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Milwaukee

ABC 2023 TECH REPORT




Associated Builders and Contractors®

The Construction Technology and Innovation committee supports the ABC strategic goal of delivering technology thought leadership and value to a diverse and committed membership. The committee is directed to understand member needs for technology solutions, so that it can deploy the best resources possible to support the innovative needs of ABC's members. The committee approves Tech Alliance membership, reviews Tech Marketplace requests and provides educational and informative resources for ABC members on technology.



Matt Abeles, ABC Vice President of Construction Technology and Innovation

ABC continues to invest in helping our members not only select the best construction technology solutions for their business, through our Tech Alliance, Tech Marketplace and Tech Report, but also in making sure members are educated on the latest technologies impacting their businesses. In the 2023 Tech Report, we show the construction industry how our members' investment technology and innovation, which has led to more profits, safer jobs and more work, is strategically adopted and implemented to attain those results. The case studies and research in this report highlight construction companies of all sizes, and how they have successfully transformed their business with the proper technology choices, rollout strategies and leadership. ABC creates the conditions for construction companies to innovate, differentiate, attract and educate their top talent, ultimately to win and deliver their work safely, ethically and profitably for the betterment of the communities in which they work. The 2023 ABC Tech Report was published by the ABC National Construction Technology and Innovation Committee and includes authored case studies from ABC members. This report was written by contractors and for contractors.



Jack Hineman, Vice President of Business Intelligence, Gaylor Electric, and Chair of the ABC Construction Technology and Innovation Committee

I started at Gaylor Electric in the information services department as the network administrator. My responsibility at that time was to optimize network connectivity between our users, offices and infrastructure. One fateful morning in the fall of 2016, my supervisor went to breakfast with the rest of Gaylor's executive team. During that breakfast, our president and CEO, Chuck Goodrich, asked the team if Gaylor had the capacity to build a production bell curve. Seeing an opportunity to impress Chuck, my supervisor mentioned that I had the capability to deliver what our president was looking for. Immediately following breakfast, my supervisor came to my office to break the news. With a smile on his face, he said, "Well, I just told Chuck you could build a bell curve—so you better figure it out!"

Take a look at the ABC 2022 Tech Report for a glimpse into some of the insights that we have been able to uncover. The committee has received great feedback on the report, and I personally have received some excellent feedback on my contribution with regard to Gaylor's use of data. One question that I have received frequently is, "How do I get started?" The ABC 2023 Tech Report will provide valuable insights on the first steps.



Brianne Stewart, Construction Technology Manager, Milwaukee Tool, and Member of the ABC Construction Technology and Innovation Committee

As a member of the ABC Construction Technology and Innovation Committee for the past three years and a construction technologist, it has been inspiring to see the level of commitment my fellow committee members have invested in the pursuit, promotion and adoption of technology in the construction industry. Technology adoption and innovation is a change management process at heart, and it needs to be focused on the people who will be affected. At Milwaukee Tool, we constantly emphasize that people and culture are the bookends of our success. We had the opportunity to highlight this approach when we hosted the committee at our headquarters in the fall of 2022. While we received great feedback on the content we provided, I was in awe of the connections and learnings we acquired while hosting representatives from some of ABC's most innovative contractors. As part of the visit, we facilitated an innovation stakeholder workshop to introduce committee members to our process of user-focused design and change management. I will introduce the framework and insights from this process on page 1. I hope you are able to combine the people-first approach to technology implementation with the case studies throughout the report in a way that adds value to your business and moves our industry forward.

ABC Tech Report 2023 Introduction

As we shift the focus of this report, the following is a framework of how to actually accomplish the same adoption and results that other companies have described in previous ABC Tech Reports. This framework drives successful adoption of technology within your company by focusing on the people affected by technology change and identifying key stakeholders and drivers throughout the process.



Trigger: What is driving the need or request for the new technology?

Without a clear understanding of the need, it is difficult to maintain clarity and deliver a successful implementation. There are many ways to identify opportunities for improvement based on technology adoption. It can be a top-down mandate to pursue new business or a grassroots survey identifying operational pain points. The most important part is to be aligned, understand who the stakeholders are and why they care about bringing in new technology.



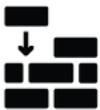
Assessment: How do you find and evaluate your options?

There is an almost overwhelming number of technology solutions on the market, and at times it is frustratingly difficult to decipher specifics of what each solution provides. Researching through multiple pathways, documenting findings and maintaining alignment to the core need that triggered the exploration are key to finding your options. Potential sources of information include peer groups, internet searches and the ABC Tech Marketplace.



Decision: What option are you deciding on pursuing?

Once your technology solutions candidates are assembled, an evaluation process is needed. It should be structured to evaluate the solution capability determined in the assessment against the business needs found in the trigger analysis. The implementation resources needed should be aligned to what is available.



Implementation: Put the technology into place

Differentiating the implementation phase allows you to manage the introduction of technology into your business in a controlled manner with dedicated resources, by planning the technical aspects of integrating and deploying the technology. What is the impact on the people in your business, and how can you prepare for the change? What support and training resources are needed in the adoption phase? In short, how will this change your processes and the day-to-day life of your team, and how can you best prepare them?



Adoption: Using the technology

Once you're ready to move into full adoption, it is critical to plan the rollout to the entire company. This involves executing the training and support steps created in the implementation phase, as well as communicating the "why" that is driving the change. As a change driver, you have likely bought in and are comfortable with the change and new technology. In this step, it's important to understand that many individuals in your company have had less time to understand and adjust to the change that comes with new technology.



Feedback: Process of requesting, receiving and consuming feedback on the new technology

Once the technology is in place after adoption, the change process is not complete. It is essential to seek out the employee experience with the new technology to capture feedback. This builds a foundation to improve the total utilization of the technology and make needed improvements, as well as build rapport within your business for future changes. Feedback should be received with an open mind and follow-ups clearly communicated.

The rest of this report will highlight real-life case studies from ABC members willing to give you a peek behind the curtain to see not only which technology they are adopting, but also the steps they took throughout the process. This is not a defined playbook, as there is no singular way to select and adopt new technology solutions. The critical takeaway is that there are multiple potential pathways, and it will be up to you to determine the best fit for your company based on your knowledge of the business and people. Focusing on the stakeholders as a guiding principle is essential, and the steps below will ensure you execute this effectively.



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Asset Management and Performance

*By Kirk Walker, Project Manager,
Power & Construction Group Inc.*

I have grown with Power & Construction Group Inc. since 2002. We are a utility and aggregate contractor in western New York with a remarkably diverse skillset. When I began my journey with P&CG, we only had 100 assets total. Today, we have over 900. A lot has changed over the last 21 years, and managing all the equipment is not easy anymore. I started as a laborer in the field and have worked my way up to a division manager, so I was able to see the changes from both sides, in the field and office. The days of being able to know where our assets are, how long it's been run and when it is due for service are long gone. As we all know, after our employees, our equipment is the next most important thing.

Trigger

To report milage with the highway use tax and the International Fuel Tax Agreement, we would have to pull all the paper logs from every truck each month and manually compile the data for reporting. This process took about two hours per truck each month. This became a task that was very costly and more difficult as the fleet grew.

Adoption

Over the years, as trucks and equipment grew, so did the need for more advanced records and reporting. A division manager at the time brought up the idea of utilizing a GPS system to our managers and executives, mainly for our over-the-road trucks. This system would take the paperwork out of the equation and provide a detailed report at the click of a button (Figure 1). In our research, we were looking for something to grow with and discussed what other data might be useful in the future. At that time, all we needed was milage reporting.

