

Implementing AI in Electrical Applications — Part 1

How the industry is incorporating artificial intelligence into the electrical space.

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EXECUTIVE SUMMARY

YOUR GUIDE TO AI AND THE ELECTRICAL INDUSTRY

Stay informed on how artificial intelligence is impacting the electrical industry, or risk falling behind.

By Michael Morris, Editor, *EC&M*

Ever since the rise of ChatGPT in November 2022, artificial intelligence (AI) has been unavoidable. Just about every industry is developing ways to incorporate AI into their field, and the electrical industry is no different. According to the results from our annual Top 40 Electrical Design Firms survey published in June 2024, 43% of respondents were “already using” AI tools in some capacity with their electrical design work. Similarly, in our annual Top 50 Electrical Contractors survey from September 2024, 25% of electrical contractor respondents said they were “already using AI” and more than three-quarters indicated they would be using AI “within two years.”

While our 2025 surveys won’t go out until a bit later this year, it’s likely those percentages will continue to grow. *EC&M* has followed the rise of AI in order to keep our readers informed on how the technology is impacting the electrical industry. This content has been immensely popular, so we decided to collect some of the best articles into our first e-book of 2025.

The first three articles in this e-book are by freelance writer Tim Kridel, all of which look at the rise of AI and how the electrical industry has incorporated it. These pieces offer valuable insights into how industry leaders have embraced AI.

The next two articles in this e-book offer practical information on how electrical professionals can utilize AI themselves. First on page 24 is Sal Paraltore’s article “Harnessing AI to Empower Electrical Contractors,” which gives insight into how the electrical contracting industry is using AI. Finally, on page 28, “Intelligent Design” by Tim Kridel was the cover story of our November 2024 issue and explores how AI is driving innovation in the electrical industry two years after the debut of ChatGPT.

The topic of artificial intelligence and its role in the electrical industry is such an important and rapidly evolving one that we decided we’ll need two e-books to do it justice. Stay tuned for “Implementing AI in Electrical Applications — Part 2” releasing later in 2025.

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RISE OF THE MACHINES

From agriculture to health care to logistics, global spending on professional service robots increased 12% between 2019 and 2020. Is the electrical industry following or bucking that trend?

By Tim Kridel

In season 3 of the HBO series *Westworld*, robots are everywhere again, this time on construction sites. One model is George (Photo 1), whose skills include electrical and HVAC installation and site surveys.

"Dull, dirty, and dangerous no more," says Delos, George's manufacturer. "Delos' fully autonomous androids are capable of a wide range of tasks with only limited human supervision required. Day or night, rain or shine, they work tirelessly to ensure the buildings around us are constructed faster and safer than ever before."

Westworld is set sometime in the 2050s. Judging by today's construction robots, George could be a reality by then. In fact, some of the marketing copy already sounds like George's.

One example is Hilti's Jaibot: "Overhead work for mechanical, electrical, and plumbing installation is strenuous, challenging, and time-consuming for construction workers. With the industry experiencing a skilled labor shortage, taking good care of your workforce is now more important than ever. With a construction robot like



Photo 1. Construction robots like "George" in the HBO series *Westworld* (set in the 2050s) could be closer to reality than we think.

Jaibot, you can count on higher productivity and speed as it autonomously marks and drills the holes according to the digital plan."

Another example is Boston Dynamics' Spot, a dog-like robot capable of payloads up to 30 pounds. New York City-based Turner Construction has been testing Spot since 2020. You can watch Spot in action

on the Boston Dynamics YouTube channel.

"It was eye opening," says James Barrett, Turner vice president and chief innovation officer. "It's like science fiction come to life. It can balance itself, jump up and down, and walk down stairs. We're walking it across an unpoured deck across the flutes. It can go up and down a big pile of rubble."

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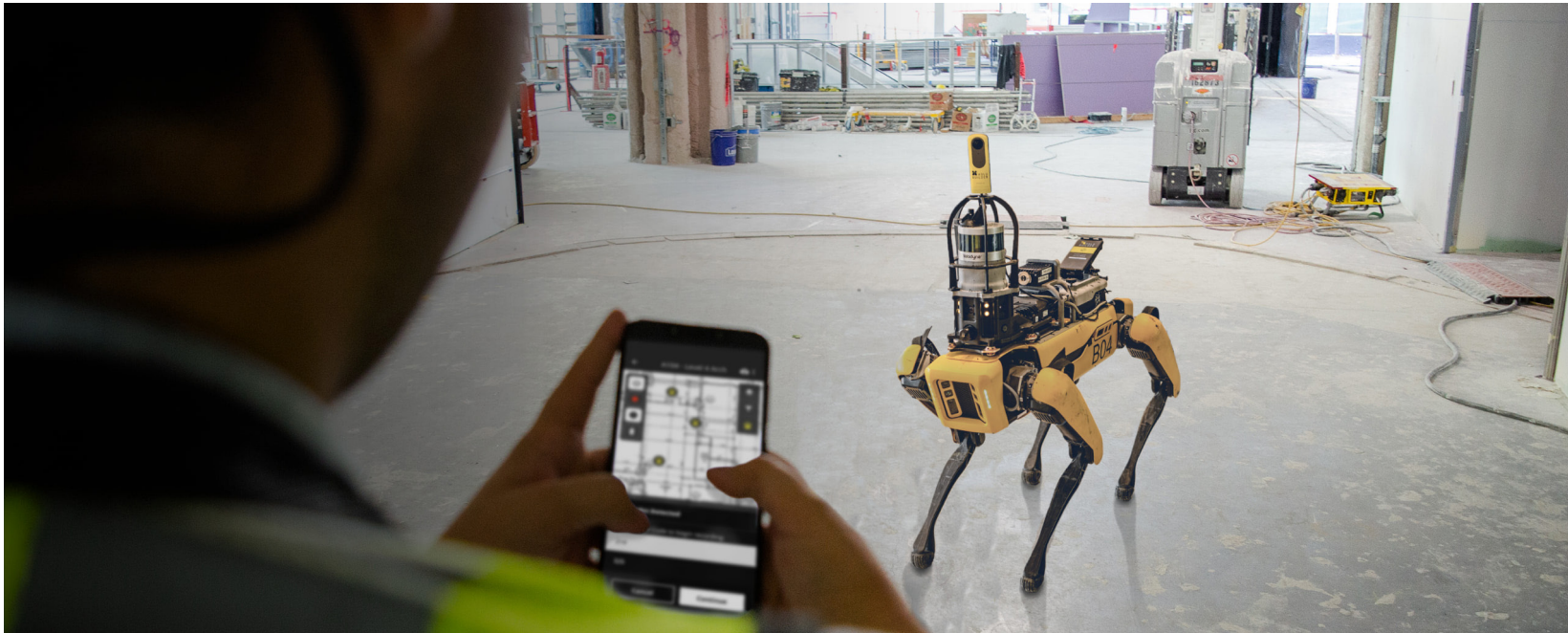
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Courtesy of FARO/HoloBuilder

Photo 2. SpotWalk, developed by HoloBuilder, features a 360-degree camera on the robot's back, eliminating the man hours and potential injury of sending employees to do that documentation manually.

Job-site robots aren't a new concept. For example, the first patent for an automated bricklaying machine was filed a century ago. Today, there are models that can lay 3,000 a day — three times more than a human mason.

Spot is part of a new generation of construction robots that leverages advances in artificial intelligence, machine learning (AI/ML), and other technologies to do things that weren't practical or even possible just a few years ago.

"Boston Dynamics is constantly upgrading the software," Barrett says. "The autonomy has gotten much better. It could go places that it couldn't before. It's getting smarter."

LEARNING ON THE JOB

Many robotics applications use building information modeling (BIM) data. In the case of Jaibot, BIM provides the coordinates for each location where a hole needs to be drilled.

