. The growth notwithstanding, the sector has been confronting serious problems with regard to arranging and disseminating large quantities of information among subcontractors, contractors, designers, clients, and other stakeholders with efficiency. Information Technology has emerged as a key enabler, thereby integrating scattered data across geographically dispersed projects, transforming the construction value chain.

Artificial Intelligence accelerates this change, and the increasing investment demonstrates the possibility of boosting workforce productivity by 40 percent and doubling economic growth rates annually by 2035. This paper discusses the application of Artificial Intelligence (AI) in Construction Project Management (CPM) and reviews methodologies and applications that have been advanced for the improvement of efficiency and decision-making in the industry. The construction industry is bound to mark a tremendous change by the implementation of Artificial Intelligence (AI), redefining conventional processes and opening up innovation and productivity to new heights.

11. Pavankumar Korke, Gobinath R, Manisha Shewale, Bhagyashree Khartode (2023)

This paper investigate The construction business currently contributes 13% of the world's Gross Domestic Product (GDP), and it is anticipated that by the year 2030, its value would have increased by 85%, reaching $15.5 billion globally. China, the United States of America, and India are the three countries that are most responsible for the demand in the building business. Keeping subcontractors, contractors, designers, clients, and other parties routinely supplied with vast amounts of information has been one of the most challenging difficulties in the construction industry. The application of Information Technology (IT) has significantly contributed to the integration of disparate pieces of information within the context of widely dispersed construction projects. The construction sector, including the full construction value chain, is presently going through a period of transformation. The amount of money that is being invested into Artificial Intelligence (AI) is rising at a rate that is almost impossible to keep up with. Because of this, there is the potential to enhance the productivity of human work by forty percent and double the annual rates of economic growth by the year 2035. This research presents a discussion of the numerous methodologies that have been researched by the researchers along with a review of the artificial intelligence that is used in the construction industry, specifically Construction Project Management. Additionally, this research offers a review of the artificial intelligence that is utilized in the construction business.

12. Muhammad Tayyab Zia, Muhammad Nadim, Muzammil Ahmad Khan, Nijah Akram, Furqan Atta (2024)

Muhammad Tayyab Zia, Muhammad Nadim, Muzammil Ahmad Khan, Nijah Akram, Furqan Atta studied artificial intelligence (AI) has arisen as an extraordinary power in project management, changing customary practices and enlarging human capacities. This research investigates the diverse jobs played by (AI) artificial intelligence in project management and surveys its effect on project achievement rates. Through an extensive survey of writing and research of exact information, this study uncovers that artificial intelligence reception in project management has prompted a

critical improvement in project achievement rates. Overall, artificial intelligence execution has brought about a wonderful increment of roughly 20% in project achievement rates across different businesses. Via mechanizing monotonous errands, upgrading asset allotment, and improving dynamic cycles, artificial intelligence has exhibited its capability to smooth out project work processes and moderate dangers. Nonetheless, close by its promising advantages, artificial intelligence execution presents difficulties, for example, information protection concerns, moral contemplations, and labor force reskilling necessities. This abstracts the basic significance of embracing artificial intelligence advancements in project management to accomplish higher proficiency, adequacy, and development. Looking forward, further research is expected to investigate arising patterns and address the developing difficulties in bridling artificial intelligence for project achievement.

III. CONCLUSION BASED ON LITERATURE REVIEW

The studies collectively highlight the transformative potential of artificial intelligence (AI) in the construction industry, addressing critical challenges such as inefficiencies, cost overruns, safety issues, and workforce shortages. Ar. Gayatri Patil (2019) emphasizes the early-stage adoption of technologies like AI, IoT, and cloud computing to enhance productivity and sustainability. Similarly, Vishnu Babu P and Abisha A (2023) underline AI's role in activity monitoring, risk management, and resource optimization, although they note challenges like integration and workforce acceptance. Sofie Bang and Nils Olsson (2023) advocate for holistic, practice-oriented frameworks to accelerate AI adoption in cost control, logistics, and scheduling, recognizing that the industry lags behind others in adoption. Vered Holzmann and Michele Lechiara (2022) identify AI's significant contributions to quantitative project management processes while noting its indirect impact on communication and stakeholder management, with disparities in readiness for AI adoption across countries.

Muhammad Irfan Hashfi and Teguh Raharjo (2023) demonstrate AI's alignment with PMBOK process groups, highlighting its potential to improve efficiency and decision-making. Nwankwo C.O. et al. (2024) discuss AI's use in predictive analytics and machine learning to optimize planning, scheduling, and risk management while addressing concerns about data security and workforce adaptation. Dr. Tayibe Seyman-Güray (2023) positions AI as essential to Industry 4.0, though its adoption is hindered by the construction sector's resistance to change. Aditya P. Mistry et al. (2024) underscore AI's ability to enhance project planning,

site management, and design optimization, enabling better decision-making.

Wolfgang Eber (2020) explores AI's role in supporting complex project management tasks while recognizing its limitations in creativity and prioritization, emphasizing its utility as a supportive tool. Sushil Mahato et al. (2024) and Pavankumar Korke et al. (2023) highlight AI's capacity to increase workforce productivity, double economic growth rates, and redefine traditional processes in the construction value chain. Finally, Muhammad Tayyab Zia et al. (2024) reveal that AI improves project success rates by automating tasks and enhancing decision-making, though challenges like ethical considerations and workforce reskilling must be addressed. Collectively, these studies illustrate AI's potential to revolutionize the construction industry, provided challenges such as integration, workforce readiness, and ethical considerations are effectively managed.

