

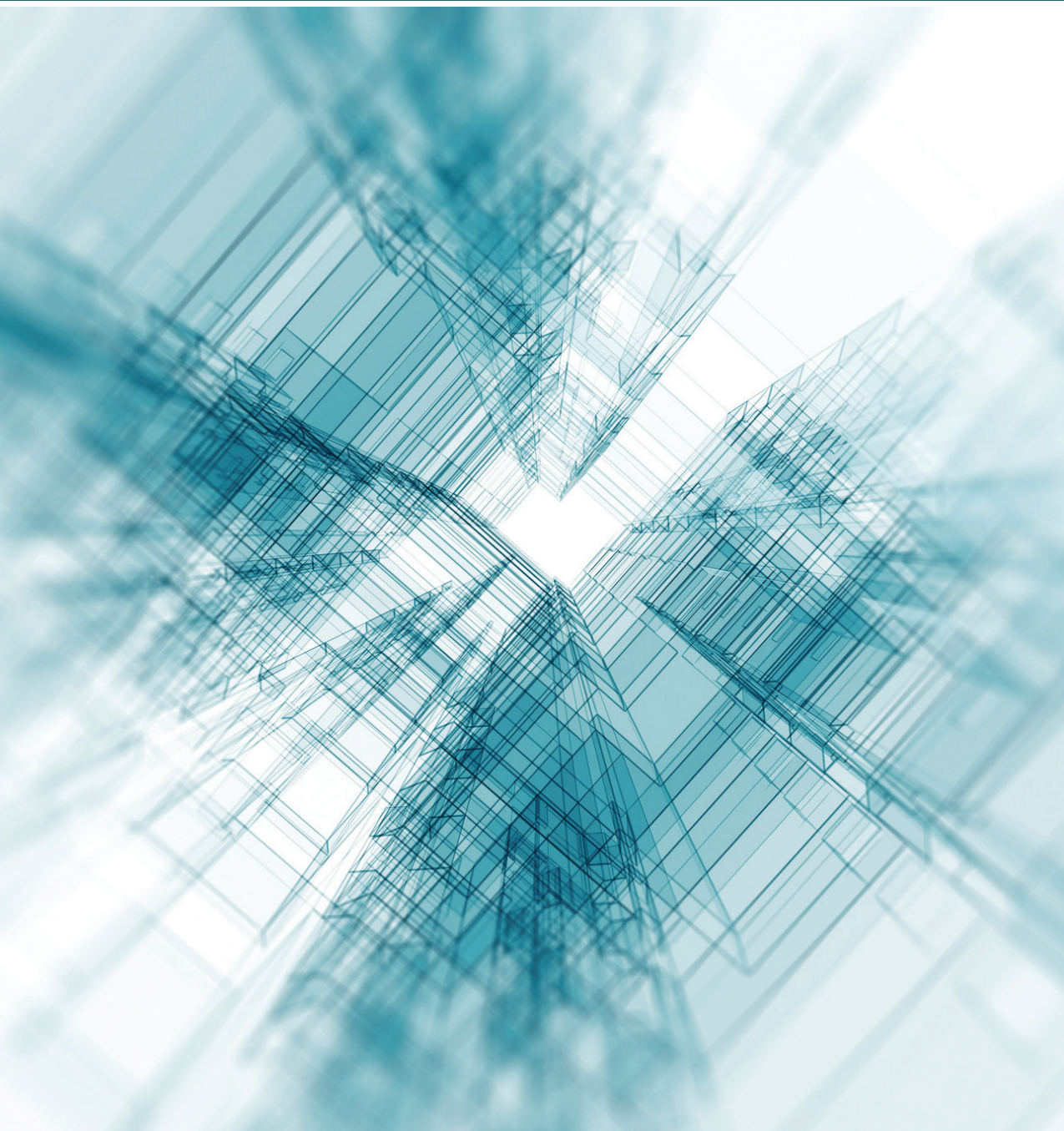


National Institute of
BUILDING SCIENCES

buildingSMARTalliance®
NBIMS-US 2021 Vision Task Force

Building Industry Vision 2021

A View into the Future: A short novel about the Springfield Children's Care Facility



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Disclaimer: This is a work of fiction. Any resemblance to real buildings or people, alive or dead, is purely coincidental.

Foreword

Building Industry Vision 2021

A View into the Future: A short novel about the Springfield Children's Care Facility

The National Institute of Building Sciences typically does not issue this type of reporting. As a technical organization, the Institute usually delivers research findings on specific issues facing the building industry. However, the *National BIM Standard-United States*® (NBIMS-US) 2021 Vision Task Force (VTF) created this document in a nontraditional format to provide readers with a narrative that captures a view of what the Task Force sees as the future of the building industry.

While this story is a view into the future, it is intended to offer a glimpse into how construction projects may be designed, built, and managed using technology being developed today and perfected as we approach 2021.

The National Institute of Building Sciences and its buildingSMART alliance® (which oversees development of the NBIMS-US™) are thankful to the sponsors of this project; the many volunteers who shared their ideas and thoughts on what they view as the future for the construction industry; and the members of the VTF who worked to create this innovative approach to addressing the future needs of the building industry.

We hope you find this an entertaining and informative preview of what lies ahead.



Henry L. Green, Hon AIA
President, National Institute of Building Sciences



Dana K. "Deke" Smith, FAIA
Executive Director, buildingSMART alliance

Springfield Globe-Times

New Children's Care Center Building Opens Today *Mayor announces town project is ahead of schedule, under budget*

By Joe Matlock

May 22, 2021—Springfield, USA

Public tours open today for the new, state-of-the-art Springfield Children's Health and Wellness Center, located on High Hope Road in downtown Springfield.

