Leveraging Artificial Intelligence to Build Sustainably and Save Money

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Constructing a sophisticated and complicated building is often challenging. It has been compared to navigating a maze where there is an obstacle, dead end, or hurdle around every corner. Budget constraints, clashing design documents, tight schedules, and workforce management are just a few of the many challenges faced by project teams. Now add the growing pressure of minimizing environmental impacts of buildings.

The role of an architect when envisioning and planning a building cannot be overestimated. Beyond simply drawing beautiful pictures and creating intricate renderings of the buildings before ground is broken on the projects, architects manage stakeholder expectations and wrestle with design revisions, all while attempting to weave cost-effective sustainability components into the documents based on the demand of their clients. All this occurs under the looming shadow of tight deadlines and accelerated project schedules. Unfortunately, architects' sustainability efforts often fall short during the construction process due to the unpredictability of owner funding, materials costs, and labor costs that necessitate budget cuts or value engineering efforts that impact the original design intent.

General contractors typically face their own set of challenges when it pertains to building sustainably. Many in the construction industry acknowledge its cautious adoption of new technologies and processes, so conventional construction practices often clash with stricter sustainability standards dictated by clients and policy. Even facility managers struggle

to keep up with modern building management systems driven by powerful computers and data, making the daily management of buildings more complicated and precise than ever before.

In the rapidly changing built world, the use of data and new technologies are promising to revolutionize the way buildings are designed and built. Specifically, artificial intelligence (AI) is showing incredible potential and could be a game changer by helping to streamline design, planning, and construction processes and ultimately delivering cost savings for real estate developers and owners.

DESIGN

Sustainable design continues to evolve to address the carbon footprint of buildings. Embodied carbon refers to the emissions associated with constructing buildings and can make up 85%

of a building's first-year carbon footprint. The carbon footprint is heavily influenced by building material choices, particularly steel and concrete. While most contractors are already making a good-faith effort to decrease embodied carbon during construction by using constructability reviews to reduce material usage, challenges still arise from incomplete or inaccurate data sets, particularly in areas such as mechanical, electrical, and plumbing systems. AI holds promise in reconciling material data between databases and BIM models, and in recommending lower-carbon alternative materials for buildings. Operational carbon refers to the emissions generated during the everyday use of buildings, and it poses its own unique set of challenges because of the sophisticated emerging technologies being implemented for energy efficiency and decarbonization, which necessitate new energy modeling techniques. AI can assist here as well by mapping optimized paths within parametric analyses.

AI will play a critical role in identifying the optimal balance between embodied carbon and operational carbon and in driving environmental sustainability and cost savings. Today, the industry is seeing many construction technology startups providing AI-enabled solutions that can be applied earlier in a project lifecycle to significantly reduce initial and operating costs of buildings, ultimately benefiting developers and owners.

CONSTRUCTION

AI has the potential to drive sustainability during the construction process as well. AI algorithms are already optimizing jobsites for minimal carbon impact and streamlining materials delivery routes to maximize efficiencies. Even waste management is being improved by the power of AI. The construction industry consumes a staggering 93% of all raw materials used annually. To combat this challenge, waste-processing facilities are leveraging AI-powered robots with object recognition that sort mixed debris on conveyor belts, dramatically boosting material recycling rates and creating a safer work environment for human resources while also minimizing the impact on the natural environment. AI will also play a role in the dismantling of buildings through the creation of reuse marketplaces and closed-loop systems where salvaged materials can seamlessly find new homes on future projects. Strides are already being taken regarding real-life and real-time applications of AI for recycling, such as startups using AI and robotics to recycle used wood by automatically and efficiently stripping away nails and fasteners on discarded dimensional lumber and preparing that recycled lumber for use on future jobsites, while other companies are employing predictive analytics to help right-size and optimize dumpster and waste collection schedules, translating into less clutter and cleaner jobsites.

POST-CONSTRUCTION

With stringent new regulations and rising sustainability demands throughout the country, facility managers are facing heightened pressure to optimize building performance and efficiency. AI-driven monitoring-based commissioning processes, aided by automatic fault detection and diagnostic tools, are focused on energy monitoring, analysis, and fault detection. Granular metering is being leveraged to help facility managers understand energy consumption patterns. Automated analysis, currently transitioning from rule-based to machine learning-driven systems based on historical data, holds promise for proactively optimizing building system performance and providing real-time insights beyond traditional reactive alarm-based approaches. These sophisticated systems are able to interpret system behavior against detailed operational sequences. Future iterations will aim to identify issues while also automatically changing and optimizing equipment operations, rather than relying solely on human facility managers. Historically provided by third parties, these systems are becoming increasingly integrated by providers into building management systems.

By embracing AI's predictive capabilities and sustainable practices, architects and general contractors can drive tangible environmental and financial benefits while shaping a greener, more efficient built environment for future generations. AI is already proving revolutionary for the construction industry and its sustainable design and building processes. The built world should anticipate AI will play a pivotal role in enhancing sustainability and streamlining and delivering cost-effective solutions across all stages of the design and construction process.

About the Author

Steven Burke is the senior director of sustainability at Suffolk Construction. He has guided green building certifications on projects of many different types and sizes, including k-12 schools, higher education facilities, mid-rise and high-rise residential, commercial interiors, retail interiors, and commercial office buildings.

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