"It's then a pretty simple step to add the drill depth, diameter, and a couple of other attributes and export that from the relevant design software (usually AutoCAD or Revit) as a .CSV file," says Aidan Maguire, business unit manager for measuring and robotics expert for Plano, Texas-based Hilti. "This .CSV file is then loaded into the Jaibot project cloud, [which] is accessed through a standard web browser.

"In the field, Jaibot is connected to the internet through a mobile data connection and will sync with the project cloud once the operator logs in. This allows live access to the project planning, allows for updates to the design if required, and syncs back the project progress, including the as-built hole locations."

Site documentation is a common use case. For example, HoloBuilder developed SpotWalk, which mounts a 360-degree camera on Spot's back, eliminating the man hours and potential injury of sending employees to do that documentation manually (**Photo 2** on page 4).

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Photo 3. Benefits of using robots for building tasks like setting timber include their ability to do things faster, more efficiently, and to a higher level of quality.

"Spot itself has advanced sensing and navigation capabilities," says Mark Benhard, global corporate communications director for Lake Mary, Fla.-based FARO Technologies, which acquired HoloBuilder in June. "When it has been trained once for a documentation route with SpotWalk, it can walk the route autonomously and take photos. All you need are floor plans of your building — no BIM models or alike."

MULLING THE BUSINESS CASE

Turner is one of the few contractors — of any type — using robots right now. Why?

Most are still mulling the potential use cases, benefits, and costs before deciding whether to try one, let alone buy or lease one. For example, Hilti says contractors often ask about productivity, such as how many holes Jaibot can drill per hour or per day compared to an employee using traditional methods.

"This is a very difficult question to answer accurately as project conditions and the nature of the application (density of holes, diameter, drilling depth, etc.) can result in different productivity rates between projects," Maguire says. "However, when

contractors consider the entire application beyond simply the labor hours required to physically locate and drill the holes — such as reduction of rework, long- and short-term health and safety implications, and increased accuracy of installation — then even under less-than-optimum conditions, contractors can find a compelling business case."

Boston Dynamics didn't respond to interview requests for this article, but its website describes some of the labor savings seen in trials. One example is from a Canadian construction company: "Pomerleau anticipates being able to free-up the typically assigned employee's time by approximately 20 hours per week based on a 500,000-square-foot project that requires nearly 5,000 images per week to properly document, allowing that employee to focus on the analysis of the captured data."

The business case also hinges on the total cost of ownership (TCO). One analogy is drones: When mobile operators, construction companies, and other businesses began implementing drones, they had to hire or train enough people to pilot and maintain them.

"When I'm looking ahead, if we had a fleet of these [robots], that's when you'd have to start asking yourself, 'Do I need to build up a team of robotics experts?'" says Turner's Barrett.

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Construction robots increasingly have application programming interfaces (APIs). Other vendors can use APIs to tightly integrate their products with those robots, as HoloBuilder did when it developed SpotWalk. In the future, contractors could leverage robot APIs to create in-house hardware and software.

"We may try to take advantage of the API because then we can start looking at all sorts of unique payloads that might give us a competitive advantage that nobody else has — in which case, we would want to have our own software people doing that work," Barrett says.

Those people probably would be new hires rather than existing IT staff.

"I think it's something separate from your IT because it's a completely new and different skill set," Barrett says. "When you get very advanced, sophisticated robots like Boston Dynamics', that's a whole different level of knowledge you would need."

JOB KILLER ROBOTS?

One of robotics' biggest selling points also is one of its biggest barriers to adoption: jobs. There's the obvious concern that as construction robots get more sophisticated, they start to become capable of doing skilled work, too. Cautionary tales abound in other industries, such as automotive, where for decades factories have been



Photo 4. Robotic 3D printing is opening exciting new possibilities for the design and manufacture of structures and structural components.

filled with robots doing precision welding and other skilled tasks. In fact, over the past decade, the number of factory robots doubled to about 3 million. And in disparate sectors, such as agriculture, medical, transportation, hospitality, and logistics, global spending on professional service robots increased 12% between 2019 and 2020, according to the International Federation of Robotics.

On the other hand, it's not like electrical has a glut of skilled workers, with hordes more people clamoring to enter the profession. So robots could help contractors cope with the roughly 195,000 construction

job openings by shouldering some of the grunt work, freeing employees to focus on tasks worthy of their skills. One example is Dusty Robotics' FieldPrinter, which drives around spaces such as high-rise floor plates painting architectural and structural blueprints for crews to follow.

"This is about how we can create a collaborative, augmented relationship with trade partners. What we're trying to do is free them up so that the trades can do more unique value-added work because humans have unique potential that robots will never replace," Barrett says about Turner's trial of Spot.

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Courtesy of ABB; photo credit: BAM Weber Saint-Gobain

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Another factor is that robots already are used for some skilled construction work — and in ways that benefit short-staffed contractors. For example, some modular home manufacturers use robots to assemble walls, including drilling holes for electrical, plumbing, and other systems. That prep enables electricians to work more efficiently when those components arrive at job sites.

To meet demand — including for affordable housing — major home builders could adopt this model to one extent or another. For instance, instead of stick building everything on-site, they could open their own prefab shops to churn out a limited number of floor plans (**Photo 3** on page 5). An application like 3-D printing is another possibility (**Photo 4** on page 6).

“Some of these national builders have 15 different floor plans,” says Chris Haynes, an instructor in the automation and robotics department at State Tech in Linn, Mo. “Maybe they mirror [this model]. ‘We can start pre-drilling holes so we don’t necessarily have to have a guy that knows everything except for getting wire from point A to point B.’ And if they can get this robot to feed wire through, then they don’t even need that. They’ll just need the guy to come in at the end and terminate the connection.”

FLYING BLIND

That’s still a far cry from *Westworld*’s George, whom some experts say won’t be possible without very deep, very elusive insights into how professionals make decisions in the field. As *EC&M*’s April 2021 “Job-Site Intelligence” column explained: “Job sites are chaotic, and workers in the field deal with new situations every day. Between different project teams, foremen, general contractors, and jobs, the way specific situations are handled can vary to a great extent.”

That particular column was titled “Invisible Decisions” because “What happens in the field on an electrical job site is often not visible to management.” Robot manufacturers also lack visibility,

which undermines their ability to develop machines that can think and do on the fly as an electrician can.

The columns are written by consultants from MCA, a Grand Blanc, Mich.-based firm whose specialties include productivity improvement of labor, project management, estimation, and more. MCA tried building a simulation of job site decision-making but found that it didn’t replicate what goes on in the real world.

“We started saying, ‘What’s missing?’” says Dr. Heather Moore, MCA vice president of operations. “The whole social atmosphere within a job site environment is part of why that discrete, logic-driven approach doesn’t fit. Those guys rely a lot on their personal networks within the company [and] within the job-site environment.”

So for at least the foreseeable future, job-site robots probably will be doing more site surveys than skilled installation work. That role also will give management deeper insights into how to use their employees most effectively.

“The big picture is, we think that the application of robots or some other kind of non-human intelligence really could be more useful [for gaining] visibility into the work environment as opposed to using them to do physical tasks,” Moore says.

Will those insights eventually produce a George? Maybe.

“It’s the nature of innovation that constantly there’s this incentive to keep improving. Eventually, it will all converge where you get all the pieces in place, and suddenly you’re making a huge impact and potentially radically disrupting construction,” Barrett says.

Tim Kridel is an independent analyst and freelance writer. He can be reached at tim@timkridel.com.

To read an online exclusive by Tom Zind about an autonomous work vehicle test at a utility-scale solar project under construction, visit <https://bit.ly/3HKimPO>.

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THE AIS HAVE IT

Some electrical contractors and design firms are using artificial intelligence tools to maximize productivity and revenue. Here's what they've learned so far — including why AI won't take your job anytime soon.