Mayor Charles Preston, who has worked with the project since its inception, pronounced the building "one of the most beautiful and functionally outstanding structures that I have ever seen." The mayor credits the collaboration of entire building team—Amy Smith, architect; Mike Evans, mechanical engineer, Brad Moore, general contractor; Owen Connolly, building owners representative, and Felicia Foster, facilities manager—with the success of the project, which the team brought in under budget and ahead of schedule.

"It's been a pleasure to be involved as a member of the team since this project started. It's amazing to me that the virtual walk-throughs were so realistic. I feel like I have been in this building many times," said Fire Chief William Edgar. "I was especially impressed at being able to use the drone to watch the building as

it went up, step-by-step. And being able to 'see' what's happening behind walls could come in very handy for us—and for the police as well."

"It only makes sense, to get the town's police and fire departments involved from the onset of the project design," said architect Amy Smith. "And it was great to get their input in real time as we went along—I think it saved us from making some mistakes that could have proven costly, if—heaven forbid—we do face a disaster in the future. And those drones the chief referred to could also come in handy for the city if a severe weather event does take place."

"And I am happy to know that the fine City of Springfield has worked with your team on a contingency plan to build temporary shelters if we need to," said the mayor. And I do hope, that come election time, the good people of Springfield will remember how we encouraged them to chime in on decisions about the building during the planning process

(Story continues on page 2.)

A Word from the 2021 Vision Task Force Chair

This is a story about a real project in 2021. Okay, so it's not real. But it is realistic. The processes, collaboration, and technologies discussed in the story are not far from being an everyday reality.

In early 2013, the buildingSMART alliance® formed the *National BIM Standard–United States*® (NBIMS-US) 2021 Vision Task Force (VTF) to focus on defining, predicting, forecasting, and in some cases guessing at what the future of the building industry might hold, and therefore what NBIMS-US™ needs to look like to support that future. This is a highly strategic effort that will form the basis of a larger effort aimed at developing a comprehensive roadmap for the entire capital facility industry. The importance of these efforts cannot be understated in any context.

The initial effort of the VTF was to request subject matter experts from every corner of our industry to provide short essays about the nature of their role, profession, or industry as it will be in 8-10 years.

We collected close to 40 of these essays, and also spent considerable time researching other references to the future of our industry (conferences, seminars, writings, etc.). We then wove all this knowledge together to create a single, compelling, and tangible vision of how a construction project may be built in the future, including the technologies and processes that would be in common use.

We deliberately chose the relatively short timeframe of 8-10 years, as we believe it can be reasonably predicted. By studying the innovators, the leaders of our industry—the “2 Percenters”—and by understanding what they are doing, how they are doing it, and what benefits they gain; it is not far-fetched to predict that the rest of the industry will soon be following suit.

And so I contend that while of course the story actually is fiction, project case studies that resemble this are coming in the not-too-distant future.

A handwritten signature in black ink, appearing to read "Chris Moor". The signature is fluid and stylized, with a large initial "C" and "M".

Chris Moor

Chair NBIMS-US 2021 Vision Task Group, Chair NBIMS-US Project Committee, Version 3, and Director of Industry Initiatives at American Institute of Steel Construction

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WALLS AND CEILINGS

John Lord
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The project in this text is a six-story children's medical care facility. It had to be designed and built in eight months' time to guarantee continuous provision of care. It opened on May 22, 2021.

The old maxim of "time-cost-quality: pick any two" was not acceptable to this owner, and the project team excelled to produce a high quality project ahead of schedule and without any cost overruns. How? The following story will explain.

<http://www.nationalbimstandard.org/vision2021>

Technology + Process = Success for New Springfield Children's Care Center

– 1 – THE MEETING OF THE MINDS

I have seen the future, and I'm here to tell you that everything works out okay. Really.

I went forward in time to 2021. I can't tell you exactly how that happened, but it somehow involved messing about with a faulty switch on a Google glass. I will say that the technology is amazing; I got to see how a project—the Springfield Children's Care Center—gets built in 2021.

My first encounter with the children's care center project team was from the perspective of the back seat of a sleek-as-a-seal, black-as-the-night-sky, sweet ride of an automobile. I was sitting next to Felicia Foster, the facilities operator for the new hospital. Brad Moore, the project general contractor, pulled his new Infiniti-AP (Auto Pilot) to the curb, and Amy Smith, the architect, hopped in. (Frankly, I was relieved to figure out that our ride was an auto-pilot vehicle, because Brad waves his hands around a lot when he talks.)

The group was headed crosstown to the monthly dinner meeting of the Institute of Designers and Builders (IDB) headquarters—a relatively new organization resulting from the merger of the American Institute of Architects and the Associated General Contractors in 2017. It took just seven minutes for Brad's new toy to traverse the town and park itself in the AP lot adjacent to the IDB building. The three friends jumped out and hurried in, as they were just on time.

"I am psyched to hear Owen Connolly's retrospective on the building industry," Amy said as they walked into the main meeting room.

"Owen definitely is a great guy and a savvy business man, and I'm so glad that he's part of our hospital project team," Felicia answered. "And look who's already here and claimed our seats!"

They all hurried to a table and enthusiastically greeted a tall, lanky redhead, who turned out to be Mike Evans, the mechanical engineer for the hospital project. "Hey, everyone! The gang's all here," he said. "Fabrio is up front near the dais. I guess he has to sit up front to receive his award."

They all were looking forward to watching their friend and colleague Fabrio Jones, who happened to be the hospital's steel contractor, receive a Lean Construction Award, an

annual prize given by the local IDB chapter to those who advance the building industry through lean construction processes and project collaboration.

The team was seated at the table and working on their dinner salads when Owen Connolly took the podium. He was a friendly-looking, middle-aged man with a sturdy build and a ready smile, whose bald head reflected the overhead lighting. “From an owner’s perspective, I marvel at the changes that have taken place in the past eight years,” he said. “Just like all the other players in the industry, we owners finally had to step up to the plate and assume responsibility for the buildings we are creating. We had to start taking part in the process, from design through commissioning, and well—we just did it. And, I know I don’t have to tell this to anyone in this room, but Building Information Modeling, which we all fondly call ‘BIM,’ made it possible for us to do just that.