But after reviewing multiple options, we found that these systems went much farther. The simpler units report miles and location, while the more advanced units will communicate how the engine is running and if the driver is wearing their seatbelt.

Our choices for what information we wanted were miles, location, idle time, hours, speed and the ability to alert when certain criteria are met. The choices were reviewed for price and ability and the decision to use GPS Trackit, a cloud-based software with a small module in each truck or asset, was made. The simplest unit cost was \$11.95 per unit per month while the more advanced units cost \$17.95 per unit per month. Our cost to report miles was one administrator for two hours per truck per month, totaling about \$50 per truck per month. GPS Trackit would cut this time to almost nothing, taking only a minute or so per truck per month. This was

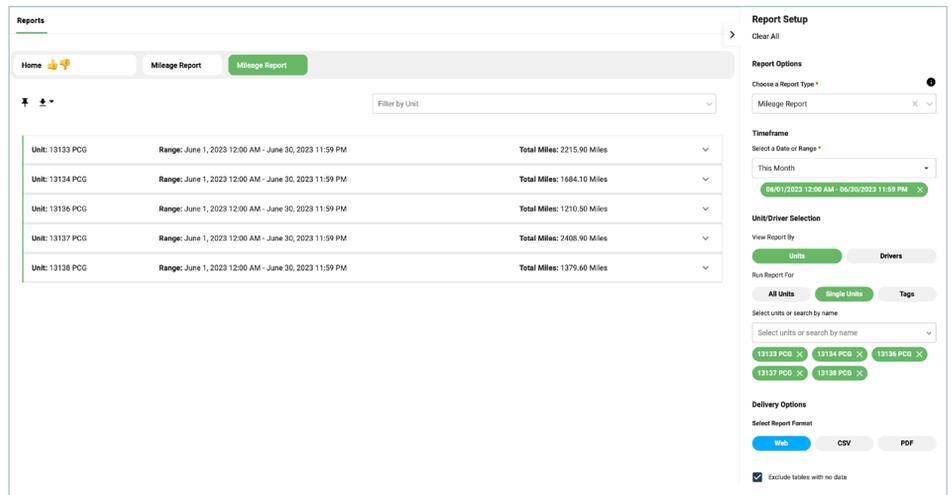


Figure 1.

projected to cut our reporting time to only two hours and \$50 per year. Another advantage was the safety aspect of installing these units. Our employees were aware of what the units were tracking, and it created a safer driving culture. It also gave us exact locations if there was an accident to allow accurate reporting to get necessary personnel to the location (Figure 2).

Implementation

We began implementation with the 10 over-the-road trucks. As we mainly travel throughout New York, most of them are based out of one of our local shops. The install time was quick and painless for our mechanics and the units were up and running quickly. After running them for a couple of months and seeing the data we were able to collect, we were surprised at what else it helped us do.

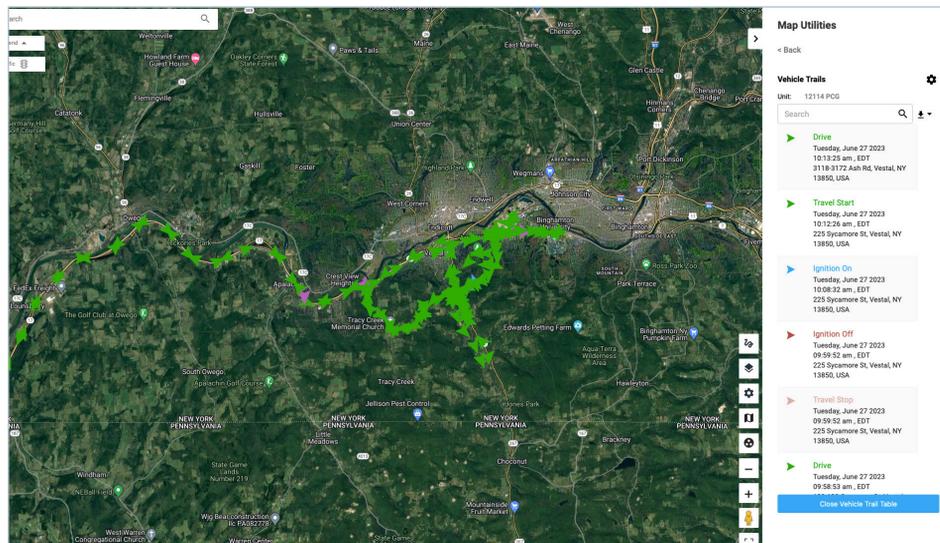


Figure 2.

Beyond the time savings for reporting, we found that it made us more efficient because we had a better knowledge of the location of each truck and could schedule loads at a better rate. We started installing units in our utility trucks and worked our way down to the pickups. As each vehicle came in for a preventive maintenance or repair, a unit was installed and was then live in the cloud services. This process took about four to five months for around 430 units (Figure 3). While that was in the works, we also started looking at our heavy equipment and how GPS could help us. In the last two years, we have had 67

DOT roadside inspections—41 without violations and 26 with violations. In addition, most of those violations were from the driver, not the truck.

Strategy

Our strategy is to incorporate technology to reduce workload and errors and become more efficient. It has succeeded across the board, from our over-the-road trucks, regular utility trucks and even our heavy equipment.

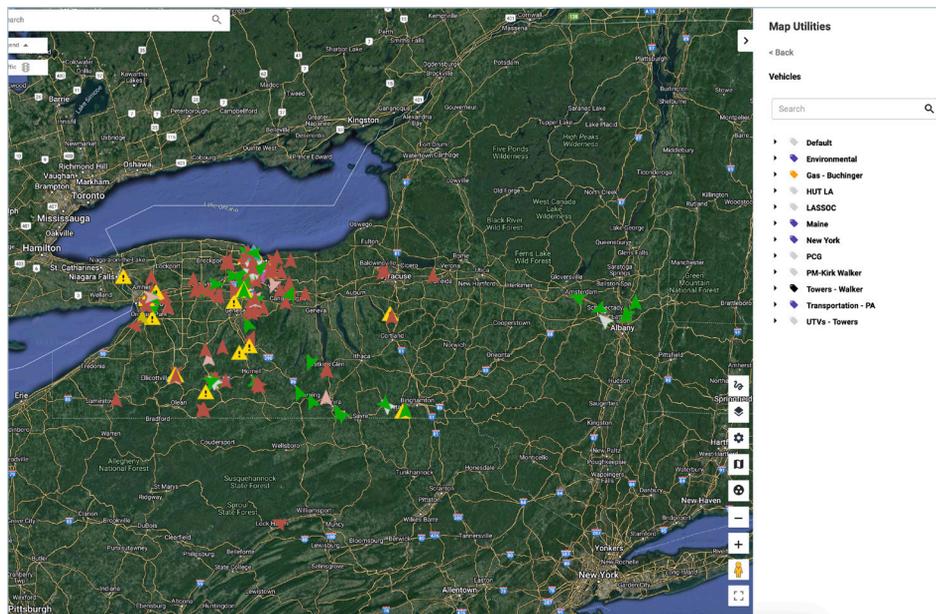


Figure 3.



Our CMMC Journey

By Chris Thomas, Director of Information Technology, Harkins Builders Inc.

