The Artificial Intelligence (AI) Impact on Construction Project Management

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Abstract – The study aims to explore the degree of Artificial Intelligence (AI) integration in construction projects and analyze its effects on cost-effectiveness, safety, and productivity. The objective is to investigate the relationship between the application of AI and its integration in the construction sector, evaluating the possible changes and adjustments in the labor force brought about by AI technological incorporation. The author employed a systematic review methodology. The review approach provides comprehensive insights into the application of AI in real-world construction projects inform data evaluation trends of AI application in the industry. The preliminary results highlight AI's enormous potential for streamlining repetitive processes, maximizing resource use, and improving construction safety standards. Integrating AI into construction projects may result in significant gains in productivity and safety, but doing so requires a careful strategy in balancing the workforce's changing requirements and technology improvements, and the role of the industry is vital in this process.

Keywords: Artificial Intelligence; AI Project Management; AI powered Construction: Construction Project Management: Machine Learning.

1 Introduction

Especially compared to more digitalized industries like manufacturing, the construction industry faces ongoing obstacles that hinder its growth and competitiveness despite its critical role in global development [1]. The industry is characterized by a culture resistant to change and firmly embedded manual procedures. As a result, it needs to catch up with new technologies, which leads to reduced inefficiency [2]. These difficulties, the industry's workforce problems, the pressing need for sustainable infrastructures, and time management highlight the importance of embracing digitalization and using artificial intelligence's (AI) disruptive potential [3].

The application of Artificial Intelligence (AI) in construction projects is not just a trend, but a transformative wave poised to revolutionize the industry's operational landscape. Traditionally known for its labor-intensive practices, the construction sector faces challenges such as low productivity, inefficiencies, safety concerns, and cost overruns. AI's potential offers solutions to age-old problems that have hampered growth and innovation within the construction domain.

The construction industry needs more productivity, waste management, safety concerns, and cost overruns. Despite technological advancements, experts in construction projects must explore AI integration. The industry's historical reliance on conventional methods and resistance to change has hindered its adoption of AI-driven solutions. Challenges include high initial costs, limited expertise, trust deficits, and cultural barriers. However, the critical need for comprehensive studies is clear.

Procore and Autodesk BIM 360 are AI-powered construction project management software that analyses data to forecast hazards and improve timelines. They free up time for making decisions by automating processes like scheduling and documentation. These technologies let teams collaborate by visualizing project progress through 3D models and reports [4]. They improve overall project efficiency and results by using machine learning to find patterns in data for improved resource allocation and cost control. The main hypotheses of the paper include: 1. Explores the AI application processes in construction project management, 2. Addresses AI integration into construction project and assesses how the integration affects productivity, safety concerns and cost effectiveness, and 3. Provides opportunities to mitigate AI applications' challenges in the construction industry.

The study's unique contribution provides insights into key AI applications and integration as they apply to construction-specific challenges and the pathway to realizing AI's measurable benefits in the construction industry.

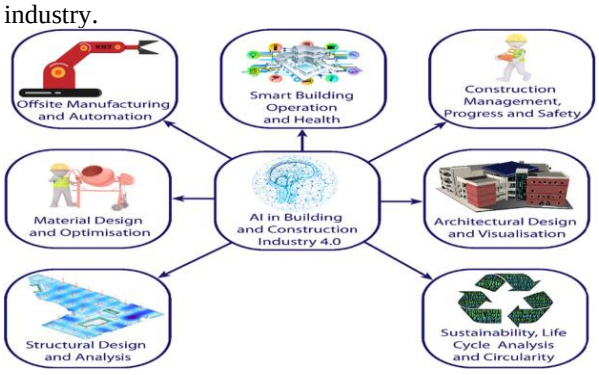

Figure 1: AI applications in different fields of construction.