By Tim Kridel

As this article was being written — by a real human, not a computer — a meme was making the rounds on social media sites in the construction industry. It shows a downtown job site wrapped with a multi-story billboard that says, “Hey Chat GPT, finish this building . . .”

No, the meme wasn't created by artificial intelligence (AI) poking fun at itself. It's a real photo of a real building: the Hotel Keyserlei in Antwerp, Belgium. Impact, a European employment agency that specializes in technical and construction jobs, created the billboard in June to capitalize on what some people

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consider an existential threat not only to the trades but also to humanity itself.

"A big nod to new technologies and in particular AI," Impact explains on its website. "However the potential of AI is enormous, the skills of crafts(wo)men are irreplaceable. We should think about that more often. Do you want a job in Belgium where you get the appreciation and the respect that you deserve?"

A year ago, that level of awareness and angst didn't exist, which highlights how quickly the world can change. ChatGPT wasn't released until Nov. 30, 2022, but within weeks, mainstream media coverage made its promise and peril a hot topic.

In electrical and everywhere else, much of the focus is on the "generative" aspect of ChatGPT and similar AI platforms. This label means they're capable of taking raw materials such as text and images and fashioning them into things such as the design for an electrical raceway. For instance, Augmenta says its platform can "create fully constructible designs in hours instead of weeks" and "reduce your overall design time by up to 70%."

"I think in the next 10 years, we're going to see that generative AI transformed our industry more than we've seen any other technology in the past 100 years," says James Barrett, vice president and chief innovation officer at New York City-based Turner Construction. "I think it's going to be a radical opportunity for dramatically increasing productivity in our industry."

ASSISTANTS RATHER THAN REPLACEMENTS

There are caveats. For example, today's generative AI tools aren't capable of creating a complete, ready-to-build design, but rather a solid first draft for humans to vet and refine. The amount of human involvement depends on a wide variety of factors, such as the tool's capabilities and the type of information it's fed.

"The [initial] 10%, 20%, 30% is really pretty easy for some of the more advanced AI tools to get," says John Guilfoyle, chief

of technology and innovation at Stanley Consultants, which is using tools such as Transcend. "Then have a human quality check it, and the engineer takes it from there. So we're not producing finished products with the AI tools. We're producing sort of early-stage, planning-level-type conceptual designs that our staff can take and run with."

More design options in less time are among the benefits that Sioux Center, Iowa-based Interstates is seeing from its pilot of Augmenta's tool.

TODAY'S GENERATIVE AI TOOLS AREN'T CAPABLE OF CREATING A COMPLETE, READY-TO-BUILD DESIGN, BUT RATHER A SOLID FIRST DRAFT FOR HUMANS TO VET AND REFINE

"We can have 100 and some motors and 100 and some devices, and it's generating 13 different solutions in less than an hour," says Josh Gillespie, director of BIM/VDC. "I could put my best team of five people on that, give them all one hour, and we wouldn't come close to what that's kicking out for us. So that's an enormous boost in productivity and efficiency — and also responsiveness to the customer."

This kind of productivity is a major reason why many people worry that AI will put them out of a job. But at least for the foreseeable future, AI will be limited to the initial grunt work on a project — the kinds of tasks that traditionally are done by junior employees or by veterans who already find it mind-numbingly mundane.

"What we're looking at is sort of redefining AI to what we call 'augmented intelligence' rather than 'artificial,' meaning this technology should be used to free up people to [do] what's really value-added, that humans are good at," says Turner's Barrett.

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As a result, firms could use AI as a way to attract and retain employees in the highly competitive labor market by offering them tools that free them to focus on more interesting aspects of design.

"We're trying to find those areas where we're trying to have humans act like robots and just design robots to do those tasks," says Dustin Schafer, CTO at Lenexa, Kansas-based Henderson Engineers. "It gives people more opportunities to do the things that people are good at."

The productivity boost also helps firms compete for clients.

"We can leverage those people across more clients because they're not doing that routine stuff," Schafer says. "Increasing efficiency means that you get to do more work for more clients because you can be more aggressive with your price point. So it opens up the market to more opportunities."

Stanley Consultants began exploring AI in 2019 partly as a way to compete for scarce talent.

"How can we continue to do top-tier work but in a way that doesn't require us to simply hire more people?" Guilfoyle says. "We're never not going to try to hire the best people, but we were seeing on the radar there's a real shortage coming of engineers."

Electrical contractors also could use AI to expand into design services, thus capturing more revenue from each project. For example, a contractor might have stayed out of design because it couldn't afford to add enough staff — especially when there's a chronic shortage. But with generative AI's productivity boost, it might be able to launch a competitive service with the few it can afford.

"This is a very strong kind of value proposition for smaller contractors or contractors that don't have design capabilities in-house," says Francesco Iorio, Augmenta CEO. "They could literally hire one person and [operate] like they had 10. This is also true for smaller contractors that already have one person, but they struggle to hire anyone [else]."

2,000 OPTIONS, BUT WHICH ONE IS RIGHT?

AI also can help increase client satisfaction by enabling employees to come up with more design choices to save money, speed up construction, or accommodate challenging architectural. For example, the AI could propose a second design that moves a bank of conduit 20 feet, thus eliminating labor costs for elaborate bends or extensive drilling.

FIRMS COULD USE AI AS A WAY TO ATTRACT AND RETAIN EMPLOYEES IN THE HIGHLY COMPETITIVE LABOR MARKET BY OFFERING THEM TOOLS THAT FREE THEM TO FOCUS ON MORE INTERESTING ASPECTS OF DESIGN.

"You can test more options," says Henderson's Schafer. "One surprising thing we found is that it allows you to give someone else the context of why you think your answer is the best other than just saying, 'I've done this a lot, so this is the right way to do it.'"

"If you start to do generative design, you could bring 2,000 options and say: 'We tried all 2,000 of these, and this one uses the least amount of duct' or 'This one is the least labor' or 'This one has the least conflicts.' You can start to put context to why you think it's the best one. Then it's way easier to move forward. Designs don't get challenged because everybody understood how you kind of proved it out."

In the future, generative AI could further refine those options by leveraging additional data sources, such as each employee's expertise and pay. But to do that, contractors and design firms will need to compile that kind of nuanced information into a format that AI tools can use.

"It will ignore everything that you don't put in there, including like this particular journeyman or this particular apprentice is

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more or less skilled at this particular thing,” Schafer says. “It’s really difficult to predict those kinds of things if you don’t have all that data captured.”

Another future possibility is using application programming interfaces (APIs) so the tool can access vendor and distributor product and pricing databases. This information would free employees from the tedium of tracking down all that information manually and then adding it to each iteration of the AI designs.

Some AI tools have “natural language” or “large language” interfaces, which let users describe something in everyday terms. For example, New York City-based CannonDesign is leveraging this capability in Midjourney to combine images created with Revit and from other sources.

“That’s the biggest time saver right now: being able to do these combos,” says Coffield King, senior lighting designer. “[Suppose you] need a hospital lobby that’s warm, bright colors, double height with connecting stair, and you’re searching for that kind of thing on Pinterest or Google and you’re not finding that image. That’s where you can use the text and just tell it exactly what you want. It does that really well.”

It also turns out that some tools do better with vernacular rather than technical input.

“Someone yesterday said, ‘I need a double-height atrium with wood ceilings and clear stories with sunlight coming in,’” King says. “That prompt right there works great. But if you use contractor or electrical or architectural spec text, it doesn’t work out very well.”

DATA SECURITY IS KEY

When developing a game plan for implementing or even just piloting AI, data security and privacy should be a top priority. The catch is that AI vendors need as much raw data as possible to continually improve their tools’ ability to make sense of the real world.

The solution is to focus on AI tools that keep confidential company and client data from being shared with the vendor. For example, Overland Park, Kansas-based Black & Veatch is piloting Microsoft’s Azure OpenAI service.

