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Introduction

[T]he external environment, for both civil engineering and infrastructure in general, [is] on the verge of more significant change over the next decade or so than what we have seen in the past fifty, hundred, or maybe even more years.

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ASCE Civil Engineering Magazine, June 2019

1.1 What Does the Future Hold for Construction?

Close your eyes and think about the future of construction. Be honest: you pictured robots, right? Why does everyone always jump to robots?

Don't get us wrong—there will be plenty of robots. Imagine a bustling jobsite where autonomous vehicles haul materials, drones buzz overhead conducting site inspections, and bricklaying robots methodically build walls with precision that's almost hypnotic. But here's the kicker: none of this works without people. People aren't going away—we'll still need sharp minds and skilled hands to program, manage, and maintain all this technology. In fact, the demand for talent may be greater than ever, as construction morphs into a high-tech collaboration between human expertise and machine efficiency.

Let's break it down. The challenges facing our industry—like labor shortages and the massive global demand for infrastructure—aren't going to solve themselves. There is an ever-present skills shortage as seasoned professionals take their exit from the industry and fewer and fewer skilled laborers and construction management professionals are there each year to take their place. A 2024 study from the Associated Builders & Contractors estimated that the construction workforce gap was more than half a million [1]. This reality is coupled with a projected explosion in global construction growth—nearly 85% over the next decade [2]. Whether it's replacing aging infrastructure, urban growth, or futuristic endeavors like building new smart cities from the ground up, the industry will not be able to accept the wholesale glacial progress that exists today. Technology will be the enabler to achieve the volume of work that needs to be put in place or replaced. The impetus will be strategic and informed technology adoption. This book will provide you with the information you need to be on the front end of the strategic technology adoption revolution.

The construction industry is poised for a transformative future, with advancements in technology playing a crucial role in shaping the firms of tomorrow. To thrive in the evolving landscape, construction firms will need to address various challenges and leverage opportunities presented by technological innovation.

In the coming decades, to enable the next generation of construction, data will reign supreme as the AEC industry increases its ability to leverage this data to support efficient and effective workflows. This will lead to connected construction that will track the supply chain, work in place, building operations, and beyond. Today the industry is inching forward as it endeavors to become more connected and more digitally reliant.

But this isn't a new phenomenon, even in construction. The industry has always...eventually...incorporated new tools, techniques, and technologies to plan, design, build, and operate in an ever safer and more efficient manner. Horse-drawn bulldozers were replaced with other animal-themed upgrades from Deere and Caterpillar. The trusty hammer now has a much faster pneumatic-powered companion in the nail gun. When you hear someone complain about having to control a tool via an app, remember that their predecessors once griped about their newfangled batteries.

This book is about preparing you to make the leap. The future of construction will hinge on three interlocking elements: **People, Process, and Product**. People will drive innovation, process will shape efficiency, and product—the technology itself—will make it all possible. To thrive in this future, firms will need to adopt a new mindset: one that embraces change and leverages technology as a strategic asset rather than a shiny novelty.

Innovations are usually met with resistance, because we're creatures of routine. Many of the everyday things we take for granted were once new and met with unease. But the inventions that really make things better find a way to stick. Imagine a modern jobsite without hard hats and backup alarms, or a plant without material safety data sheet (MSDS) books and fire extinguishers.

So yes, the future holds robots. But more important, it holds opportunities—for individuals and firms willing to lead the charge. The question is, will you be ready?

1.2 The Successful Firms of the Future

The coming improvements to this industry will be driven by inspired (or frustrated) individuals, as well as firms that want to build a business model around what's next rather than playing catch-up. Now that we've moved beyond horses, what are the modern-day pain points inviting a technological leap?

The construction industry is in a state of flux, driven by complex challenges that demand creative, forward-thinking solutions. Successful firms of the future will thrive by addressing these hurdles head-on, leveraging technological innovations, and reshaping their business models.

The firms of today that want to still be around as firms of tomorrow are likely considering some of the following:

- **Problem: Increased Labor Costs and Decreased Availability**

Possible Outcomes: Automation, Offshoring, Efficiency Upgrades

The rising cost of labor, combined with a shrinking pool of skilled workers, has created an urgent need for firms to rethink how they operate. Automation is one of the most promising solutions. Picture a jobsite where robots handle repetitive tasks like bricklaying or rebar tying, freeing up human workers for more complex, value-added roles. For firms that embrace this shift, the payoff is twofold: reduced labor costs and increased output.