2 Artificial Intelligence Relevance in Project Management

The advent of AI dates back to 1950 when the British mathematician Alan Turing asked whether machines could think [4]. After experiencing ups and downs over 60 years, AI has regained technological importance due to rapid developments in computing, big data, artificial neural networks, deep learning, and other new technologies [5, 6]. AI is a computer system that perceives visual perception, recognizes speech, and can translate between languages. It solves complex decision-making processes that mathematics cannot solve directly by understanding project information and the environment [6]. Machine learning is a subsidiary of AI, using algorithms and statistical models to study data and make decisions 8, 7]. With the advancements in machine learning and big data technologies, AI has become a significant technological opportunity globally. The potential of this technological advancement also triggers the need for AI use in the AEC industry. On a limited scope, the need for AI use in construction arises from the desire to improve cost management, enhance quality control, increase efficiency and productivity, and address complex issues in project management. The potential areas that the AEC industry can benefit from AI use are enormous.

As construction projects become complex and large-scale in the AEC industry, the number of participants and the volume of construction data, including project plans, schedules, and performance metrics, increase. In this regard, AI stands out as one of the digital technologies with significant potential to leverage the vast amount of available big data for problem-solving and enhancing decision-making within construction management [10-9]. AI can use machine learning algorithms to inform decision-making, optimize resource allocation, and improve project outcomes by identifying patterns, trends, and insights. As a result, artificial intelligence can offer continuous real-time monitoring and analysis of construction operations, enabling project managers to make well-informed decisions based on data [11] promptly. This process improves project control, reduces risks, enhances overall project performance, and prevents poor decision-making through the project management processes.

The use of AI in the AEC industry also has the potential to sustain project success. Project success is mainly defined by the project management triangle, consisting of time, cost, and quality pillars [12]. Planning a project is one of the most critical processes in project management, but the importance of designing software needs to be investigated [13]. Construction cost control is crucial, as delays in any project stage can cause cost overruns due to increased artistry, working time, or material usage [14]. AI has the potential to forecast cost overruns by considering project scale, contract type, and the competence of the project manager [15]. By implementing AI in construction scheduling, managers can monitor schedules more efficiently by estimating construction project completion and delay times [16]. AI can be applied in real-time, enabling project managers to swiftly and knowledgeably decide how to allocate resources as the project unfolds [17]. This can help prevent project delays and lead to more realistic timelines for future projects.

Furthermore, AI can provide a clear and realistic view of construction site activities to top-level management and engineers, improving construction efficiency and quality [18]. AI can also analyze data from various sources, such as sensors and cameras, to monitor real-time construction quality. It can identify defects, deviations from specifications, and potential issues, enabling early intervention and improving overall quality control.

Safety is a paramount and indispensable aspect of the construction industry. AI's potential to anticipate and prevent occupational accidents and equipment-related safety issues during construction projects is a significant development. AI-powered technologies, such as drones, robots, and wearable technologies, can be used for site inspections, monitoring hazardous areas, identifying potential safety risks, and monitoring workers' behavior. AI algorithms can analyze real-time data on-site from sensors to detect unsafe conditions, helping to prevent accidents and improve safety on construction sites. Additionally, pattern recognition-based AI technologies are used for data and system integration to enhance safety management. These technologies become even more potent when paired with virtual reality as they assure real-time personnel safety.

As the main field of construction management, AI can monitor, recognize, evaluate, and predict potential risks in terms of safety, quality, efficiency, and cost across teams and work areas, even under high uncertainty [19, 20]. AI-based risk analysis can provide insights to help project managers quickly prioritize potential risks and identify proactive actions rather than risk mitigation responses [21]. Machine learning and natural language processing are being applied in construction for risk detection and assessment to issue early warnings [20]. Consequently, AI is expected to play a significant role for project managers in risk assessment, generating decision support, automation of risk monitoring, and simulation and scenario analysis. Additionally, AI technologies, such as Building Information Modeling (BIM) and virtual reality, allow for better visualization, clash detection, and coordination among different disciplines, reducing errors and rework during construction.

In summary, the introduction of AI systems in the construction industry represents a significant leap

forward. These systems leverage advanced technologies, data analysis techniques, and automation to address specific challenges and improve efficiency, productivity, safety, decision-making, and overall project outcomes. AI systems bring new capabilities, insights, and efficiencies to the construction industry, enabling practitioners to leverage data-driven intelligence for better project execution. By embracing AI technologies, the AEC industry can drive innovation, increase productivity, support decision-making arising from complex project management challenges, and achieve better project outcomes. The potential for AI to drive innovation in the AEC industry is vast, inspiring a new era of technological advancement and efficiency.

