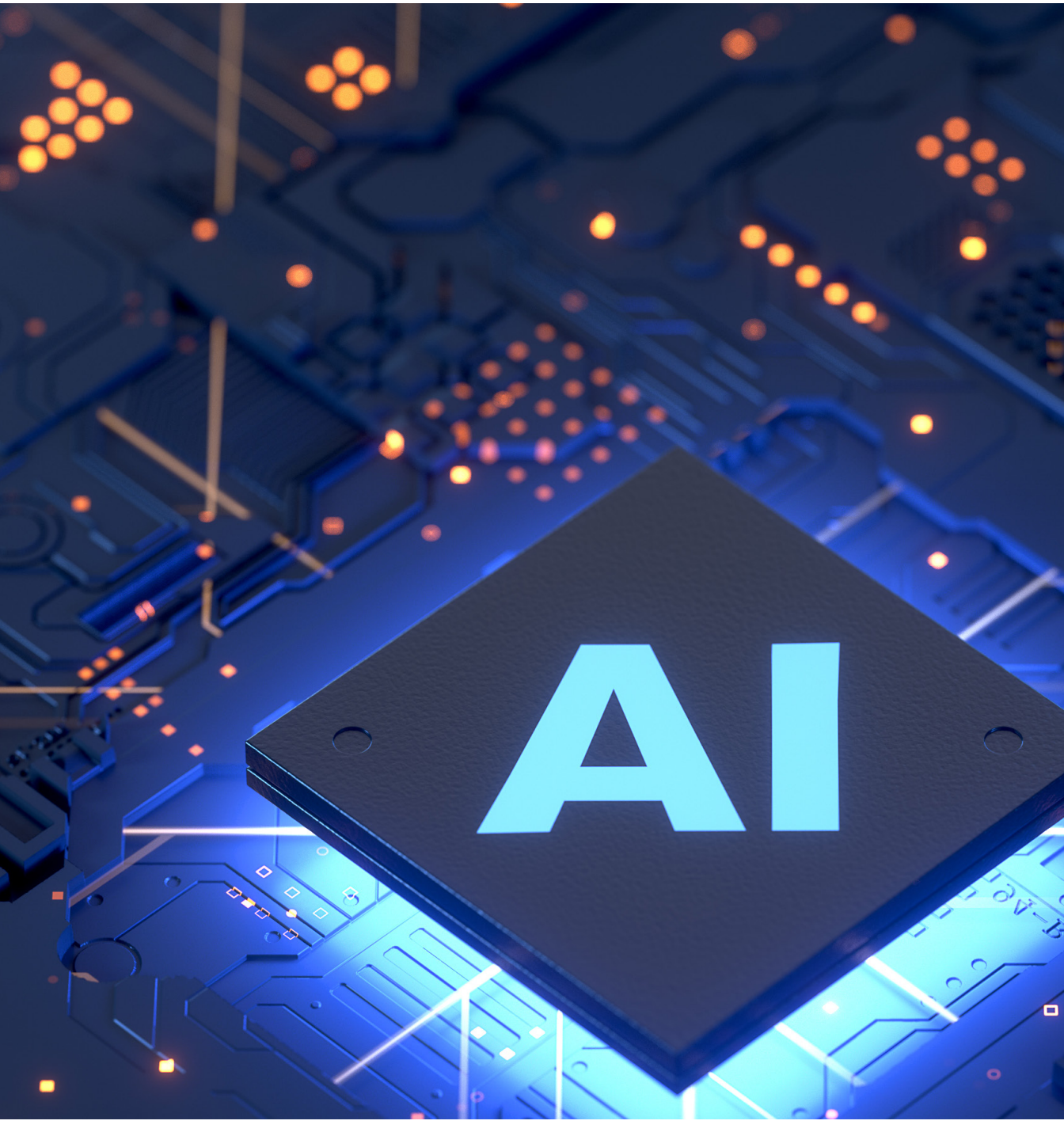
AI: Engineering and Construction Firms Are Watching Early Adopters

By James Boileau



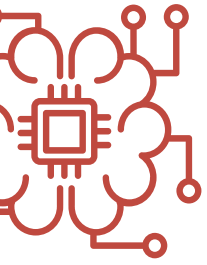
Artificial intelligence in construction was just in its infancy when this article was published. The technology remains in very early stages and is expected to continue to evolve for years to come.