“That allows us to use the ChatGPT model that secures our data and our intellectual property,” says Andrew Scott, chief digital strategist. “It means that our internal data isn’t making it out into the big wide world. That gives us a sense of protection within our organization but also allows us to have the benefits of using a model that is trained globally on massive amounts of data. We have plans to expand that pilot into full general release production within the next quarter.”

WHEN DEVELOPING A GAME PLAN FOR IMPLEMENTING OR EVEN JUST PILOTING AI, DATA SECURITY AND PRIVACY SHOULD BE A TOP PRIORITY.

Stanley Consultants is avoiding the natural/large language tools for security reasons.

“We are specifically not using ChatGPT because of some of the security issues that platform has,” Guilfoyle says. “We don’t want to give Stanley data to that platform and have it become part of their cloud and part of their model. There are more secure, closed-in technologies that do large language models that we’re looking at using instead. This allows us to feed like all kinds of old proposals, resumes, project descriptions [and other] work we’ve done previously that’s similar.”

Stanley also sees this challenge as an opportunity to gain a competitive edge.

“We’re going to be training those large language models on our own content so that we have much more bespoke tools,” Guilfoyle says.

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Data security is another reason for studying generative AI ASAP rather than waiting to see how the industry uses it — and which vendors survive the shakeout that inevitably comes with any red-hot market. For example, when employees are left to explore AI on their own, it can become a “shadow IT” project that escapes company notice until something bad happens, like a leak or hack of proprietary information. Black & Veatch is heading off these kinds of risks by developing policies and best practices that let employees use these bleeding-edge technologies now but with safeguards.

“We’ve set some guidelines [and] given some examples of things that they could use it for and shouldn’t use it for,” Scott says. “People can request access to it through our service management processes, so they have to read and acknowledge the guidelines, along with a quick start guide and FAQ. Then we grant them access.”

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IS AI THE FUTURE OF BIM?

For electrical design firms, another challenge is keeping up with all of the new AI tools and their capabilities. The selection grows every day — not only from BIM vendors, but also from IT companies. Here's how — and what it will take to achieve that and other business benefits.

By Tim Kridel

"Building information modeling (BIM) may be another way firms can maximize the efficiency of their staff." That was one takeaway from *EC&M's* 2007 Top 50 Electrical Contractors Survey. Seventeen years later, adding artificial intelligence (AI) to BIM is shaping up to be another breakthrough way firms can maximize the efficiency of their staff.

"In the next 10 years, AI will transform the industry more than anything has in the past 100 years," says James Barrett, vice president and chief innovation officer at New York City-based Turner Construction. "I think that applies to revolutionizing BIM, as well."

EC&M's 2024 Top 40 Electrical Design Firms Survey also indicates that this revolution is underway. When asked how they're using AI, some respondents, such as Salt Lake City-based Spectrum Engineers, indicated they are using it to generate, analyze, and optimize electrical designs/BIM (e.g., conduit groupings, raceway sizing, routing, etc.).

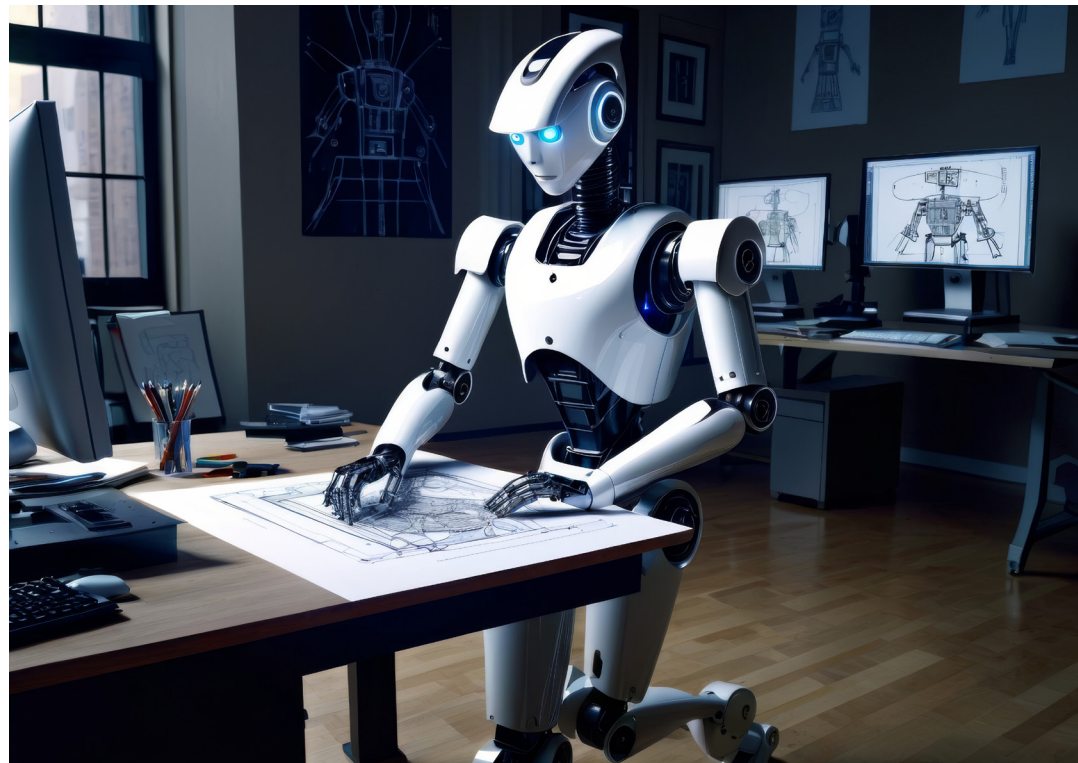


Photo 318759442 © ScorpionProduction | Dreamstime.com

"The industry has been using genetic algorithms in geometric design of building façades and general architectural designs for the past few years," says Steve Germano, software development team lead at Rock Island, Ill.-based IMEG. "There are platforms

like Testfit — targeted at building owners and architects — that are using AI and machine learning (ML) to iterate through permutations of leasable tenant space designs on lots for multifamily dwellings, commercial office spaces, etc. Conoa is

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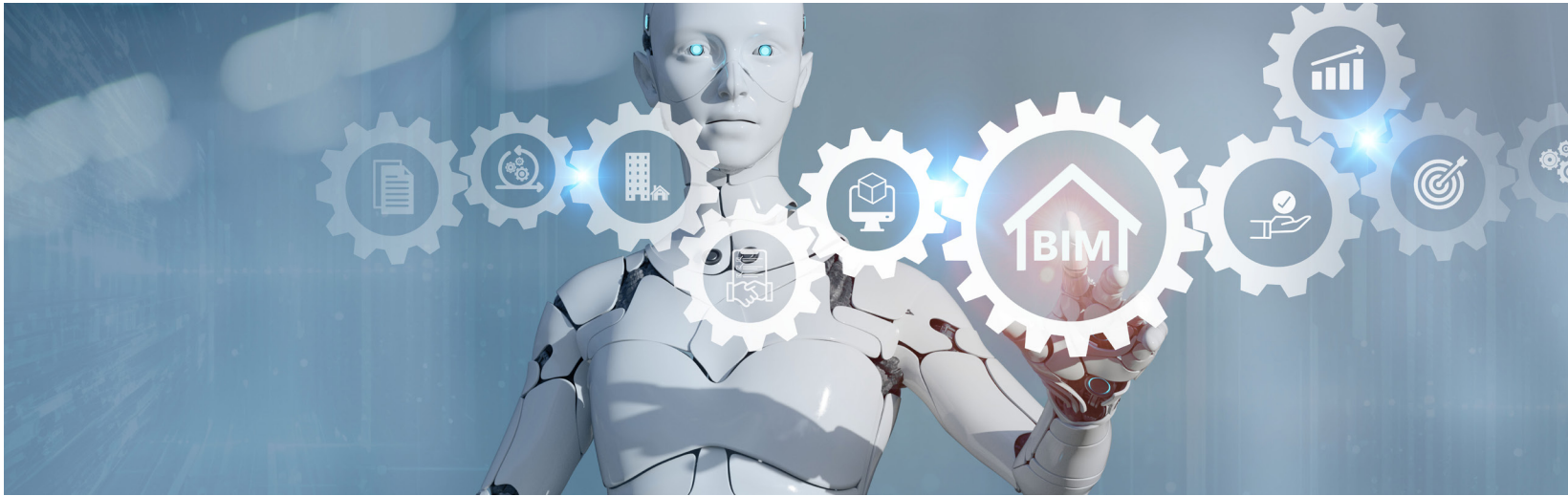


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As more electrical design firms strive to combine AI with BIM, big changes could lie ahead in terms of productivity and versatility.

another great platform that uses various ML/AI to help select products for buildings while analyzing total carbon footprint, taking into account product sourcing, proximity, manufacturing materials, and other factors.”

