How to Work Smarter, Not Harder

Inside tips and best practices for contractors to improve productivity and profitability on the job site

HOW TO WORK SMARTER, NOT HARDER

SPONSORED BY

ABB

FROM THE EC&M E-BOOKS LIBRARY, A COMPILATION OF TECHNICAL ARTICLES FROM EC&M

EC&M

WHY BOOSTING YOUR JOB-SITE IQ MAKES ALL THE DIFFERENCE

Real-world strategies for contractors to increase productivity on the job and maximize profits in the process

BY ELLEN PARSON, EDITOR-IN-CHIEF, *EC&M*

It's no secret everyone wants to work smarter, not harder. Given the fast-paced, climate of construction projects today, poor planning and inefficient work practices can have a disastrous effect on your electrical contracting business. Whether you're talking to general contractors or subcontractors, increased productivity means increased profitability — the ultimate goal on any job site in addition to maintaining optimal safety standards, ensuring the highest quality of work, and delivering state-of-the art project outcomes.

According to a research report conducted by Autodesk in collaboration with Dodge Data & Analytics, "The Key Performance Indicators of Construction," even "minor inefficiencies can result in staggering costs" when it comes to labor productivity. In fact, the study uncovered the following statistics among contractor respondents: "62% of general contractors cited coordination and communication between project teams to negatively impact labor productivity; 68% of trades cited poor schedule management to negatively impact labor productivity; 61% of general contractors cited quality of construction documents to negatively affect labor productivity; and 70% of trades said prefabrication at least moderately improved labor productivity."

When it comes to the leading players in electrical contracting specifically, *EC&M*'s annual Top 50 Electrical Contractors survey reveals similar insights on the power of productivity. When asked what influences had the greatest impact on their ability to get a job done on time and within budget, respondents found the following factors most disruptive (in this order): delays due to the pandemic; poor design; change orders; weather delays; delays with material delivery and logistics; project scheduling fines and penalties; and internal management and company process issues — all of which boil down to productivity problems.

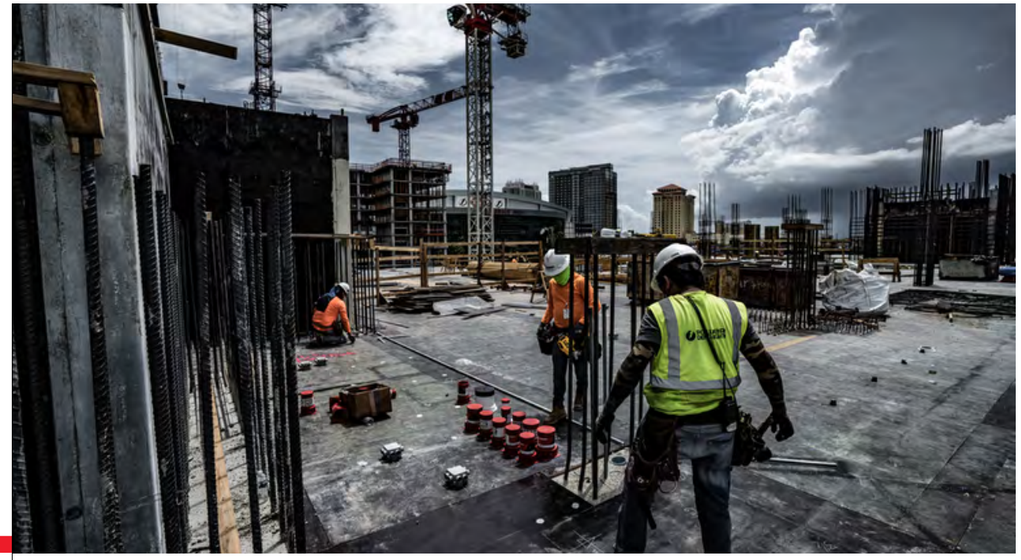
Seeking to streamline operations and bolster efficiency, some electrical contractors turned to augmented reality (AR) and virtual reality (VR) tools to enable detailed plan and job-site visualization/manipulation as well as collaboration. Although survey results indicate AR and VR technology usage looks to be on a slow rise as a gap opens between committed users and wait-and-see types, the curve is definitely trending upward. With VR, the ranks of current users among Top 50 survey respondents grew to 20% in 2020, up from 7% from the previous year. With AR, current-user ranks grew to 18% from 13%. Both technologies present multiple productivity-enhancing opportunities, but improving collaboration with other trades and training remain the top usage scenarios.

The editors of *EC&M*, in cooperation with ABB, are pleased to bring you this compilation of articles that offer real-world examples of how to manage schedule changes on the job site, how to expect the unexpected with change orders, and how to increase efficiency and create safer work environments with BIM. The advice and recommendations offered in this e-book should be essential reading for any electrical professional looking to improve productivity and profitability. I encourage you to read them all before you put your job-site IQ to the test.

TAKING VIRTUAL TECHNOLOGY UP A NOTCH

How the nation's largest electrical contractors and design firms are investing in virtual technologies to save time and improve productivity.

BY AMY FISCHBACH, FREELANCE WRITER



With 360-degree-capture technology and instant uploads, OpenSpace helps our teams across the country stay in the know about their job sites from the trailer to the corporate office.

In today's construction climate, electrical contractors and engineers must still wrap up projects on time and within budget — even in the midst of skilled labor shortages, material delays, and the global pandemic. To stay competitive, companies are investing in the latest virtual technologies.

For example, according to the 2020 *EC&M* Top Electrical Design Firms survey, 44% of the Top 40 firms are already using augmented reality (AR) compared to 29% in 2019. Furthermore, the number of those firms using virtual reality (VR) soared from 30% in 2019 to 58% in 2020.

In the electrical contracting arena, only 20% stated they are already using VR and 18% are using AR, while approximately one-third of *EC&M*'s 2020 Top 50 Electrical Contractors expected it to take about five years for virtual technologies to become an integral part of their business.

Jose Samaniego, Building Information Modeling (BIM) technology solutions development lead for San Jose, Calif.-based Rosendin Electric, says now is the time to invest in the latest technology.

"The farther behind that we fall, the more we hinder our team from growing and meeting the demands of an ever-decreasing project timeline," Samaniego says. "The market is also very competitive right now, and it is vital to enable our teams to be as efficient as possible to compete."

Implementing various construction technologies has also saved time for Victor, N.Y.-based O'Connell Electric. For example, through Virtually Designed Construction (VDC), the electrical contractor can improve both layout processes and actual installations. In addition, using 3D scanners and software creates faster, more accurate layouts, leading to time savings.

Not long ago, electrical contracting and engineering firms marked up drawings by hand, which was labor-intensive and resulted in the need to modify constructed work in the field, says Russ Lancey, president of Ozone Park, N.Y.-based Five Star Electric. Since that time, the electrical contractor has invested in BIM, which it expects to get more ubiquitous as time goes on.

"It's expected that the ability to view, quantify, or develop 3D models will be required at all stages on large construction projects from the bid, through engineering and construction, to the as-built drawings," Lancey says.

