

Assignment#2

Assignment Report: Benefits of Machine Learning in Construction Management

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Benefits of Machine Learning in Construction Management

Problem Statement:

Construction projects are full of same problems: delays, cost overruns, low productivity, quality defects, and safety accidents. These issues happen in part because construction data is big and dispersed (BIM models, schedules, cost records, site photos, sensors, and reports). Conventional construction administrative methods rely heavily on manual labor and anecdotal experience, so they are sluggish and occasionally incorrect as projects grow intricate. Newer studies reveal how machine learning provides managers with improved predictions and automated project monitoring from project data. ML, for instance, helps forecast cost and time and aids with automated progress and safety tracking.

But current ML options are not being rolled out in applications. Most studies are being tested at small training sets or within a small number of sites, so the findings may not be universally applied. Studies concentrate on model accuracy, yet fail to demonstrate a tangible improvement in project KPIs such as delay reduction, reduction of accident incidence and so forth. Furthermore, ML instruments are not always incorporated into an actual construction management system and privacy, explainability and other such issues still exist.

Thus, the construction industry still requires a clear, validated approach to utilize ML over the lifecycle of the project to obtain true quality, productivity, safety, and cost/time gains.

Research Objectives:

- To develop and validate a working framework to enhance construction management performance using machine learning.
- To identify the core construction management problems that ML has attempted to solve (cost, time, safety, productivity, and quality).
- To evaluate the extent to which current ML and deep-learning methods improve forecasting and site monitoring.
- To identify the main limitations that prevent ML from being adopted broadly (data size, poor generalization, weak integration, privacy, and unclear model decisions).
- To propose a lifecycle-oriented ML adoption framework aligned with BIM and site-data workflows.
- To validate the framework against project performance markers like schedule reliability, cost predictability, monitoring efficiency, and safety performance.

Literature Review:

This paper demonstrates the strong advantages of ML in construction management in terms of the literature. Abioye et al. (2021) note that ML models enhance cost and time prediction, risk analysis, and automated inspection that assists the managerial in identifying the difficulties earlier and minimizing the rework. Datta et al. (2024) indicate that ML is most utilized during planning and construction phases in forecasting and safety prediction, while its usage during operation and maintenance is still minimal.

Most deep-learning studies have been performed on site data. Elghaish et al. (2021) demonstrate that computer-vision models are capable of detecting activities, tracking workers/equipment, and even unsafe behavior to support real-time control of sites. Liu et al. (2022) demonstrate that deep learning enhances hazard recognition and PPE detection to inform proactivity in safety management while datasets and real-site validation are still limited.

Other studies turn towards automation of management functions. Al-Sinan et al. (2024) suggest ML + BIM scheduling to automatically generate project schedules; however, this process requires high-quality historical BIM and schedule data. Using site images, Chua & Cheah (2024) demonstrate deep learning can estimate progress of prefabricated projects, which supports earned-value based control, but it is only evaluated on a small number of project types.

To summarize, ML does better than any other techniques, whether it be forecasting, monitoring, or safety. Indeed, research still requires an applied adoption framework that works best across projects with KPI benefits to report.

References:

Abioye, S. O., Oyedele, L. O., Akanbi, L., et al. (2021). Artificial intelligence in the construction industry: A review of present status, opportunities and future challenges. *Journal of Building Engineering*, 44, 103299. <https://doi.org/10.1016/j.jobbe.2021.103299>

Datta, S. D., Islam, M., Rahman Sobuz, M. H., Ahmed, S., & Kar, M. (2024). Artificial intelligence and machine learning applications in the project lifecycle of the construction industry: A comprehensive review. *Heliyon*, 10, e26888. <https://doi.org/10.1016/j.heliyon.2024.e26888>

Elghaish, F., et al. (2021). The application of deep learning in construction site management. *Construction Innovation*. <https://doi.org/10.1108/CI-10-2021-0195>

Liu, J., Luo, H., & Liu, H. (2022). Deep learning-based data analytics for safety in construction. *Automation in Construction*, 140, 104302. <https://doi.org/10.1016/j.autcon.2022.104302>

Al-Sinan, M. A., Bubshait, A. A., & Aljaroudi, Z. (2024). Generation of construction scheduling through machine learning and BIM: A blueprint. *Buildings*, 14(4), 934. <https://doi.org/10.3390/buildings14040934>

Chua, W. P., & Cheah, C. C. (2024). Deep-learning-based automated building construction progress monitoring for prefabricated prefinished volumetric construction. *Sensors*, 24(21), 7074. <https://doi.org/10.3390/s24217074>