AI also could make it easier to use BIM tools by enabling “natural language” or “large language” interfaces. These let people type everyday terms to tell the AI tool to do something, such as: “Show all of the options for running conduit on this floor.” Another example is having the AI scour product databases to identify all of the luminaires that would work in a particular space based on requirements, such as features, size, cost, energy consumption, or price.

“There are a lot of resources that designers use on a daily basis that are in disparate locations on our intranet: a designer interface, code books, client requirements, project requirements, materials specifications, things like that,” says Adam Roth, BIM/VDC director at Lenexa, Kan.-based Henderson Engineers. “The benefit of having AI would be that you would just be able to ask questions and cut down on the transition between platforms.”

In a July 2023 *EC&M* article, New York City-based CannonDesign explained how it’s using Midjourney AI to combine images created with Revit and from other sources.

“[Suppose you] need a hospital lobby that’s warm, bright colors, double height with connecting stair, and you’re searching for that kind of thing on Pinterest or Google, and you’re not finding that image,” said Coffield King, senior lighting designer. “That’s where you can use the text and just tell it exactly what you want. It does that really well.”

So well, in fact, that some people consider AI on par with the mouse when it comes to user interface breakthroughs.

“Large language models are quickly becoming the easiest user interface humanity has had to computing power,” says IMEG’s Germano. “The last big change in computer interfaces was the mouse. Using natural language, the average person can leverage far more computing power than they could in the past.”

WORK SMARTER, NOT HARDER

IMEG is so bullish on these benefits that it developed its own AI-powered chatbot named Meg, which currently answers more

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Many electrical design firm executives predict AI will transform the industry more than any other technology in recent memory, reducing the time historically spent on manual, time-consuming processes drastically.

than 1,000 questions a day. In a recent podcast series, Germano explained how Meg makes it quicker and easier for employees to get information from a wide variety of internal databases that have been carefully curated and verified. That's key because with any type of AI, quality output requires quality input.

"In the future, our engineers will be able to ask Meg, 'Give me the total solar load on the west wing of the building,'" Germano says. "Upon receiving the answer, the engineer then will be able to instruct the AI assistant to increase the size of the air handlers to accommodate the stated solar load."

AI also can improve productivity by freeing employees to focus on BIM tasks that can't be automated.

"I envision AI being used to cut down on highly repetitive tasks and to help identify solutions that meet a prescribed/defined list of evaluation criteria," says Matt Goss, senior vice president and MEP + Energy practice leader at Latham, N.Y.-based CDM Smith. "AI will most certainly increase design efficiency and allow engineers and designers to focus on more complicated tasks and solutions."

Some people envision AI evolving into a personal assistant.

"I believe what's going to happen is the tool almost being an AI assistant that will sit alongside the user and guide them through codes or things that are not readily available during the design process," says Austin Stone, director of design efficiency and analytics at West Chester, Pa.-based Core States Group. "There's a ton of them. It's time consuming. It's challenging in the sense of, 'Where do I get this information?'"

In the future, AI assistants would ask and answer those types of questions based on parameters, such as a project's location and what the authority having jurisdiction (AHJ) requires in addition to the NEC. This could be done automatically in the background and in real time, alerting designers when something could or should be changed — similar to how Microsoft Word can check for grammar and spelling using specific dictionaries and style guides.

"Instead of stopping and doing research, it's going to be right there," Stone says.

AI assistants also could use ML to understand its user's personal work style. Those insights could enable the assistant to make suggestions without being asked.

"Having an AI to riff with is, in my opinion, what we will have readily available across the industry within the next few years," says IMEG's Germano. "Each person can have their own AI assistant with whom they can spitball ideas in real time

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and offload trivial tasks, so they can focus their time on more important and critical decisions.”

AI assistants eventually could be the primary way that people access BIM tools.

“I think, ultimately, our personalized AI are going to be the place we go to first,” says Turner’s Barrett. “All the solutions will be behind that in the sense that you’re not going to open up Revit or Navisworks. It’s not going to be about the solution. It’s going to be about what you are trying to get done: ‘Build me a design. Give me a cost. Give me a schedule.’ I think that’s the world where AI is bringing us. It’s not here yet — but it’s coming fast.”

ALL TOGETHER NOW

But a lot of groundwork remains before the AI-BIM mash up can live up to its potential. Some of this will be internal work done by electrical design firms.

“Henderson is working on organizing and structuring our data, and mapping the different systems together: ERP, accounting, project database, BIM database, design database,” Roth says. “Mapping that all together is really where AI can transcend all those platforms and be able to give you analytics and insights that you would not otherwise have. We’re [also] focusing on structuring our data and getting it organized. AI is very, very powerful, but only in regard to structured data sets. If you have a bunch of unstructured data, then AI will not help you sort through that.”

On the vendor side, the groundwork can be grouped into two types. Electrical equipment manufacturers will need to put their product catalogs and other information into formats that AI-powered BIM tools can use. They’ll also need to create application programming interfaces (APIs) so the tools can connect to those databases.

“I think you’re going to see a lot more vendors developing tools that can be easily bolted onto an application that already



Vendors are developing experimental AI models that generate 3D shapes from a variety of inputs, giving electrical design engineers new options they never thought possible.

exists,” says Core State’s Stone. “You’re already seeing that through Revit API.”

Integration takes time and money, which helps explain why some vendors may want to charge for that access.

“I don’t think you’ll ever get out of the ‘paywall versus free API’ [conundrum],” Stone says. “That’s going to be tough unless there’s some kind of lobbying or some kind of campaign from construction and AI [firms].”

The second type of vendor-side work involves the AI and BIM software providers.

“The majority of the AI out there is not compatible with BIM directly,” Roth says. “The nature of the BIM file and proprietary file formats, usually with the compatible software, is prohibited from running AI or any generative algorithms directly on the data set. So the majority of the time, we’re trying to extract certain parts of the data to run generative algorithms or evolutionary solvers on that data. That’s where you can really have some impactful decisions.

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Despite the potential and excitement around AI tools that could be integrated with BIM, one of the greatest challenges for electrical design firms is keeping up with all of the new tools and their capabilities — and weighing how those might integrate with their current processes.

“I think the reason that the file format proprietary is that’s just the nature of the industry for the past few decades. The industry is trending toward more open data formats and interoperability, but we’re just not there yet.”

As AI proves its worth, BIM vendors will begin building it into their tools.

“BIM authoring tools like Revit have not integrated too much AI directly into their packages yet, but there are many trade-specific apps that integrate into these platforms that leverage ML/AI for modeling processes,” says IMEG’s Germano. “There also is a duct design tool, and another general MEP modeling tool that not only helps to draw the geometry but also considers total cost of installation based on the current design. This allows

the design engineers to see the impact (both in sustainability and cost) at the time of design (the most economical time to make changes).”