Offshoring certain design or back-office tasks to regions with lower labor costs could also ease the financial burden. Meanwhile, efficiency upgrades through smarter technology—like AI-driven project scheduling or wearable safety tech—help teams accomplish more with fewer resources, maximizing the productivity of every worker on-site.

- **Problem: Fragmentation by Geography and Market**

Possible Outcomes: Standardization of Delivery, Design, and Data

Construction projects often suffer from fragmentation, with wildly different processes and outcomes depending on location, market, or even individual teams. The future calls for greater standardization. Imagine global firms implementing consistent delivery models that ensure every project, whether in New York or Nairobi, meets the same high standards of quality and efficiency.

Standardized data practices will play a crucial role here, enabling seamless collaboration across geographies. With unified systems and interoperable tools, project teams can share insights, avoid duplication of effort, and streamline workflows. This approach not only enhances consistency but also strengthens a firm's brand, making them the go-to partner for clients worldwide.

- **Problem: Increasing Complexity in the Built Environment**

Possible Outcomes: Vertical Integration

As buildings and infrastructure become “smarter,” the complexity of construction projects continues to grow. No longer is a simple contractor-client relationship sufficient; modern projects require a web of specialized trades and consultants. To stay competitive, some firms are turning to vertical integration, bringing more services in-house to control quality, reduce delays, and streamline communication.

Vertical integration allows firms to offer a one-stop shop for clients, handling everything from initial design and engineering to construction and facility management. This model not only reduces risk but also builds stronger client relationships through a more seamless project experience.

- **Problem: Global Demand for Development**

Possible Outcomes: Standardized Codes, Materials Innovation, Sustainable Practices

The global population boom and the push for new urban developments have placed immense pressure on the construction industry. To meet this demand, firms must innovate in ways that increase speed and efficiency without compromising quality. One pathway is the standardization of building codes and data practices across regions, which could accelerate project approvals and simplify cross-border collaborations.

Materials innovation also holds great promise. Picture self-healing concrete or carbon-negative building materials that not only perform better but also reduce environmental impact. Alongside these advancements, firms must champion sustainable practices, moving toward net-zero construction and creating buildings with superior lifecycle performance.

- **Problem: Infrastructure Backlog and Deferred Maintenance**

Possible Outcomes: Public-Private Partnerships, Alternative Project Delivery Methods

Decades of underinvestment in infrastructure have left many nations grappling with crumbling roads, bridges, and utilities. Addressing this backlog requires more than just government funding; it calls for new partnerships and delivery models. Public-private partnerships (P3s) are emerging as a vital tool, leveraging private investment to deliver critical projects faster and more efficiently. In tandem, alternative project delivery methods like design-build-operate, Integrated Project Delivery (IPD), or unsolicited proposals could pave the way for innovative solutions. These approaches distribute risk more equitably among stakeholders while incentivizing long-term performance and maintenance.

Putting together all of these problems and possible outcomes, the industry of the future may include a select number of large, vertically integrated firms spanning wide geographies and markets. These firms may offer turnkey project development, financing, and operation plus a consistent customer experience to clients. Imagine the top firms in the world for some industries—computing, travel, finance, healthcare, food, energy. What are some things they have in common? Highly controlled and standardized processes, brand recognition, and ultra-connected environments exchanging vast quantities of data. Now imagine some of them providing construction services. Would they employ more coders than engineers, architects, project managers, and superintendents?

The future of construction will belong to the bold. Firms that thrive in the coming decades won't simply react to change; they'll anticipate it, adapt their business models, and take calculated risks. While some will cling to traditional ways, the most successful firms will be the ones asking "What's next?" and actively building their future around it. At the heart of this transformation is a commitment to rethinking the status quo. Successful firms will embrace a more collaborative, data-driven, and technologically sophisticated approach to every phase of their projects. The result? Faster timelines, higher quality, and a better bottom line. It's not just about surviving in this brave new world—it's about leading it.