Introduction

If you work for a company involved in government projects, you might be familiar with CMMC, the Cybersecurity Maturity Model Certification. It requires organizations handling controlled unclassified information to meet specific requirements that demonstrate their environment is secure enough to be trusted with it. There are different levels of CMMC, so it's essential to research and determine that you're setting down the correct path from the start.

My experience with CMMC began in 2020 when a colleague from our government division asked me if I was aware of it. I confessed that I wasn't and, after some reading of my own, I concluded that it sounded like something we should investigate, since a significant portion of the work we do at Harkins relies on the government. I contacted a consultant that we had utilized for past IT work, and they put me in touch with a company that specializes in helping organizations navigate the CMMC process.

Over the following year, I became buried in an overwhelming amount of Word and Excel documents as we slowly chipped away at documenting how we met each requirement. Deciphering the government jargon and acronyms added to the confusion. Although some controls were reasonable and were based on sound security practices, there were redundancies and nonsensical aspects that added to the frustration.

The New and Improved CMMC 2.0

In late 2021, the government unleashed CMMC 2.0, which brought some pretty big changes and even simplified it a bit. We had recently added an information technology and security specialist to our staff, so I was able to share the CMMC awesomeness with someone else. In mid-2022, we decided to engage a new partner, Edwards Performance Solutions, which not only better understood our environment, but also had a consistent team we could rely on. We also adopted FutureFeed, an outstanding application that streamlined our progress tracking and moved us away from the pile of Excel and Word documents we had accumulated.

We started fresh with Edwards, engaging various departments at Harkins, such as accounting, marketing, human resources and, of course, members of our

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government division, to understand how they each interacted with CUI. Data flow diagrams were completed, followed by a gap assessment to identify areas that required improvement. This helped us build our plan of action and milestones, which is an essential piece of the CMMC puzzle.

FedRAMP and Microsoft 365

Since Harkins is heavily invested in the Microsoft 365 platform and utilizes SharePoint and Teams to store much of our project data, we faced a challenge. The commercial version of Microsoft 365 is not FedRAMP compliant, which means that we can't securely store CUI there. Rather than move our 300+ users and 600+ devices over to the Microsoft 365 Government Community Cloud (the 365 environment that is FedRAMP compliant), we set up a new GCC environment only for employees needing to interact with CUI, reducing the CMMC scope.

Where We Are Now

With that project mostly complete, we continue working through the controls with Edwards, now with a simpler scope. Regular biweekly meetings help us progress steadily, addressing items on the list and establishing new processes when needed. We still have a few larger items on our radar that will need to be addressed. For instance, we utilize Procore at Harkins, and it is not yet FedRAMP compliant. There are compliant products out there, but the thought of moving to a new platform is daunting, to say the least.

Another item of concern is understanding what our responsibility is of ensuring that the trade partners that we engage with in the future on government jobs are CMMC compliant. I have heard mixed opinions about whether the government is going to ever enforce CMMC, and many companies have either decided to completely ignore it or just adopt a wait-and-see attitude. This is a decision that businesses will have to decide for themselves. The amount of time and money that it will take to complete the CMMC process is considerable, and I often wonder how smaller organizations are handling it.

Why We Did It

The decision to comply with CMMC or ignore it lies with each business. However, the importance of increased security when handling CUI cannot be denied. Those enticing government contracts that we all love will come at a higher cost and companies will have to weigh the benefits and decide accordingly, considering the effort and resources required for the CMMC process.



Rolling Out Cybersecurity Maturity Model Certification

By Brian St. George, Director of IT, Stronghold Engineering Inc.

As the director of IT for Stronghold Engineering Inc., I was faced with the critical task of enhancing our cybersecurity measures to safeguard our organizations and the U.S. Department of Defense’s sensitive data and intellectual property. With cyberthreats becoming increasingly sophisticated, it was imperative that we implement a comprehensive framework to assess and improve our cybersecurity practices. In this case study, we explore the journey of the initial rollout of Cybersecurity Maturity Model Certification within our organization, with a specific focus on employee training and the integration of artificial intelligence for incident detection and alerting.



Figure 1. AI Monitoring and Detection System

The CMMC is a standardized framework introduced by the DOD to ensure that organizations operating within the defense industrial base adhere to robust cybersecurity standards. Recognizing the relevance and significance of this certification for our business, we embarked on a strategic initiative to achieve CMMC compliance and be one of its early adopters.

Our first objective was to empower our employees with the necessary knowledge and skills to contribute to a secure cyber environment. Recognizing that human error and lack of awareness are significant factors in successful cyberattacks, we devised a comprehensive training program. This program aimed to educate our employees on best practices, cyberthreats and the importance of cybersecurity in their daily roles. Through a combination of classroom training, e-learning modules, unannounced testing and company policy and procedures, we aimed to create a security-conscious culture across the organization.

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Simultaneously, we sought to leverage the power of AI to strengthen our incident detection and response capabilities. Traditional cybersecurity approaches often rely on manual monitoring and analysis, leading to delays in identifying and mitigating threats. With the introduction of AI-based solutions, we aimed to automate and streamline our incident detection processes, enabling real-time alerting and faster response times.

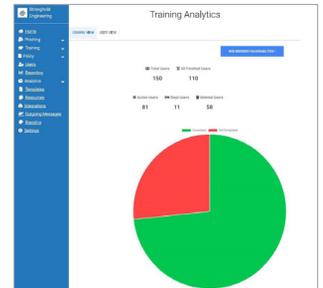


Figure 2. Monthly Employee Training System

By integrating AI algorithms and machine learning techniques into our security infrastructure, we aimed to create a proactive and adaptive defense system. This would enable us to detect anomalous patterns, identify potential breaches and alert our incident response team promptly. Leveraging AI’s ability to analyze vast amounts of data in real time, we aimed to enhance our threat intelligence and reduce our mean time to detect and respond to security incidents.

Throughout this rollout, we will continue to explore the challenges encountered during the implementation of the CMMC framework, the strategies employed to overcome them and the outcomes achieved. By focusing on employee training and AI-based incident detection and alerting, we aimed to strengthen our cybersecurity posture, mitigate risks and demonstrate our commitment to protecting our organization’s and our client’s sensitive information.

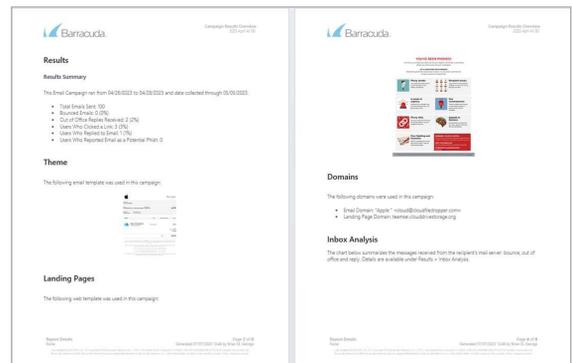


Figure 3. Monthly Employee Blind/Unannounced Testing System

BIM: Adoption Through Employee Opportunity

By Russ Gibbs, VP, Director of VDC, Innovation, and Operational Technology, Brasfield & Gorrie

In 2023, most commercial contractors should understand 3D models, and most commercial trade contractors should have in-house 3D modeling capabilities. Master contracts from companies like Brasfield & Gorrie mandate participation in the building information modeling process. This begins in the bidding process by scoping subcontractors for these capabilities. At Brasfield & Gorrie, we develop a unique plan and provide resources for any company we work with that lacks internal capabilities.