As with any disruptive technology in any industry, it takes time to grasp the new possibilities, let alone identify which new tools have the greatest potential value for your particular business. For AI to gain more ground in construction, for example, a few hurdles must still be overcome.

Integrating new technology can require a shift in mindsets and skill sets among workers. This challenge is complicated by the labor squeeze. It's not easy to learn a new process or system when there are barely enough hours or hands to complete the familiar tasks. Firms must have a long-term view, understanding that struggles upfront will pay off over the long run.

As an industry, engineering and construction have yet to fully digitize and analyze data. A great deal of E&C work is still done via paper and pencil, which never makes it into a database. A movement toward digitizing data, however, is gaining momentum. The next steps are managing, understanding and leveraging the data.

As E&C firms see their peers putting AI's potential into practice on real job sites, adoption of this and other technologies will continue to gain momentum.



AI: Engineering and Construction Firms Are Watching Early Adopters

By Andrew Henderson

Four ways artificial intelligence can transform an industry that's finally poised to embrace technology.

As technology continues to disrupt many industries, offering exciting and meaningful opportunities to improve how we work and deliver evermore complex projects for our customers, it has long been acknowledged that construction has been slow to implement these tools.

Although the most sophisticated engineering and construction (E&C) professionals collect data and use technology to analyze that data and become more effective, in my experience, it's still a small percentage.

The tide appears to be changing, necessarily so: Projects continue to grow in number and complexity while the labor shortage continues to challenge the industry. Recent investment in construction technology has been robust, according to recent research, noting that between 2008 and 2012, construction technology received $9 billion in cumulative investment. That number doubled to $18 billion between 2013 and February 2018.[1]

[1] Blanco, Jose Luis, et al. "Seizing Opportunity in Today's Construction Technology Ecosystem." McKinsey & Company. September 2018.

The technology solutions being proposed and/or implemented in E&C are still in the early stages and run the gamut—3D printing, robotics, digital twin technology and modularization are a few examples. The applications that promise to drive real change involve artificial intelligence (AI) and machine learning. AI's capabilities include, but aren't limited to, document analytics, cognitive services and cameras, risk analysis and prediction, and data analytics.

AI and Machine Learning

AI consists of software or computer systems that, upon receiving either structured or unstructured data and learning from it, can mimic human decision-making. Given that the E&C industry can now collect enormous amounts of data, the possibilities for AI truly are exciting.

To cite one example, if you input thousands of images of people wearing hard hats as well as thousands more images of people without hard hats, a computer can learn to identify noncompliant workers, whatever their size, shape or gender, on any given building project. The more data a system

receives, the closer it will come to attaining complete accuracy in its assigned task.

For the purposes of this article, we consider machine learning a subset of AI. Machine learning differs from AI in that it uses statistical information to provide computer systems the ability to learn from data, but within a stricter framework. For example, let's say you want to prevent a fire. If you teach a machine to alert you when the temperature in a room has exceeded 100 degrees Fahrenheit and to shut off the thermostat at that temperature, that would be machine learning. To meet the definition of AI, the machine would be able to recognize fire and make independent decisions based on that event.

Most applications currently used in E&C involve machine learning. However, AI has the potential to transform the industry in many ways, helping us keep projects on track and boosting the safety, efficiency and bottom line of any given work site.

Here are four examples of AI's potential that we find particularly intriguing:

1. **Predictive Analytics.** As its name suggests, this type of analytics can predict future events based on current and historical data. The E&C industry has always collected data, but we haven't always known what to do with it. We are capable of collecting a dizzying amount of data—roughly 2.5 quintillion bytes every day[2]—so the potential applications of AI in our industry are vast. For a construction job site, examples could include optimizing supply chain logistics, identifying the impact of weather trends on project scheduling, or managing budget overages through analysis of the team's experience level and contract type. As a risk engineer for an insurance company, I especially welcome how predictive analytics can predict safety hazards on a job site, thus allowing stakeholders to track and mitigate risk.