Along with these contributions that artificial intelligence will provide to project management, there has been a notable rise in research on the application of artificial intelligence in the construction industry. It is evident from the literature that the use of AI techniques in the construction industry has become a trending topic.

3. Research methodology

This section outlines the research approach for the study, emphasizing the systematic and rigorous nature of the author's methodology. The author considered the approach based on the recommendations made by Kitchenham and Charters [22]. The case investigation 'Software Scent Detection Techniques: A Systematic Literature Review (SLR) '[23] served as a crucial tool for establishing the systematic literature review process we employed to investigate earlier research on our chosen subject, 'The Impact of Artificial Intelligence (AI) on Construction Projects.' Following the SLR methodology, our inclusion criteria guided the selection process, prioritizing papers with relevant abstracts and titles, while our exclusion criteria methodically eliminated irrelevant articles.

A systematic search across reliable resources guarantees a thorough assessment of the content. The author learned about standard procedures to conduct this detailed research, which gave me a solid basis for the subsequent projects. A paper titled "Software Smell Detection – Systematic Literature Review" [24] influenced the initial portion of the study as it provided knowledge about software smells and a solid basis for the author's work. The report utilized these data sources for our investigation: Electrical and Electronic Engineers (IEEE), Google Scholar, and ACM.

The study's topic, 'The Impact of Artificial Intelligence (AI) in Construction Projects,' was closely related to specific papers in which the author thoroughly examined the library's resources. The following research questions were formulated to guide our study and provide further details on the fields of study connected to our chosen topic and how the inclusion and exclusion criteria are implemented. These questions, carefully crafted to focus our search and ensure we only included relevant papers in our review, played a crucial role in shaping the direction of our study.

3.1. Search Process

The selections are limited to studies between 2010 and 2024, constituting the current literature. The databases used for searching are IEEE Xplore Digital Library, Web of Science (WOS), and Scopus. The keywords used for searches are "**AI** Project Management," "machine learning," "artificial intelligence," "AI-powered Construction," "Machine Learning," and "construction project management.".

The author's approach to selecting studies was to define the parameters for inclusion or exclusion criteria, determine the impacts of artificial intelligence applications and integration on construction projects, and select the trends and quality of the studies. The study's time frame was restricted to between 2010 and 2024 to keep up with current studies, with older studies being excluded under the assumption that they may be insufficient or irrelevant. The exclusion criteria were also applied to studies not closely related to the subject matter. Figure 2 illustrates the literature search approach.

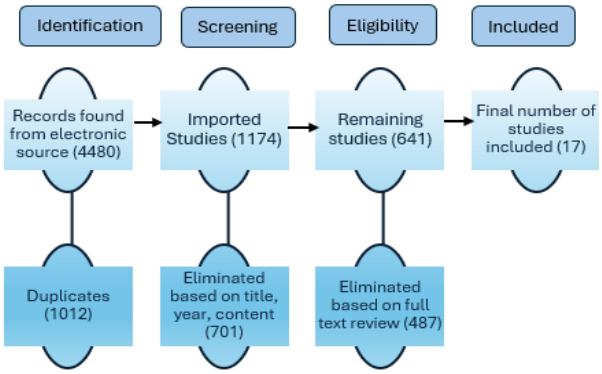

Figure 2: Literature search process

4. AI Applications in different construction sectors.

Artificial Intelligence (AI) is transforming the construction industry from the ground up, primarily by significantly improving productivity. It does this by streamlining processes and resource allocation using sophisticated algorithms and machine learning. This enables precise task scheduling, anticipation of potential hazards, and wiser resource allocation, all of which contribute to shorter project turnaround times and fewer delays. In addition, AI-powered Building Information Modelling (BIM) solutions provide more intelligent designs, collision detection, and thorough simulations, which expedite the planning and design stage and reduce mistakes. The main benefit of AI in the construction industry is its ability to significantly improve

productivity, thereby transforming the sector into many aspects.