“I guess in the beginning, owners might have wondered, ‘Why should I pay extra for BIM when it is supposed to be saving the rest of you guys in the building industry money?’ I can tell you, we have benefitted by ensuring we don’t pay more at the end of the project. Those coordination disasters used to be written as owner-directed changes because of the general contractor’s ownership of the pen. That’s just not acceptable anymore.”

Amy caught Brad’s eye, and they both smiled and nodded.

“One of the main drivers of change in the building industry—and one of the biggest changes itself has been procurement. Today, it’s mostly design-build or design-build-operate,” Owen continued. “For a while there, we thought Integrated Project Delivery—what we call ‘IPD,’ would become ‘it’ as a delivery method. That didn’t happen for every project in the country, but it did demonstrate that the old traditional building methods were holding back the industry.”

Owen wound down. “I’m also happy to say that facility data created during design is being further used to support other facets of the owner’s business mission,” he noted. “This has brought opportunities to design firms and members of the practice network to provide new services. Take our new hospital project, for instance. Mike Evans, the project’s mechanical engineer and his firm already have a contract to analyze the monthly energy use for the new hospital and suggest tweaks to keep usage and operating costs down.”

Amidst hearty applause, Owen made his way to the gang’s table and took the empty chair. By then, they were digging into their grilled salmon with twice-baked potatoes and fresh asparagus. Brad swallowed a big bite, took a healthy swig of his beer, and commented, “Good one, Owen. No doubt that procurement methods have really changed with the industry. But I maintain that if there is one overarching factor that has made this quantum leap in practice possible, it’s the fact that we can actually share data effectively—interoperability now works and as a result, so does collaboration.”

Felicia bobbed her short, dark curls in the affirmative. “Agreed. Our world is no longer drawing-centric, it’s now data-centric; that means data sharing, not data duplication. I see that as the sea change for the way we started operating in 2017.”

“Was it that long ago? You know, you’re right,” Brad said. “That was the year that the economy boomed and people like Mike, Amy, and I returned to the industry. That also was the year that the National Institute of Building Sciences hired the National Institute of Standards and Technology to update its 2004 study on the cost of inadequate interoperability in the US capital facilities industries. Remember that one? The original study put the cost at \$15.8 billion/year; the 2017 study put the costs at nearly double that. “

“That study concluded that to ignore the costs of interoperability is not sustainable, and called for immediate action by the industry’s public and private sectors,” Amy added. “One of the first things the President did when she took office in 2017 was to issue a federal executive order for the formation of a public-private Capital Facilities Interoperability Commission. Of course, protocols and standards make this all possible, and the industry standard is NBIMS-US™. I’m on the NBIMS-US Project Committee working on another update, and we’re projecting that the 2024 study will prove that the number has dropped by \$18 billion/year.”

Mike said, “Yeah, and that was just about the time that the cloud-based everything took off. It sure makes sharing information easier.”

“Interoperability is important, but even more important is the collaborative way that practice networks now work,” Amy asserted. “I’m just happy that we work in practice networks now. Besides, it gives us a better Big Picture about the project. And frankly, just talking to other architects day in, day out—got old. I can learn a lot more from keeping it interdisciplinary.”

Mike’s blue eyes twinkled as he pondered a retort about talking to architects day in and day out, but he settled for a grin and a dive into his dessert. After polishing off the chocolate mousse, Mike rose from the table. “Got to present ol’ Fabio with his Lean Award. Can’t think of anyone who deserves it more. Are you ready, Amy? ”

“Ready.” Amy, curiously, checked her watch.

Mike loped up the podium and announced to the hushed crowd, “Okay, folks, I’ll keep this very brief, because tonight’s honoree needs no introduction. I am pleased to present this year’s Institute of Designers and Builders Lean Construction Award. This award honors those who advance lean processes for the industry—making our world of building more collaborative, efficient, cost-effective—and just plain less wasteful—throughout the project life-cycle. This year’s award recipient is Fabio Jones, owner of Jones Steel of Florence, Italy, and Springfield, USA—and a good friend.”

A tall, distinguished-looking man, whose black clothes complemented his dark hair and eyes, was all smiles as he took the podium and captured Mike in a bear hug. “Thank you, my friends. This is an incredible honor, and I am truly grateful,” he said. “The award really goes to the lean design process that has enabled us to make great advances in steel fabrication. Let me tell you briefly about our collaborative process and the way we work today. The evolution we have gone through over the past eight years is simply incredible.

“By collaborating with designers and contractors much earlier in the process, we are able to provide the project team with extremely accurate schedules and pricing and can even forecast problems before they happen. We have a model of our shop that enables us to digitally fabricate the project before we have even purchased any steel. This means we can simulate the work load on our robotic and CNC equipment as well as our assembly and welding areas,” Fabio explained. “Any bottlenecks show up immediately, as well as any errors or problems with the design or detailing. Everything is passed to us via a model, and we can run that model through the shop to estimate times, schedules, and so on—and of course to see how the mix of work fits with the other jobs we have going on. We actually share this shop model with the general contractor so that we can adjust schedules and ensure the minimum of disruption when something does change or is wrong. It’s a long way from just 10 years ago.

“The difference is that now we have a standard format for sharing data—sharing the model. It’s all based on buildingSMART’s IFC open standard and a lot of work that the American Institute of Steel Construction did a few years ago to improve workflow and data sharing. Rather than dealing with the hundreds of files and proprietary systems we used to deal with, we now just get a single file that gives us all the information we need.”

