

# BIM TODAY

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## Four Futures, One Choice: Construction in 2040

Dr Didem Güdür Broo on digital transformation,  
sustainability and making the right decisions today  
for a better tomorrow



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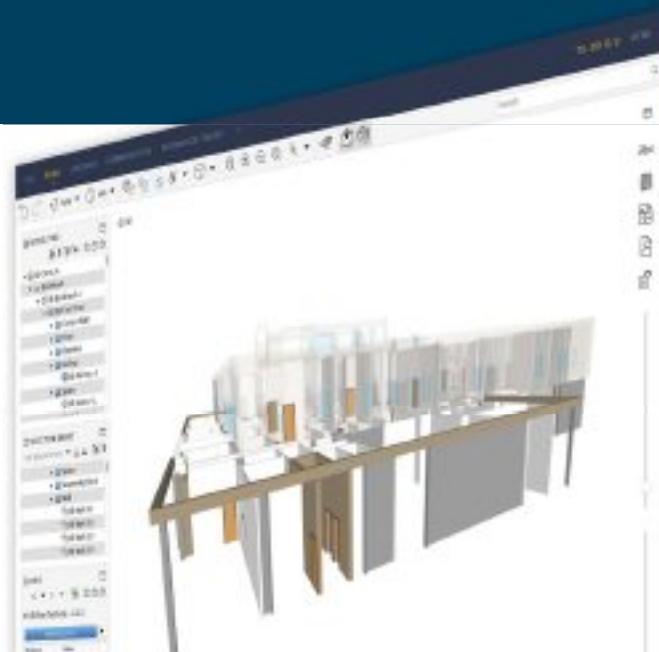
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# Introduction

A warm welcome to the December edition of BIM Today, our last publication in what has been an extraordinary - and extraordinarily challenging - year for all of us.

In the midst of the pandemic, the AEC sector can be proud of its efforts to keep working safely, while continuing to push forward with Modern Methods of Construction and digital transformation.

In this edition, we take a look at some of the projects and initiatives that are expanding the limits of how we design, deliver and operate buildings and infrastructure.

Our cover story examines a new report from experts at the Centre for Digital Built Britain, which sets out four possible scenarios for how the construction industry and built environment will look in 2040. Lead author Dr Didem Gürdür Broo explains how the choices we make today can shape a better tomorrow.

Meanwhile, Sam Chorlton, head of the CDBB's Digital Twin Hub, looks back on its first six months, which has seen over 700 members sign up, and what the future holds for this fast-growing community.

Also looking to the future, Women in BIM core team members Rebecca De Cicco, Vicki Reynolds and Dr Jenni

Barrett discuss advances in technology over the last five years and the trends they expect to see emerge next.

Elsewhere, BIM4Water's chair Jamie Mills and newly elected vice-chair Clare Kovacs look back at the strides the group has made in this most difficult year and how it is "planning for the unplannable" for 2021.

We also hear from David Philp, digital impact director for the Construction Innovation Hub, about the benefits of the Government Soft Landings approach in improving the performance and outcomes of built assets to ensure they deliver whole-life value to users, owners and wider society.

In addition, Gillian Charlesworth, chief executive of the Building Research Establishment, argues that meeting ambitious sustainability targets for the built environment will require everyone to do their part, and looks at the collaboration behind the launch of NEBARS UK, which will measure the energy performance of existing buildings.

There is much more besides, including HS2's adoption of digital engineering, the launch of the Intelligent Infrastructure Control Centre developed by the TIES Living Lab and Niru Sundararajah of Aecom on the need for solid foundations when adopting AI in construction.

We also have a selection of case studies highlighting the role of BIM and digital technology in projects around the world, from Brighton to Edinburgh to one of Stockholm's trendiest neighbourhoods and even a tin mining plant in Peru.

As ever, a big thank you to all our contributors and it only remains for me to wish all our readers a peaceful, safe and happy Christmas and New Year.

Andy Jowett | Editor

**Writers**  
Steph Blundell | Elisha Sketchley

**Production Coordinator**  
Emma Faulkner-Dunn

**Designers**  
Andrew Bosworth | Ben Green | Ben Ellis

**Sales**  
Glyn Jackson

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Datum House  
Electra Way  
Crewe Business Park  
Crewe  
Cheshire CW1 6ZF

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# Reclaiming Innovation: How to Manage Change Amid Industry Tech Growth

Embracing the impact of new and disruptive technology in the construction industry means also managing the organizational change that comes with it

It's no secret that the construction industry is one of the most rapidly evolving sectors of the global economy. Thanks to industry-wide changes including the use of 3D printing, modular building technology and digital transformation, construction is undergoing arguably one of the most dramatic technological shifts since the Industrial Revolution.

According to Dr. Jack Dennerlein, co-director of Harvard's Center for Work, Health and Wellbeing, these changes may come with an increase in worker anxiety. Workers, particularly those with more career experience, are afraid that the impact of technology on the construction industry may result in them being left behind. And more often than not, companies don't do a good job of addressing these anxieties on an organizational level.

"The problem is that you have competing demands within the organization," Dennerlein said. A desire for the increased speed or efficiency of production that come with the use of new technologies can be slowed by inefficient communication within an organization whose members may feel their positions are threatened by such rapid change.

At the center, we look at social technical systems, which is the organizational structure of construction and how that impacts worker health, safety and well-being.

As a result, how should the industry introduce technological change while minimizing resistance? The answer, Dennerlein said, is to focus on the big picture.

## Manage workplace culture

When introducing major changes to a workplace amid the impact of technology on the construction industry, it's important that companies develop a realistic sense of how its organization functions.

"We look at how work is organized, what the demands are on workers and how they're supported by their supervisors—the social, technical and organizational structure."

Only by developing an accurate sense of the unique structure and needs of a particular workplace can construction firms begin making the large-scale technological and interpersonal changes that today's rapidly evolving industry demands.



In the beginning of introducing a new concept or technology, however, Dennerlein recommends developing an in-depth understanding of how the company works and how the proposed change will meet the firm's particular needs.

"Every company is different in how it's structured: the personalities of the people who work there, the issues that it is facing, what's working and what's not working," Dennerlein said. "So, to come in with a very prescriptive solution isn't really fair, even though that's what they might want. You really need to give them something they can adapt and sustain on their own."

Instead of presenting employees with a finished product—whether that be the logistics of a technological shift or a change in their responsibilities and the company structure resulting from it—involve employees in the decision-making process to help them feel personally invested in the company's growth.

### Reduce resistance to change

The Center for Work, Health and Wellbeing has a very specific process for assessing what changes need to occur within a workplace as the impact of emerging technologies on the construction industry takes hold.

Although the issues it helps companies address vary in nature and occur in businesses at every level—from multinational corporations to small firms—Dennerlein said that it always starts with the same questions for employees and stakeholders.