John Mavros, sales and marketing director for Predictive Solutions, a company that uses predictive analytics to reduce workplace injuries and fatalities, explains how predictive analytics can help general contractors (GCs): "On any given project, you might collect 5,000 to 6,000 data points a month. If a GC has 50 different projects, do the math and you realize how difficult it is to digest and interpret all that information at the same time," Mavros says. "A predictive analytics model is essentially interpreting all of that information for you and delivering a more intelligent data point that is capable of considering everything all at once and presenting you with the risk."

By recording data from inspections and on-site observations, the model creates a matrix of leading indicators and predictions on future risk in real time.

"We can provide intel on not only whether a location has a high-risk score but also the top high-risk elements on any given site—say, falls, struck-bys, caught-betweens—that the model is triggered to detect," Mavros says. "We put certain services around that to say, 'Okay, when it triggers, what are the appropriate actions to take?' So you can

[2] Marr, Bernard. "How Much Data Do We Create Every Day? The Mind-Blowing Stats Everyone Should Read." Forbes. 21 May 2018.

ultimately plan how to mitigate that risk before it actually happens."

As more data is added, a predictive analytics model becomes even more intelligent, eventually able to identify what "normal" is for a particular project and eventually what "good" looks like. With the Internet of things (IoT), he adds, the increased ability of passive devices, such as optical fibers and electrical resistors to record data, further expands the enormous potential.

2. **Photo Documentation.** Capturing images to provide data is one of the more exciting applications of AI. Software is now capable of recording photos and highlighting meaningful information to help GCs monitor projects and track progress.

   OnSiteIQ is one company that is doing this work and expanding the possibilities of photo documentation with AI. "We walk through a customer's entire site every week, so they'll always know the current conditions of every single square foot of their project as we build a digital archive of its progress," says Ardalan Khosrowpour, CEO and co-founder of OnSiteIQ.

   After capturing high-resolution 360-degree imagery (think of the experience on Street View), the tool can collect a variety of information, allowing stakeholders anywhere in the world to view the results and collaborate on the model's outputs. This technology can also be used to narrow its focus to perform more specific tasks. For example, teaching a system how to identify a defective ladder would allow it to inspect all of the ladders on a 1 million-square-foot job site in a matter of minutes.

   "It would take a person a long time to complete this task, and there's no benchmark for human accuracy in finding, say, all of the ladders that might be defective and need to be removed," Khosrowpour says. "Plus, remember that a machine doesn't get tired like a person can. It will detect all the ladders and is able to identify the defective ones, with a very high probability that you aren't missing any. This is an example of AI allowing your skilled employees to focus on more difficult and complex tasks."

3. **Augmented Reality (AR) and Building Information Modeling (BIM) Technology.** BIM creates a 3D computer-generated model of an entire project before a shovel even hits the ground and includes the schedule of erection. It has already begun to transform our industry.

   On a construction site, it's all about the schedule. Applying AR to a BIM model allows stakeholders to see not only what the building is supposed to look like when it's completed, but also where they're at in any given moment—as well as the ability to step back in time or look ahead, courtesy of a digital archive built within the system. By teaming this up with AI, the computer can compare in-place construction to the model and where stakeholders are in the process (compared to the schedule) at any given point in time.

   Imagine putting on a pair of glasses and viewing the project in every phase of its development. You can stand in a "room"

at the beginning of a project and see where it is at the moment and where it's supposed to be in one month, two months or further down the road.

