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"CONSTRUCTION RISK ASSESSMENT AND REDUCTION USING ARTIFICIAL INTELLIGENCE"

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Abstract: In construction, dealing with unexpected problems is crucial for project success. This study aims to improve how risks are assessed and reduced by using artificial intelligence (AI). We plan to use AI to predict, manage, and lower risks in construction projects. By analyzing past and current data, AI models can find patterns and signals that indicate potential risks. These AI models will act like smart helpers, giving project managers early warnings about possible issues. This proactive approach can help avoid problems, control costs, and improve safety. The project involves gathering a vast amount of historical and real-time data from various construction projects. By feeding this data into sophisticated AI algorithms, we aim to create models that can accurately forecast potential risks. These forecasts will provide valuable insights, enabling project managers to take preventive actions before issues escalate. This method not only helps in identifying risks but also offers solutions for risk mitigation. The project seeks to combine traditional risk management with modern AI technology. By using AI, we hope to see and address risks early, making decision-making better and more efficient. This new method can set higher standards in the construction industry, leading to safer, more efficient, and cost-effective projects. Additionally, this approach promises to enhance collaboration among stakeholders by providing a shared understanding of potential risks and strategies to address them. Ultimately, the integration of AI in construction risk management aims to revolutionize the industry, fostering an environment of innovation and continuous improvement.

Keywords: artificial intelligence, construction, risk mitigation, AI algorithms.

INTRODUCTION

In the construction world, dealing with unexpected problems is very important for project success. This project aims to change how risks are handled by using artificial intelligence (AI). The goal is to improve how we predict, manage, and reduce risks in construction projects. By using advanced AI and data analysis, we want to give project managers early warnings about possible risks. This will help them avoid problems, keep costs down, and improve safety. The main goal is to use old and current data to train AI models. These models will find risk patterns and signals, acting like a smart helper. They can spot potential issues in projects based on past and present data. By using AI this way, we hope to let construction teams address risks before they become big problems, leading to smoother projects and better success rates. This project also aims to combine traditional risk management with AI. By mixing old project data with AI, we want to move to a system where risks are seen and handled early. This will make AI a valuable tool, helping with better decision-making and risk management. Making AI a key part of construction risk management will set new standards, leading to better project outcomes, more efficiency, safety, and lower costs.

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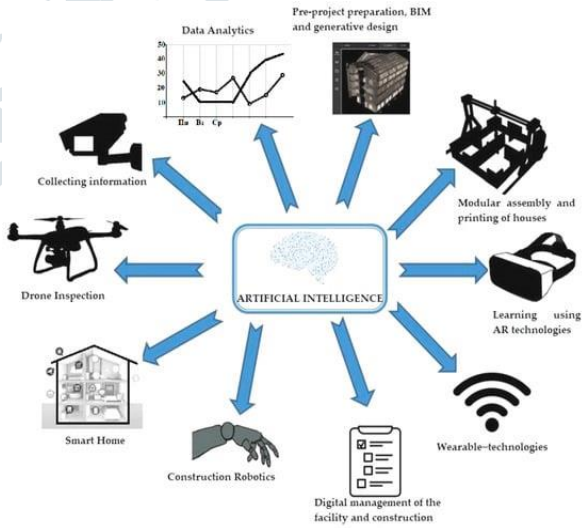

Figure 1: Types of AI and their use

Risks in Construction

- **Cost Overruns:**
  - The actual project costs exceeding the budgeted or estimated costs due to unexpected expenses, changes in material prices, or unforeseen challenges.

- **Schedule Delays:**
  - Unforeseen events, such as weather disruptions, permitting issues, or unexpected site conditions, leading to delays in project timelines.
- **Design Changes:**
  - Modifications to the project design or specifications during construction can result in additional costs and time.
- **Safety Hazards:**
  - Workplace accidents, inadequate safety measures, or non-compliance with safety regulations can pose risks to workers and project continuity.
- **Contractual Disputes:**
  - Disagreements or disputes between project stakeholders, such as owners, contractors, and subcontractors, regarding contractual obligations and responsibilities.
- **Environmental Risks:**
  - Unforeseen environmental challenges, such as soil contamination or habitat disruption, may lead to regulatory issues and project delays.
- **Supply Chain Disruptions:**
  - Issues with the availability or delivery of construction materials can impact project schedules and costs.
- **Technological Challenges:**
  - Implementation issues with new technologies or failure of construction-specific software can affect project efficiency.
- **Political and Regulatory Risks:**
  - Changes in government policies, zoning regulations, or permitting requirements can introduce uncertainty and delays.
- **Geotechnical and Site Risks:**
  - Unstable soil conditions, groundwater challenges, or unforeseen geological issues can impact the stability of structures and foundations.

Figure 2: Risks in constructions

Aim of the Study

The aim of this study is to leverage artificial intelligence (AI) to help construction by predicting and preventing problems early. By analysing data from past projects, AI can foresee potential risks like
delays or material shortages. The goal is to train AI to assist builders in spotting and addressing these risks before they become serious issues, ensuring smoother and more efficient construction projects.