"We talk about what's good," Dennerlein said, explaining that his firm always strives to make space for employees to celebrate the positive aspects of their workplaces and to celebrate what's working about the organization's systems and technologies.

"By talking about what works," he continued, "we get people to focus on the positive. We encourage them to focus on what's working and to feel proud of their contributions to the workplace. This gives them a space to see a model that works and to understand how the changes we're going to make together will contribute to supporting the positive aspects of how the organization is functioning."

Starting on a positive note allows employees to understand how their contributions to change will support the healthy functioning of their company as technology continues to reshape the construction industry, but it also shows how it will impact their own daily work experiences.

"What it does is create a dialogue, where they can explore the solutions and explore ideas and explore understanding the concept," Dennerlein said. "Saying what works gives them some ideas of how to build on past successes."

Accentuating the positive when creating change also helps workers and management feel connected as a team and to understand the ways they're building toward a common goal. As Dennerlein put it, when creating change;

“  
Don't just attack your  
weaknesses—build off  
your strengths.  
”

### Focus on communication

The most common reason for change to cause employees stress or for progress on a planned technological change to falter is a failure in organizational communication.

"There's so many opportunities for that communication chain to sort of break down," Dennerlein said.

Especially in multinational organizations, change that makes sense locally can falter when it's upscaled globally when management hasn't taken a big-picture approach.

"In a multinational organization you're going to have places that have different kinds of cultures, where different issues may arise—in South America vs. North America or even Texas vs. Massachusetts," Dennerlein said. But these issues can crop up even in smaller companies, where differences in company culture or the expectations for communication may vary even between divisions.

When bringing change to any organization, Dennerlein believes that it is important that management understands the experience and concerns of front-line workers.

"No matter how big an organization is, they have to understand what it's like to walk the floor," Dennerlein said. "A manager should be able to understand what's going on at the front line of their organization and how the decisions they're making may impact everybody down below. When making a change, they need to realize that there's this whole organization that will be implementing their policy; they need to understand how that policy disseminates through the company as a whole."

To create this understanding and effectively implement change in a psychologically and organizationally coherent way, leaders must learn to perceive their company as a whole, understanding how interconnected labor and communication creates a productive atmosphere.

"The infrastructure of the whole organization needs to understand how to be connected to that front-line worker," Dennerlein said. "By doing that, you create a dialogue. You create a psychological safe space where the workers can communicate back to managers of what the managers' decisions are doing, how that's impacting those workers and how they have to deal with that from day to day."

Only by creating this cohesive understanding can a company effectively implement change.

Learn more about Bluebeam Revu at [bluebeam.co.uk](http://bluebeam.co.uk).





# Four Futures, One Choice: The construction industry in 2040

**A new study developed by experts at the Centre for Digital Built Britain examines four scenarios for how the construction sector and the built environment will look by 2040. Lead author Dr Didem Gürdür Broo discusses how the choices we make today can shape a better future**

*While many worried that automation would lead to unprecedented levels of unemployment, the built environment in 2040 is powered both by a growing skilled workforce and supported by automation. More people than ever are now in employment, a change that happened rapidly in response to the Green New Deal and other post-recession measures. The challenges of sustainable digital transformation have drawn Generation Zero into careers in the built environment. They are the products of an undergraduate curriculum focusing on digital literacy and sustainability across disciplines. The stable workforce has enabled an increase in green building and infrastructure projects, such as the change to resilient micro-grids running on 100% renewable sources. This generation is comfortable working alongside AI as partners in decision-making and, thanks to the undergraduate curriculum, continuing professional development and lifelong learning, is highly literate in using data securely for the public good.*

If this vision of the future of our built environment is something that you want to see become a reality then the

choices we make today are crucial. The arrival of 2020 has brought with it some of the most turbulent global events experienced in generations. Global pandemics, political unrest and environmental disasters have all contributed to 2020 being, for the majority, the very definition of "unprecedented times".

## **Driving forces that may affect how the future will unfold**

Four Futures, One Choice, developed by experts from the Centre for Digital Built Britain, a core partner of the Construction Innovation Hub, presents four future scenarios for what the construction sector of 2040 could look like, depending on the choices we make today.

Available now in summary form and published later in December as an ebook at <https://www.cdbb.cam.ac.uk/fourfutures>, the publication provides a future lens enabling us to view, with clarity and detail, four scenarios of what Britain could look like in 2040, depending upon the decisions that are made now, in these unprecedented times.

It presents us with four scenarios that provide us with an insight into how we can take swift and decisive actions that will not only aid the Covid-19 recovery but also help develop a built environment that supports a flourishing future and reduces our negative impact on the global environment.

In order to develop the scenarios, experts who specialise in the built environment and how it relates to technology, the economy, design and society, came together to imagine, organise and describe different future states.

The four scenarios were developed by identifying potential driving forces and factors that may affect how the future may unfold. These were focused on:

**1. The SDGs – Sustainable Development Goals:** 17 goals set by the United Nations that envision a world where the built environment is a platform for the flourishing society and the natural world.

**2. The Age Dependency Ratio:** The number of dependents (aged zero to 15 and over the age of 68) compared with the total (working age) population.

### Actions to achieve SDGs

Whatever the demographics of 2040 look like, there is clearly a broad spectrum of actions needed over the next 20 years in order to achieve the SDGs, keep us within targets for carbon emissions and global heating, and save ecosystems from collapse, all while ensuring people are supported through the likely long-term economic impact of the Covid-19 pandemic.

In all the scenarios, greater digitalisation is taken as a certainty – the difference between the scenarios is how it is utilised based on the economic model, governance and most pressing need. For example, where the climate emergency had become more acute and there was an aging population, digital technology has to be deployed primarily to support a shrinking workforce and predict the next disaster.

**These are grouped into three areas:**

**1. Thoughtful investment in digital technology.** This includes a call to make a commitment to build smarter by using smart technologies (such as digital twins) to build efficiencies into the lifecycle of the built environment, enabling improved performance, reduced cost, higher quality and longer-lasting assets, while avoiding algorithmic biases that would exclude people from accessing these benefits.

This points to the need to put people and planet first in decisions about digital technology. Investment in digital technology for its own sake, or for financial value alone, can lead to exploitative, exclusionary systems. It is for that reason that ethical frameworks and standards are so vital to enabling "data for the public good". The Gemini Principles were developed in 2018 to guide the development of connected digital twins and the information frameworks to support them in order to make better decisions that create flourishing systems and better outcomes for people.

### 2. Prioritise decarbonisation and biodiversity.

Included here is a focus on Modern Methods of Construction, researching and adopting methods that substantially reduce the carbon footprint of the sector and valuing the natural environment in equal weight to the built environment in order to drive decarbonisation of the built environment.

Starting at the beginning (and end) of the building lifecycle, we can prioritise design for reuse and remanufacture, wherein materials from decommissioned assets are repurposed for future assets. The carbon footprint for reusing steel components, for example, is much lower than for creating new ones.