Some BIM vendors are developing their own AI tools. One recent example is Autodesk’s Project Bernini, which the company says includes an “experimental generative AI model that quickly generates superior 3D shapes from a variety of inputs, including a single 2D image, multiple images showing different views of an object, point clouds, voxels, and text.”

BUILT TO LAST?

For electrical design firms, another challenge is keeping up with all of the new AI tools and their capabilities. The selection grows every day — not only from BIM

vendors, but also from IT companies such as Microsoft, AI specialists such as OpenAI, and startups such as Augmenta, whose initial product is designed specifically for the electrical industry.

“We get bombarded with new solutions,” says Kris Wahl, Turner Construction innovation manager. “It’s hard to cut through the noise now because everybody its touting AI capabilities on their websites. Every solution is now claiming to be AI powered. That’s a challenge.”

Another challenge is trying to determine which vendors will still be in business a year or two for now and which tools will continue to be upgraded like any other piece of software.

“[Some] will release their first tool set, and then that’s it,” Roth says. “There’s no progression from a company standpoint. We want to commit to a company that we can have a good partnership with and we know where they’re going and that they will progress their tool set along with the industry.

“It’s very important that we have somebody that’s in it for the long haul — that’s just not hoping to do the bare minimum and only doing it to get acquired by a larger company. We’ve seen that business model over and over again.”

Tim Kridel is an independent analyst and freelance writer. He can be reached at tim@timkridel.com.

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HARNESSING AI TO EMPOWER ELECTRICAL CONTRACTORS

An inside look at the next frontier in tool innovation

By Sal Paraltore

The electrical contracting industry is no stranger to innovation. From the adoption of digital multimeters to thermal imaging cameras, electrical contractors have consistently leveraged new technologies to improve accuracy, safety, and efficiency. As we stand on the cusp of the next technological revolution — artificial intelligence (AI) — the opportunities for further advancements are more significant than ever. AI is set to transform the tools of the trade, enabling smarter, safer, and more efficient work.

AI AND THE EVOLUTION OF MEASUREMENT

One of the core tasks for an electrician/technician is measurement — voltage, current, resistance, and beyond. Historically, these measurements have relied on the precision of the tools in hand and the expertise of the technician using them. But what happens when AI is introduced into this equation?

AI, coupled with machine learning (ML), allows for the analysis of vast datasets at



Courtesy of Fluke

One of the benefits of AI-enabled tools for electricians is taking the same measurements across multiple sites and aggregating that data to generate historical reports and analysis.

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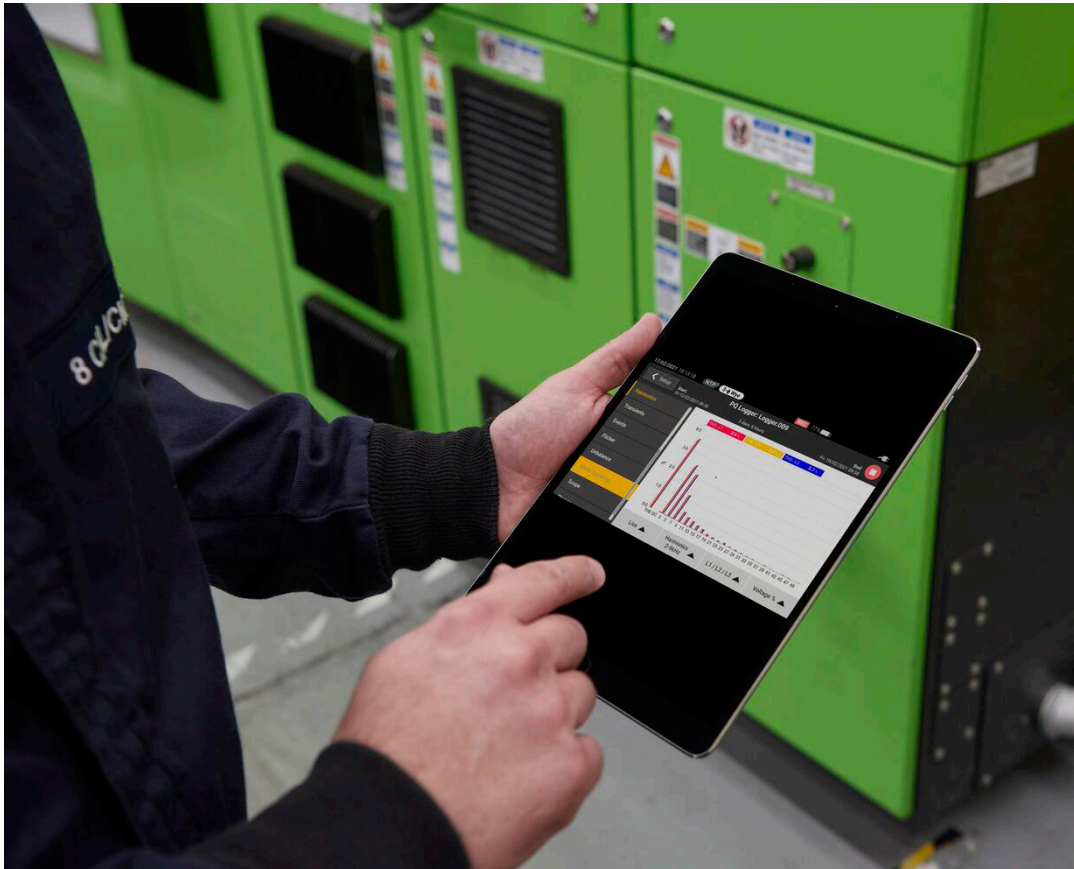
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As artificial intelligence enables more devices to be interconnected with the Internet of Things (IoT), data sharing and more comprehensive system monitoring will become possible.

speeds and accuracies far beyond human capability. By recognizing patterns in data that might be invisible to the human eye, AI can enhance the precision of measurements and reveal insights that were previously unattainable. For instance, while the fundamental modalities of measurement (such as voltage or temperature) remain the same, AI can interpret the data from these measurements in new ways. This could mean identifying subtle anomalies

in electrical systems before they become major issues, saving both time and money on repairs and downtime.

Moreover, AI can integrate data from multiple modalities (such as combining thermal imaging with voltage measurements) to provide a more comprehensive understanding of a system's health. Imagine a tool that not only measures but also analyzes and predicts potential issues, offering recommendations on the spot.

This isn't science fiction; it's the future of electrical work.

PRACTICAL BENEFITS FOR ELECTRICAL CONTRACTORS

For electrical contractors, the most pressing question is often, "How will this make my electrician's job easier or more efficient?" AI-powered tools promise to do exactly that.

Automating routine tasks: Many tasks that electricians perform are repetitive — taking the same measurements across multiple sites, for example. AI can automate these tasks, aggregating data, performing initial analyses, and even generating reports. This automation not only saves time but also reduces the potential for human error.

Enhancing safety: Safety is paramount in electrical work. AI can act as a second set of eyes, double-checking measurements, and ensuring that nothing is overlooked in the rush of a busy day. This added layer of safety is particularly valuable when working with high-voltage systems or in complex environments where multiple factors must be considered.

Simplifying complex analyses: Interpreting data, especially when dealing with complex systems, can be challenging. AI simplifies this process by making inferences from the data collected, providing clear, actionable insights. For example, an AI-enabled

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tool might analyze power quality data in a commercial building and recommend installing a harmonic filter to prevent excessive heating in motors caused by harmonic distortion. It might also flag a specific voltage sag as a priority issue that needs immediate attention, ensuring the contractor addresses the most critical problems first.

Reducing training time: As AI tools become more integrated into the workflow, they can also help bridge the skills gap that exists in the industry. For newer technicians who may not have extensive experience with older systems, AI can provide guidance and suggestions, effectively acting as a “mentor.” For example, a new technician might use an AI-powered tool that detects poor connections based on resistance readings, guiding them to tighten connections in a breaker panel and suggesting the proper torque levels — ultimately offering guidance while reducing the learning curve.