Developing a virtual design and construction team dedicated to implementing a business information modeling, or BIM, process within your company requires thoughtful planning and implementation. Your journey toward adopting BIM will develop at its own pace. We've seen that firsthand over the last 14 years. Here are a few lessons you can take from how BIM became our gateway to construction technology.

Clearly Define a Vision To Gain Stakeholder Buy-In

Early on, a few people within our organization asked what we were trying to accomplish through using 3D models. They asked how models would make us better, given that we already had 2D drawings. Those questions prompted us to define a vision around BIM so that we could clearly communicate its benefits and how it could help the company in the long run.

Our goal (Figure 1) was to recreate every physical construction process within the 3D model. If we could mimic the jobsite in our 3D simulation, then trusted information could pass between the 3D model and the

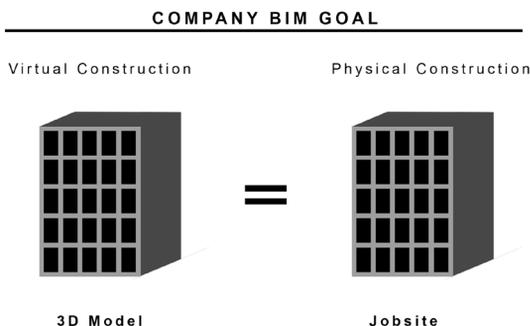


Figure 1. Graphical Representation of Brasfield & Gorrie's Vision for BIM.

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jobsite. We predicted that we could build a trustworthy digital simulation by capturing the existing conditions, modeling building components, exporting component locations and tracking their installation in the field.

This was a lofty goal, and there were many tools and processes necessary to make it reality. We tested and purchased laser scanners to capture the existing conditions, became certified by the Federal Aviation Administration to fly large sites and convinced Leica to loan us robotic total stations to test 3D model layouts. We quickly learned that we had a lot to learn! However, we also realized that the construction industry contractors and vendors were also on this digital journey. Few companies understood the "why" behind what they were selling, but we tried to figure it out together.

At this point, we had enough momentum that we knew our vision could become a reality. The road would be long; however, we were picking up huge wins along the way. By incorporating processes like 5D quantities, 4D scheduling and 3D concrete modeling, we were resetting how our company solves operational problems. Buy-in from leadership was pivotal, and early successes helped us gain trust throughout the company.

Support Your People and Provide Them Opportunities for Growth

It's important to have thick skin when you take on a technology role within a construction company. In 2010, Brasfield & Gorrie had two people dedicated to 3D modeling (Figure 2). These two employees spearheaded the growth of our BIM department by embracing change in an already-successful company. Their day-to-day work was not easy, but they believed in the vision and the positive impacts that 3D modeling would have on the entire organization.

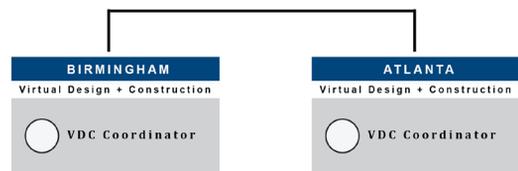


Figure 2. Employee Growth Opportunity in VDC in 2011.

2011 Virtual Design + Construction Opportunity

- ▶ VDC Coordinator

2023 Virtual Design + Construction Opportunity

- ▶ Assistant VDC Manager
- ▶ VDC Manager
- ▶ Senior VDC Manager
- ▶ Senior VDC Manager - Lead
- ▶ VDC Operations Manager
- ▶ Regional VDC Operations Manager
- ▶ Regional VDC Manager
- ▶ VDC Director

2023 Innovation and Operational Technology Opportunity

- ▶ Inno and Op Tech Specialist
- ▶ Senior Inno and Op Tech Specialist
- ▶ Senior Inno and Op Tech Specialist - Lead
- ▶ Director of Inno and Op Tech

Figure 3. Employee Growth Opportunity in Construction Tech in 2023.

Within three years, the two employees had created a six-person department, which has now evolved into a 72-person department that assists with 63% of the company's new construction projects (Figure 3). As the team has grown, our team members have been able to grow in their careers and specialize in areas that serve their interests and the company's needs.

Develop a Replicable Process

The adoption of visual design and construction helped Brasfield & Gorrie both embrace technology and set up a process to implement other technology as it emerges. Our Innovation and Operational Technology Department uses an implementation workflow (Figure 4) to assess whether new tools will help us solve construction problems. We see many new gadgets come and go, but few are ready to be deployed in the field at a large scale. By sticking to this process, we hold ourselves accountable for the guidance we provide our colleagues across the company. We're not interested in spending tens of thousands of dollars on a flashy gadget if it doesn't deliver results!

Your company's path to embracing BIM and other technology may look different than ours. Regardless of the structure you build, embracing these lessons should help you serve your clients in ever-more-efficient ways.



Figure 4. Implementation Workflow Used by the Innovation and Operational Technology Department.





Virtual Reality

By Thai Nguyen, Director of Innovation, Hensel Phelps

As an industry professional, I have witnessed firsthand the transformative potential of augmented reality/virtual reality in revolutionizing how we design, plan and execute construction projects. These cutting-edge technologies have opened a realm of possibilities, enhancing collaboration, improving safety and boosting efficiency on construction sites. The following is a compilation of case studies and real-world experiences from Hensel Phelps Virtual Design & Construction team members who are using these technologies on various jobsites across the country.

Drew Rebman, Senior VDC Manager, Pacific

AR and VR have been around for many years, but until recently it has not been a driving factor serving as an essential tool in the construction industry. In the past year, there has been a tremendous push to improve the technology's accuracy and disrupt our day-to-day work positively.



Figure 1.

Now, when I put on my headset, I can see the actual space at full scale, comprehending the scope and complexity of installations better. Utilizing the technology with the field crew, I no longer need to explain the intricacies of some of these very difficult installations I am involved in. The technology aids in planning and communicating intricate installations. For example, I can stand in the field at an airport project and clearly see the new steel as a virtual element fitting between two existing baggage systems. It allows the team to review the sequence and adjust to better suit the site

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conditions at any given time. It allows my team and me to review sequences and make real-time adjustments for site conditions.

I can incorporate safety task assignments and pre-task walks with safety professionals, so crews better understand the work they are about to perform. AR and VR might not be a necessity, given Hensel Phelps' 87-year history of building complicated structures, but they undoubtedly help in presenting the work to the team effectively.

Monty Newman, Senior VDC Manager, NorCal

The most common augmented reality units I have used are Microsoft HoloLens 1 and 2 for a variety of use cases, including virtual mockups and field validation.

In virtual mockups, during the design phase of a project, HoloLens helps display and visualize spaces for owners, facilitating space configuration, wall device layout, overhead clearance and equipment layout.



Figure 2.

For field validation, my team and I use HoloLens to demonstrate congested spaces to owners and trade partners, fostering better understanding and collaboration. One of Hensel Phelps' health care projects had a catheterization lab with heavily congested overhead space. The owner and some of the field trade partners didn't understand what it would take to build it. Once I had the team members put on the Microsoft HoloLens, they were able to visualize and see the heavy overhead congestion.

The most common virtual reality technology unit that I have used is the HTC Vive Pro for a variety of use cases, including virtual presentations and virtual mockups.