We need to improve our ability to recycle these components safely and reliably, as well as create a market for previously used materials. This would be part of a larger effort to create a circular economy, in which buildings, services and consumer goods become less and



less reliant on the input of newly extracted or manufactured materials and before a product is created there is a known route to reuse or remanufacture it.

Similarly, innovative Modern Methods of Construction, such as offsite and modular construction and a platform approach to design for manufacture and assembly, may offer opportunities to dramatically reduce the waste created and energy used during construction. Digitally managed operations using a BIM methodology and/or digital twins may also help reduce the carbon footprint of assets while they are in service by giving better data about energy use and other aspects of performance, enabling smarter maintenance and longer life.

**3. Governance today for a better tomorrow.** In order to achieve this, we need Digital Democracy, which supports wider participation and engagement of UK citizens, through the use of technology, in the decisions that directly impact them and legislation that protects the wellbeing of current and future generations.

Governance can hold organisations accountable for social and environmental wellbeing, especially at times of economic difficulty. While the SDGs set targets for reducing poverty and environmental destruction, Green New Deal-style policies attempt to address both crises simultaneously. If this legislative route were selected, the UK government could increase employment rates while simultaneously upgrading our infrastructure to reduce future carbon emissions.

While we can't guarantee with any certainty the outcomes our decisions will have, exploring future scenarios helps us identify the direction we would prefer and ultimately which way we should steer. The book sets

out suggested actions that experts have suggested would result in a fairer, greener future for all.

Of the four future scenarios presented there are two that are clearly preferable – focused on a sustainable, equal and diverse world within which Britain's economy, society and environment can thrive. Given the unprecedented opportunity we've been presented with, we can't stand still any longer. We have the choice, let's make it now. To follow the progress, or learn how to improve our chances for a better recovery please visit:

<https://www.cdbb.cam.ac.uk/fourfutures>

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**Dr Didem Gürdür Broo**  
**Lead author, Four Futures, One Choice**  
**Centre for Digital Built Britain**  
**enquiries@cdbb.cam.ac.uk**  
**[www.cdbb.cam.ac.uk/fourfutures](https://www.cdbb.cam.ac.uk/fourfutures)**





# Digital Twin Hub marks a successful first six months

The Centre for Digital Built Britain's Digital Twin Hub (DT Hub) has signed up more than 700 members since it was launched in March. Find out more about this exciting, fast-growing community and how it can help you to accelerate your digital twin strategy

It has been just three years since the National Infrastructure Commission first recommended the development of the National Digital Twin in its [Data for the Public Good](#) report and momentum behind the idea has been building steadily ever since.

No longer is a National Digital Twin merely an ambitious concept. It has now grown into a viable goal, with a rapidly growing number of organisations recognising the benefits of being part of an ecosystem of connected digital twins, securely sharing information. Here, at the Centre for Digital Built Britain (CDBB), we've had a front seat on this journey through our National Digital Twin programme (NDTp).

## A digital twin support network

Even in the early days of the NDTp, it was clear that the people who were leading the thinking and the practice of digital twinning would benefit from being connected. So, on 31 March this year, we launched the DT Hub to create a community and start the conversation. Essentially, the DT Hub is a web-enabled community to foster

communication, connections and collaboration between digital twin practitioners within the built environment. The focus has been on the digital twin owners, both actual and potential, and on the suppliers of relevant products and services, but other key contributors, such as academics, will be very welcome too.

Over the last six months, the DT Hub has become the beating heart of the National Digital Twin programme. It is based on the understanding that no one organisation has all the answers and it's only through a safe community openly sharing lessons learned, good practice, common principles and ideas that real progress can be made.

Members were quick to recognise these benefits and by June we had reached 500 members.

Our members are made up of people and organisations interested in developing digital twins across the built environment: asset owner/operators, local authorities, architects, engineering consultants, construction companies, software developers, AI companies, big tech

and more. All of them interested in developing digital twins and in the potential to connect digital twins through secure, resilient data sharing.

One founder member, Matt Edwards, chief data officer at Anglian Water, shared with us why they were so keen to get involved: "As an organisation, targeting a step-change in digital capability through digital twins, the opportunity to connect with both like-minded organisations and experienced leading innovators in the field who can guide our roadmaps and progress, is not only beneficial but essential. The resources are excellent in quality, engaging for our people and allow them to learn and develop their knowledge, all while giving them confidence in sharing their own advancements. Having the foundation of CDBB resources within easy access is critical to national infrastructure staying on the path to a connected digital future through data."

The lively and growing community provides a space for conversation with varied online and offline discussions based around common themes, as well as regular webinars, workshops and other events to explore topics in more depth. In April, we began our first Digital Twin Talk Series on Conceptualising Digital Twins, followed by a second series in July on Interconnected Digital Twins. Both series included a chance for our members to input and discuss with the panel how current thinking is being realised in their own organisations.

Steven Zhang, from Modular Geospatial Data for Everyone, said the talks "have played a very important role for my personal development, and [a great opportunity] for me to better connect with leading experts, who are working towards the same ambitious goal!"

### Finding common ground

We plan to take a pragmatic approach, "learn by doing and progress by sharing" – including what works well and lessons learned from early pilots and projects. This can then feed into an evolving view of what good looks like and inform the need for future standards.

We want our DT Hub members to join in and be an active part of this process and believe that they all play a key role in co-developing a guide to what a digital twin is and how we can best harness its value to improve and change the built environment. A benefit of joining early is that you can be a part of this pioneering group, together establishing an exciting transformation of our digital world.

# 2020

## March

Launch of the DT Hub portal (beta)

## April

First Digital Twin Talk Series on Conceptualising Digital Twins

## May

Digital Twins for the Built Environment published

## June

The community reaches 500 members

The DT Hub welcomes Innovators

Launch of the IMF Network for architects and developers

## July

Second Digital Twin Talk Series on Interconnected Digital Twins

Launch of the first Smart Infrastructure Index Survey

## October

The community reaches 700 members

## December

DT Hub to welcome members from the academic community

DT Standards roadmap to be published

# 2021

## January

DT Hub to welcome international members

DT Hub Annual Benchmark report to be published



Samuel Chorlton

As part of this process, we launched the Information Management Framework Community, which will play a pivotal role in shaping the underpinning framework that will support the subsequent development and integration of emergent digital twins into a connected ecosystem.

### **How can you get involved?**

We want to bring everyone on the digital twin journey with us and we would love to encourage more of you to join the conversation. We're grateful for all the input we've had so far, whether it's been a quick, "yes, I agree this works" or a more in-depth response.

We are building membership in phases and in December, we plan to welcome members from the academic community and early next year we will open the DT Hub to international members.

If you are interested in joining please go to  
<https://digitaltwinhub.co.uk/>

### **What does the future hold?**

As we approach the end of the year, we're really excited to publish our Digital Twin Standards roadmap. It provides a very practical and comprehensive summary of the current

standardisation landscape for digital twins in the built environment and includes national, European and global standards. It's intended to guide all stakeholders from asset owners to users, by signposting relevant standards, including BSI (British Standards Institution) documents, so everyone can be aware of current good practice.