Objective of the Study

- To utilize artificial intelligence (AI) as a strategic tool for optimizing construction risk management.
- By collecting data from various Construction companies which AI in their projects.
- By analysing data from past projects, AI can foresee potential risks like delays or material shortages.

LITERATURE REVIEW

Aladags (2023) study focuses on evaluating the accuracy of an AI language model in managing risks across different types of projects. The objectives include determining the key performance indicators (KPIs) for assessing the model's accuracy, gathering data based on these KPIs, and analyzing the correctness of the data through expert review. The study reveals that the AI performs reasonably well in risk management, with notably higher accuracy in risk response and monitoring compared to risk identification and analysis. However, the performance varies with different project contexts. Human involvement remains essential to judge the suitability and execution of AI-generated methods in risk response processes. The study concludes that the AI is moderately effective in risk management, showing consistent results across various sub-processes. Identified limitations include reliance on a single platform, insufficient training data, and the necessity for project-specific data collection and stakeholder involvement for enhanced accuracy.

Rane (2023) investigates the diverse roles that generative AI models play in construction engineering and management. The study highlights the contributions, challenges, and innovative potential of generative AI in this sector. Generative AI is transforming the construction industry by altering how new materials and technologies are developed and utilized. The models demonstrate the potential to revolutionize construction safety, risk management, quality control, defect identification, and supply chain and inventory management.

Chen et al. (2022) Aims to trace the evolution of AI technologies in the construction industry, identify key development trajectories, and suggest future applications in architectural design, engineering design, and construction services. The study indicates a growing prevalence of AI applications in the construction sector, with a significant increase in related publications since 2018. Utilizing Main Path Analysis (MPA), the study underscores the complexity and impact of AI technology on the construction industry.

Rampini et al. (2022) provide an overview of AI applications in building asset management, identifying existing research gaps and discussing future developments. The study highlights the extensive potential of AI in areas such as energy management, condition assessment, risk management, and project management within the AECO (Architecture, Engineering, Construction, and Operations) sector. It also underscores the importance of Digital Twin (DT) technology and synthetic images to enhance AI applications. Additionally, the study suggests combining deep learning (DL) and reinforcement learning (RL) to improve energy management efficiency. The methodology involves defining keywords, conducting bibliometric analysis, and performing an in-depth review of selected articles, resulting in a final selection of 83 articles.

Abioye et al. (2021) focus on reviewing AI applications in construction, identifying challenges to AI adoption, and analysing the growing number of publications in this field. The comprehensive literature review spans from 1960 to 2020, utilizing several databases and focusing on English-language papers. The study reveals challenges such as high initial and ongoing costs of AI solutions, the need for ongoing maintenance, a shortage of AI engineers, security risks, the lack of AI-driven financial audit tools, limited AI solutions for small businesses and subcontractors, and the practicality of voice-enabled user interfaces in construction.

Schwarz et al (2015), The study states typical approach of risk management in construction projects, the necessity of useful tools for successful risk management, and the proven use of artificial neural networks and Monte Carlo simulation in construction projects are among the paper's key conclusions. The risk management procedure, support vector machines, Monte Carlo simulation, and the combination of MCS and artificial neural networks are all parts of the study's approach. There is no clear reference of the Outcome measured or Main or primary outcome measured in the study in Jürgen Schwarz, Sc.-Ing J Alfredo Sandoval-Wong, Maria Pedro, Sánchez (2011). The main topics covered in this article are the significance of risk management in construction projects, the requirement for efficient risk analysis tools, and the application of artificial intelligence techniques in along with simulation techniques to forecast hazards. As a result, the study's primary or major outcome is not given.

METHODOLOGY

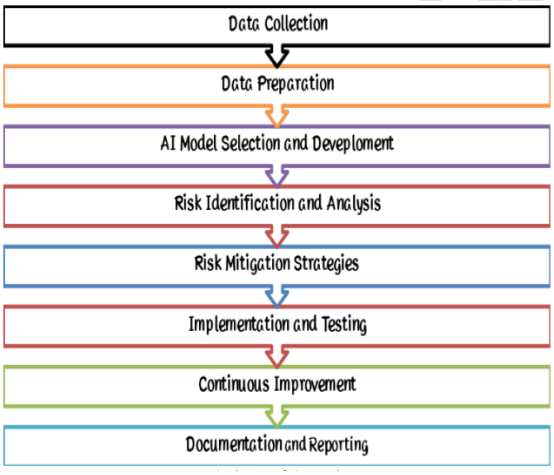

Figure 3: Flowchart of study

CASE STUDY

Efficiency, accuracy, and regulatory compliance are crucial in the dynamic construction industry. At Stantec Company in Nashik, we've developed AI-powered software that revolutionizes the production of Mechanical, Electrical, and Plumbing (MEP) drawings. Our innovative software can condense 30 days of labour-intensive work into just 15 minutes, resulting in significant time and cost savings while ensuring compliance with the National Building Code (NBC) standards. This report outlines the components and advantages of our AI-driven solutions and their application within the construction sector, demonstrating the transformative impact on traditional workflows.