In the following profiles, eight electrical engineering and contracting firms share their journey of how they improved the productivity of their office and field workforce by adopting virtual technologies.

POWER DESIGN

Solving field challenges in real time

Building Information Modeling (BIM) has brought St. Petersburg, Fla.-based Power Design's Virtual Design and Engineering teams together in a more streamlined, collaborative environment, says Dave Hughes, director of virtual design and construction.

For more than a decade, the MEPS contractor has been using BIM, and the company has been researching and developing its VR and AR programs for about four years. To teach its team how to use the technology, Power Design develops and deploys all of its BIM training in-house. The subject matter experts (SMEs) have developed the content and facilitated the hands-on lab training and virtual classrooms.

Power Design leverages the visual components of BIM design to engage its SMEs in the field. In addition, its employees wear hard-hat cameras that capture job-site footage.

"We are able to identify and solve potential deviations in real time," Hughes says.

By using the trending deviation data from these technologies, Power Design can improve the constructability components of its engineering design. In turn, the company can drive more efficient installations.

In the future, the contractor is looking for more opportunities to leverage new technology.

"We are looking into expanding our fleet of Robotic Total Stations, Scanning Technology for installation verification and as-builts, and learning about more AR field applications," Hughes says.

A Power Design foreman captures a photo of an in-progress deck, using an app on his iPad to make real-time field notes. Photo courtesy of Power Design

Virtual reality tools help Rosendin teach its employees how to operate equipment, including forklifts. Photo courtesy of Rosendin Electric

ROSENDIN ELECTRIC

Training employees and improving productivity

BIM is the cornerstone virtual technology for Rosendin Electric, San Jose, Calif. By creating an information-rich 3D model of a project, the contractor can iron out many of the unforeseeable issues before they arise in the field — translating to better productivity, efficiency, and profitability, says Jose Samaniego, the company's BIM technology solutions development lead.

To further capitalize on BIM, the contractor is leveraging several technologies like AR and VR. With AR, the contractor can extend accessibility to BIM and its embedded information to the field. While AR is used primarily for pre-planning, quality analysis, and quality control/layout verification, VR enables office personnel to have a full-scale interaction with the model and can be used for coordination.

Additionally, Rosendin is developing training and assessments based in VR, which allows the company to better assess and certify its field personnel without putting them in harm's way with active electrical equipment or an active job site.

Rosendin develops its virtual technologies through a dedicated innovation team whose primary focus is to research emerging technologies, both inside and outside construction, to determine how to meet its needs and improve processes.

"The team often works in reverse, analyzing our current processes to determine possible areas of improvement, and either finds or develops the required solutions," says Dr. Jad Chalhoub, BIM technologies solutions implementation lead. "Many of the technologies and tools that we use are internally developed due to not finding suitable, commercially available solutions."

A training team works with the end users — including engineers, modelers, and field personnel — to ensure they have the proper access and training to the technology.

"The technology exists to serve the user, and we are committed to refining and adapting it to best serve them in whichever way they need," Chalhoub says.

Beyond AR, VR, AI, and BIM, Rosendin is constantly monitoring automation, using drone scanners and robotics, to handle repetitive manual tasks in the field. The company also is looking into software solutions to automate parts of the modeling and coordination process.

"Technology and innovation are fast-moving targets with something new happening almost every day," Samaniego says.

SMITH SECKMAN REID

Exploring new technologies on a project-by-project basis

With new technologies rapidly changing, Nashville, Tenn.-based Smith Seckman Reid (SSR) is investing in employees who can quickly adapt and become proficient, staying aware of new virtual technologies and developing proficiencies based on client needs, on a project-by-project basis, says Jesse Felter, commissioning discipline manager.

For example, on certain high-level, large-scale projects, companies must commit to using new technologies to coordinate between engineers and contractors, says Cody Swayze, EI, LEED AP and Electrical EIT.

SSR uses BIM 3D modeling and clash detection software to maintain coordination in the design of systems across all trades. The type of project delivery also impacts SSR's involvement in clash detection via various AR and VR platforms throughout the construction phase of the project to ensure constructability of design, he says.

"Investment in these types of software can be expensive, and therefore typically must have owner buy-in as an extended service," Swayze says. "We as engineers must be willing to adopt the new software and quickly adapt."

SSR's team was one of the early adopters in the design engineering world to use BIM 3D modeling and virtual clash detection software. The company now has dedicated BIM team members to facilitate complex processes and create proprietary software tailored to its designs.

As far as AR and VR platforms go, SSR is relatively new to using these technologies. When the company is asked to adopt these technologies as part of its design and consulting services, its engineers learn how to use the programs. For example, the team has used VR to provide better visualization of a space or areas to test out design options to provide the best aesthetic appeal for the architect and owner, Swayze says.

"Previously, our firm and other firms across the industry used a simple overlay of drawings to detect clashes, and we relied on architectural renderings alone to visualize spaces," Swayze says. "Now, our productivity has greatly increased, as these programs are able to determine clashes within a given set of parameters that the engineers are able to alter and control. We are also able to see changes across all disciplines live as they happen and can react much more quickly to these changes."

Looking forward, SSR is looking at furthering its training in VR to more and more of its colleagues.

"We are looking for new ways these technologies can be used to enhance the products and services we are able to deliver to clients," Swayze says.

Steve Lane, PE, BCEE, FACEC, the CEO and president of Smith Seckman Reid, participates in a VR call from his office. Photo courtesy of Smith, Seckman Reid

O'CONNELL ELECTRIC COMPANY

Keeping pace with technology changes

When O'Connell Electric first started investing in virtual technologies, the New York-based electrical contractor constantly scanned the internet, reached out to other contractors, and partnered with software designers to create products to increase efficiency.

"This is still an ongoing endeavor since technology is constantly evolving," says Rob Sampson, virtual design team lead.

To stay up to date on the latest technologies, the company created a virtual design team, whose members not only understand the electrical industry, but also have a strong computer background and can leverage rapidly developing technologies.

"As we built this team, we were constantly vetting out new software as the electrical industry was rushing to get up to speed with the mechanical world that had been utilizing these design software programs for years," says Brian Rittenhouse, vice president of construction and construction services.

Currently, the electrical contractor is exploring both AR and VR options. VR helps individuals who are not used to viewing a 3D environment to better visualize the design of the project and the user to become "part" of the design model and move about it more naturally. AR technologies can include demonstrations/walkthroughs for various assembly or troubleshooting situations, making dangerous situations potentially safer.

This aerial view shows electricians working in the field using a digital system to lay out conduit. Photo courtesy of O'Connell Electric

"By adopting AR technologies, one could conceivably view a completed project, while they are standing in a freshly excavated pit," Sampson says. "AR could be used in the field to see conflicts amongst trades, before the actual installation. This could lead to the re-work being done before the actual work has taken place."

Currently, the contractor uses different virtual technologies, including BIM, 3D scanners and Robotic Total Stations, to ensure everyone on a project team is on the same page, translate the design into real-world dimensions, and perform layout of the designed work.

"Construction technologies have allowed us to bring our coordinated 3D model to the field," Sampson says.