It's a particularly important milestone as it supports future thinking on the global standards architecture for digital twins. Again, we encourage our members to engage in the process - it is still an evolving area and, as such, there are some areas that require industry validation. We're inviting DT Hub members to interrogate the findings and further develop the roadmap in a workshop on 3 December. Please [REGISTER](#) your place to receive details for how to take part.

The Gemini Programme has also been established, which aims to develop resources for the DT Hub community and expand the outreach of the Information Management Framework and of the programme itself. The Gemini Programme brings together people and organisations willing to contribute time and resources to develop materials for use by the DT Hub community.

Samuel Chorlton, chair of the DT Hub, said: "Although our physical worlds have felt much smaller and more constrained this year, I am encouraged that the digital world has been able to transcend some of these limitations and provide a refuge in such challenging times. To allow the UK to continue to grow and thrive in years to come, it is going to need to be able to harness the digital more fully than ever before. Harnessing the potential of digital twins and the digital world will need the support and involvement of as many people as possible. We look forward to seeing you in the DT Hub soon."

---

**Samuel Chorlton**  
**Chair**  
**Digital Twin Hub**  
**dthub@cdbb.cam.ac.uk**  
**<https://digitaltwinhub.co.uk/>**



**Detlef Schneider**  
CEO of ALLPLAN



**Kevin Lea**  
Senior Vice President Product  
Management, ALLPLAN

# Cloud technology as the key to more efficiency in the AEC industry

**An interview with ALLPLAN's CEO Detlef Schneider and Senior Vice President Product Management Kevin Lea**

The digital disruption continues to revolutionise the way buildings and assets are designed, constructed and operated, and any company that wishes to remain competitive needs to embrace these changes wholeheartedly. ALLPLAN's CEO Detlef Schneider and Senior Vice President of Product Management Kevin Lea give their view on some of the challenges that face the AEC industry and how cloud technology can help solve them.

## What are the main challenges companies face when it comes to embracing new technologies?

**Detlef Schneider:** Technology in the construction industry is evolving faster than

ever before. Now that digitalisation and digital processes are being increasingly adopted, significantly more data is being added to models to service the needs of the entire project lifecycle, including facilities management. In turn, this presents technical challenges for software vendors to provide solutions on how to manage such large sets of data for their customers.

This is combined with the challenge of balancing computing power and performance. Relatively speaking, computer power has not advanced at the same speed as we now expect. Even with modern 3D solutions, having to wait a few minutes between commands is not enjoyable! Even if the

software is solving thousands of problems behind the scenes that traditionally would have taken many hours, if not days. Advancements with emerging technologies such as digital twins and the use of artificial intelligence pushes the topic of how we practically handle large sets of data efficiently.

## How is ALLPLAN addressing these technology challenges in the industry?

**Detlef Schneider:** At ALLPLAN, we are addressing the topic of data handling and performance on two levels: the first is focusing on both scalability and performance within the software. This is to improve the

overall speed of how the software operates and how we intelligently handle data to provide an experience that is consistent for both small and large projects.

Scalability is not always fully understood. Often, a product can look and feel quick until you work on a real-life project. These days, models can include every finish, fixture, reinforcement and bolt, at which point the software can grind to a halt. We have anticipated that scalability is a fundamental requirement for our clients as we move into the future. Therefore, we have invested significantly into making Allplan operate as efficiently as possible. The results we are seeing in Allplan 2021 are quite amazing.

The second area we have focused on is the use of cloud technology. Cloud technology is really the only practical way to handle and process extremely large data sets. This is not just about storing data, but also about how the data is processed.

**Kevin Lea:** There is no doubt certain tasks can be processed more efficiently using cloud technology, so our aim is to provide our clients with the right tools to process their project efficiently; either on local computers or the cloud. And, of course, the flexibility to share data anywhere, anytime comes from access to the cloud and is extremely valuable. Whether staff are working from the office, on the site, or even collaborating on projects live from home offices.

This year we are excited to announce that Allplan Bimplus Professional, our cloud model management and collaboration solution will now be included with valid Serviceplus and subscription licences. This is the decisive step towards bringing a combined workflow to our clients, so they can use cloud technology to maximum effect.

Of course, we recognise that some customers may have concerns about the use of cloud technology. However, as an industry we must learn to embrace it, as there is no doubt in my

mind that this will be the only practical manner in which we handle a digital world in the future.

### What do you feel are the most important upcoming trends?

**Kevin Lea:** For me, it is the adoption of cloud technology and understanding how tools like Bimplus can benefit every project. As an example, this year, along with numerous enhancements, we are also bringing another exciting innovation to our clients with workflows through the new SCIA AutoConverter. This is a great example of how, using cloud technology, we can quickly and efficiently process an Allplan model into a structural analysis wire model. The benefit of this method is that it produces a model exactly the way a structural engineer wants to see it, without the modeller requiring structural skills and without compromising the coordination model.

**Detlef Schneider:** With Allplan, Bimplus and SCIA AutoConverter, we now provide intelligent workflows with a wide range of structural analysis programs, including our sister brands SCIA, Frilo and Risa. An added advantage is that there is no need to learn different workflows for each system. This is achieved through a new open file format, which has been specifically developed by Nemetschek, called Structural Analysis Format (SAF). Any structural analysis system can now link intelligently with tools such as Allplan via a straightforward Microsoft Excel file. It is exciting to see so many prominent structural analysis solutions adopting this format, which bodes well for an even greater streamlined BIM solution for the AEC industry.

### What advice would you give to engineering and architectural firms to help them be more comfortable in starting using new technologies to improve their business?

**Kevin Lea:** However hard we try to take the pain out of designing in a digital world, there

is a certain amount of knowledge and skills required to maximise the return on any investments. Software is naturally becoming more involved as we use computers, not only to create traditional drawings but also to build prototypes of our projects in the computer memory.

Investing the time to understand both capabilities and limitations is time well spent and ensures the chosen solution addresses not just today's requirements, but your future needs as well. After all, the cost of change can be greater than the investment. The best approach is to find a vendor you trust and who will support you on your technology journey, both in terms of software functionality and as an adviser as new technologies emerge.

**Detlef Schneider:** ALLPLAN aims to be the trusted partner to service our client's technology needs both now and in the future. With adoption of digital processes, we are well placed to support the AEC industry around the globe and look forward to helping our clients to realise the full potential digital workflows offer.

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# Women in BIM: Thoughts on the future of construction



**Women in BIM core team members Rebecca De Cicco, director of Digital Node, Vicki Reynolds, chief technology officer at i3PT Certification, and Dr Jenni Barrett, director at coLAB and senior lecturer at the University of Central Lancashire, discuss what has impressed them the most in the past five years and what future technology trends they predict for 2021**

Over the past few years, the built environment has witnessed significant transformational change, no less than in the introduction of new technologies such as Artificial Intelligence, robotics and the Internet of Things combined with the advancement of smart city technology and the digital twin.