CHALLENGES AND CONSIDERATIONS

While the potential benefits of AI are immense, some challenges need to be addressed.

Ensuring reliability and safety: Electricians rely on their tools to be accurate and reliable. Any AI implementation must meet the same high standards as the physical



Courtesy of Fluke

tools themselves. From an electrical safety standpoint, AI can aid electrical professionals in double checking measurements and making sure nothing is overlooked during a busy day, which adds an additional layer of safety when working on high-voltage systems or in complex environments, for example.

tools themselves. This means rigorous testing and validation to ensure that AI does not introduce errors or overlook critical issues. For instance, AI-enabled tools would undergo validation tests by simulating various real-world electrical faults, such as arc faults and overloads, ensuring that the AI can consistently identify these issues under different conditions before the tools are deployed in the field.

Balancing innovation with usability: AI tools must be user-friendly. It's not enough for a tool to be powerful if it's too complex to use in the field. The key is to design AI interactions that feel natural — almost as if the AI is another colleague who's knowledgeable and ready to assist without adding unnecessary complexity to the workflow.

Overcoming resistance to change: As with any new technology, there may be

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resistance to adopting AI, particularly from those who have been in the industry for a long time and are comfortable with traditional methods. The challenge will be demonstrating the tangible benefits of AI in a way that convinces even the most skeptical users.

THE ROAD AHEAD

Despite these challenges, the future of AI in the electrical market is bright. Early adopters are already seeing the benefits of AI-enabled tools — from improved efficiency to enhanced safety. As the technology continues to evolve, we can expect even more sophisticated tools that further integrate AI into the daily workflow.

One area of significant potential is in predictive analytics. AI's ability to analyze historical data and predict future issues could be a game-changer, allowing contractors to address problems before they occur. This proactive approach not only improves system reliability but also reduces the stress and pressure associated with unexpected failures.

Moreover, as AI becomes more integrated with the Internet of Things (IoT), the interconnectedness of devices will allow

for seamless data sharing and more comprehensive system monitoring. The companies that succeed in this new landscape will be those that not only build great tools but also understand the complex workflows of their customers and can help them solve problems through a combination of hardware, software, and AI.

AI represents the next frontier in tool innovation. By enhancing measurement accuracy, automating routine tasks, improving safety, and simplifying complex analyses, AI-enabled tools will empower contractors to work more efficiently and effectively. While there are challenges to overcome, the potential benefits far outweigh the risks. As we continue to develop and refine these technologies, the electrical contracting industry will be better equipped than ever to meet the demands of an increasingly complex and interconnected world.

Sal Paraltore is the Vice President of Products at Fluke, where he oversees product management and software operations across 10 business units serving both retail and industrial distribution markets globally. With nearly three decades of experience in product development and leadership, Sal has held numerous executive roles at leading tool and appliance manufacturers prior to joining Fluke. He holds a BS in Business from Cornell University.

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INTELLIGENT DESIGN

This month marks two years since the debut of ChatGPT. Here's an inside look at how artificial intelligence is driving innovation in the electrical industry.

By Tim Kridel

In September 2024, Microsoft signed a 20-year contract to buy all the electricity produced by the Three Mile Island Unit 1 nuclear reactor to help its data centers keep up with soaring demand for artificial intelligence (AI) tools. This deal is the latest example of how AI affects electrical contractors and design firms even when they don't use the technology.

Electrical design firms and contractors benefit from AI's use by other industries simply because all of the necessary computing power — from employee PCs to the data centers for cloud computing and storage — requires enormous amounts of electricity. How much? Three Mile Island's Unit 1 reactor is capable of generating about 837 MW, enough to power more than 800,000 homes. Shortly before the contract was announced, Microsoft and other major AI vendors met with the White House to discuss the need for several new data centers around the country that each would use 5 GW.

The Biden-Harris Administration's resulting proposal emphasizes renewables, which



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highlights how AI can drive more business for electrical contractors and design firms that specialize in solar, wind, and battery energy storage systems (BESSs). The proposal also calls for using streamlined permitting to expedite the construction of data centers and grid upgrades. Those upgrades could benefit more than just AI

data centers if, for example, the new transmission lines mean more businesses have the grid infrastructure necessary to electrify their fleets or add public EV chargers.

Even if those handful of 5 GW data centers never materialize, hundreds of smaller ones will continue to be built, such as Google's \$1 billion facility underway in Kansas City

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that will use 400 MW of renewable energy. Those projects will mean plenty of work for electrical contractors and design firms that target the data center market.

"Gaylor Electric is already at the forefront, taking on some of the country's most complex and robust data center projects," says Chuck Goodrich, president and CEO of the Indianapolis-based firm. "We believe AI is a key driver in the expanding data center market. Over the next decade, this trend will significantly enhance data processing, storage solutions, and overall efficiency."

WORK SMARTER, NOT HARDER

In addition to designing and building AI-related infrastructure, electrical contractors and design firms are starting to use the technology to increase employee productivity and efficiency. One example is having AI speed up the process of reviewing contracts and assessing risk by doing a first pass and flagging things for humans to scrutinize.

"We currently use ChatGPT but will likely migrate to Document Crunch," says Gaël Pirilot, vice president at Mableton, Ga.-based Inglett & Stubbs. "We have baseline exhibits with our general contractor partners that have been scrubbed by our executive team and lawyers and discussed with the respective GCs. These documents are used as the baseline for comparison with new project documents."



The recent deal from Microsoft, in which it will buy all of the electricity from Three Mile Island Unit 1 nuclear reactor to help power its data centers, is the latest example of how AI affects electrical contractors and design firms even when they aren't necessarily using the technology yet.

"For new GC partners, we typically start by scrubbing for financial exposure (fee, liquidated and consequential damages, retention, non-billable items, etc.), staffing requirements (safety and QA/QC minimums), BIM requirements (LOD), and schedule. These AI scrubs are the first pass but not the final pass. AI saves us approximately four hours per initial contract review."

AI also can streamline the design process for engineers.

"[Over the] long term, AI will revolutionize how design, construction, and prefab are being approached," says Tony Mann, CEO

at Long Island City, N.Y.-based E-J Electric Installation Co. "AI-driven generative tools use algorithms to generate and optimize building component designs based on predefined constraints. This will allow for more efficient, cost-effective, and innovative solutions on projects."

"All of this is in the early stages here at E-J, but long term we envision that AI can handle preliminary design in a fraction of the time. It can do things like run multiple models for optimal routings, which is key for fast-track project delivery, and the projects will see the most cost-effective solutions."

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The ongoing demand for data centers, such as Google's \$1 billion facility underway in Kansas City that will use 400 MW of renewable energy, will continue to create work for electrical contractors and design firms.

This efficiency also highlights how AI can help electrical and other trades address the chronic shortage of skilled workers.

At a time when an estimated 40% of the construction workforce will retire by 2030, AI can alleviate the burden on the remaining employees by reducing nonoptimal work, says Associated Builders and Contractors' latest construction technology report, which focuses on AI.

WASTE NOT, WANT NOT

AI also could help address equipment and material shortages.

"We are exploring predictive analytics where AI can help predict the exact quantity of materials required for prefabrication,

minimizing waste and keeping a near-exact inventory," Mann says. "AI will do this through analyzing historical data and forecasting supply chain disruptions to optimize material procurement."

Ferreting out waste is a use case that vendors are increasingly highlighting in the marketing for their AI and building information modeling (BIM) tools. By some estimates, up to 30% of building materials — and 6% of a building's budget — are wasted due to misorders, errors, and rework. How can AI help? By automating the process of creating multiple design options, which humans then review to pick the one that best meets the project requirements. For example, one design might

have a low material cost but a higher labor cost, while another might be the reverse. Having multiple designs to choose from helps identify the Goldilocks one.