O'Connell, which was founded in 1911, has been focused on adopting these newer construction software technologies for just over seven years now. O'Connell is always trying to stay ahead of the technology curve to constantly improve its productivity and safety results.

"We know from past experience that if we do not take this approach, our tremendous success could be put in jeopardy," says Victor Salerno, CEO. "Most investments in technology have been very successful except for a few minor failures."

INTERSTATES

Saving time in the field

With the demand for skilled workers growing and the supply declining, electrical contractors must push technology as much as possible to boost workers' efficiency, says Dave Ver Hoef, a VDC technician at Interstates, Sioux Center, Iowa.

By using both AR and VR in the field, the project team members can share what they have modeled in 3D.

"It grants the field the ability to see what the installation might look like and the routes that might work," Ver Hoef says. "We are able to use this technology on about any project that allows, especially those which require a large amount of coordination with other contractors."

A team of employees researches new technology and tests it out. Interstates then conducts in-house training sessions for its field electricians and educates its team on the technology and how it can be incorporated on their sites.

When rolling out the technology to the office and the field, the deployment can take a significant investment. During certain times, the technology may not work, requiring visits to the site or sending the equipment back for troubleshooting, Ver Hoef says.

Josh Vollink, VDC designer, demonstrates how to use VR equipment in a simulated plant environment. Photo courtesy of Interstates

Despite the challenges with the new technology, it can also offer benefits. For example, at Interstates, electricians are using technology for reviewing electrical routes, electrical equipment placements, and any potential collisions with other trade equipment.

"This allows our teams to be more productive by saving them time and rework by being able to make adjustments in the model before installation," Ver Hoef says.

FIVE STAR ELECTRIC

Streamlining the transfer of data from the office to the field

From tablets, construction apps, software, and field devices to document control and BIM modeling, Five Star Electric, New York, has always tried to adapt and incorporate these technologies into its day-to-day routines.

"Technology can be incorporated into every aspect of our business," President Russ Lancey says. "It increases efficiency, accuracy, speed, and effectiveness in both the office and on our construction sites."

Specific to virtual technology, Five Star Electric has been using 3D technology for decades, and as it has advanced, so has the company. For its business, the contractor uses 3D technology mainly in BIM modeling and in 3D coordination. What started as a contractual requirement for its World Trade Center projects quickly grew into a standard for many of its projects. Five Star Electric has taken advantage of this technology's benefits, specifically virtual clash detection with other trades work and other features that help with equipment selection and conduit placement during a project's coordination phase.

"Essentially, you are building the job virtually before building it in reality," Lancey says. "BIM allows the field electricians to see all the architectural and structural elements of a project in conjunction with the dimensions and elevations or other trades' work. Any coordination changes that are required can be made in real time. Because the project has been properly coordinated virtually and in advance of construction, this will allow the electricians to work more efficiently on the job site."

Five Star Electric equips its field supervisors with tablets, construction-oriented apps and access to in-house databases to constantly receive drawing and model updates, access to project documents, specifications, RFIs, material ordering capabilities, and the ability to track job progress by the use of photo documentation.

Five Star Electric is always looking for more advanced technology to incorporate into all aspects of its business — from engineering and construction to as-built production, document control, reporting and estimating.

"There is truly no limit to its capabilities," Lancey says. "However, as technology is continuously advancing, we are always cautious to adapt a new technology until such time it is proven to be effective and beneficial to the company."

A Five Star Electric project manager compares the BIM model to physical installation at the Newark Airport Terminal One project. Photo by Brian Leonard, courtesy of Five Star Electric

Dewberry personnel go over observations and discrepancies noted on an electrician's field report with the general contractor. Photo courtesy of Dewberry

DEWBERRY

Investing in tablets, software, and technology for the workforce

Fairfax, Va.-based Dewberry is currently in a trial phase, which started in October 2020, to test a construction document software to organize all documents for projects. The mission of the program is for Dewberry's construction administration personnel to be the authority on construction documents for a project — while they are in the field and not just when they are at their desk.

Before using the software, many Dewberry personnel printed drawings prior to performing field visits. They would then take pictures and organize them when they returned to the office. After writing the field reports on paper, they would next input them into a PDF template. Now, however, Dewberry employees can create and organize field observations and punch list items while in the field when they have good situational awareness and the ability to take photos.

"The goal is for the field report to be more than 80% complete when the employee leaves the job site," says Robert Deaton, assistant department manager. "Once the employee is back in the office after a field visit, this software allows them to quickly and efficiently review the field report again, send it out to the contractors and owners, and move on to the next task."

By loading the new software on the tablets, Dewberry can ensure that its employees are pulling up the most current set of drawings in the field. In addition, the employees will have real-time access to all equipment submittals, shop drawings, and RFIs.

In the future, Dewberry plans to use 360° site visit photos to make it easier and more efficient for personnel to document construction progress, identify potential issues, and photo document as-built conditions in mechanical/electrical rooms. Also, the company is looking to export the BIM/VDC model from the construction team to Dewberry field personnel's tablets so they can be referenced in the field.

"We also expect to purchase additional tablets so more Dewberry field personnel can take advantage of the software," Deaton says.

HEAPY

Virtually connecting with clients and colleagues

Building design requires both planning and collaboration, says Dwayne Henderson, information communication and technology practice director at HEAPY, an engineering design, and construction administration firm.

"We use communication and collaboration tools, as well as BIM to deliver a better project for our clients," Henderson says. "Ultimately, these tools make clients feel more connected to the project and help our team meet client expectations, which results in better outcomes for everyone."

HEAPY uses BIM for every project to anticipate and model day-to-day progress, as well as coordinate deliverables and responsibilities in real-time.

"This technology allows our team to handle and address issues as they arise and before they become problems in the field," Henderson says. "Using BIM can also help our clients better understand project progress and make sure we are bringing their vision to life. In addition, we can save time and resources because we reduce the need for colleagues and clients to travel to physical locations."

The COVID-19 pandemic highlighted the need for more integrated service delivery, but HEAPY was an early adopter of remote work and BIM technology, Henderson says.

"These integrated tools allow us to better serve our clients, and our clients are now more comfortable with virtual reviews and progress meetings," Henderson says. "The pandemic has simply accelerated widespread adoption of tools that HEAPY has been using for many years."