After Fabio had finished and the applause wound down, Mike returned to the podium. “Thanks, Fabio, for the great and informative show.” And as Fabio looked slightly confused, Mike added, “I suppose you’re looking for your actual award? Well, we took a page from your outstanding delivery process, and it’s arriving *‘just-in-time!’*”

The entrance door flew open as Amy stood, pointed her watch, and clicked the side button. In glided a scarlet delivery drone, playing “You’re Just the Best” (that 2019 We-Tube sensation by Lexi’s QT Country Band) and bearing an elegant crystal statue. The drone dipped and hovered in front of Fabio, who accepted the award and bowed to the applauding crowd.

The team swarmed the podium and high-fived Fabio. “Remember, this coming Monday is Faceday,” said Felicia. “Can we all meet?”

They agreed to get together in the project space at Amy’s firm. Fabio said he would be in Italy at the firm’s other plant, but would conference into the meeting. “You know I wouldn’t miss Faceday.”

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COVERING THE CONSTRUCTION SITE

You're probably wondering, as I did, what Faceday could be.

The project team had designated first and third Monday of each month as “Faceday,” because even though they all worked remotely most of the time, they tried to meet in person on those Mondays. It was the crack of dawn on Faceday as Brad pulled the Infiniti-AP up to the hospital site entrance just as Owen walked up the street from the opposite direction.

Brad and Owen followed a group of workers through the fence and onto the site. Everywhere it was evident that lean techniques are the backbone of the entire operation. The process just seemed to flow smoothly and quickly.

All the construction team workers carried individual, location-aware tablets with instructions on them. At the gate, Brad and Owen watched the workers badge into a project portal, which displayed a tutorial on their work assignments for the day. After they completed the tutorial, they keyed into a scheduler to confirm their work start and finish, thus eliminating the need for manual collection of as-built data.

The site was buzzing with activity, but everything was calm and ordered. Many of the components were arriving just-in-time; as much as possible, they had been prefabricated and tested off-site. The project team used a “pull” system from the site to signal the suppliers and subcontractors when to deliver.

Brad and Owen joined the foreman to catch the weekly job meeting. While that was going on, just-in-time supply trucks and even some drones were delivering the materials and equipment the workers needed to their designated work locations. RFIDs on each piece or component ensured right piece to the right specification is delivered to the right place.

Brad and Owen looked at the model that shows the erection sequence. It was available and easily accessible to everyone on the site. Brad took out his foldable phablet to make sure he was synched to the latest version.

“You know, I’m so proud of this operation,” Brad told Owen. “It makes me feel good that it’s been lean throughout the process. It’s integrated all up and down the supply chain. To my mind, that’s what makes for quick, safe, and cost-effective construction of a high-quality care center.”

“I like the fact that it’s so orderly,” Owen countered. “All machines, people, and tools are tracked—everyone knows where everyone else is. Even an old codger like me can follow what’s going on.”

“Owen, you’re the coolest Old Codger I know,” Brad slicked on his Tennessee drawl. “Hey, did you bring your Google glass?”

“Of course!”

“You gotta see this! Fabio sent it—turns out he wasn’t just vacationing when he was climbing rock faces in the Alps last month. Put your Google Glass on, and grab one of these hard hats with the green LED on the left side.”

Brad put on one of the special hard hats and clicked his watch toward the green LED until it beeped twice. He then pointed and shot at Owen’s hat. “Okay, Owen, get ready to hit the green button. Ready? One-two-three!”

“Wait—Let me try it again...Oh, I got it! It’s on. Wow! Oh, wow! This is insane! Where are we?”

“On the northeast corner of the building. Where High Hope Street crosses Skillset Lane,” Brad replied.

“Geez, Brad, I feel like King Kong! No, actually I feel more like Spiderman! Yeeeeeee, I feel like I am going to fall off the side of the building...”

“Don’t look down! Just kidding, we’re really on the ground. Follow me.”

“Fabio is crazy—he combined a rock climbing Google Glass virtual reality with the building erection model? Wow—who would do that? Hey, are we at three?”

“Four--two more to the roof. Keep going. Okay, we’re jumping onto the roof...”

“I’m right behind you, so to speak. Cool! Oh, is that the final design for the healing garden? Amy described it to me, but I hadn’t seen it,” Owen said.

“That’s it. It’s a meditative place that the kids—and the staff—can use, and it’s a green roof, too. Hold on—I’m going to click the time into sunset mode.”

“Wow! Everyone will love this space. You’ve got to get better if you come up here,” Owen said reverently.

Brad’s watch dinged suddenly, so they abandoned the special hard hats, and Brad checked his message screen. “Speak of the rock-climbing devil, it’s from Fabio—he probably wants to know if I checked on the ‘Request for Inspection’ notice that the checker drone sent us overnight. It’s for the connectors on one of the panels for the third floor.”

“Can you check his shop drawings on your phablet?”

“He doesn’t need shop drawings anymore, Owen. We have such accurate representations in the model, he can fabricate key parts of the building well ahead of hitting the ground. You should visit his fabrication shop! The equipment reads the data it needs from model and fabricates the parts. Equipment manufacturers, component manufacturers, fabricators and designers have agreed to model representations across the steel and MEP sectors, that the need for shop drawings are minimized and in most cases eliminated. This also facilitates the prefabrication of piping, HVAC, and electrical components enabling just-in-time delivery and safe field installation.”

“You mean robots do the welding and such?”

“Yes. There are very few humans in the shop; you even have automatic Quality Control by laser or scan. QC continues seamlessly on the construction site. The Overnight Supplemental Drones check everything that was done the day before, backing up the human inspectors. If they find anything amiss, they send an inspection request notice to Fabio and me. I already checked the one on the third floor—false alarm. Let me just watch-mail Fabio and put his mind at ease.”

“Those drone things still wig me out,” Owen says. “When we first started using them back in 2015, I was always afraid one would whack me upside the head.”