Figure 4: Workflow steps in MEP

1. AI-Powered Automation:

- The AI code that powers their software and which minimizes the drafting and design workload.
- Has the ability to quickly process large volumes of data and deliver detailed MEP CAD drawings.

2. Compliance with NBC Codes:

- Ensuring that all designs strictly meet the most recent National Building Code (NBC) directives.
- As code changes, regular updates to the software are made to keep it compliant without manual review.

3. Error Elimination:

- This AI-driven approach reduces implementation time and mitigates human errors often associated with manual drafting.
- These are checks and validations that are built into the design process and ensure the design is not only correct but that it is dependable.

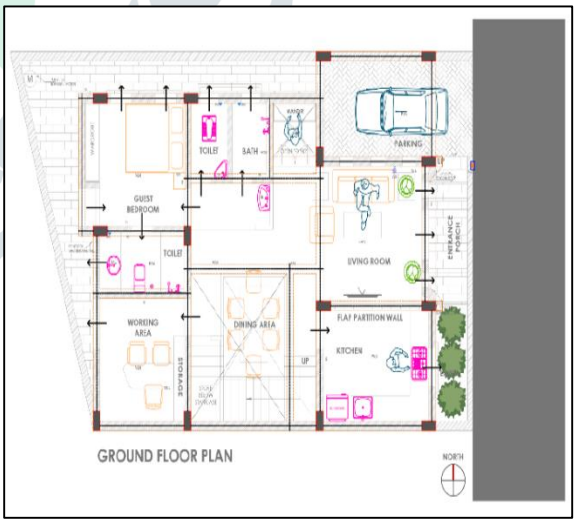

Figure 5: Layout Plan (CAD)

4. Comprehensive MEP Solutions:

- Drafts Mechanical, Electrical, Plumbing, and Fire safety systems. Comes with an extensive BOQ (Bill of Quantities) which is a full and to the point breakdown of materials and prices.

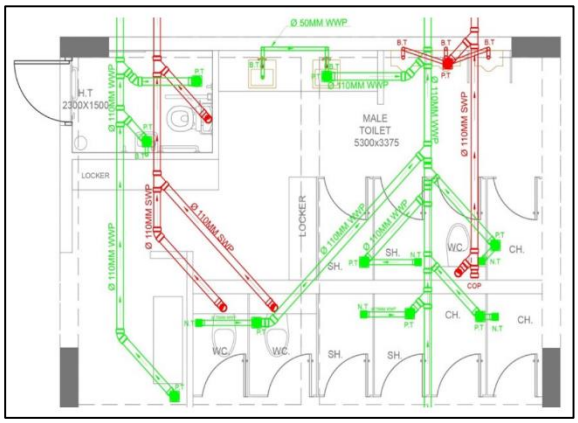

Figure 6: MEP Layout by AI

5. Impact on the Construction Industry:

- **1. Improved Project Management.**
  - Their software's speed and accuracy allow for more effective project planning and management.
  - Project schedules can be more adaptable and responsive whenever there is a fast turnaround.
- **2. Sustainability:**
  - Efficient design methods help to promote more sustainable construction practices by optimizing resource utilization.
  - Accurate BOQs and error-free designs result in less waste.
- **3. Advantage of Competitiveness:**
  - Their software may obtain a competitive edge in the market by providing speedier, more dependable services.
  - An improved reputation for compliance and quality draws in new business and projects.
- **4. Growth and Innovation:**
  - Creates new design and compliance requirements, which encourages innovation in the sector.
  - Allows businesses to take on more tasks with the same resources, which spurs development.

Their AI-powered MEP design software integrates the benefits of artificial intelligence with exacting compliance and quality requirements, marking a substantial breakthrough in the construction sector. They provide unmatched efficiency, cost savings, and quality by reducing a 30-day workload into a 15-minute effort. In addition to satisfying the requirements of contemporary building projects, this creative approach creates the way for further developments in building design and management.

CONCLUSION

The integration of AI-driven solutions has led to significant advancements in efficiency, accuracy, and sustainability within the construction sector, proving to be revolutionary. Various case examples illustrate AI's profound impact in different scenarios:

- **IoT-Enabled Devices:**

These devices enhance operational efficiency and safety in challenging conditions through predictive maintenance and real-time data insights.

- **Integration of Machine Learning with Building Information Modelling (BIM):**

While integrating ML into intricate BIM workflows enhances project planning and accuracy, it also requires extensive support and training.

- **AI in Procurement and Inventory Management:**

Despite the initial complexity of integration, AI reduces inefficiencies and expenses in the procurement process while maintaining quality control.

- **AI-Driven Mechanical, Electrical, and Plumbing (MEP) Design Software:**

This software showcases the effectiveness and accuracy of AI in design processes by significantly reducing design time, ensuring regulatory compliance, and producing high-quality outputs.

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