For virtual presentations, my team and I have used the HTC Vive Pro for procurement interviews with owners. The owners have had the option to see what the potential project's design will look like during the interview. In some cases, this has contributed to getting the project awarded to Hensel Phelps.

In the case of virtual mockups, in a laboratory project Hensel Phelps was working on, the walls had many surface-mounted and recessed devices. After extensive virtual design and construction coordination with the team to determine device locations, my team and I conducted a virtual mockup review with the owner. This effort helped eliminate risk and rework, and allowed the owner to validate device placement.

Will Plato, Senior VDC Manager, Southcentral

AR/VR might not be new technologies, but their application in construction is rapidly expanding. When one contemplates the essence of the design process and the communication process of construction, it starts with an idea of 3D that is often napkin sketched



Figure 3.

in 2D; which is then modeled in 3D, only to be printed in 2D sheets; which is then recreated in 3D to produce the shop and fabrication drawings; which are converted back into 2D, to then be interpreted in 3D by the trade craft; which is then as-built back into 2D record documents. This translation process introduces opportunities for risk to manifest itself throughout that lifecycle and encourages the industry to find tools that can help mitigate that risk.

I've discovered that increased stakeholder involvement in active coordination can resolve more items before construction. For years, 3D technology has been available, with various programs displaying content on 2D screens or in building information modeling caves for a more immersive experience. While effective, these techniques may require skilled operators to engage the audience. Though our VDC team members and I use them daily, they may not be the best tool for most audiences.

“This technology offers diverse use cases, including safety, design planning, virtual mockups, field validation, facility maintenance access studies and user group functionality analysis. Each situation often has a specific technology that stands out as the best application, driving technology adoption.”

For field validation, devices like the HoloLens, XR10 or iPad work well, allowing pass-through to the existing world and anchoring 3D models within the physical world. We've tested headsets with higher-fidelity camera pass-through, like the Meta Quest Pros, but they face challenges with room mapping. In VR, Meta Quest Pro provides high-quality models comparable to HTC Vive. The headset's form factor supports shared experiences, making it truly wireless. Consider both software and physical aspects when deploying this technology, ensuring user-friendly solutions and continuous maturation of these modified realities.

AR/VR technologies are transforming the construction industry at Hensel Phelps. These cutting-edge solutions propel us to new heights of excellence, offering innovative answers to age-old challenges. As technology advances, we eagerly anticipate more groundbreaking developments that redefine how we build and construct, ensuring Hensel Phelps remains at the industry's forefront. Together, with AR/VR as our allies, we shape the future of construction, forging a path toward innovation and unparalleled excellence.

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Building Efficiency: The Data-Driven Story of Gaylor Electric

By Jack Hineman, Vice President of Business Intelligence, Gaylor Electric

Preparation

Build a Culture of Truth

I am sure you have probably heard the phrase “garbage in, garbage out.” When it comes to analytics, the output is only as good as the input. A few years ago, my team developed a mission for the department to “empower measurement-focused accountability by uncovering and communicating the stories in our data.” In order to allow measurement-focused accountability, the measurements need to be based in fact.

Figure 1 shows labor curves for two different fixed bid projects, illustrating labor utilization over the course of the project compared to the expected bell curve. We allocate our salaried employees (pink portion of bars) to our projects in an effort to move as much cost into direct job cost.

- Red and Orange Lines: Bell Curve of Projected and Estimated Labor Hours
- Dark/Light Blue Bars: Gaylor and Leased Labor Craft Hours
- Pink Bars: Allocated Salaried Supervision
- Grey Bars: Forecast of Remaining Hours

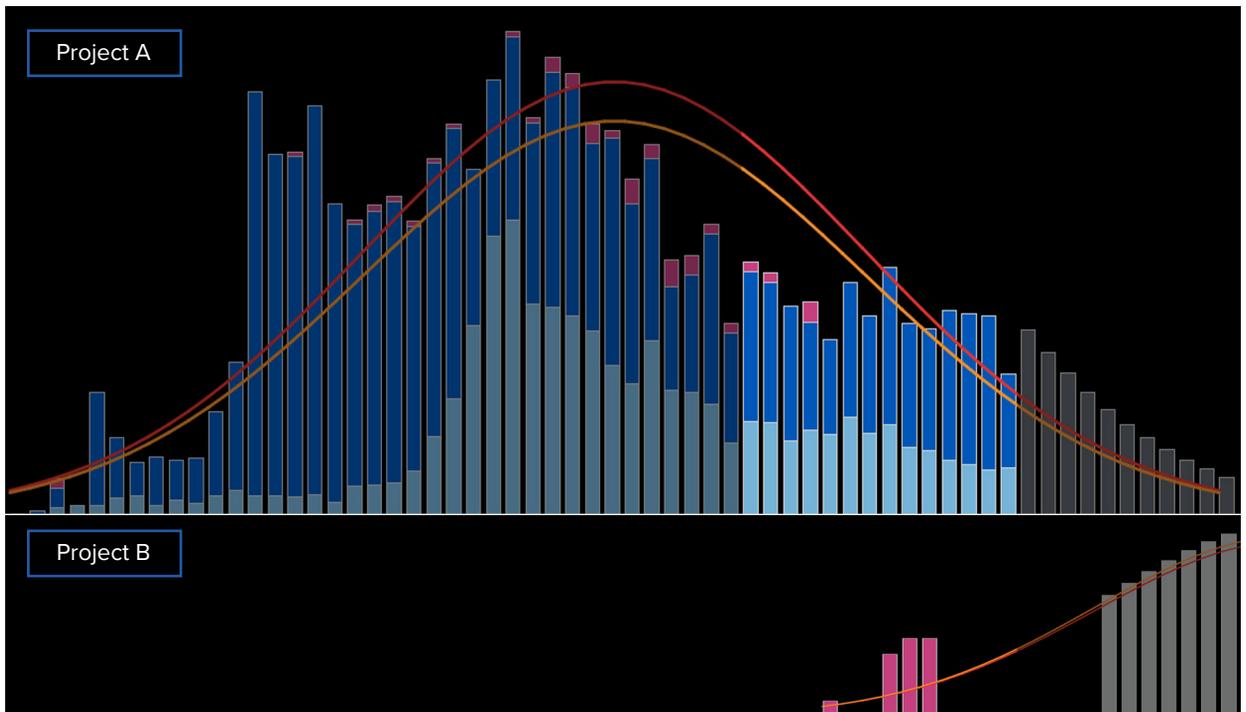


Figure 1. Labor Curves for Two Projects From the Same Team

Doesn't it seem strange that the allocated supervision seems to drop off at the end of Project A? It also seems odd that we have supervision on Project B without any craft labor. And isn't it a coincidence that this is happening at the exact same time? In this instance, Project A is beginning to fade, so they are allocating their time to Project B to temper that fade. This obviously throws off the true cost of Project A. This problem gets compounded in the future when we are estimating a similar project to Project A. We wind up referencing the performance of Project A and use incomplete job cost information as the baseline for our bid on the future project, which starts that future project at a disadvantage.

Keep the Toothpaste in the Tube

One of the first points of analysis I conducted at Gaylor focused on looking back at historical trends and how those trends related to profitability, essentially focusing on, “I wish we knew then what we know now.” As I stated in our 2021 Tech Report entry:

“Our industry is composed of problem solvers. We build America. When a tool didn’t exist to solve a problem, our users put in the sweat equity to build a spreadsheet that resolved their issues to the best of their ability. This investment has formed an emotional barrier against solutions that aim to replace that spreadsheet.”