As 2020 draws to a close, we begin to question what lies ahead for the future of construction and what will 2021 and beyond look like. We asked three global built environment experts for their views on what has worked well, what has been instrumental in driving digitalisation and what comes next.

## **What has impressed you the most in the digital built environment in the past five years?**

**Rebecca De Cicco:** "As an advocate for global unity and having worked with governments and organisations all over the world, it is clear that the UK government's commitment to the development of a BIM policy has

been an impressive and incredibly forward-thinking approach toward change for an industry so desperately lagging behind.

"The globalisation of construction industry standards in the UK, with the development of the ISO 19650 series, was certainly a turning point and one that has been instrumental in export opportunities. I have seen that the use of technology and process in construction in this way has driven industry to upskill and educate and therefore brought about enormous change.

"The varying initiatives in the UK for BIM have influenced a wider digital debate with the development of the National Digital Twin (NDT) and the Information Management Framework to support the implementation of the NDT. These policies and principles are now seeing momentum globally, with the uptake of the terms used and the language around these concepts becoming more mainstream."

**Vicki Reynolds:** "The built environment is vast, with an exceptionally broad range of stakeholder types, capability levels and needs. Often, when looking at the industry from a single angle it may seem that the rate of change is happening frustratingly slowly but, in reality, the job at hand is huge and driving change in an environment such as this is incredibly hard. With that in mind, I am proud and impressed by the progress we have made so far."

"The work of the UK BIM Alliance and the development of the ISO 19650 suite of BIM standards has been a considerable achievement, and the innovative work the Centre for Digital Built Britain (CDBB) is doing to explore and drive the use of digital twins across the built environment is incredibly exciting."

"If you consider how, as an industry, we might have reacted to a global pandemic five years ago, it would have been very different - although pre-Covid we weren't quite using digital tools day to day, we did at least have them available, making the transition to home working much easier than it would have been in 2015. We are certainly moving in the right direction."

**Jenni Barrett:** "When I started working in UK construction in the early 1990s, the industry was considered adversarial and it was perceived to be lagging behind in comparison to some other industries. Communication was seen to be a key barrier to excellence and equally, innovation was lacking as supply chains, designers, contractors and different professional disciplines struggled to work together in a competitive environment. In recent years, however, the industry has changed, responding to the digital revolution as a shared goal."

"The digitalisation of communication has been a challenge and a real culture change for many businesses and particularly difficult for longstanding members of the industry who have been used to more traditional forms of collaboration for many years. But the industry has embraced this challenge and appropriated many forms of digital collaboration which have not only improved communication via standard forms such as email or online forums but also tailored portal solutions."

"This has brought us closer to each other, allowing us to develop good relationships and shared knowledge globally, rather than just with those in geographical proximity. It has also allowed us to communicate better with our clients, users and stakeholders."



Rebecca De Cicco

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**"As an advocate for global unity and having worked with governments and organisations all over the world, it is clear that the UK government's commitment to the development of a BIM policy has been an impressive and incredibly forward-thinking approach toward change for an industry so desperately lagging behind."**

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### **What has had the greatest impact in the shift to digitalisation?**

**De Cicco:** "The work around international standards spins into the wider digital landscape for the implementation framework around smart cities. The UK has driven the adoption of the PAS suite of documents to also globalise the initiative, with the ISO 37106 and Smart City Standards being more widely used and acknowledged across the world. And with the development of the technology, it also comes with new skills and education requirements."

"The Skills Framework for the Information Age (SFIA) is a framework for describing and managing skills and competencies for professionals working in information and communication technologies, software engineering and digital transformation. This is by no means exempt when discussing skill requirements in construction and the acknowledgement of this framework and use of this documentation, but it is something I am very impressed by when it comes to change."

"As construction and digitalisation further infuse our current working environment, we are witnessing greater demand for enhanced technical compatibility and collaboration, and it is this visionary thinking that is influencing decisions makers the most."

**Reynolds:** "Smart(er) machines that use machine learning to make better decisions and increase efficiency on site are no longer something we simply talk about; these now exist and are fully operational.

"Smart technology has the power to anticipate potential systemic transformations, enabling the necessary strategic dialogue needed to analyse change and, as a consequence, unlock new and visionary approaches to digital information management.

"This way of working allows us to reveal dynamic change and use these insights to reach sustainable solutions and greater building process efficiencies. Not to mention breaking through communication barriers and seeing how current and alternative development pathways may affect the future."

**Barrett:** "Cloud-based, industry-wide initiatives are allowing us to close knowledge gaps and share visions to increase our potential for interdisciplinary thinking and generate more collaboration across the design chain to embrace the challenges of BIM and the possibilities that the internet of things might offer for the built environment.

"This is bringing about a change of culture and it's one that will not only allow us to take advantage of the digital innovations that can improve our working practices and enable new business models, but also create better buildings. Better interdisciplinary thinking has empowered us to rethink the contracts that we work within and forced us to break out of our professional silos to create universal standards and real solutions to the challenges that lie ahead, such as climate change and inclusivity in design.

"This openness to change and improved communication has been brought into sharp focus by the global Covid pandemic. There have been years of dialogue about how the built environment might operate in a digital future, but lockdown restrictions motivated everyone to act quickly and to adopt many of these ideas about remote working and collaboration, even if the risks and pitfalls had not yet been resolved. This is a noticeable change in the construction industry, which had previously been so risk averse."



Vicki Reynolds

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**"If you consider how, as an industry, we might have reacted to a global pandemic five years ago, it would have been very different – although pre-Covid we weren't quite using digital tools day to day, we did at least have them available, making the transition to home working much easier than it would have been in 2015. We are certainly moving in the right direction."**

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### **What are your future technology trend predictions for 2021?**

**De Cicco:** "As an industry, we are thwart with fear when it comes to how technology will begin to change how we live and work. Having said this, and being the digital evangelist I am, I feel that there is much to look forward to when looking to the future and how technologies will advance how we deliver simple tasks. For me, it is about using consistent frameworks for delivery. This is very important when it comes to avoiding risk and dispute on projects and therefore more stringent rules around Information Management and the Information Management Framework both in the UK and globally is one way this can be achieved.

"Digital twin and smart cities are becoming common terms, but what I do predict is the implementation on a more detailed and advanced level of some of the concepts, not only driven by technology but also by the international standards to support the development of the Smart City Initiative and the uptake of ISO 37106, as well as ISO 37120 series for smart city indicators.

"As the world changes and our city infrastructure becomes more intelligent, it will be something that I feel will certainly be a big game-changer heading into 2021. Using open data, technological advancements to capture city data and then the use of individual digital twins to inform the wider city landscape, will certainly be driven more heavily in construction across the world."