AI-driven technologies are revolutionizing and significantly enhancing safety protocols in the construction industry. Using computer vision algorithms to examine data from sensors, drones, and cameras, AI can identify potential risks on construction sites, thereby improving safety procedures and preventing accidents. Furthermore, AI's ability to predict equipment faults makes it easier to perform maintenance, ensuring prompt repairs and reducing downtime. The role of AI in selecting environmentally friendly materials and optimizing energy use is also crucial, as it is leading to the adoption of greener and more sustainable building techniques. Incorporating AI is changing and significantly improving the construction industry, making operations safer, more environmentally friendly, and more efficient. Examples include autonomous cars and robotics performing mundane jobs and data-driven insights altering decision-making.

AI is revolutionizing and plays a pivotal role in waste reduction, safety, and project management in the construction industry. It is used in advanced software like Procore and Autodesk BIM 360 for resource allocation, scheduling, and communication. AI-driven wearables, computer vision systems, and IoT sensors enhance safety measures, while AI-powered trash tracking and recycling technologies improve waste management and recycling effectiveness. The comprehensive impact of AI in these areas is transforming the construction industry, making it more efficient and sustainable.

4.1. AI tools in construction

Several artificial intelligence (AI) solutions have been developed expressly for the construction sector, focusing on waste management, safety protocols, and project management. Here are a few instances:

Procore: This AI-powered tool manages documents, tracks timelines, keeps an eye on budgets, and streamlines communication to assist with project management. It provides insights to streamline operations and use machine learning algorithms to forecast possible project hazards.

Building information modeling (BIM): This tool is made easier using Autodesk BIM 360, which offers a centralized platform for project teamwork with artificial intelligence (AI) systems that examine data from several sources to facilitate better decision-making, identify conflicts and optimize construction scheduling.

Smartvid.io: This program uses artificial intelligence (AI) for safety to identify possible dangers and hazards by analyzing photos and videos taken on-site. By proactively addressing problems, it can identify patterns in safety occurrences and contribute to reducing accidents.

Predictive Solutions: This platform uses machine learning to forecast possible safety events by examining past data, spotting trends, and spotting patterns that might result in mishaps. It makes it possible to implement preventative safety measures.

Eco Domus: This technology optimizes waste management during construction by fusing AI and BIM. It follows the life cycle of building materials and analyses data to reduce material waste, allowing for effective recycling and reuse techniques.

4.2. Machine learning

The creation and application of computer systems that may be specifically intended to learn from prior data or experience to model, control, or forecast using statistical approaches is known as machine learning. Among the machine learning techniques are: (A) Supervised machine learning: this area of research focuses on how computers decide what to do after learning from labeled datasets or pairs of input and intended output. It is divided into regression and classification categories. (B) Unsupervised Machine Learning: this approach teaches machines the fundamental organization seen in unlabeled datasets. Techniques for dimension reduction and grouping are divided into two categories. (C) Reinforcement learning (RL) is the process of "learning a mapping from situations to actions to maximize a reinforcement signal or scalar reward." This computational method involves deducing knowledge from the results of interactions with the surroundings; also, (D) Deep Learning: this is the most advanced machine learning methodology available today, and it has been shown to provide predictions that are more accurate than those made using traditional methods.

4.3. Automated Planning and Scheduling

In artificial intelligence, known as planning, activities are carefully chosen and arranged according to their anticipated results to enable intelligent systems to accomplish specified goals or objectives. Determining plans and allocating the time and resources required to achieve the intended purposes using the available resources constitute scheduling. Planning and scheduling techniques create complicated application solutions that better meet user requirements and issue limitations. Due to its complexities, expense, and duration, planning is employed only in circumstances where its advantages surpass the disadvantages. Standard techniques and algorithms include genetic algorithms, search approaches, and optimization techniques for planning and scheduling.

4.4. Robotics

Robots are highly automated machines that do real-world physical tasks. Engineering that crosses many disciplines is called robotics, and it deals with creating, building, and maintaining robots and other computer programs that simulate real-world human movements.