“C’mon, Owen, can’t happen. You know that safety still is Job 1. The model scans for hazards and flags them for attention as they arise. These on-site checks make recordable injuries to become a thing of the past; I can’t remember the last year when the industry lost someone on a site.

“Oh, look, there goes Amy’s drone—I recognize the purple tail feathers she painted on it for a joke,” Brad continued. “She and Felicia must be at the project office already—they must be looking at a fly-by. Ready to go? Let’s beat Mike there.”

– 3 –

INTO THE INTEGRATED STUDIO

I was hoping that Owen would sit in the back of the Infiniti so that I could ride up front, but it didn't work out; he plopped himself up front. No matter: It was a quick trip—only a few miles from the job site to the architecture firm's office where Amy works. The firm owned a serene-looking, five-story brick building, and we were headed to its top floor.

In the lobby, Owen and Brad met Mike, who had seen them come in and ran up the stairs in hopes of beating the elevator to the top.

Brad, Mike, and Owen filed into the large conference room. It was a hoteling space that could be used by the co-located work group for this project whenever they need it. In the entryway, they each swiped their RFID wristwatches at the Keurig28, which has stored their preferences and delivers a piping hot coffee of their choice almost instantaneously.

Meanwhile, Amy and Felicia were looking at a map of the project site on the smart board, overlaid with the surrounding underlying and overlying GIS data, permitting information, and infrastructure. They were knee-deep into a discussion of how good the project data was for site planning and infrastructure procurement within the model. “That third generation LiDAR scanning makes it easy to know what the site is really like—we can all see the project's context on the Big Hologram Screen,” Amy noted. “We got the site permit on line—it's also part of the model now.”

“By the way, Brad,” said Owen, “Talking about permits and such, I want to make sure that we meet those new low-vision requirements in the building code. Can you call that up on the screen? And how much is meeting those provisions going to cost me?”

“No problem, Owen, and with the automatic code-checker, we're already sure that we meet code,” Brad replied. “You know that Amy and Felicia especially think those new low-vision provisions are really important, and they did some nifty simulations to make sure that the requirements are not only met but exceeded.”

“I didn't see it on the base model.”

Brad cranked up the screen. A video appeared, depicting Amy and Felicia doing a walk-through of the virtual hospital lobby with low-vision simulation glasses. It was very dim. All of a sudden, the space got much brighter and the contrast sharpened considerably.

“That second simulation is with the new LED lighting we want to install, Owen,” Amy explained. “Mike got Lila Davis, our lighting engineer out in Boulder, to run some calcs, and she estimates that over three years, the energy savings from the new lighting system will more than cover the increased first cost.”

“Not to mention your reduced O&M costs,” Felicia added.

“Okay, but why isn’t it in the base model?” Owen persisted.

“Because it doesn’t have your approval, yet. The simulations and Lila’s report are in your folder. Mike, Amy and I have signed off—it just needs your approval,” Felicia pointed out.

“Oh!” With a flourish, Owen finger-signed the reports on his tablet and they appeared on the master list, now up on the big screen.

A minute later, Amy’s watch dinged. “Lila saw the new specs and sent us this We-Tube video of a luminaire she would recommend for the public spaces.”

Amy set the video to the large screen, and everyone oohed and aahed about the look of the new luminaire, which they were able to view from all angles. She sent a TWT (talking watch-text) to Lila, asking her to incorporate the fixture into the model’s 3D simulations and to send a hologram of the result so they could get a better idea of what the lighting will be like.

Then, just as Brad cranked up the master files list on the Big Hologram Screen, Fabio’s image appeared on the corner of the screen as he connected in from his sister’s house in Florence, Italy. “This is my niece, Anna,” he said, putting his arm around the smiling young woman sitting to his right. “She is studying for an integrated building design degree and wants to see how a model works on a big project.”

The group seemed delighted to comply.

“We have an online design room,” Amy explained. “Everyone is allowed access.” We now work within practice networks, not the mega firms of the past. It’s all about following a lean design process.”

“Your office looks so neat and clean—it’s not littered with piles of drawings and mountains of specs,” Anna commented.

“We’re not paperless yet, but we’re getting closer. It took us a long time to dispense with drawings—social tools and virtual meetings are just a big part of how we work now,” Amy said.

“And it seems as though everyone’s BIM capabilities and general experience and expertise is widely known, so we have the ability to more easily assemble a team due to transparency of experience,” Mike added. The project’s subcontractors—like your Uncle Fabio—are selected based on qualifications—sometimes even on their BIM Rating.”

“Our process is collaborative, but using the lean IPD process that we do means the architect functions more as a master builder, while the GC, that’s Brad in this case, is more of a master scheduler and planner,” Amy chimed in. “It’s less about roles and more about the process—being lean and eliminating waste of time, money, and effort.”

“I’m the project BIM manager,” Brad added. “I earned the NBIMS-US certification three years ago—I spent two weeks at NBIMS-US boot camp—sure it was hard, but it’s the best investment I’ve made in a long time—and that includes my new Infiniti-AP.”

“Shut up about the car, Brad!” the group yelled in unison, and Brad grinned sheepishly.

“So, the model is how you do 3D drawings?” Anna asked.

“3D, but that’s not all!” Brad responded. “We do 5D! The 4D schedule and 5D cost are developed directly from the model data and in the integrated model itself. It’s totally worth it, but it took us a long time to dispense with drawings. Our specifications are generated as reports from the models.”

“Social tools and virtual meetings are just how we work,” Felicia reiterated.

“Do you all use the same hardware and software?” Anna asked.

“Oh, no, and it doesn’t matter at all,” Felicia said. “A big part of what makes the lean process and data sharing work is interoperability—everything can work together because the interface is so good these days. “

“We don’t need to export huge models so that the next guy has to import them. Our data is in a cloud. The drawings, specs, and models are seamlessly linked,” Amy told her.