In attempts to analyze data at Gaylor, I have uncovered several instances where we implemented workarounds away from the intended use of our software, which has made analytics difficult. As an example, we were looking for a way to identify that an employee is part time or seasonal. This field didn’t implicitly exist in our software, so we created a fake “supervisor code” to represent seasonal employees. This worked fine until we actually wanted to use the supervisor code field to document our reporting structure as it was intended. We had to create a new identifier for seasonal employees, attempt

to find all of the areas where the false supervisor code was in use, and replace all of those references. Once we thought we had cleaned up all of the references, we attempted to migrate supervisor codes to reflect our reporting structure, only to uncover a few other instances where that seasonal code was still being referenced.

Analyze Something

I somehow still haven’t answered the question, “How do I get started?” Not to be the type of person that answers a question with a question but, “How do you eat an elephant?” The answer is one bite at a time. My recommendation is to start somewhere but start small. You could bring in a summer intern that has a focus on analytics. There are many great firms that provide outsourced analytics, such as [Onware](#) or [TC Business Solutions](#). There also some tools that are starting to focus on analytics for construction, like [Toric](#). With any of those approaches, I would recommend that you task them with providing an answer to a specific question:

- Do you know your profitability based on industry or customer?
- Do you know your safety record based on industry or customer?
- Do you know the impact that travelling has on safety or profitability?

There are hundreds of stories in the data that you have already collected just waiting to be unearthed. Whether you have a shovel or a backhoe, I encourage you to start digging.

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Technology Training for the Construction Industry

By Paul Hedgepath, Director of Virtual Construction, M.J. Harris Construction Services

INTRODUCTION

I have been in construction technology leadership positions since 2005 and have spent much of my career implementing training programs. One of the main tools that companies can use to support employees is training. A piece of technology can make someone's job easier or harder depending on the quality and frequency of the training they get. Technology training can be challenging in construction, as we are a hands-on industry where some of our most valuable employees aren't regular tech users. With the right training plans, we can make people's jobs easier, add project quality and enhance team communication.



Figure 1. Trimble Robotic Total Station Training

LEARNING RETENTION

There are differences between how students and adults learn. Adults expect the training to be immediately relevant to them. If it is applicable, it will be easier to retain. Most adults need help remembering, as they keep about 25% of what they learned within one hour and 85% within one week. As a tech trainer, you must reinforce taught skills throughout a project with periodic check-ins to increase retainage.

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Figure 2. Procore BIM iPad Training

THREE STAGES OF TRAINING

There are three stages of training in terms of technology training at a construction company:

1. Onboarding

Onboarding is a time to expose new employees to everything you use but keep the information manageable. Take the time to ensure success and be sure that training will continue while they are on the job. All hardware should be ready when a new hire arrives. If you are spending time fixing hardware, you will lose attention before you begin. It will be harder to gain new employee buy-in with a negative first training experience.

2. On-the-Job Kickoff Training

Group training is recommended at the project start to review all the tools the job will use. Look at project-



Figure 3. Procore BIM Trade Foreman Training

specific tools like the 3D model and drawings. Kickoff meetings are great opportunities for a lunch-and-learn. Setting a date one month out or more is good practice to give everyone enough notice. The on-site training is the opportunity to ask how technology can help the team. Discuss the relevance and share success stories from other projects and how that can apply to that project using the same tools. Relevance is critical in understanding and accepting any new concept. You will find that most don't want to be the first to try something until it is proven. Include examples of success on other jobs to gain trust.

3. Ongoing Training During the Project

If employees aren't using what they learn, they can forget. One way to ensure that teams use the processes they learned is to have follow-up sessions throughout the project. Have a session at least every three months. Send invites out at the beginning of the job so everyone has notice when the sessions will be held. Not everyone can attend all of these, but the point is that someone on the job is discussing which tools they are using or are not and why. Have a training video library that includes videos of you explaining the systems for reference between sessions. You can also create project-specific training videos for even more detail. Keeping technology top of mind for the team allows you to ensure you are doing everything to support them.

Total Project Team Training

The internal field team will need the tech tools and skills to do their job the best, but trade partners also need support. This total internal and external project team training effort is possible with tools like Procore, with unlimited license access for team members. Training a technology champion on each project to prepare the trade partner teams and keep up with tech usage is key.

Feedback and Interaction

Ask people questions to keep engagement. Talk about relevance and if they share that same view. During follow-up training, be sure to give positive feedback when a team is using tech. One way to promote interaction is to use some of the tech tools during training. Have people try a tool on their devices. Guide them through the processes to get better training knowledge retention.

Be the Difference!

Keep training relevant, engaging and frequent; it will allow technology adoption to grow more than ever imagined. There are endless opportunities for the industry to improve using technology. It's just a matter of being that technology champion that makes a difference for a company.



Figure 4. Procore Mobile Field Tools Training

LiDAR Scanning for Efficiency, Accuracy and Analysis

By Jason Eddings, VDC Coordinator, PROCON

There are many benefits of Light Detection and Ranging (LiDAR) scanning, a cutting-edge technology that has revolutionized how we capture and analyze spatial data. LiDAR scanning enhances PROCON's workflow efficiency and accuracy during the design and construction of our projects.

PROCON is a fully integrated design-build firm; all of our architects, engineers and construction management team are under one roof. When a project starts, traditionally, the field layout verification

data collected was important as a new conduit bank was to be installed and connected through our newly constructed building into the existing boiler room.

LiDAR scanning has positively impacted all our projects as it can foresee problems, document existing conditions and verify drawings, all saving the entire team time. The scanner rapidly captures millions of data points per second, providing a highly detailed and accurate representation of the project site. LiDAR scanning reduced our field verification time by almost

