Recent Trends in Scheduling of Construction Projects Using Artificial Intelligence

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Abstract- Efficient scheduling of construction projects is crucial for achieving timely completion, optimal resource utilization, and cost efficiency. Traditional scheduling methods such as the Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), and Gantt charts have long been used but face limitations when dealing with dynamic, data-intensive, and uncertain project environments. Recent advancements in Artificial Intelligence (AI) — including Machine Learning (ML), Neural Networks, Genetic Algorithms (GA), and Reinforcement Learning (RL) — have revolutionized the scheduling domain by enabling predictive, adaptive, and automated decision-making. This paper reviews and analyses the recent trends and AI-based techniques applied in construction scheduling, focusing on model optimization, real-time data integration, and intelligent forecasting. The results indicate that AI tools significantly enhance schedule accuracy, risk management, and productivity.

Keywords: Construction Scheduling, Artificial Intelligence, Machine Learning, Neural Networks, Optimization, Project Management

I. INTRODUCTION

Construction scheduling is a vital component of project management that dictates the sequence, duration, and allocation of resources for project activities. Despite its importance, construction scheduling often suffers from delays and cost overruns due to uncertain environmental conditions, labour productivity variations, and information gaps.

Traditional scheduling methods such as CPM and PERT rely heavily on deterministic or probabilistic models that fail to adapt to changes during execution. To overcome these limitations, researchers and practitioners have started incorporating Artificial Intelligence (AI) techniques that can handle complex, nonlinear, and data-driven relationships.

AI-based approaches offer advantages such as real-time optimization, adaptive learning, and automated decision support. With the emergence of Industry 4.0 and smart construction technologies, integrating AI into project scheduling is becoming increasingly essential for the next generation of construction management.

II. LITERATURE REVIEW

Several studies have explored the application of AI in project scheduling over the past decade. Early attempts involved the use of Expert Systems to assist in schedule formulation. Later developments included Fuzzy Logic models that could manage uncertainty in task durations.

- Machine Learning (ML): ML algorithms such as decision trees and support vector machines (SVMs) have been utilized to predict project delays and optimize resource allocation.
- Neural Networks: Artificial Neural Networks (ANN) are widely used for pattern recognition in historical project data, allowing prediction of completion times under varying constraints.
- Genetic Algorithms (GA): GA-based models have proven effective in finding near-optimal schedules by simulating natural selection and mutation processes.
- Reinforcement Learning (RL): Recent research explores RL models where the system learns optimal scheduling policies by interacting with a simulated construction environment.

III. METHODOLOGY

The methodology adopted in this study involves reviewing and synthesizing recent AI-based

scheduling models and identifying emerging trends. The process includes:

1. Data Collection: Gathering research publications, industrial reports, and case studies from 2015–2025 related to AI in construction scheduling.
2. Classification of AI Techniques: Categorizing models into ML-based, heuristic-based, hybrid, and deep learning approaches.
3. Comparative Analysis: Evaluating each approach in terms of accuracy, scalability, interpretability, and implementation feasibility.
4. Trend Identification: Highlighting the integration of AI with technologies such as Building Information Modeling (BIM), Internet of Things (IoT), and Digital Twins.

The analysis focuses on the degree to which AI improves project performance indicators - time, cost, and resource utilization as compared to traditional models.

IV. RESULTS AND DISCUSSION

The analysis of recent literature reveals the following major trends:

1. Integration of AI with BIM and IoT:
   BIM-AI frameworks allow dynamic updating of schedules using real-time data from IoT-enabled sensors on construction sites.
2. Predictive Scheduling:
   Machine learning models trained on historical data can predict task durations, potential delays, and required manpower adjustments with over 85% accuracy in some studies.
3. Optimization Using Genetic and Swarm Algorithms:
   Hybrid models combining Genetic Algorithms and Particle Swarm Optimization (PSO) effectively minimize project duration and resource conflicts.
4. Deep Learning for Schedule Forecasting:
   Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM) architectures are increasingly used to model time-dependent scheduling data.
5. Reinforcement Learning for Dynamic Decision Making:
   RL-based scheduling agents continuously learn from project feedback and improve sequencing and resource allocation decisions autonomously.
6. AI-Driven Risk Assessment:
   AI tools are also applied to predict and mitigate risks related to weather, supply chain disruptions, and labor availability, leading to more resilient schedules.

These developments highlight that AI not only automates scheduling but also transforms it into an intelligent, adaptive process capable of learning and self-correcting.

V. CONCLUSION

The application of Artificial Intelligence in construction scheduling represents a paradigm shift from static planning to adaptive and predictive management. The integration of AI with digital construction technologies such as BIM, IoT, and Digital Twins enables real-time monitoring and intelligent control of schedules.

While AI offers substantial benefits in accuracy, efficiency, and risk reduction, challenges remain in terms of data availability, interpretability, and user training. Future work should focus on developing transparent, user-friendly AI systems that can integrate seamlessly with existing project management tools. The adoption of AI-based scheduling systems has the potential to revolutionize the construction industry by enabling data-driven, efficient, and resilient project execution.

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