1.3 How Are Firms Currently Finding Success Leveraging New Technologies?

While the future of construction may be filled with promise, many firms are already making impressive strides by adopting cutting-edge technologies. From industry titans to nimble mid-sized players, firms that strategically invest in tech are reaping rewards in efficiency, profitability, and client satisfaction. This section is a snapshot of how it's being done.

1.3.1 Led by the Giants: Large Firms Setting the Pace

In today's AEC landscape, the biggest players are often the ones taking the boldest steps. These firms, with their deep pockets and expansive project portfolios, can afford to experiment, absorb the risk of R&D, and lead the charge in innovation. For example, Skanska has pioneered the use of digital twins to optimize building performance [3], while Turner Construction leverages AI-driven platforms to improve project planning and on-site safety [4].

These firms have the advantage of scale. When they roll out a new technology across multiple projects, they can quickly generate data, refine processes, and achieve economies of scale. They also influence the broader industry by setting standards that smaller firms often adopt in their wake. However, while large firms may set the paces, small and midsize firms may be more agile in making new technology strides.

1.3.2 Outside Capital Fuels Innovation

Another driving force in construction tech success is the influx of venture capital. Investment firms are increasingly pouring funds into startups that promise to revolutionize construction processes. This financial backing enables rapid development and scaling of solutions, from modular construction platforms to machine learning algorithms for predictive analytics.

The surge of venture capital in construction technology has been a game changer. A clear example of this impact is the proliferation of building information modeling (BIM) platforms, which have evolved from niche tools to industry mainstays. With the backing of outside capital, these platforms now offer more robust features, seamless integrations, and scalable solutions that cater to firms of all sizes.

1.3.3 Data-driven Decision-making

Firms leveraging data analytics are also setting themselves apart. Today, data flows through every phase of construction, from initial design to long-term facility management. Companies that harness this data effectively can make smarter, faster decisions. AI-powered platforms analyze project data in real time, identifying risks before they materialize and optimizing resource allocation.

One notable example is Suffolk Construction’s “Smart Labs,” where the company uses predictive analytics to refine project schedules, track labor productivity, and forecast potential delays [5]. This data-driven approach has become a powerful competitive advantage, helping Suffolk consistently deliver projects on time and under budget.

1.3.4 Success Stories Across the Industry

From wearables that enhance safety to drones that streamline site surveys, firms across the construction spectrum are finding innovative ways to leverage technology. These success stories aren’t just about adopting flashy tools; they’re about aligning technology with business goals, training staff to embrace change, and continuously iterating to improve outcomes.

The lesson? Firms that treat technology as a strategic enabler—not just a shiny toy—are the ones that will thrive in today’s competitive landscape. Whether you’re a multinational behemoth or a regional contractor, the opportunity to leverage tech for success is there. The key is knowing where to focus your efforts and when to take the leap.

1.4 Our Case Studies: What to Look For

In this book we will go beyond physical technology that has the ability to impact our site autonomously, and dive into **People, Process, and Product**. We will use this common theme to frame each history lesson, best-practice guide, and case study that we present in this text. Some of the framing will be glaringly obvious, and some will be more subtle.

In the chapters ahead, we’ll dive into projects that implemented BIM, adopted robotics, and optimized workflows using AI. As you read each case study throughout the book, look for each element:

- **People:** These are the characters involved in each scenario. Like any story, some will be main characters while others will play supporting roles. We’ll showcase professionals from every corner of the industry, including owners, designers, construction managers, contractors, technology vendors, executive sponsors, implementation leaders, and the last-mile users who ultimately determine if an initiative was successful. We hope that each reader, no matter their background or current role, finds characters to relate to across the stories contained within.

- **Process:** This tells the story of how and why. We'll explore the origins of the underlying circumstances that led to a recognition of a problem and a need for a technology-driven solution. Once the problem is introduced, we will illustrate the evaluations of options and which considerations were involved, which players were part of that process, what product(s) were chosen to address the issue, and how the solution was designed.

Finally, we'll tell the story of the implementation: what went well, what didn't, the state of things post-implementation, and what, if anything, those involved would have done differently. What unexpected things occurred? Were there blind spots in their planning? Not every story will contain all of these elements, but each one is an essential puzzle piece in understanding the bigger picture.