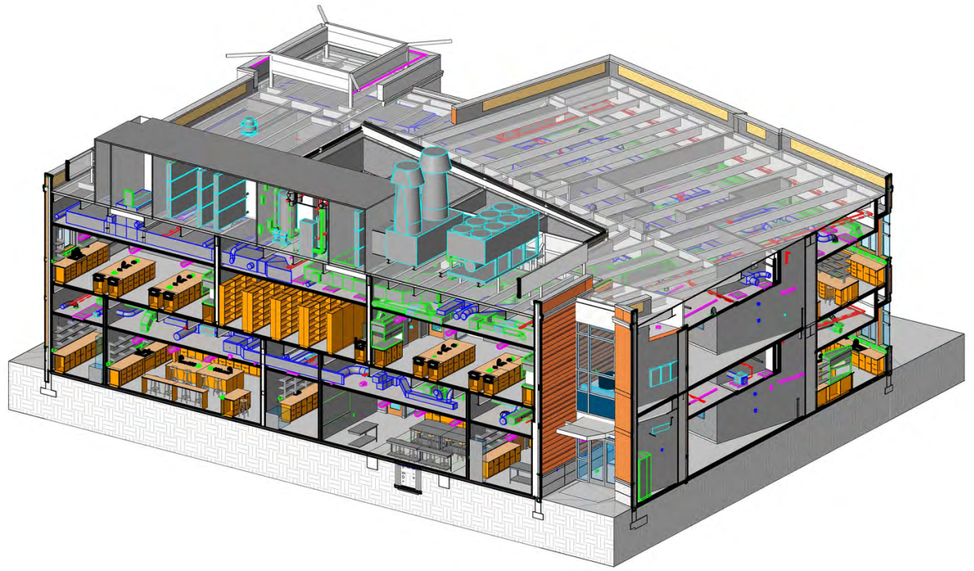
Because the HEAPY team is never physically located in the same office at the same time, virtual collaboration and project management software can open the door to more perspectives and input at each stage of a project.

"In the past, many of HEAPY's projects proceeded in a very linear fashion," Henderson says. "Now, many conversations and meetings can be happening simultaneously throughout each project stage. Owners, architects, and construction managers are more active in each phase and aspect of the design, and response time is much faster when we need to solve problems or make decisions."

In the future, HEAPY looks to further explore technologies that leverage AI and VR to improve client communication and experience.

"Technology changes every hour of every day, and our firm is always thinking about how to leverage new tools to serve our colleagues and our clients," Henderson says. "Most importantly, we vet new tools and software with a lot of feedback and input from the end-users — our engineers and our clients. If you don't listen to your end-users, you can end up with poor technology selection and adoption."

Amy Fischbach is a freelance writer based in Overland Park, Kan.
She can be reached at amyfischbach@gmail.com.



HEAPY designed the mechanical-electrical systems for Ohio Dominican University's new 25,000-square-foot Battelle Hall, an undergraduate laboratory building to support students in STEM disciplines as well as the nursing program. Program spaces include flexible teaching laboratories for biology, chemistry, and physics departments, as well as collaborative research laboratories and social spaces. Additionally, the facility includes bulk systems for purified water, compressed air, and vacuum. Photo courtesy of Heapy Engineering

Five Tips for Getting Buy-In for Virtual Reality

Rosendin Electric offers these five tips to successfully deploy a new technology at your company.

1. **Look past the gimmicks of the technology to realize the actual value.** At Rosendin, one of the most significant challenges for adoption was getting the teams to discover the value beyond the magic trick, says Dr. Jad Chalhoub.
2. **Fix bugs that arise.** Discover ways to improve the process of using the technology.
3. **Address specific challenges.** (VR) can cause the older generation to feel motion sickness, so Rosendin worked to reduce the amount of motion needed for the programs it built for VR.
4. **Realize that perfection is the enemy of progress.** Not everyone has to use every technology, and not every technology has to be used in every scenario.
5. **Build a team and create processes.** After the team deploys a new technology, the members can continuously review performance, identify bottlenecks, and work on finding or developing a solution.

PUTTING BIM TECHNOLOGY TO WORK IN THE FIELD

How one electrical contractor changed its model to counter the labor shortage, increase efficiencies, and create safer environments.

BY JAD CHALHOUB & FRED MEESKE, ROSENDIN ELECTRIC

Rosendin bridges the gaps of two-dimensional visual content with three-dimensional environments.

Rosendin, the largest employee-owned electrical contractor in the United States and headquartered in San Jose, Calif., employs more than 1,000 office workers and 6,000 field personnel. In an effort to counter the labor shortage, increase efficiencies, and create safer environments for its electrical contractors, the company recently took some significant steps to boost its building information modeling (BIM) capabilities. In fact, over the last seven years, Rosendin's BIM department has grown from six people in 2012 to more than 200 in 2019.

This department is responsible for creating 3D, information-rich models to enable the construction of complex structures: electrical panels, conduits, and equipment containing corresponding cost, material, and schedule information. The model is used throughout the phases of construction for coordination with different trades — creating construction documents, supporting quality control and assurance, and inclusion in project turnover documents. In short, the model aims to serve as the one truth to be referred to throughout the life cycle of the project.

One of the main phases of the BIM process is the coordination phase, during which coordinators ensure that each building trade has exclusive space for its installation. However, during construction, many components tend to shift and often end up in space "reserved" for other trades. Since electrical is often one of the last systems to be built, the foremen and their teams typically go on site and compare the model to the field conditions to conclude whether the model can be constructed as-modeled before prefabrication begins. This process is time consuming and often inaccurate because it's unreasonable to pull every dimension from every angle to ensure the modeled content fits the available space.

One possible solution is to place the model in space at full scale using AR and to visually compare the model to its potential placement. This theoretically increases the accuracy and reduces rework that would, in turn, save time and money. The key word here is "theoretically."

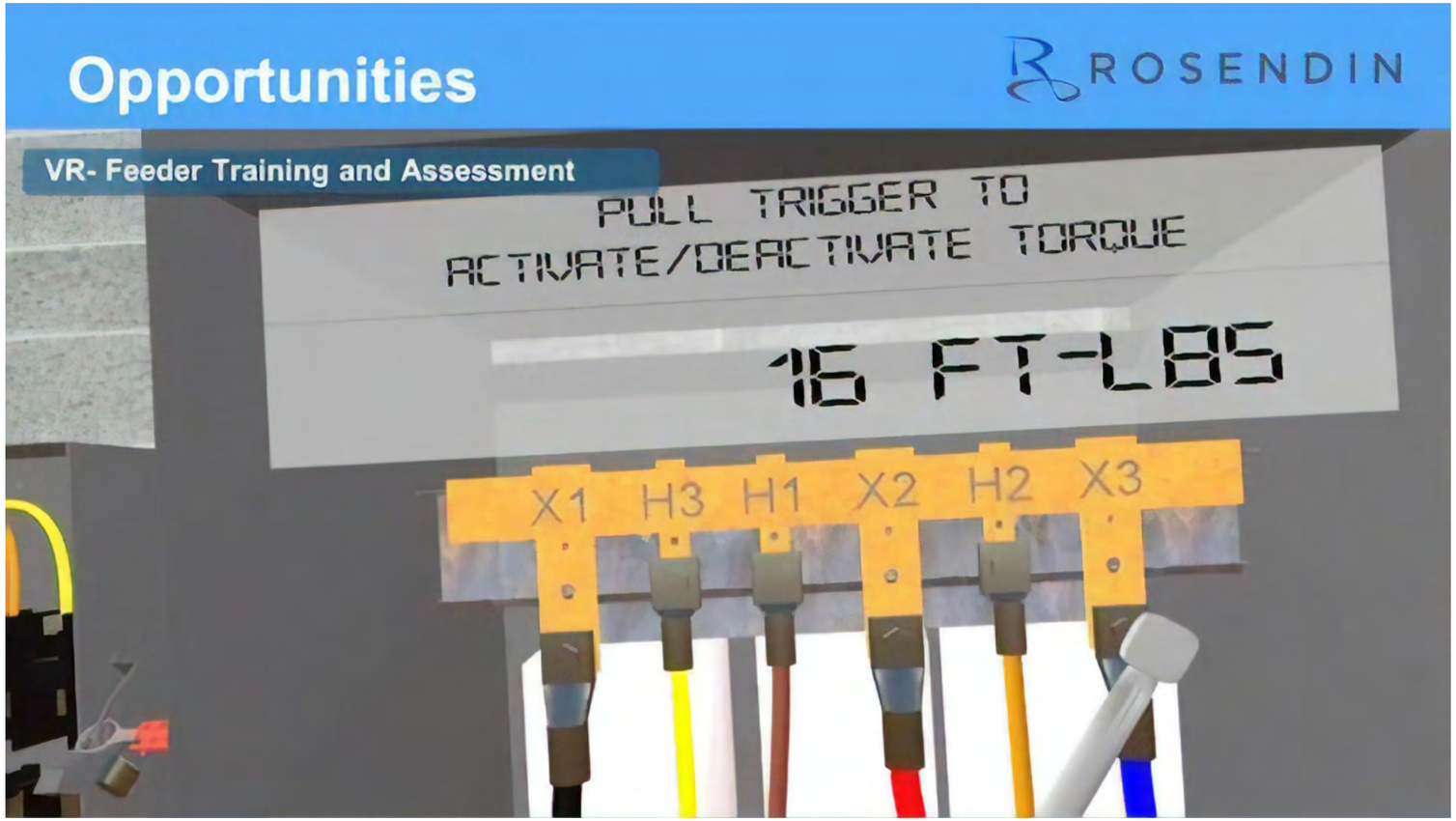
A pilot study was conducted at one of Rosendin's job sites to ensure that the solution was viable and to quantify potential savings before company-wide deployment was initiated. The following synopsis summarizes some of the lessons learned during this pilot study.