To offer an even more basic example of AR's value: If the computer shows you on day five that a stud is in the wrong place, it takes very little effort to get back on track on day six or seven. If that misplaced stud is discovered weeks or months later, it will take a lot more effort to correct that problem and get back on schedule. This is particularly significant, considering a recent survey from FMI and PlanGrid, which found that poor communication and poor project data collectively accounted for a total of $31.3 billion in rework in 2018 for the U.S. construction industry.[3]

Moreover, once a project is completed, AI can create ever-smarter buildings that can optimize energy usage and enhance safety, among other capabilities

4. **Autonomous Vehicles.** Heavy construction equipment is becoming semiautonomous and even autonomous, creating the potential for huge productivity boosts. Feed a machine structured data—information you typically get from a drone or laser scanner—and let it identify the most effective way to do the job. Think of cranes, bulldozers and dump trucks not only doing the work, but also making intelligent decisions. More realistically in the near future, consider a backhoe that can optimize the way to dig a ditch: It can recommend the specific size and depth to excavate and can correct itself, when necessary, to decrease or increase the amount of material it's cutting.

   A few companies are already beginning to use these smart vehicles in their construction fleets to boost efficiency and productivity. One example is a 400-ton hauler truck that can make 20 trips per day. The safety impact can't be underestimated either, because these machines are operated remotely, keeping workers out of harm's way. Remote diagnostics also boost efficiency, ensuring equipment lasts longer and is more fuel-efficient.[4]

Tech's Time Has Come

Although E&C will be playing catch-up compared to other industries in technology adoption, research suggests that AI applications in other sectors, such as transportation and retail supply chain, may have relevance for the E&C industry as well.[5]

Despite some early adopters in the E&C space, leadership across the industry must step up its game and recognize the opportunities that technology offers. E&C leaders also need to address the industrywide reluctance to technology adoption by reassuring their teams that these new systems are designed to optimize the skills and knowledge they bring to a project.

[3] Schott, Pete. "Construction Disconnected: The High Cost of Poor Data and Miscommunication [Report]: New Construction Survey Reveals a $177 Billion Industry Problem." PlanGrid. 1 August 2018.

[4] Alderton, Matt. "The Robots are Coming! Driverless Dozers and the Dawn of Autonomous Vehicle Technology in Construction." Redshift by Autodesk. 3 May 2018.

[5] Blanco, Jose Luis, et al. "Artificial Intelligence: Construction Technology's Next Frontier." McKinsey & Company. April 2018.

"Technology, including AI, is empowering the construction industry to focus on the things that matter," Khosrowpour says. "But the state of AI right now can't fill the human connection for the foreseeable future. At OnSiteIQ, for instance, we do a lot of risk assessment. We never claim that what we're doing is risk management. A machine cannot attain human emotion and intelligence for now, and it's hard to imagine AI fully replacing that."

James Boileau is construction segment director for The Zurich Services Corporation of Zurich North America, a role he has held since 2014. Responsible for the technical direction of loss control services provided to customers and underwriters, James manages a team that studies emerging risks in the construction industry and leads the development of new products and services designed to help mitigate those risks. He joined Zurich's Risk Engineering unit in 2002 and has served in a variety of construction-related technical and management roles. Prior to Zurich, he had experience directing project supervision as a project manager and superintendent in commercial and industrial projects. James holds a bachelor's degree in civil engineering and a civil engineering technology diploma from Lakehead University in Thunder Bay, Ontario. He holds the P.Eng. (professional engineer) designation from Professional Engineers Ontario and is a member of the Associated General Contractors of America (AGC) and the Construction Users Roundtable (CURT).

for the Built Environment

Denver
210 University Boulevard
Suite 800
Denver, CO 80206
303.377.4740

Edmonton
Edmonton, AB
204.232.1373

Houston
1301 McKinney Street
Suite 2000
Houston, TX 77010
713.936.5400

Phoenix
7639 East Pinnacle Peak Road
Suite 100
Scottsdale, AZ 85255
602.381.8108

Raleigh (headquarters)
223 S. West Street
Suite 1200
Raleigh, NC 27603
919.787.8400

Tampa
4300 W. Cypress Street
Suite 950
Tampa, FL 33607
813.636.1364

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