"If you don't know what options you have and the consequences of your choices, you're never going to make the right choice," says Francesco Iorio, co-founder and CEO of Augmenta, whose initial AI agent is designed specifically for electrical.

But to offer all of those options, the AI tool must have access to all of the necessary information, including codes like the NEC. The internal information is somewhat easier because the electrical contractor or design firm already has it, whereas the external data might not be accessible if it's in a format that the AI tool can't use. For example, electrical equipment manufacturers will need to put their product catalogs and other information into formats that tools can use. They'll also need to create application programming interfaces (APIs) so the tools can connect to those databases. And design firms also will need to convert their internal unstructured data into forms that AI can work with.

"We're in the data governance and accumulation mode on this," says Inglett & Stubbs' Pirlot. "We have archived build types (build books) for each project completed over the last five years and formatted the data in a uniform and searchable manner. This data will be merged with defining project

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attributes and presented through Power BI. We are assessing the right project attributes to review. Our goal is to eventually use AI to predict and align prefab/modular capacity based on market outlook.”

PREDICTING THE FUTURE

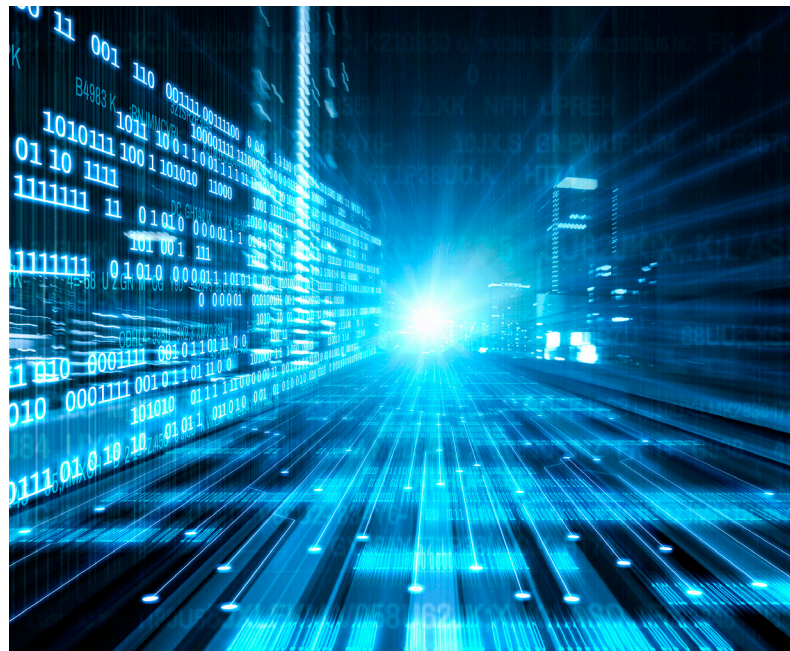
Another use case involves collecting and analyzing data about an electrical network, such as the one in a building, a factory, or an office campus. This application could use machine learning (ML), which is a subset of AI that analyzes normal behavior so it knows what anomalies look like. Depending on how the system is designed, the AI either alerts humans or takes corrective action on its own, such as shutting down a circuit and rerouting power.

“It’s more prevalent in the [electric] utility side for optimizing the energy use of distributed energy resources (DERs), but we have seen it applied in microgrid applications on commercial facilities, as well,” says Dan Webb, integrated automation technical director at Lenexa, Kan.-based Henderson Engineers. “[An example is] training a model to assess and predict control of the DERs.”

“Monitoring out-of-range or out-of-tolerance variables is more in line with what we would refer to as advanced fault detection and diagnostics,” notes Webb. “It’s a fairly common use of ML in predictive analytics in regard to electrical systems, monitoring the various attributes of a system to create a model. It may be voltage, ampacities, or energy consumption, for example. From that model, equipment maintenance (predictive maintenance) schedules and equipment failure could be assessed.”

The AI monitoring these networks could be provided by an electrical contractor or design firm as part of a managed service contract.

“Predictive maintenance leverages AI to monitor and analyze the behavior of electrical systems, identifying problems before they lead to failures,” says Gaylor’s Goodrich. “This proactive approach can enhance system reliability and open new revenue



For AI tools to be specifically useful for electrical professionals, they must have access to all of the necessary information, including codes from the NEC and all AHJs. Electrical equipment manufacturers will also need to put their product catalogs and other information into formats AI tools can use.

opportunities for contractors by offering predictive maintenance as a service.”

Others agree.

“I think this is a definite possibility,” Pirlot says. “It requires us to set up an early relationship with the end user to install and have access to the proper monitor points. These points are available on smart grids by default but may not be available on the majority of our other builds. A digital twin is the ideal means of doing this, but there are easier means to get there.”

Monitoring and managing networks requires accurate, granular information about each component. This information can be used for additional applications.

“We’ve been involved in testing and exploring different kinds of algorithms to monitor network performance, predictive analytics, and things of that nature,” says Ed Sutton, enterprise evolution

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director of AI and innovation at Overland Park, Kansas-based Black & Veatch. "But I think it's even more basic than that: Where are the assets? What condition are they in? Do I have good data? The scale and scope of these networks are growing, and the devices are getting changed out faster. You have environmental context with increasing large-scale weather events, and that compounds stuff. So we're really seeing AI coming in helping make sense of the basics, such as asset management, and our testing is showing many downstream benefits from better supply chains, optimized maintenance, and data-driven capital planning; that really represents the pulse of the organization and its real-time operations."

This information can inform the design process.

"Interconnects for solar and battery storage and stuff like that, you need grid data, and usually from multiple sources," Sutton says. "'Do I have to upgrade this feeder because I want to bring X megawatts on? Can I trust the information I am using in my design?'"

QUESTIONING THE TECHNOLOGY

Generative AI uses "natural language" or "large language" interfaces. These let users type everyday terms to tell the AI tool what to do, such as: "Show all of the options for running conduit on this floor." There's no shortage of off-the-shelf generative AI tools, such as ChatGPT, but some electrical firms are developing their own.

"We've developed a quality management system (QMS) chatbot that basically brings to life typically 'dry' process and procedures into an interactive experience," Sutton says. "[It's to] help our employees have the right information at the right time so they can quickly look up: 'What's this process? What's this checklist? What's that procedure? Empowering professionals with tremendous amount of knowledge and trusted information in a way that is opening up a lot of potential for even more innovation.'"

Besides being highly customized for a firm's particular needs, these homegrown AI tools also can improve cybersecurity by ensuring, for example, that company and client data don't wind up in a public cloud or training a vendor's AI tool.

"We generally use a RAG process, which uses OpenAI for the service, but the data is all private to our company," says Brian Melton, Black & Veatch technology innovation lead for governments and communities. "We're trying to leverage the technology, but the privacy and security piece is always in the back of our mind."

Whether the tools are off the shelf or developed in-house, we need to think about integration with other platforms and technologies, such as building information modeling (BIM), which will unlock new types of capabilities and workflows.

"One of the things we found is AI becomes almost a commodity," says Greg Tanck, Black & Veatch project manager for operating assets data analytics. "That's not really what makes a piece of software or an organization successful. It's more about everything that goes into supporting that software, [such as] having a good workflow that makes it easy to interact with and to get out of it what you need so it's not: 'Stop what I'm doing, go do this AI thing, and then come back.'"

That's one more example of AI's learning curve.

"AI has been a hot topic, and its impact on the electrical contracting and design industries has been encouraging," says Gaylor's Goodrich. "Companies are reporting notable gains in efficiency and productivity. There are certainly instances where AI has streamlined construction processes. But, in my opinion, there needs to be more test results and white papers providing solid documentation. Although we're still in the early stages, the opportunities for growth and innovation with AI in construction are immense."

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