Before starting the study, the testing team was successfully able to determine the metrics to be tracked. They included the number of clashes per area, number of change orders per area, and associated costs. They were all tracked before and after the deployment of AR. The data collected enabled the team to later analyze before and after comparisons that clearly quantified the benefits of this use of AR and highlighted the success of this application.

Furthermore, a theoretical understanding of the benefits of this application was established with the entire field team early during the pilot; the project manager, superintendent, coordinators, and foremen were able to grasp the potential of this application. Having this initial buy-in was instrumental in the success of this pilot, since the site team provided continuous support while the application and underlying process were

being refined. In fact, having end-user buy-in is the most important factor when introducing a new technology. Regardless of how good the technology is, it will only add value if the end-users actively use it.

On the other hand, the team faced multiple unexpected issues. First, although the AR tool was tested and worked effectively in an office setting, it lagged and shut down repeatedly on site due to unforeseen conditions like heat, lack of connectivity, and dim lighting. Before the actual testing could even begin, the tool and usage process had to be refined numerous times, and workarounds were invented to achieve the desired functionality. Once more, the construction team's insights into possible limitations and concerns enabled the development team to make the tool more functional and robust.



Virtual reality view of training for wire termination and torquing.

Another aspect that had to be revised was the exporting process from the original BIM authoring software to the device. The original process worked well on small models, but in practice, it required around 30 minutes of processing time on the computer before the model was ready to be displayed on the device. The loss of productivity while exporting was likely to offset some of the perceived benefits, so the team worked to optimize the exporting process, bringing it down to less than 5 minutes per export. The faster export not only immediately increased productivity, but it also streamlined the training process, which would later accelerate wider deployment.

Overall, the pilot for using AR for comparing the model with site conditions prior to installation was a resounding success. Not only was it well received by the field teams, but it was also shown to reduce spots that required rework to about a third per area and subsequently saved on cost and schedule overruns. In fact, the AR tool is in such high demand on the original testing job site that there is more need for the AR devices than the supplier can deliver. Generally, it is important to gauge expectations, but it is also important to be ready to capitalize on huge successes. Right now, a scheduling tool is put in place to check out the AR devices while waiting for the new devices to be delivered and the required software to be installed.

This is one of many examples of how Rosendin continues leveraging BIM to improve productivity, safety, and efficiency for its internal and external customers.

Meeske is the corporate BIM director and Dr. Chalhoub is the technology implementation lead in the BIM Department at Rosendin, San Jose, Calif. They can be reached at Fmeeske@rosendin.com and Jchalhoub@rosendin.com.

ReliaGear™ smart power distribution

Smart design. Smart technology.

Next generation power distribution technology that can make you more money
ABB's new ReliaGear™ family of power distribution products was designed to create new value for every contractor business by lowering your installed costs to create efficiencies and more profit and by delivering what more customers now want in their power distribution products. **electrification.us.abb.com**

THE KEY TO GATHERING JOB-SITE INTELLIGENCE

Specific things every electrical contractor should look for on the next on-site visit.

BY HEATHER MOORE, PH.D. AND JENNIFER O. DANESHGARI, J.D., MCA, INC.

Collecting data through the job-site visit checklist with the foremen on-site.

The key to an electrical contractor's profitability is quickly knowing information on the job site. Although visiting and walking the job site is obviously important, knowing what information you need and how to gather it quickly is even more critical. That is job-site intelligence.

Job-site intelligence means understanding the three Ms: money, manpower, and material. These areas are a constant thread from the beginning of the job to the end. They must be constantly and consistently reviewed, with adjustments made along the life cycle of the job. Only when you're fast to detect issues and correct them can you keep your team doing what it does best — delivering high-quality installations on time with profitability.

Over the past three decades, through thousands of job-site visits across the country, MCA has identified some key items to help turn your routine "job-site visit" into a gold mine of data and information. These key performance characteristics reveal a project's current health and future wealth.

DO YOUR PREP WORK

Your first task is to understand where the job stands today — in other words, know the answers to the following questions before you step foot on-site:

- How much material has been ordered, and how does it compare to the estimate?
- What is the current manpower level on-site and the weekly burn rate?
- What is the financial status of the job?
- When is the last time you've heard or touched base with your customer or other trade managers on-site?

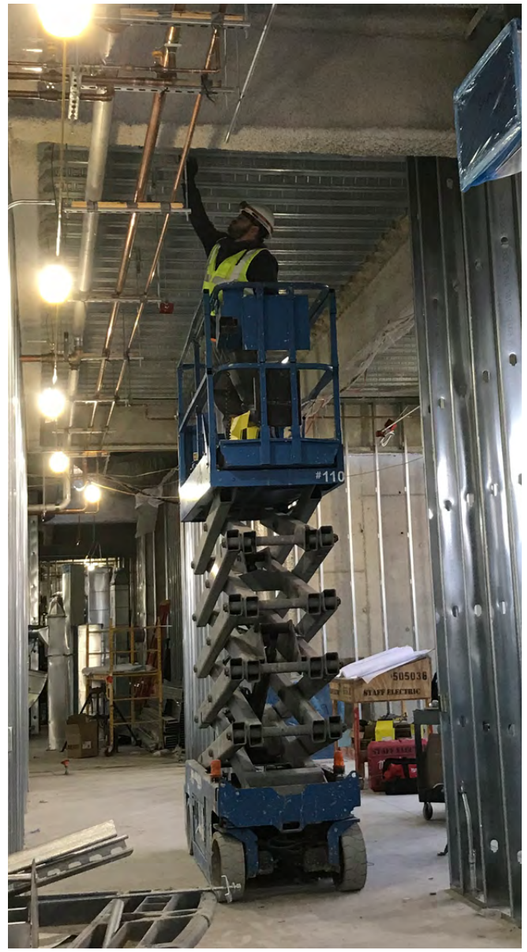
Review feedback from the field:

- When is the last time you received an update from the team that knows the most?
- What obstacles have they faced?
- Have you been able to support your team in overcoming these challenges?