“Here’s an example: Your uncle gave us a digital model of shop capabilities—it took Fabio just about two weeks to get it up and running,” Brad said. “The steel model is an enhancement of the Amy’s design model, and is updated to the base model any time a change is made.”

“What’s really neat is that estimating has become a smooth hybrid of analysis of models and documents—estimates are much faster than they used to be. They now include metadata so that has eliminated the need for multiple take-offs,” Mike added. “And remember, Anna, that BIM is a tool for the entire project life cycle, not just for design. Take estimating into cost analysis: It’s a continuous process from start to finish—all costs will be in the model against all estimates and will be constantly refined.”

“Likewise, the model also will support a wide range of facility operation and maintenance activities over the building’s life span. And Anna, I personally can tell you it works,” Owen said. “Costs run about 20 percent less using these new lean processes compared to the old design-bid-build.”

“Fabrio, Owen did the roof garden climb this morning,” Brad said with a grin.

“Oh! Uncle Fabrio showed me the Google Glass modeling of the healing garden and the green roof,” Anna cut in. “I love how sustainable the hospital will be, and how it is a living example of how not to waste resources.”

“For us, sustainability just ‘is.’ The building, designed to Green Codes, is going to provide a net energy gain and be restorative to the environment,” Mike explained. “I used Amy’s photovoltaics array and green roof designs to run analyses through the model to get the building permit.”

Amy said, “That reminds me, Mike. I need to share some tweaks so that you can update our monthly report to the city.”

“You all have such great ideas! What about copyrights for your work?”

“No worries: The paradigm for intellectual property for us is that anything we create is attributed to us and is going to be a mouse-click away for others. We also have the information-creator control who has access to the information,” Felicia explained. “Our value is in the knowledge and processes we use to create new connections, ideas, spaces, communities, and value. But we can always check with our lawyer, if we have concerns.”

“It’s just great that the lawyers are involved early on—there is just so much less hassle and worry,” Amy remarked. “Their involvement has also significantly reduced our practice insurance costs. The model tracks who created what, and if someone put in faulty information, then that person would be identified, and the whole team would not be punished for one person’s errors. The at-fault individual would simply pay more for their insurance premium.”

Brad, who sported a few more gray hairs in his dark crew cut than the rest, remembered that it wasn’t always that way. “Since we’ve been sharing information from the minute the project was a twinkling in Owen’s eye, there have been a lot fewer reasons for turf battles.”

Fabrio and Anna said goodbye and clicked off.

“Always great to meet here in person, Amy,” Owen commented. “Such a great space—especially that beautiful courtyard.”

“Yeah,” Brad said. “I’ve always thought it would be the perfect place for a wedding.”

Felicia's gaze dipped demurely.
Mike put his coffee cup down with a thud.
Amy giggled.
Owen looked confused.
And no one said a word.

Amy and Felicia stayed to work out the lighting plan with the lighting designer, and Brad, Mike, and Owen took the Infiniti-AP to grab some veggie burgers and zucchini fries at the local McWendy's.

WALKING THE WALKTHROUGH

Blame the technology, but I just don't remember what that meal was like. The next thing I do remember was that funny tingling you feel in your solar plexus as you are pulled into the future, and the realization that I was in the middle of the almost completed hospital.

It was a few weeks later, and Amy, Owen, and Brad, all dressed in their best Star Trek-like work suits, escorted the mayor of Springfield, the chief of police, and the fire chief on a walk-through of the finished building.

“I must tell you, Amy, that it's been a pleasure to be involved as a member of the team since you started this project. It's amazing to me that the virtual walk-throughs were so realistic, I feel like I have been in this building many times,” said Fire Chief William Edgar. “I was especially impressed at being able to use the drone to watch the building as it went up, step-by-step. And being able to ‘see’ what's happening behind walls could come in very handy for us—and for the police as well.”

“It only makes sense, Chief,” Amy replied. “And it was great to get your input in real time as we went along—I think it saved us from making some mistakes that could have proven costly, if—heaven forbid—we do face a disaster in the future. And those drones you like so much could also come in handy for the city if a severe weather event does take place.”

Mayor Preston chimed in, “And I am happy to know that the fine City of Springfield has worked with your team on a contingency plan to build temporary shelters if we need to.”

“Lean construction and using modular construction makes it a lot easier to do that, Mr. Mayor.”

“And I do hope, that come election time, the good people of Springfield will remember how we encouraged them to chime in on decisions about the building.”

Springfield Globe-Times

New Children's Care Center Building Opens Today *Mayor announces town project is ahead of schedule, under budget*

By Joe Matlock

May 22, 2021—Springfield, USA

Public tours open today for the new, state-of-the-art Springfield Children's Health and Wellness Center, located on High Hope Road in downtown Springfield.

Mayor Charles Preston, who has worked with the project since its inception, pronounced the building "one of the most beautiful and functionally outstanding structures that I have ever seen." The mayor credits the collaboration of entire building team—Amy Smith, architect; Mike Evans, mechanical engineer, Brad Moore, general contractor, Owen Connolly, building owners representative, and Felicia Foster, facilities manager—with the success of the project, which the team brought in under budget and ahead of schedule.

"It's been a pleasure to be involved as a member of the team since this project started. It's amazing to me that the virtual walk-throughs were so realistic. I feel like I have been in this building many times," said Fire Chief William Edgar. "I was especially impressed at being able to use the drone to watch the building as

it went up, step-by-step. And being able to 'see' what's happening behind walls could come in very handy for us—and for the police as well."

"It only makes sense, to get the town's police and fire departments involved from the onset of the project design," said architect Amy Smith. "And it was great to get their input in real time as we went along—I think it saved us from making some mistakes that could have proven costly, if—heaven forbid—we do face a disaster in the future. And those drones the chief referred to could also come in handy for the city if a severe weather event does take place."