- **Product:** Which specific tools or applications were chosen, and why? We'll explore the specific technologies chosen to address the challenges at hand. From software platforms to hardware solutions, the "Product" is the tangible toolset that enables transformation. These aren't just abstract ideas—they're the applications and systems that teams rely on daily, often forming the backbone of a successful initiative.

We'll dive into why certain products were selected, examining their unique capabilities, limitations, and fit within the broader strategy. Whether it's a cutting-edge innovation or a tried-and-true system, the focus will be on how well the product met the defined goals and integrated with existing workflows. The lessons learned here will help you make informed decisions when building your own tech stack.

Through our collective experience, we've come to believe that tangible positive change in the construction industry relies heavily on our ability to influence people. To allow these people to both see and experience positive impacts in adopting technology. We've seen the shiny things (product), and we've seen those shiny things fail due to poor implementation strategies (or lack of process). We're not alone in that observation. Research from Forbes indicates that the failure rate for digital transformations may be as high as 84% [6].

To help you avoid those results, we will showcase proven processes that will allow you to enact positive technology change. In doing so, those shiny things move from the toy box to the project tool shed and more importantly to the project site on a daily basis. These tools are changing the way we work on projects large and small, civil and vertical, mission critical and residential. By sharing our own experiences and those drawn from our case studies, we will enable the reader to spark that positive change, maybe even with a robot or two in tow.

This book is arranged in three parts:

- **Past, present, and near future:** Understanding the arc of technology change in the AEC industry
- **A playbook for success:** Creating a winning strategy from the top of the org chart to the very last user
- **Application spotlights:** An overview of several categories of technology, assessing their current state, future potential, and sharing real-world case studies of their adoption

1.5 A User's Guide to This Book

Welcome aboard! Whether you're an industry veteran or just dipping your toes into the world of construction technology, this book is designed to be your go-to resource for navigating the ever-evolving tech landscape. But let's be clear: this isn't a linear narrative where you're expected

to read cover to cover. Think of it more as a tool kit—one you can dip into whenever a specific challenge or curiosity strikes.

Here's how to get the most out of your journey.

1.5.1 Start Where You Need To

You don't have to begin at Chapter 1 and march through to the end. If your firm is grappling with how to implement a new project management platform, jump straight to the case studies and insights on digital project delivery. Curious about the future of robotics on the jobsite? Head to the chapters that explore automation and AI. Each part is designed to stand alone, giving you actionable insights tailored to your immediate needs.

That said, we do recommend spending some time with the early chapters—particularly Chapters 2 and 3. These chapters lay the groundwork, providing a deep dive into the current state of technology in construction and offering a playbook for successful implementation. Think of them as the foundation on which the rest of your tech strategy will be built.

1.5.2 The Three-part Framework

This book is built around the framework of **People, Process, and Product**—a recurring theme that underscores every chapter. Why? Because the success of any technology initiative hinges on more than just the tool itself.

- **People:** Who are the key players driving or resisting change? What roles need to be filled to ensure a smooth rollout?
- **Process:** How do workflows and organizational culture need to adapt for the technology to deliver its full value?
- **Product:** What solutions are worth your time, and how do you choose between them?

Each chapter uses this framework to help you assess your situation holistically, ensuring you're not just buying technology but solving problems.

1.5.3 Case Studies: Real Lessons from Real Firms

Throughout the book, you'll find case studies highlighting firms that have taken the leap into new technologies—with varying degrees of success. These stories go beyond the surface, delving into the decisions made, the challenges faced, and the lessons learned. Some are inspiring tales of transformation; others serve as cautionary reminders of what can go wrong when process and people are overlooked. Either way, they're packed with insights you can apply to your own journey.

1.5.4 Keep This Book Handy

Technology in construction is a fast-moving target. What's cutting-edge today might be standard practice tomorrow—or obsolete next week. This book isn't meant to be a one-time read. Keep it within arm's reach as a reference guide, a source of inspiration, and a reminder of the principles that will help you navigate the shifting landscape. As new challenges arise, you can revisit key sections to find fresh perspectives or validate your approach.

1.5.5 Your Journey Starts Here

The construction industry is at a crossroads. The firms that thrive in the coming decades will be those that master not only the tools of today but also the strategies for adopting the tools of tomorrow. This book is your roadmap, offering guidance and insights to help you lead your organization through the maze of construction technology.

So, where will you start? Flip the page, and let's find out.