Robots are meant for highly specialized activities; they don't always take on human-like forms but adopt shapes best suited to their purposes. They communicate with their surroundings using sensors and movements. The system outlined how reinforcement machine learning issues make up the bulk of robotics learning difficulties.

4.5. Safety Measures

Real-time Monitoring: AI-driven cameras and sensors monitor building sites around the clock. They enable quick response by identifying safety issues, illegal individuals, or risky behaviors.

Wearables and IoT Devices: To ensure worker safety and avoid accidents, artificial intelligence (AI) analyses data from wearables and IoT devices worn by workers to monitor vital signs, movement patterns, and tiredness levels.

5. Case Studies

Case Study 1: Integrating AI-Based Tool to Streamline Workflows

The case study highlights the integration of AI-based tools such as "Procore Copilot," which aims to improve communication and provide actionable insights across construction projects.

Procore's Copilot AI is a game-changer in the construction industry, addressing critical issues such as labor shortages and manual data processing. By automating tasks and accelerating data access, it expedites decision-making. The suite of AI tools, including Procore Copilot, AI Locations, and Procore Maps, revolutionizes project management by providing vital insights and seamlessly integrating with popular collaboration tools.

Procore's AI-driven tools, unveiled at the 2024 Innovation Summit, are designed to make project data more accessible and user-friendly for construction teams. Procore Copilot's integration with Microsoft Teams allows for natural language interaction with project data, making it easy and intuitive to access information such as Requests for Information (RFIs) and submittals. AI Locations simplify project organization by automatically generating location lists from project drawings, making it easier for teams to structure and locate items. Procore Maps introduces spatial tracking, enabling users to view photos mapped by location and filtered by date, providing a clear visual overview of project progress and facilitating workflow optimization.

Procore's AI implementation has not just improved project management, it has revolutionized it. By automating tasks such as location tracking and submittal management, Procore's AI tools have significantly reduced the time required for manual data entry, thereby enhancing workflow efficiency. The integration of Procore Copilot with Microsoft Teams has streamlined communication, enabling teams to access and discuss project information seamlessly. Procore Maps has enhanced data utilization by visualizing work progress with mapped photos, aiding decision-making and reducing delays. This efficiency gain is a testament to the potential of AI in the construction industry.

Procore's AI advancements, while promising, come with their own set of challenges. These include data privacy and security concerns, especially with third-party integrations like Microsoft Teams. Safeguarding sensitive construction project data is crucial for user trust. Additionally, users need training to adopt new AI tools effectively. Developing advanced features like Procore Copilot's natural language processing involves technical complexities and significant resources. By being aware of these challenges, the construction industry can better prepare for the future of AI.

The advantage

Procore Copilot integrates directly into Microsoft Teams, allowing users to access project data and context in natural language. Its features, such as AI Locations and Procore Maps, streamline visual data, enabling users to monitor and optimize project progress more efficiently. Also, IProcore uses AI to surface critical insights from Requests for Information (RFIs) and submittals, helping project teams make data-informed decisions.

Challenges and Barriers

While beneficial, Procore's AI advancements pose challenges. Data privacy and security are crucial, especially with third-party integrations like Microsoft Teams, to safeguard construction project data and maintain trust. Advanced AI tools also require user training for effective adoption. Developing features like Procore Copilot's natural language processing also demands substantial resources and expertise.

Case Study 2: BIM 360 and Smartvid.io AI

Autodesk BIM 360 introduction of AI agents has the potential to elevate the capabilities of Autodesk BIM 360 to enhance decision-making and operational efficiency.AI agents can transform project management and automation by integrating with Autodesk BIM 360.

AI integration in Autodesk BIM 360 can greatly enhance workflows. Though the platform lacks built-in AI, integrating AI solutions can improve efficiency by analysing data, automating tasks, and offering insights through analytics and machine learning, thus supporting smarter project management decisions. Automation for Architectural and Design Efficiency The key examples of AI-Driven automation include:

Automated Document Management: AI can process project documents and organize them for easier access., **Predictive Risk Management**: By using historical data, AI can identify potential project risks

based on previous projects and **Enhanced Collaboration**: AI agents can improve communication by summarizing project updates and informing team members of changes.