Before you go:

- Do you know what the crew has on their plan for today? How about yesterday and tomorrow?
- Are you on track with your scheduled deadline, or have you fallen behind schedule?

To accurately compare what you're looking at when you go, you need to know what you expect to see.



Ensuring safety protocols are being followed is an integral step in effective project management.

HAVE A GAME PLAN

It's best to show up on the job site with a checklist (see **Table** at right) so you can easily review the three Ms. Here are some thought starters for the visit.

- *Manpower* — What's the crew mix? Is everyone working? What are they working on? Was it in the plan? Is there other trade interference with the work? Is the team working where they should be working? Are safety protocols in place and being followed?
- *Material* — Is the material in the right location, or is the crew having to move material to the point of installation? Is the material clean and presented to the installation crew in a ready state? Is any material damaged? Are your vendors saving you money or costing you money?
- *Money* — Are there items for charge backs and credits? Is there a plan to recover those in a timely manner? Do you know the change-order status from a request status, a build/installation status, and an approved/paid status?

USE TECHNOLOGY

While it's great to be on the job site to see firsthand the items listed in the checklist, you can also use software tools to tell you how the job is going when you're not there. It is important to break a large job down into manageable and measurable tasks, ensure the team has a daily plan, and assess that the daily plan is getting done in a timely manner.

Scheduling your team's work and recognizing and measuring distractions is key to adapting and improving before it's too late. It is even better when you can use the intelligence across your jobs to do lessons learned in real time. Take your tablet with you to compare to the drawings. Take pictures of the job site, and share them with your vendors and crew. Document what you see for immediate discussion both on the job site and with the office as needed.

Going beyond basic data gathering and turning what you've learned into action items will give your company a competitive edge. You'll become more efficient by reacting in real time to the challenges, which enables you to be more productive and profitable.

Dr. Moore is vice president of operations and Daneshgari is vice president of financial services for MCA, Inc., Grand Blanc, Mich. They can be reached at hmoore@mca.net and jennifer@mca.net.

Author's Note: Special thanks to Sonja Daneshgari, manager of field operations, MCA, Inc., and Deanna O'Dell, technical assistant to the vice president of operations, MCA, Inc., for additional contributions on this article.

Job-Site Visit Checklist

Project Number: _____
Date: _____
Attendees: _____

Work

- Is the design complete and correct?
- Is there a layout plan for the entire installation?
- Is the layout complete to the level of the installer?
- Do you see any safety risks or concerns?
- Is the work plan visible to the entire crew on-site?
- Is there a daily work schedule for quantitative production goals?

Manpower

- What is the crew structure (current and future plan)?
- What are the activities they are doing (install, non-install, waste)?
- How do the crews get their direction?
- How are they measuring the work and performance (if at all)?
- What is the general morale and attitude of the crew members? Note any personnel issues.
- What is the physical job-site layout for getting to/from work and break areas?

Material (and Tools)

- Material Storage
  - Where are the tools and gang boxes (i.e., "go-to" locations) located?
  - How organized is the material?
  - How much material is lying around the job site?
- Material Handling/Movement
  - Who is moving material from area to area on-site? How far is egress?
  - How is material moved to/off the job site?
  - Are the crews doing any prefab and/or kitting?
  - Are there any opportunities for vendor management or VMI?
- Material Utilization
  - Are the correct material and tools being used for the tasks?
  - Is there evidence of overbuilding?

Vendor Management

- How many/what type of vendor carts are on-site?
- Where are the vendor carts in comparison to the other materials? (Try to get a rough measurement.)
- How close are the carts/kits to the point of installation?
- How many times do the carts get replenished, and who performs this task?
- Who moves the carts around the site?

MANAGING SCHEDULE CHANGES ON THE JOB SITE

How do the following questions apply to your current project?

BY DR. PERRY DANESHGARI, MCA, INC.

As with any job site, the main crux of issues usually revolves around the general contractor (GC) schedule or lack thereof. An overall project schedule is usually produced prior to the job starting and passed on to all the respective trades, who then plan their work accordingly.

As the project progresses, impacts and issues start popping up on a weekly or even daily basis. Areas are not ready as scheduled, your team is constantly working on top of another crew, or they can't complete their work due to waiting on another trade. Sound familiar? How does your company handle schedule changes on job sites? Do you delegate certain people to handle them accordingly, or is it up to the foreman and crew to fend for themselves?

Take a few minutes to read through the following simple questions that pertain to project schedules as a whole (they are not trick questions), and see how they apply to your current project or one you have been involved with in the past.

WHEN DO YOU FIND OUT THAT THE GC'S SCHEDULE HAS CHANGED?

1. When they tell you.
2. When the other trades can't finish their work on time.
3. When the owner wants to issue change orders.
4. When the architect changes the plans and drawings.
5. When the engineers change their specs.
6. When the weather impacts the job.

WHO FROM YOUR COMPANY IS THE FIRST TO KNOW THAT THE SCHEDULE HAS CHANGED?

1. Your project manager.
2. Your general foreman.
3. Your foreman.
4. You hear it from other trades.
5. You hear it from the GC's project manager.

WHAT ARE YOUR OPTIONS WHEN THE PROJECT SCHEDULE CHANGES?

1. Inform the GC that you need a few days to let them know the impact.
2. It's a waste of time to try to tell anyone anything.
3. You have no options because you have to continue to do your work.
4. Move your guys just to keep them busy somewhere else in the job.
5. There isn't anywhere else to move your guys so you just (fill in the blank)...
6. You think you have unlimited time to react.

IN YOUR COMPANY OR ON YOUR PROJECTS:

1. Do you know who is responsible for reading the contract about the schedule change and the time to react to its impact?
2. Who would know how much time you have to respond?
3. Have you ever sent a letter stating that you reserve the right to respond within the next few week?
4. Do you have a way to measure the impact of the schedule change?
5. Do you have a way or process for reporting back to the GC to show the impacts from the schedule change?