"And I am happy to know that the fine City of Springfield has worked with your team on a contingency plan to build temporary shelters if we need to," said the mayor. And I do hope, that come election time, the good people of Springfield will remember how we encouraged them to chime in on decisions about the building during the planning process

(Story continues on page 2.)

I was wondering where the mayor was going with this when suddenly, I felt that tingling sensation in my gut again and whoosh! Into the future again. It was opening day for the Springfield Children's Care Center.

A bright-blue late May morning sparkled down on the Center. The sidewalk had been transformed into a welcoming walkway to the beautiful new building. Hospital employees swiped their brand-new RFIDs at the bank of readers at the door and received cheery, individualized verbal greetings and advice on unique issues awaiting their attention.

The black flash zoomed to the curb and parked itself perfectly. Amy, Brad, and Mike hopped out of the car and practically flew down the walk, faces beaming with anticipation. A swipe of Amy's watch on the reader told them that Felicia Foster was currently rounding up a group in the lobby for a tour, to which they were invited. The reader lit up with an image of Felicia surrounded by a small group of townspeople and hospital employees, which they hurried to join. Owen, of course, was smack in the middle of the crowd.

"See these sensors, folks?" Felicia was saying. "They allow us to continually collect and analyze the data about how our new hospital is performing. This data allows us to monitor and adjust the building's operations, but also will help us to build better buildings in the future as well."

“How do they work?” a man dressed in purple healer’s scrubs asked.

“Sensors imbedded in project materials and equipment self-report maintenance and forecast the end of equipment useful life,” Felicia said. “Automatic notifications are sent to vendors to replace equipment. Smart tags track all the parts of the building, the equipment, the furniture—and the people, too. The kids here have RFIDs built into their ID bracelets now. No more playing hide-and-seek with them—unless you want to.”

As the group murmured about these developments, a petite woman with very short hair came out of the elevator and walked over to Felicia. “Hi, there, Sandy. Folks, this is Sandy, the best assistant and facilities manager in the world. She’s going to show you around the building controls center—enjoy!”

As the group tagged after Sandy, the project team turned toward the Dunkin’ Doughbucks sitting unobtrusively in the corner of the lobby. I was torn: Controls center? Latte? I knew I could get a copy of the controls center report later and I was really thirsty, so I went with the team.

Brad, Amy, and Felicia decided to go with their pre-programmed favorites, and swiped their watches on the reader. Mike decided on a chai tea instead of his usual quad-shot latte, and placed his order with the barista. “Can you believe that not too long ago, people thought coffee and doughnuts weren’t good for you?” Amy wondered. “Let’s go up to the healing garden for our snack.”

The group took their drinks up to the roof (ascending by elevator this time) and sat on a bench, enjoying the satisfied silence of a job well done, joined to the challenge of more good work to do in the future.

Brad was all smiles. “So, Felicia, as facilities manager, what are you going to do next?”

“The usual tweaks that come with a new building—but with our lean processes, there just are a lot fewer surprises than there used to be. But really, the work is just beginning—the building has a long life ahead of it, and most costs on a project are incurred for operations and maintenance. And I’m going to be collecting and analyzing use and performance and sending it back to you monthly, Mike.”

“Great—we can help you tweak as we go along. And all of that performance data will be necessary when we apply for an Institute of Designers and Builders Building Performance Award next year,” Mike responded.

“It’s just rewarding to think about the model—our model—being used for the rest of the building’s life,” Felicia said. “And, in the end, that same model will be used for recycling of a significant portion of the structure at decommissioning. Who knows what the industry will be like then? Maybe Anna, Fabio’s niece, will be the person to oversee reuse of the steel...”

Amy said, “I have to say this: I love working with you guys. It’s just great to know that all the hard work that we did on NBIMS, beginning—when was it? 2014? It really paid off, didn’t it? They called us the “2 Percenters” at the time—but now everyone works the way we did back then. I’m really glad that we stuck it out, and that eventually, so many people in the industry joined in.”

“Owen was right,” Brad said. “You know, he said—wait, what’s that?” He sat up straighter. “Wow, look at that drone coming toward us! I’ve never seen one like that! It looks so... weird.”

The group sat mystified as the whirling light ball dropped down and hovered in front of them. It projected a message as a small LED scrolling marquee, onto the concrete pathway in front of a patch of petunias:

“To: Springfield Children’s Center Building Team....Date: May 22, 2029.....Re: The Future of the Building Industry....Caution: Handle with Care.... To: Springfield Children’s Center Building Team... Date: May 22, 2029.....Re: The Future...”

“Wow, it looks like it’s from the future. That’s eight years from today. How can that be? Should we open it?” Mike asked.

“Yes, we need to know,” Amy said. She unhesitatingly pointed her watch at the whirling drone and BOOM!

We’re back in 2014 again.

Good to know: It’s going to take some hard work from many people, but in the end, the future of the building industry is going to turn out fine.

Summary and Conclusion

by Chris Moor, Chair, 2021 Vision Task Force

The story of the Springfield Children's Care Center Project offers a realistic view of how projects can and will be built in the future. If we look hard enough, most of the technology, processes, and collaboration mentioned can be found in operation today, albeit in their infancy and, of course, in silos.

The story imagines a world without limits, a world in which the industry at large understands how to move forward for the benefit of all. After all, the benefits are obvious, and real, with many projections illustrating a:

- 20% reduction in costs of building with an even bigger saving during operations
- 20% reduction in energy use.