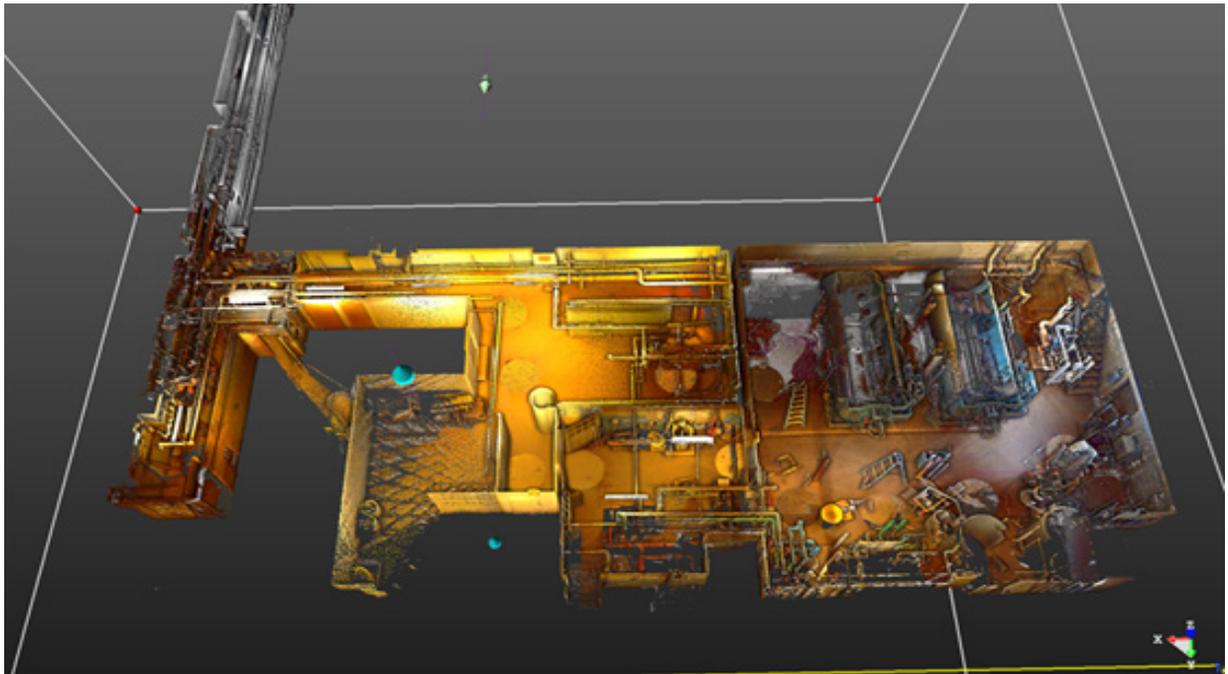


Figure 1. Boiler Room Utility Scan

process and existing conditions review involve manual measurements and data collection, which is not timely and often prone to errors. To overcome these challenges, especially on the complex Joyce Cummings Center project at Tufts University, we adopted Trimble's TX8 LiDAR scanning technology.

PROCON purchased the Trimble TX8 LiDAR scanner, and our team was trained in its operation and data processing techniques. On site, the team set up the LiDAR TX8 laser scanner to capture data at an existing boiler room adjacent to our project site at Tufts. The

70% compared to traditional methods. We can collect vast amounts of data in a fraction of the time, allowing us to allocate resources more efficiently and accelerate project timelines.

One of the most notable advantages of LiDAR scanning is its exceptional accuracy. The scanner's laser pulses measure distances with precision, creating a dense point cloud that accurately represents existing conditions. This level of accuracy has lowered our contractor risk by ensuring as-built drawings are precise by exposing any inaccuracies early in the process before they turn

into change orders during construction. The team scans progressively during construction to compare with as-designed models and drawings, provide archival records and document critical milestones throughout construction. This process benefits the owner as the building is managed, maintained and renovated.

The LiDAR scanner produces point cloud data that can be easily integrated into various software applications. My team utilizes specialized software to process and analyze the collected data, generating detailed 3D models. The accurate 3D data obtained from LiDAR scans can be incorporated into BIM models, enhancing the overall accuracy and reliability of the digital representation. This integration improves coordination



Figure 2. Installing Boiler, Pipe Out of Tunnel



Figure 3. Tufts University Joyce Cummings Center, Medford, Massachusetts

among project stakeholders and facilitates better collaboration. The ability to overlay LiDAR data with existing models has proven invaluable for identifying potential clashes or design conflicts before construction.

Adopting LiDAR scanning technology has transformed how we approach documenting existing conditions, field verification and MEP designs. The benefits of increased efficiency, enhanced accuracy and seamless data analysis have not only elevated the quality of our deliverables but also provided us with a competitive edge in the industry. LiDAR scanning has become an indispensable tool in our arsenal, empowering us to deliver exceptional client results while saving time and resources.

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Boots-on-the-Ground Innovation: The Power of Field-Driven Solutions

By Steve Moore, Innovation Lab
Manager, Robins & Morton

In today's construction industry, innovation can play a key role in meeting client expectations, requirements and goals. For companies serious about implementing strategies to continuously improve, sourcing ideas from front-line team members offers valuable opportunities to promote companywide innovation. However, the process for identifying and acting upon these ideas can present a significant challenge. Great ideas are identified frequently on project sites, but for team members without the time or resources to develop them, they rarely become something more.

Driving Overall Company and Industry Improvement Through Field Challenges and Solutions

Since joining Robins & Morton eight years ago, I have been involved with several iterations of the company's innovation services, beginning with industry-focused tools and software. As time went on, I recognized the value lost in ideas generated by our field team members that were never acted upon, and I envisioned a way to bring those ideas to light, along with a place to bring them to life.

In 2021, Robins & Morton opened the Innovation Lab, a new space in the company's Birmingham, Alabama, headquarters designed to cultivate ideas. Though the Innovation Lab provides modeling services such as



Figure 1. Robins & Morton's Innovation Lab was established in the company's Birmingham, Alabama, office in 2021.

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Figure 2. The Innovation Lab produces high-fidelity virtual reality models to accurately depict future spaces. Pictured here is Robins & Morton Regional VDC Manager Mike Ruizzo.

computer-generated imagery animation, high-fidelity virtual reality models and 3D printing-scaled building models, its main purpose is to provide space for me to meet with team members about their ideas for finding solutions to issues they face in the field.

This process often includes designing and developing prototypes for products that don't yet exist. One of the first prototypes was a 3D-printed drill attachment that prevented dust contamination, an idea brought to the lab by a project manager. Following that, I worked with a layout manager to pioneer PrismPointe, a device that speeds up conventional layout work by maintaining a perfectly level prism and projecting a laser onto the floor. Currently, we've graduated five products from development to field use and we're testing six products, with nine more in development.

Process Is Key as Ideas Take Shape

The plan-do-check-act cycle, used frequently by lean construction practitioners, is the cornerstone of the Innovation Lab. The process begins with someone believing that there's a better way to get something done. They bring the issue to the lab and we find, or create, an answer. Once we find that answer, we implement it in the field, revisiting it a short time later to determine if it's working. If not, we adjust and continue the cycle.

Cultivating a Culture of Innovation

Engaging field-level team members in driving innovation has benefits beyond developing successful solutions, enhancing collaboration and strengthening company



Figure 3. Research and development is an important step in testing the viability of a technology solution before deploying it companywide. Pictured here is Robins & Morton Regional VDC Manager Mike Ruizzo.

culture. One of the Innovation Lab's most important services is creating a network of innovators within the company. Each product or approach that we develop is the result of one of our team members being willing to step outside the norm and try something new.

My role includes serving as a conduit between the team members I work with to create solutions and those on other jobsites with similar challenges. By connecting our team members, I help them see that our ability to share knowledge is the foundation for the company's continuous improvement.

Corporate Culture Must Support Vulnerability, Trial and Error

It's important to realize that, although I can support bringing solutions to life, we innovate only if our team members think of themselves as innovators and are willing to be vulnerable enough to share their ideas for improvement. For that to happen, team members must trust that they will be respected regardless of outcome. Each success inspires more team members to engage in the process, and over time, I expect our biggest success to be the culture of innovation we've created within our teams.

Beyond contributing to successful lean implementation in the field, our continuous improvement dialogue engages and motivates team members to see themselves as integral to the company's overall advancement as well as its success on a project level. That shift in perception can propel development of leadership skills, with significant positive long-term performance and succession implications.

The Takeaway

When innovation is limited to researching, assessing and adopting off-the-shelf solutions, we miss opportunities to harness the brilliance of team members at every level. Creating a platform to solve real day-to-day problems in the field that is driven by the team members who actually put the work in place is effective in developing physical solutions that can be deployed companywide. More importantly, it creates a ripple effect that encourages engagement and more innovation.



Figure 4. As their capabilities have increased, drones are now critical components of Robins & Morton's jobsite operations. Pictured here is Robins & Morton Regional VDC Manager Mike Ruizzo.