**Reynolds:** "Technology shapes so much around us and has long played an important role in our industry, influencing fundamental processes in design and operation. As we step into the next decade, two factors are the major players in the future of our ongoing digital transformation: the Golden Thread and digital twin.

"Implementation of the Golden Thread will change the way we work, potentially disrupting the way we manage contracts, with interoperability becoming key to success. Whereas, a digital twin of the built environment will be able to unlock the full potential of the virtual outcome-based service provision by linking the physical and virtual asset. These two factors are not stand alone and full digital integration will see an industry which builds faster and smart, in ways we have never witnessed before.

"The use of the digital twin ensures that data is always flowing and creating a digital twin network means new opportunities for the way we use and interpret data, allowing us to understand not only how our assets are performing but also predict how they will perform in the future."

**Barrett:** "While the digital progression of construction has been impressive, we've still got a lot to do. But my prediction is that this trajectory of behaviour change will continue. I think we are at a tipping point in industry digitalisation where we will consolidate the knowledge we have gained so far and reflect on our experiences of 2020 to make significant changes to our organisational cultures.

"I believe we will refocus our thinking beyond the nuts and bolts of technology to think about how we use better the human beings that populate our industry. This will require radical shifts in the way contracts are set up and how project networks can collaboratively share the financial rewards for delivery, rather than maintaining the individualistic contract system that will decreasingly be fit for purpose in the networked digital environment.

"I also predict that human-centric skills, that are often sidelined due to the heavy load of mundane and



Jenni Barrett

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**"When I started working in UK construction in the early 1990s, the industry was considered adversarial and it was perceived to be lagging behind in comparison to some other industries."**

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repetitive tasks involved in project delivery, will become key areas for learning and talent acquisition. Artificial Intelligence (AI) and Machine Learning (ML) will be able to do these repetitive and mundane tasks, freeing up human time and intelligence to focus on creative thinking, innovation and strategic change. A number of other sectors, such as law and medicine, have already starting to work in this way. I predict that AI and ML will be further developed in an industry focused way to speed up communication flow and reduce communication overload, allowing information automatically to get to the right people at the right time."

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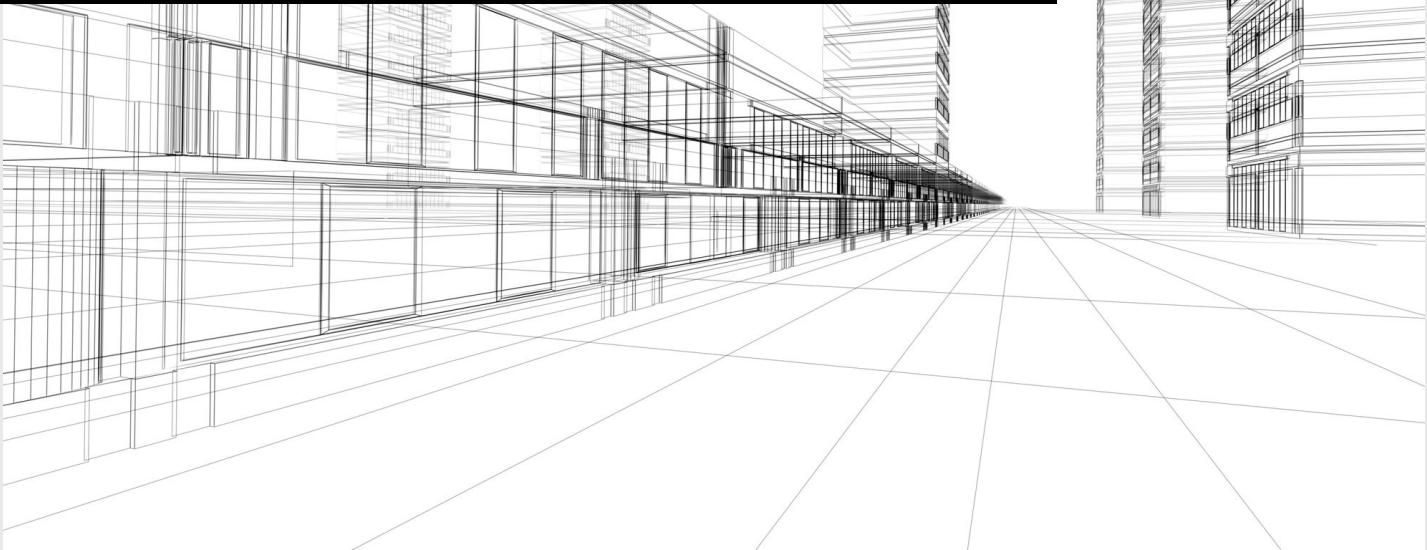
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# Government Soft Landings: Creating buildings that deliver for everyone



**David Philp, digital impact director for the Construction Innovation Hub, highlights the benefits the Government Soft Landings (GSL) approach brings to improving performance and outcomes of our built assets to ensure they improve whole life value to users, owners and society at large**

The cost of maintaining and operating a building during its lifecycle often far outweighs the original cost of its construction. Getting the transition right from build phase to operation is therefore essential. This is particularly true for social infrastructure like schools and hospitals, which should be delivering not only better outcomes for their end users (patients and students), but for society and the environment more broadly.

This is exactly what the Government Soft Landings (GSL) approach sets out to achieve. GSL, however, goes further than the traditional "soft landings" approach by requiring clear, measurable targets, post-occupancy evaluation (POE) and, crucially, a smooth transition of data and information contained in the project information model to that required for facility operation in the form of the asset information model.

## Building better schools

As part of our four-year transformative programme, the Construction Innovation Hub is working with pioneering Whitehall departments and other public sector organisations to develop tools that can be applied across the sector to improve briefing, business case, design, construction, use and management across an asset's lifespan. These pioneers include NHS Scotland, Scottish Futures Trust (working with the Scottish Government) and the Department for Education, who are working to develop tools that can be used by schools, hospitals and other government clients such as the Ministry of Justice to realise the benefits.

During a webinar I hosted last month for Digital Building Week, the Department for Education's Stephen Batcheler offered some fascinating insights into how the dedicated



David Philp

GSL navigator tool led to better planning, construction, management and operation of schools and share more information about that has been developed as a training aid for DfE project managers.

All school construction projects now adopt the DfE Soft Landings strategy from project inception and follow it throughout the development of the project, not just at handover. This ensures that the new building reflects the school's requirements for building functionality and operational performance, but is sufficiently flexible and adaptable to accommodate future changes.

GSL also helps to ensure that the transition from construction site to building occupation is streamlined and schools to make sure that new and refurbished school buildings meet the school's performance requirements for both staff and pupils from day one. In terms of implementing the approach for the school building programme a bespoke DfE GSL strategy that aligned with existing DfE project and contract management processes and also with the latest UK BIM Framework guidance. Training programmes and presentations were delivered to DfE project managers, technical advisers, contractors and their supply chain.