Analysis of the various essays and research used to develop the story shows their findings essentially can be placed under six broad headlines:

1. Sustainability

Many of the references to sustainability within the essays are largely implicit, because it is so core to the general working practice envisioned. The concept of sustainability and "green building" as we know them today will not exist in 2021. It will be normal practice to consider not only the energy usage and performance of a building during its occupancy, but also through the overall lifecycle of that building, even after its useful life—with, for example, recycling planned into the initial construction of the project. As with many other things, what is innovative in 2014 will be common in 2021. One intriguing concept presented is that of the design team remaining responsible for the actual performance of the building for several years after occupancy. The idea of developing contracts that tie design to performance is one worth exploring.

2. Facility Management and Operations

Facility owners, managers, and operations management often are touted as the big winners in any publication on how to improve the capital facilities industry and construction industry. While this is true, the bulk of the necessary effort to make it true happens much earlier in the project's lifecycle, specifically in design and construction. By having a building designed with facility management and operation in mind, the owner can indeed reap the benefits through maintenance savings, energy savings, and occupancy savings. But the owners first must take responsibility for ensuring the environment is in place to be able to take those benefits.

3. Data, Interoperability, and Integration

The digital world brings with it an immense amount of data—aptly termed “big data”—but it is the accessibility and usability of that data that really makes the difference in this vision. With the advent of accepted open standards, the change in psychology about sharing data, and the philosophical shifts in how data should be shared, the “I” in BIM (Building Information Modeling) clearly plays a strong role in the future of the industry.

Similar to sustainability, interoperability and data-sharing across platforms and across disciplines in the story were largely implicit: they just worked. Open Standards, such as buildingSMART’s Industry Foundation Classes (IFC), played a huge role in that. In fact, by 2021, IFC had almost become equivalent to what html is for the Internet—perhaps leading to the “Internet of Buildings.” Yet one of the key takeaways from our research is the value of using data from across the spectrum. A small example is the compatibility of GIS (Geographic Information System) data with BIM data, but another is the ability to integrate outside data sources as well. An example of this would be integrating historical weather patterns with demographic and psychographic information.

The accessibility of the data and of open standards appears to lead toward new and innovative software solutions that focus on small niches yet still fit in seamlessly with all of the other software being used. The bottom line is there is a major expectation that the information and data we generate can be used effectively to help every aspect of a building project and a building’s occupancy. There is a subtle but crucial paradigm change too, in that people retrieve the information and knowledge they need when they need to consume it, not just when it happens to be available. In other words, learning shifts from “just in case I need to know” to “just in time—I need to know now.”

4. Building Codes, Specifications, and Standards

Building codes, specifications, and standards were rarely referred to in the essays. In fact, the issues surrounding them were deemed to be just as complex in the future as they are today, even if access to the information were somehow easier. There were two progressive concepts surrounding these issues: The idea that update cycles were drastically reduced due to the emergence of social media; and that code checking, permitting, and standards compliance all were part of an automatic (or at least semi-automatic) process.

5. Technology

While the issue of technology, ranging from drones to robots and from the cloud to Google Glass™, was very prominent in virtually all the essays and research, it must be remembered that technology only enables everything else to happen. Focusing on the use of UCUVs (unmanned construction utility vehicles) that deliver materials around the site when they are needed, or the use of SMART tools that know where they should be and when, ignores the reason why they are important. Any feature without a benefit is unnecessary. However, almost without exception, any introduction of the many technologies

was always done in relation to the function it fulfilled and the benefit it provided. UCUVs, SMART tools, sensors, and tags (such as RFID) were all brought into play with regard to safety issues. Augmented reality and heads-up displays such as Google Glass™ played a huge part in planning and operations (and maintenance) as well as in assembly and construction. Laser scanning played a role not only in surveying, but also in quality control and assurance. One could posit that the technology references indicate where the industry suffers the most pain, as well as how it envisions those issues being resolved.

6. Process, Efficiencies and Collaboration

Social and cultural aspects play a huge role in the success of any delivered project, and references to process planning, efficiency planning, and various collaborative methods were abundant to the point of being assumed. The idea of IDCO (Integrated Design Construction Operations) organizations; enterprise delivery; virtual design, fabrication, construction, and facility management; just-in-time techniques; business process mapping; early involvement; collaborative contractual arrangements; or reducing waste was at the center of just about every essay. There were few direct references to “lean” specifically, but the process references all pointed in that direction. Interestingly, the issues and fear currently surrounding issues related to data and model sharing—such as Intellectual Property; trust, liability, and risk; and an increase in disputes due to changing roles and responsibilities—were unfounded, overcome, or in fact non-existent. Unfortunately, we still have a need for lawyers though...

So how do we get there?

The mandate of the Vision Task Force was not to discover the magic bullet: There isn't one. It was to spark some debate and awareness about how we can all play a part in making our industry more efficient.

The essays and the research pointed us subtly in various directions, none of which are particularly challenging when taken alone. The top four needs for the industry as I see them are:

1. We need a crisis or a **Mandate** to initiate change. Many would argue we already have the crisis, we just need others to recognize how inefficient our industry actually is and mandate some change—from the top. A government mandate may be enough, but mandates come in many forms. Also, owners need to start taking some responsibility for spiraling construction costs
2. We need **Investment** for technological support of open standards and open platforms—IFC and other formats
3. We need to change our **Culture**, starting with contractual arrangements and the way project teams are organized, including, perhaps, a 2-3 year operating component to ensure that buildings perform as they should

4. We need funding for huge amounts of **Education**, i.e., a brand new educational platform to:
 - Initiate cultural change
 - Support new technologies and ways of working
 - Enable leaders and innovators to share their experiences
 - Support lean education – principles, methodologies, and action plans.

We did not intend for this publication to be precise or to accurately predict exactly what a construction project will look like in 8-10 years. We wrote it to provoke some thought about solutions to our clearly floundering industry. We are in the midst of a massive paradigm shift, and it's an exciting time. Everything we learned through this exercise points to how all facets of the building industry are looking for solutions they can embrace; we need to step forward and embrace the challenge of finding those solutions.

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