AI agents simplify workflows in complex settings like construction or architecture, accelerating processes and reducing manual effort.

6. BIM-AI Framework for Construction Integration

The framework, which focuses on data interoperability, AI algorithms, and application areas, is designed to improve efficiency, reduce errors, and optimize building performance across the project lifecycle. Figure 5 illustrates a continuous process of capturing the project team's knowledge into BIM and AI practices in the four (4) toolbox knowledge areas. The framework's use case not only presents processes and corresponding appropriate BIM and AI tools but also emphasizes the adaptability of the framework to different phases of the project life cycle, making it a versatile and attractive solution for stakeholders.

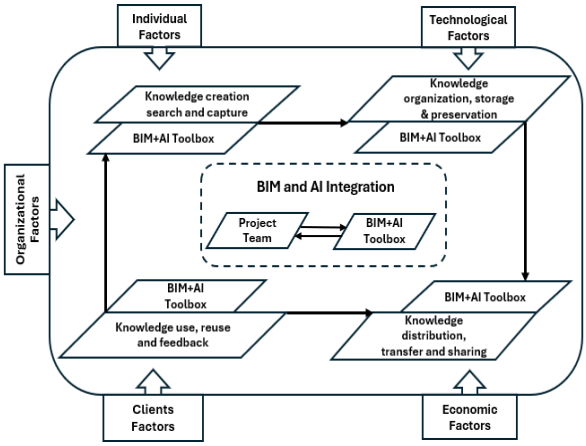

Figure 5. Conceptual knowledge framework for the integration of knowledge into BIM-AI practices

The framework is further subcategorized into four (4) classifications:

1. Data Interoperability and Preparation:

Standardized Data Formats: Establish clear protocols for data exchange between BIM models and AI systems, using Industry Foundation Classes (IFC) or other relevant standards.

Data Extraction and Transformation: Develop methods for extracting relevant data from BIM models (geometrical, semantic, and parametric) and transform it into formats suitable for AI algorithms.

Data Quality and Management: Ensure data accuracy, consistency, and completeness to support reliable AI analysis.

2. AI Algorithms and Applications:

Machine Learning: Utilize machine learning algorithms for tasks such as clash detection, cost estimation, schedule optimization, and performance simulation.

Image Recognition and Processing: Employ AI algorithms for visual inspection, quality control, and progress monitoring on-site.

Predictive Analytics: Leverage AI for predicting potential problems, optimizing resources, and making informed decisions throughout the project lifecycle.

3. Application Areas:

Design Optimization: Use AI to explore design alternatives, optimize building performance, and identify sustainable solutions.

Construction Scheduling and Management: Automate scheduling tasks, predict delays, and optimize resource allocation using AI.

Cost Management: Analyze cost data, predict project costs, and optimize resource allocation using AI.

Quality Control and Safety: Implement AI-powered systems for visual inspection, safety hazard detection, and quality control.

Facility Management: Use AI to monitor building performance, optimize maintenance schedules, and improve energy efficiency.

4. Challenges and Mitigation Strategies:

Data Availability and Quality: Address data gaps and inconsistencies by implementing robust data management practices and standards.

Algorithm Accuracy and Reliability: Validate AI algorithms and ensure their accuracy and reliability before deploying them in real-world projects.

Interoperability Issues: Develop standardized data formats and protocols to facilitate seamless integration between BIM and AI systems.

Lack of Expertise: Invest in training and education to equip construction professionals with the necessary skills to use BIM and AI effectively.

Ethical Considerations: Address potential biases in AI algorithms and ensure responsible use of AI in construction.

7. Traditional Approach to AI process in construction sector Integration

Automated decision support and artificial intelligence (AI)-driven solutions empower you with real-time data insights, automating tasks like scheduling and documentation to bolster your decision-making process.

Improved collaboration cloud-based platforms allow teams to work together in real-time while accessing 3D models and reports, enhancing communication and helping with project management.

Real-time project visualization technologies provide

a dynamic, real-time perspective of the project's state, enabling more informed decision-making. They do this by utilizing 3D models and progress reports.