### **Patients put first**

The benefits that this approach is also unlocking for NHS Scotland are a prime example of the progress made in this space and, crucially, how learnings could be shared

across the wider sector. NHS Scotland and the Construction Innovation Hub have collaborated on an interactive GSL process map which provides a framework and reference for government departments and other public sector organisations to create their own specific plan that responds to their unique business requirements and procedures.

Health Facilities Scotland is helping embed GSL across the NHS Scotland boards and it is already being successfully utilised on several of their flagship projects, providing common/unifying understanding and unlocking the benefits across the health system. The navigator guides users through setting operational strategy, clear purpose and user needs defined within the brief to meet the required outcomes and ensuring these are delivered. It encourages collaborative stakeholder engagement, ensuring feedback and lessons learned informs the brief and design strategy.

### **Outcomes, outcomes, outcomes**

By starting the process of delivering a new built asset with the end user in mind, we can ensure that we create hospitals that promote improved healthcare provision, schools that improve teaching outcomes, and houses that are better for residents to live in and will also save them money on their energy bills. Simply put, Government Soft Landings supports better operational and societal outcomes.

The [Government Soft Landings report](#) provides guidance for the public sector in applying BS8536 parts 1 and 2 and reflects the changes introduced by the publication of the international standard suite ISO19650. The report published by the [UK BIM Framework](#) - the overarching approach to implementing BIM in the UK, brought to you by UK BIM Alliance, BSI and CDBB.

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**David Philp**  
**Digital impact director**  
**Construction Innovation Hub**  
[www.constructioninnovationhub.org.uk](http://www.constructioninnovationhub.org.uk)



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A portrait of a young man with a beard and short brown hair, smiling at the camera. He is wearing a blue and white checkered shirt. The background is a light grey with a subtle geometric pattern.

Join here: [ypg.jctltd.co.uk](http://ypg.jctltd.co.uk)

JCT YPG is a focus group for professionals within roughly the first ten years of their career, those that are “young in the industry” regardless of age, and students, whose members are interested in elevating their professional profile, expanding their industry network and connecting with peers, and giving back to the industry through fostering a long-term engagement with JCT.

## Join today

YPG is a brand new initiative, and we are looking for input from young professionals and interested potential members across the construction industry to help shape the group’s agenda. Join today if you would like to be kept in touch and if you would like to be further involved.

◆ A platform for young professionals and those new to a construction career regardless of age, across different sectors of the industry, to network and share experiences, knowledge, and ideas in an informal way.

◆ A link between YPG members and industry experts for the sharing of knowledge and experience.

◆ A range of useful on and off-line tools to link professionals together with JCT.

◆ A way for professionals to engage with JCT, the UK’s largest provider of construction contracts, and a key example of a cross-industry collaboration, to shape the future of construction contracts.



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# BIM4Water in 2021:

## Planning the unplannable

**The newly elected vice-chair of BIM4Water, Clare Kovacs (national digital rehearsal lead for MWH Treatment) and current chair Jamie Mills (global BIM manager for Xylem) reflect on and discuss some of the strides forward and developments made by the BIM4Water group over the challenging months that this year has brought**

2020 has been an unprecedented and challenging time for everyone but it has also created opportunities to take stock and reassess. This is exactly what BIM4Water has been doing to push forward and achieve its mission "to lead, drive and support organisations to realise value through the digital transformation of the water sector".

### **What has been BIM4Water's major achievement in this time?**

Jamie Mills says: "There have been lots of things happening but I'd say our major achievement has to be the Roadmap alignment. Having completed our initial roadmap back in 2018, we decided it was now time to redefine the direction of travel and more importantly ensure alignment of all seven BIM4Water task groups with the current UK government objectives in developing a digital built Britain and helping drive the creation of an information management framework for water."

"To do this, we have been working collaboratively with the Centre for Digital Built Britain (CDBB) National Digital Twin Programme to assist the BIM4Water task group chairs and their Steering Group sponsors to engage in workshops, redefining the direction of travel and our key milestones, ultimately carving out a strategic vision to drive digital transformation in water over the next five years.

"This review comes at a critical point in the group's evolution. We have made a number of key strategic partnership agreements, established a new task group - the Data Security Quality & Governance group (DSQG) - and reshuffled lead roles, including appointing Clare as

elected vice-chair, gained new a new chair of the 4D Task Group and also a co-chair within the Water Industry Classification Hierarchy & Standards Group (WICHIS)."

### **Do you think the pandemic has had an effect on the group's activities?**

Clare Kovacs says: "Yes, absolutely! As a group of industry-leading champions in our fields within the water industry, ranging from recruitment, BIM managers to asset managers, we have noticed a significant gear shift in digital adoption. It is clear to see that the Covid pandemic has helped fast-track both the embedding and operation of digital tools and processes within organisations. It has raised the profile and criticality of the need for a clear digital strategy, which covers the fundamentals of education, collaboration, formulation, standardisation and quality."

"From data quality, accessibility and digital rehearsals to having the right people for the job, it is both the machine and the human elements working simultaneously together that is essential for successful digital delivery."

"In 2021, BIM4Water hopes to make the water industry more aware of these elements and believe that successful change is only achievable by connecting two elements: machine and human. Where machine refers to technology and systems for data creation and use, including how it is acquired, shared, structured and protected. And human refers to the skills of the industry, collaborative working practices, communication, thought leadership, culture and behavioural practices of organisations."

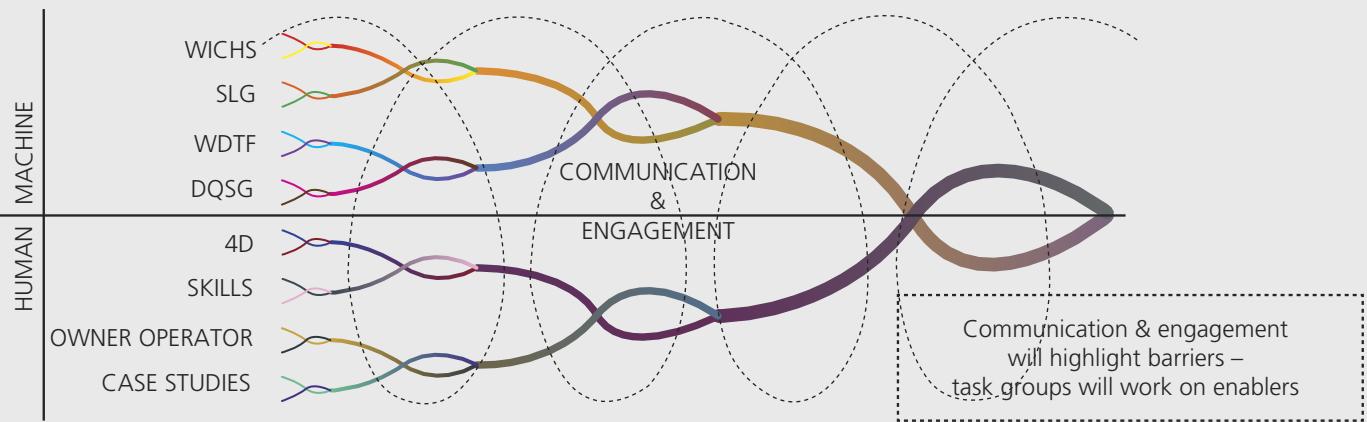


Figure 1: Human vs Machine (TJ Pearson)  
– BIM4Water Task Group Alignment

## Human X Machine = Change

"For BIM4Water to achieve its goals of driving digital transformation of the water industry, the two key elements must be combined (positively) to create the (positive) change."