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Construction Technology in the Digital Century

By Steve Jones, Senior Director, Industry Insights Research, Dodge Construction Network

As we navigate the third decade of what promises to be known as the Digital Century, groundbreaking technologies like AI, machine learning and immersive virtual realities are captivating both consumers and businesses worldwide. However, the largest industry on earth—construction—significantly lags in adopting and benefiting from technology. This is clear in numerous labor productivity studies that consistently show construction trailing all other industries.

Despite common myths, this is not due simply to disinterest or a lack of available technology solutions. It has more to do with the complex and inherently fragmented nature of the construction process compared to those other businesses, as summarized below from the Dodge Optimizing Subcontractor Management With Technology report.

CONSTRUCTION	OTHER MAJOR INDUSTRIES
Unique projects	Repeatable products and services
Project-specific teams, often selected by bidding	Established supply chains
Many, mostly small companies	Fewer, larger consolidated providers
Labor-intensive work, mostly conducted outdoors	Automated production in controlled conditions

Figure 1.

Different Paths to Digital Transformation

During the 1980s and 1990s, major manufacturing industries were developing:

- **Object-oriented design** (which later came into architecture, engineering and construction as building information modeling) to rapidly iterate, test and optimize the design and manufacture of new products in a completely virtual environment.
- **Computer-assisted manufacturing** equipment that could produce high volumes of complex components precisely as designed with less waste.
- **Enterprise resource planning** systems that efficiently connect and coordinate vast global supply chain networks of vendors, suppliers, fabricators and distributors to optimize an integrated digital design and production process.

This systemic approach to technology enables those industries to efficiently design and produce cars, ships, planes, equipment, appliances, etc., at lower costs and higher volumes with less waste and more consistent quality.

However, technology is rolled out very differently in AEC. Due to its extreme fragmentation, software companies launched hundreds of highly specialized point solutions, separately automating drafting, scheduling, payment processes, contract management, bidding, estimating, timesheets, accounting, safety reporting, equipment tracking, field reports and so on. While each was beneficial to its specific users, there was little impact on improving the overall project delivery process for the industry.

Multiple Point Solutions for the Same Task in Many Companies

Point solutions have become so prevalent in construction that many companies are currently using several separate ones for the same task, dramatically reducing productivity. Findings from a recent Dodge study of 203 general contractors exemplify this concerning situation.

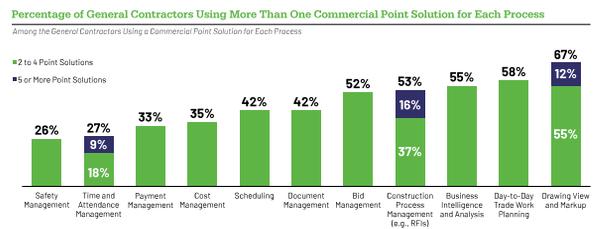


Figure 2.

Compounding the problem, point solutions typically do not exchange information easily with each other (i.e., lack interoperability). This hardens proprietary data silos around each solution, requiring cumbersome one-off integrations and almost guaranteeing that companies working together on a project cannot share data to enable multiparty digital workflows.

Data-Related Challenges To Achieving More Value From Technology

These issues reflect directly in another finding about general contractors' most troublesome data-related challenges, with the top five being:

- Data migration challenges (i.e., moving data from one solution to another)
- Difficulty integrating the solutions in our technology stack
- Difficulty exchanging data effectively with other team members' solutions
- Poor integration with other software used at my company (e.g., financial, CRM, ERP, etc.)
- Lack of internal ability to develop integrations between solutions

Organizational Challenges Impede Progress

Over three quarters of the contractors in that study also report experiencing at least one of these internal organizational challenges to improving the value of technology. And most face multiple challenges, including:

- Lack of qualified users at my company
- Lack of training resources at my company
- Challenges getting data from the jobsite from those performing the work (trades, superintendents, etc.)
- Poor internal processes for technology implementation
- Internal user resistance

Difficult-to-Optimize Technology

These factors create a significant challenge for construction companies to achieve the potential benefits of their technology investments. The chart below shows how effectively contractors are optimizing their current technology stack for data gathering and analysis. Only about one quarter believe they are doing reasonably well.

Degree That Companies Are Optimizing Their Current Technology Stack for Data Gathering and Analysis

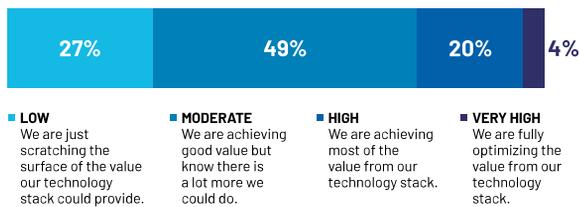


Figure 3.

Best Strategies To Improve Technology Value

Also in that study, general contractors identified what strategies they believe would be most effective at improving the value of their technology stack over the next three years. Although half cite adding more point solutions, far more identify consolidation and integration, underscoring the critical importance of data integration.

Percentage Who Believe Each Strategy Would Significantly Improve the Value of Technology for Their Company

Percentage of General Contractors Who Rate the Potential Effectiveness of Each Strategy as Medium, High or Very High

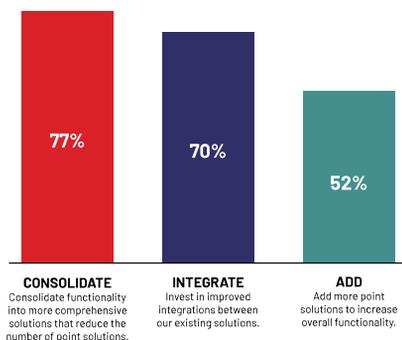


Figure 4.

Two key trends are emerging in recent Dodge research with the potential to increase the value of technology for everyone in the construction industry.

- **The Rise of the Platform.** Several studies validate the numerous benefits of platform technology solutions that feature multiple, pre-integrated functions and inherent interoperability with other solutions and data sources.
- **Owners Coming Off the Sidelines.** Findings indicate owners, once reluctant to engage with construction technology, are now deploying contractual requirements for standardized digital practices by their teams, adopting platform solutions for their own use and defining digital deliverables to manage their completed assets as digital twins. This approach allows for more consistent, real-time collaboration.

Best Practices for Technology Adoption and Implementation

Regardless of where each company is on its digital journey, everyone can glean valuable insights from those who have navigated challenges and achieved success. Contractors who reported receiving quality value from their technology stack shared what factors and practices most effectively contribute to their success. Their responses outline a roadmap for how to create an environment that fosters productive technology use and optimizes its available benefits.

The top three organizational factors are:

- Senior management buy-in on the strategic importance of technology
- An adequate budget for construction technology
- Dedicated IT resources focused on optimizing technology for our company

The top three technology management practices are:

- A well-developed process for adopting, piloting and implementing construction technology
- Investment in adequate training
- Technology is part of the standardized company processes

The top three external factors are:

- Good vendor support
- Other companies on our project teams have high levels of technology capability
- Active engagement with industry associations concerning technology practices

Bright Future for Digital Construction

The construction economy is robust and, despite current technological challenges, the industry can be confident that, especially with a new wave of digital natives entering the workforce, it will continue to adopt increasingly integrated and highly functional technology solutions. Those solutions will improve outcomes for specialized teams that are building unique projects.

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