Data-driven resource allocation and machine learning algorithms analyze extensive data to find trends, which helps with targeted cost control plans and efficient resource allocation.

Efficiency compared to manual techniques, Procore and Autodesk BIM 360 considerably increase efficiency by streamlining procedures and providing real-time data. Waste management integration with AI undergoes a few steps to convert the scrap, decrease inefficiencies, and promote sustainability throughout project lifecycles, revolutionizing waste management in the construction industry. AI is essential for predictive analytics because it can estimate possible waste generation using past project data. As a result, less waste is produced overall, and proactive efforts to optimize material utilization and purchasing are made possible. Moreover, by precisely recognizing and classifying diverse waste products, AI-powered systems with cameras and sensors enable effective sorting and recycling procedures. Artificial intelligence (AI)-powered real-time monitoring systems monitor waste production on building sites and provide prompt decision-making to reduce trash accumulation. Complete lifecycle analysis is made possible by integrating AI with Building Information Modelling (BIM), which helps architects create buildings with the least amount of waste possible during their lifespan.

AI is crucial in project planning, from requirement gathering to plan selection and implementation. Leveraging AI can help choose the best plan, improving project efficiency. AI's benefits in project management include improved project planning, real-time project monitoring and alerts, enhanced efficiency, communication and collaboration, risk management, predictive analytics, and better decision-making. Drones, wearable tech, autonomous equipment, and 3D printers contribute to improved safety measures in construction. Drones enable efficient site inspections, real-time safety monitoring, and emergency response, reducing worker exposure to hazardous areas. Wearable tech provides real-time safety alerts, biometric tracking, and immersive training experiences. Autonomous equipment reduces worker exposure to high-risk tasks, minimizes errors, and operates 24/7, potentially reducing fatigue-related accidents. 3D printers allow for safer prototyping, reducing the need for workers to handle sharp materials. These technological advancements contribute to mitigating risks, enhancing monitoring capabilities, and reducing exposure to hazards in construction environments.

8. Results

Table 1: Results [3][25][26]

	Traditional method	AI methods
Staff evaluation	Project planning with long period involves in recruiting.	Automatic skill matching and team making.
Work assignment	Planning tools, team meetings, strategy making, business alignment, one-on-one meetings, time consuming.	Auto tasks assigned and auto availability detection as needed.
Performance monitoring	Qualitative and quantitative data feedback	Automated monitoring
Safety measure	Emergency Response Planning, Site Inspections and Hazard Identification, Safety Education and Training, and Personal Protective Equipment (PPE), etc.	Wearable Tech, 3D printers, autonomous equipment's and drones etc., can be used.
Cost analysis	Excessive purchase is made, and cost cannot be analysed prior to the time, Estimation Techniques.	No excess purchases are made, planned accordingly.
Waste management	Safe disposal and recycling methods are not adopted	Recycling and safe disposal of scrap
Project planning	Information issues, resource productivity, Gantt charts, CPM, scheduling, and resource allocation.	Planning accordingly, considering material availability, time and cost management.

9. Conclusion

The results in Table 1 demonstrate how artificial intelligence (AI) may transform building methods by tackling long-standing problems such as poor productivity, safety, and overspending. The arrival of artificial intelligence (AI) in project management software, such as Autodesk BIM 360 and Procore, is demonstrating uses that improve decision-making, optimize workflows, and allocate resources as efficiently as possible.

Furthermore, this report highlighted how AI is revolutionizing the construction industry. The study projects that increasing the integration of AI would improve operational efficiency while also requiring a shift in the qualifications and abilities of the workforce. Ultimately, the data supports more AI applications in construction projects despite difficulties. The argument for industry-wide adaptation is substantial, given the possible advantages of increased production, safety, and cost-effectiveness. To fully realize AI integration's potential and advance the construction sector toward a

more inventive and sustainable future, coordinated efforts to remove obstacles and develop knowledge in this area are essential.

Future research should explore AI's sustainability and dispute management domains, address resistance to technology adoption, and increase the availability of datasets for AI applications in construction project management.

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