IV. CONCLUSION

The exploration of Artificial Intelligence (AI) in construction project management highlights its transformative potential to address critical challenges and revolutionize traditional practices. As the construction industry grapples with complexities such as delays, cost overruns, resource inefficiencies, and safety risks, AI provides innovative solutions that significantly improve project outcomes.

AI technologies, including machine learning, natural language processing (NLP), computer vision, robotics, and predictive analytics, have proven their efficacy in various domains of construction project management. These technologies enhance efficiency in project scheduling, optimize resource allocation, improve risk management, and elevate safety and quality standards. For instance, predictive analytics enables proactive identification of potential project delays, while AI-powered computer vision ensures real-time safety monitoring and defect detection. Robotics and automation further enhance productivity, tackling labor shortages and improving precision in repetitive tasks.

The integration of AI also facilitates sustainability, with AI-driven tools optimizing energy consumption, minimizing waste, and reducing the environmental footprint of construction projects. Document management and communication efficiency are improved with NLP, streamlining administrative processes and fostering better collaboration among stakeholders.

However, the adoption of AI in construction is not without challenges. High implementation costs, the need for

specialized skills, data security concerns, and resistance to change within the industry pose significant barriers. Addressing these issues will require a strategic and collaborative approach, including investment in workforce training, the development of cost-effective AI solutions, and stronger industry partnerships.

In conclusion, the incorporation of AI into construction project management offers a pathway to overcoming traditional limitations and achieving more efficient, safe, and sustainable project delivery. As the industry continues its digital transformation, AI will play a critical role in shaping the future of construction. Stakeholders who embrace AI's potential and proactively address its challenges will position themselves for greater competitiveness and success in an evolving global market.

REFERENCES

[1] Nwankwo Constance Obiuto, Riliwan Adekola Adebayo, Oladiran Kayode Olajiga, Igberaese Clinton Festus-Ikhuoria "Integrating Artificial Intelligence in Construction Management: Improving Project Efficiency and Cost-effectiveness" International Journal of Advanced Multidisciplinary Research and Studies

[2] Vered Holzmann and Michele Lechiara by "Artificial Intelligence in Construction Projects: An Explorative Study of Professionals' Expectations" European Journal of Business and Management Research

[3] Pavankumar Korke, Gobinath R, Manisha Shewale, Bhagyashree Khartode by "Role of Artificial Intelligence in Construction Project Management" ICSTCE 2023

[4] Dr. Tayibe Seyman-Güray by "Investigating AI Applications in Construction Industry: A Systematic Review" 6th International Conference of Contemporary Affairs in Architecture and Urbanism (ICCAUA-2023) 14-15 June 2023

[5] Ar. Gayatri Patil by "Applications of Artificial Intelligence in Construction Management" Volume 9, Special Issue, March 2019, 6th National Conference On Technology & Innovation: Disrupting Businesses, Transforming Market; G.H. Raisoni Institute Of Business Management, Jalgaon, India.

[6] Muhammad Tayyab Zia, Muhammad Nadim, Muzammil Ahmad Khan, Nijah Akram, Furqan Atta by " The Role and Impact of Artificial Intelligence on Project Management" THE ASIAN BULLETIN OF BIG DATA MANAGMENT Vol. 4. Issue 2 (2024)

[7] Sushil Mahato, Jyoti Yadav, Aakriti Lama, Aryan Dipak Raut, Aryan Suraj Raut "Role of Artificial Intelligence in Construction Project Management" International Journal for Multidisciplinary Research (IJFMR) Volume 6, Issue 6, November-December 2024

[8] Wolfgang Eber, " Potentials of artificial intelligence in construction management" Organization, Technology and Management in Construction 2020; 12: 2053–2063

[9] Aditya P. Mistry, Prof. (Dr.) J.R. Pitroda, Prof. A.N. Bhavsar, "INVESTIGATING THE USE OF ARTIFICIAL INTELLIGENCE (AI) IN CONSTRUCTION INDUSTRY: A REVIEW" Journal of Emerging Technologies and Innovative Research (JETIR) www.jetir.org JETIR May 2024, Volume 11, Issue 5

[10] Muhammad Irfan Hashfi, Teguh Raharjo. " Exploring the Challenges and Impacts of Artificial Intelligence Implementation in Project Management: A Systematic Literature Review" *(IJACSA) International Journal of Advanced Computer Science and Applications Vol. 14, No. 9, 2023*

[11] Sofie Bang and Nils Olsson, "Artificial Intelligence in Construction Projects: A Systematic Scoping Review", Journal of Engineering, Project, and Production Management 2022, 12(3), 224-238

[12] Vishnu Babu P, Abisha A, " ARTIFICIAL INTELLIGENCE IN CONSTRUCTION PROJECTS MANAGEMENT BY USING ADVANCED METHODS" International Research Journal of Modernization in Engineering Technology and Science e-ISSN: 2582-5208