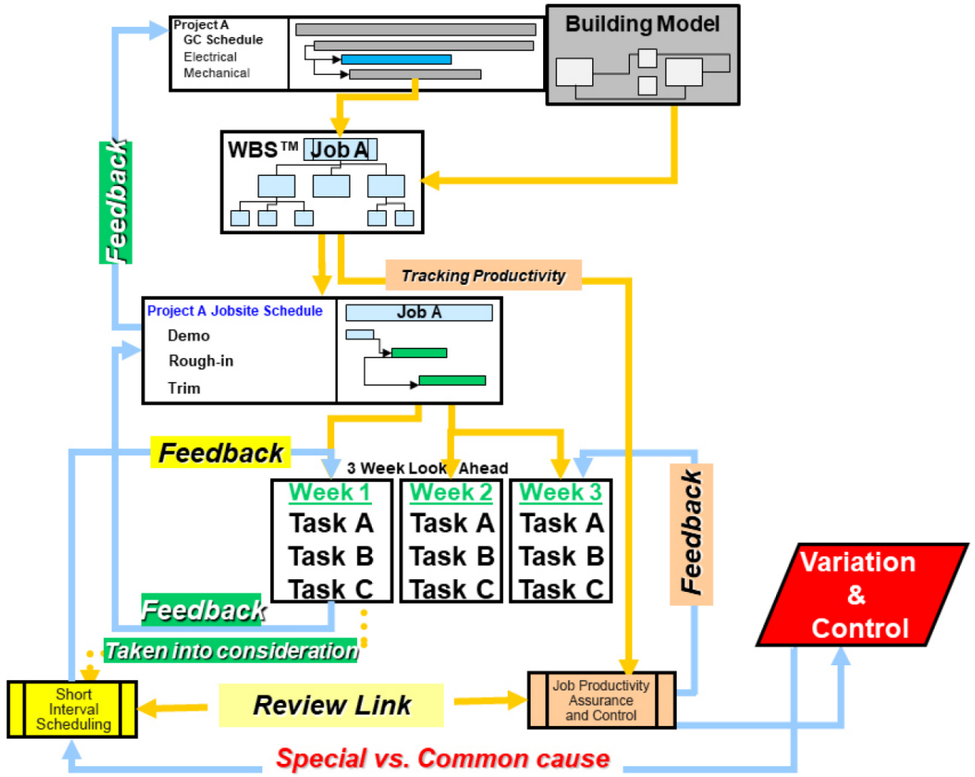
If you were unable to apply answers to all the questions above — or continue to struggle with managing schedule changes — then you probably do not have an actual scheduling process. What if I tell you that if you don't have a process for getting the instantaneous feedback from your jobs about the schedules, you are likely to lose 15% to 30% productivity for working on the unscheduled tasks?

To create a schedule process in your company, it is important to have a flow that starts with the GC schedule and includes steps and tools that help you to measure, respond, and manage the schedule impact on your jobs. Job-site intelligence will play a big part in creating the process flow, as is outlined in the **Figure** on the next page.

Using the data gathered from your job site on a daily and weekly basis, you can set up the same exact flow shown in the Figure. Here's how:

- Get the GC schedule (if one is available).
- Have the foreman break down work in measurable tasks (one example is MCA's Work Breakdown Structure or WBS), using their plans, specs, and BIM model if they have one.
- Take this information and create a job-site schedule, adding in start and end dates.
- Create your three-week look ahead from your schedule. This rolls every week for the next three weeks and shows the areas and work that will be available for the crew to complete.
- Have the foreman and crew do daily task schedules using software tools that also have the option to show impacts if tasks can't be completed.
- Use the WBS to track productivity (you can use what you have or use ASTM E2691 JPM).
- Use the feedback your electricians are giving you from productivity and scheduling tracking to identify any impacts due to schedule changes.
- Use this job-site data to update the schedule and create the next three-week look ahead.
- Take the feedback from your schedule to your GC to show the impact of their schedule change (for whatever the reason may be).
- Enjoy the extra money you make by avoiding lost productivity and controlling job-site variations.

Dr. Perry Daneshgari is president and CEO of MCA, Inc., Grand Blanc, Mich. He can be reached at perry@mca.net.



Job-site intelligence plays a big part in creating the process flow, as explained in the book, *Agile Construction for the Electrical Contractor, 2nd Edition.*

THE TRUE COSTS OF CHANGE ORDERS

Prepare and present your way to profitability.

BY PAUL GOLDSMITH, TRIMBLE

While it may seem cliché to say, "The only constant is change," that phrase often conjures groans of frustration from contractors in the building construction industry. While changes have become an inevitable — and, at times, necessary — part of the construction process, submitting change orders for acceptance and receiving prompt payment on them can be a significant challenge that negatively impacts a contractor's profitability. The size and number of changes on a particular project can substantially alter final costs and schedules, not to mention increase risk. If handled improperly, changes can lead to distrust between parties that, in some cases, results in detrimental disputes and litigation.

The single most common area of dispute in the change order process is cost. Among cost-related disputes, items related to what's fair and reasonable for recoverable direct costs, indirect costs defined by overhead-profit percentage, and impact factors resulting in consequential costs make up the majority of the disagreements. Direct costs are more easily justified and often included in change order requests. However, a lack of general acceptance, inexperience, and poorly defined standards for these — as well as indirect costs and consequential costs — plague many projects.

What's needed is a standardized change order process and a set of standards that all owners, architects, engineers, general contractors, and subcontractors can adopt for all construction contracts. Standardization will facilitate a fair and reasonable process for costing and pricing change orders. It will also promote open communication and drive efficiencies in estimating. Lastly, it can help ensure fair profitability and project success for all participants.

PROGRESS IN MOTION

A number of subcontractor associations have started promoting a set of change order standards to the construction industry that may help the submittal and approval process. In 2011 — after nearly three years of research and collaboration — members of the Toronto Trade Association Standard Practice Committee introduced a Change Order Protocol that outlines guiding principles and a standard format/definitions for costing and pricing change orders. The document was drafted by a task force made up of electrical, mechanical, and sheet metal contractors, along with engineers, general contractors, and owner representatives from more than a dozen of Canada's construction industry trade association partners. The Change Order Protocol is available from the Greater Toronto Electrical Contractors Association.

The Electri International released a study in December 2014 entitled, "Change Order Guidelines for Electrical and Low-Voltage Contractors." The research team included construction management faculty Matt Syal, Joseph Diffendal, and Daniel Duah from the School of Planning, Design and Construction at Michigan State University. Included in the report are guidelines and templates that provide a systematic, standardized, fair process for the pricing of change orders for electrical and low-voltage contractors. This study identified various cost categories and items, investigated overhead-profit practices, and identified various impact factors and methods used to calculate associated consequential costs. The full report and its companion Quick Reference Guide are available on the Electri International website.

The single most common area of dispute in the change order process is cost.

Building on the valuable resources from Electri International and Toronto Trade Association Standard Practice Committee, what follows are key findings, tips, and suggestions for establishing a consistent, effective, and profitable change order management process. By using these updated standards, the subcontractor community has an opportunity to educate and gain acceptance with general contractors, engineers, and owners.

IMPROVE CHANGE ORDER APPROVAL AND ACCEPTANCE

As an industry, we must expand our level of understanding and general acceptance of what is reasonable and fair for handling change orders. This requires a sweeping cultural change enabled by broad participation and support by everyone involved in the construction process — from owners, architects, general contractors, electrical contractors, and other MEP partners. To help establish a common ground of understanding, here is a list of guiding principles outlined by Electri International:

- Changes in the scope of work may be inevitable; however, a greater effort to diminish the volume of contract changes on construction projects is strongly encouraged.
- When changes become necessary, change orders should have a 30-day maximum turnaround. Contractors should submit an appropriately prepared quotation within 15 days, and owners should approve/reject within 15 days.
- Change orders should be fairly and reasonably priced, and payment of approved changes should conform to contract terms.
- Contractors are entitled to overhead and profit.
- Reasonable disclosure of costs is encouraged, while excessive requests can be counter-productive, cause delays, and give rise to additional costs.
- If it is necessary to issue a change directive in advance of approval pricing and all related approvals, this formal direction to proceed should not diminish the urgency to negotiate a final change order price.
- The parties should be proactive in resolving disputes, and every effort should be made to ensure that these disputes will not impact the balance of the project.

If specialty contractors will embrace these publications, create internal documents emulating the findings, and educate their staffs on the need to consistently apply and use the documents, then everyone in the construction industry will benefit.

DETERMINE TRUE COSTS

Establishing a consistent, detailed, and logical methodology to classify and justify costs for recoverable direct costs, overhead/markup, and consequential costs is vital to gaining change order acceptance and for project success.

Direct costs are the easiest to identify and quantify because they're tangible. They also often visibly impact project outcomes; therefore, they're generally easier to justify in the event of changes or alterations. Typical direct costs include labor, materials, equipment, and expenses related to the change such as moving, adding, or upsizing conduit, wire, and supports. However, there are additional direct labor, material, and equipment costs that are often overlooked and therefore impact profitability. For example, beyond the hourly rate to install a change, have you accounted for the time or direct expenses it takes to analyze, discuss, estimate, manage, and present the changes to the owner or engineer? Have you accounted for additional drawings, CMP revisions, or cost analysis? Does the composite labor rate include safety meetings, clean up, and supervision, and does it guarantee the work in addition to the list of all employer burdens?

For detailing direct material and equipment costs, don't forget to consider that materials may be purchased for a different price at a different time and could have separate delivery costs. Additionally, presenting a complete rental schedule with daily/monthly costs — along with general expenses that may be applicable — can go a long way to help justify rental costs. You don't want to surprise the engineer or owner with costs they haven't seen before. By clearly listing the details for each category, you can greatly improve the approval process.

Establishing a consistent, detailed, and logical methodology to classify and justify costs for recoverable direct costs, overhead/markup, and consequential costs is vital to gaining change order acceptance and for project success.

INDIRECT COSTS: OVERHEAD AND PROFIT

Defining indirect costs and calculating overhead versus markup versus profit can present a challenge. The percentages for overhead and markup are often predefined in the contract documents and typically range between 5% to 10% for each. Thus, the problem is not simply with the definition but also agreeing to a percentage that properly recovers both overhead and profit.

It's important to appreciate that profit and markup on cost are not the same — and that a generic 5% to 10% range is arbitrary in many cases, preventing contractors from recovering their true costs. Subcontractors need to fully understand what overhead, markup, and profit is/how each is calculated, and be prepared to defend their positions.

Overhead expenses are administrative expenses of a business that cannot be allocated to any specific project but are necessary for the business to operate. To calculate an appropriate overhead percentage, add up all of office personnel salaries and benefits, office utilities, office furniture and equipment, business licenses, legal fees, autos and insurance, dues and subscriptions, property taxes, etc., that aren't directly attributable to running a project. Then, divide all of these expenses by the total annual sales for your company. This should give you the overhead percentage you would expect to apply to the total change request to recover your overhead.

Research from the Electri International study mentioned earlier shows an average electrical contractor's overhead is actually 19.16%. Critical to fully recovering that overhead percent is to know that applying 19.16% to direct costs (most often called markup) is different than applying overhead to the total change order amount. To calculate overhead on direct costs only:

(Overhead % ÷ direct cost %) = markup %

For example, if overhead is 19% and the direct cost is 81% of the total cost, then the correct markup to recover overhead would be (0.19 ÷ 0.81) = 23.5%.

This is a significant difference — and one that will likely require coaching and education to the GC/CM community before subcontractors gain acceptance.

Profit is generally defined as the amount of money a company makes after accounting for all costs and expenses (including overhead). Let's assume that a 5% profit has been agreed to in a contract for all change orders. In order to convert the 5% profit to an appropriate markup on costs, use the same calculation as noted for overhead.

(Profit % ÷ all costs w/ overhead %) or (0.05 ÷ 0.95) = 5.3%

By marking up the total by 5.3%, you will achieve a 5% profit. The bottom line is that using the all-too-common 10% for overhead and 5% for markup or 15% combined overhead and markup (or even a 10%/10% factor) is likely not covering the true costs of your change requests.

CONSEQUENTIAL COSTS

The final piece in recovering your true costs is to understand and account for consequential costs. These are the costs incurred due to timing and scope changes, which may impact overall project costs or duration. These include things like stacking of trades, reassignment of manpower, dilution of supervision, site access interference, or impact of seasonal and weather conditions.

It's important to include potential costs on the change order with proper documentation. The Electri-International published more than 15 types of consequential cost references cost guidelines in its latest report. Detailing and substantiating calculations are key to your success. (click here to see a PDF version of the **Table**).

While consequential costs are real and do impact profit, historically these have been an area of contention for change orders. Clearly documenting and substantiating these costs will help you reduce risk.

(Click here to see a PDF version of a sample Change Proposal)

Goldsmith is the electrical/ICT segment manager for Trimble MEP, Westminster, Colo. He has more than 35 years of experience in the construction industry working as a contractor/owner before moving into the software side of the business. He can be reached at paul_goldsmith@trimble.com.

ADDITIONAL RESOURCES:

- ABB Website:
  electrification.us.abb.com
- ABB Electrification Products:
  electrification.us.abb.com/products
- ABB Contractor Resource Center
  informacem.lookbookhq.com/l/ecm_ge
- ABB Contractor Web Page:
  electrification.us.abb.com/your-business/contractor
- ABB Contractor E-News:
  powertalk.campaigns.abb.com/IS-ContractorBetter-Newsletter-Subscription-Form.html
- ABB Digital Industry Solutions:
  http://us.abbinel.com/
- ABB Source to Socket Portfolio:
  electrification.us.abb.com/best-both
- ABB Technical Tuesday's:
  https://electrification.us.abb.com/tech-tuesday-webinar-series
- ABB Webinar Center:
  https://electrification.us.abb.com/webinar-center

ABOUT ABB ELECTRIFICATION

Writing the future of safe, smart and sustainable electrification.

ABB's Electrification Business is a global leader in electrical products and solutions, operating in more than 100 countries, with over 200 manufacturing sites. Our 55,000+ employees are dedicated to delivering safe, smart and sustainable electrification. With ABB Ability™ enabled digital solutions at its core, our portfolio protects, connects and optimizes the flow of electrical energy, including the integration of renewables and energy storage for smarter electricity distribution for utilities, industry, infrastructure and transportation.

For more information visit Electrification.us.abb.com