Figure 1 illustrates how we can see BIM4Water task groups can be divided between the two elements: "All groups are interlinked but sit in very separate categories, which are both as critical and interdependent as each other."

"If we look at this mathematically, both elements must be positive and not equal to zero to have positive change; if one does equal zero then no change will occur. And it is both effective communication and engagement that is required to maintain the values above zero."

### Has the BIM4Water focus changed? What are your thoughts on moving the group forward into 2021?

Mills says: "Our initial roadmap focused heavily on understanding our approach, the enablers and our desired future state, which would have been driven by the need to get out of the starting blocks, establishing a foundation for the group and raising the profile so digital was talked about across the industry in an applicable and useable way."

Kovacs continues: "My focus to help drive the group forward will now be on removing duplication of efforts across other groups and organisations. This is already being supported by establishing partnership agreements and pledges with strategic stakeholders such as the CDBB, Smart Water Networks Forum (SWAN) and

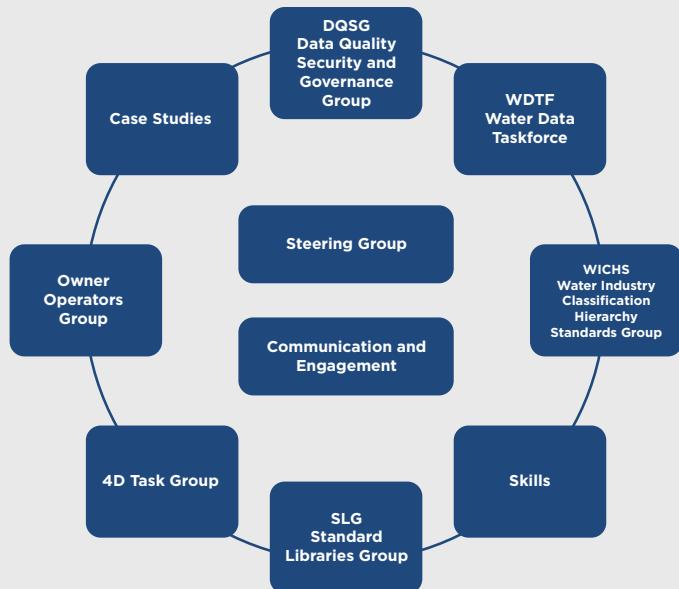
Teesside University to drive forward momentum, raise our intensity in setting standards and providing guidance on digital transformation.

"As an unfunded/non-commercial organisation, BIM4Water's aim is to help drive the embedment of digital practices in delivery and make these business as usual for Tier 1s (main contractor), and also focusing on Tier 2s (supply chain), on how to bring them on-board and help support them. This will be achievable by aligning data, work breakdown structures (WBS), understanding level of information needs and their timings (LOI), and taking an active shift (on the plan) to the left to ensure it is available at the right time. More importantly, understanding the commercial, contractual and legal envelope of this work, so it is not based on goodwill but data, is a clearly defined requirement."

Mills adds: "Many of the major water companies are setting flagship examples of understanding the benefits of successful digital adoption especially with a focus on data and regulatory reporting. For this to work across the industry, BIM4Water needs to sit as the facilitator and raise the profile of digital, developing best practice and making this business as usual!"

Kovacs says: "My aim as vice-chair of the BIM4Water group is to work closely with the Steering Group and task groups to drive accountability of data quality and to help set out clear requirements, in exchange information requirements (EIR). And by working closely with the Owner Operators group, highlighting the fundamental role they play in achieving digital transformation in the water industry. The Owner Operators is a task group formed of members from the water companies."

Mills says: "The government sector regulators and stakeholders have acknowledged the importance of



digital in tackling key challenges across all sectors and ultimately being better for the public good. This is evident in the Data for Public Good report and visible from the establishment of the CDBB National Digital Twin Programme. To make better use of data, water and other sectors need to overcome key challenges including ontology, interoperability, data quality and data accessibility. An information management framework will be a key enabler for this but the work of specific industry groups like BIM4Water needs to be in place to ensure its delivery across all sectors.

"To ensure the smooth delivery of objectives BIM4Water will establish a new workstream for 2021. This will focus on governance of data and this links directly to the need for alignment, control and direction, in order to maximise the benefits data needs to be valid, useable, accessible and of quality."

Kovacs adds: "Both Jamie and myself believe that data governance will drive intelligent and informed decision making from clients, contractors and the supply chain across the asset lifecycle in its entirety, and having this on the BIM4Water Roadmap will work to make this happen."

"There is also a need to understand the gap between industry and academia for digital roles. For example, are academic programmes developing the right skills for the workforce of the future and what does that career path look like? Often seen as a 'starry-eyed' concept that is impractical and idealistic, digital roles are not given the attention they deserve with regards to chartership among professional institutions and such status is still only

recognised for the more traditional engineering roles. To move forward, recognition for digital professions needs to change and the BIM4water Skills Task Group is well placed to drive this message for the water industry. Additionally, supporting learning and development skills, and providing human resources and senior management guidance to how these roles align within organisational structures.

"I'm keen to assist BIM4Water in creating that recognition and portray what 'good' looks like across the water sector. I believe that the BIM4Water Awards is a great place to do that. Although our 2020 awards did not come to fruition, we hope 2021 will be kinder and allow us to celebrate some of the great work being done in the industry with the following three main award categories: achieving health, safety and risk mitigation through digital construction; driving efficiency through digital construction for the asset owner; and digital construction and the data-driven approach."

**"From data quality, accessibility and digital rehearsals to having the right people for the job, it is both the machine and the human elements working simultaneously together that is essential for successful digital delivery. "**

Summarising, Mills says: "It is BIM4Water's vision to be recognised as the voice of the information management landscape and framework for the water sector and, in doing so, developing commonality and standardised ways of working, closing loops of knowledge, sharing best practices and skills to enable open data that is accessible to all. With our new Roadmap, myself and Clare expect 2021 will be about delivering digital transformation as a collective, through joined-up thinking, further collaboration, resource application and realising value for all!"

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**Jamie Mills  
chair**

**Clare Kovacs  
vice-chair**

**BIM4Water**  
[www.britishwater.co.uk/bim](http://www.britishwater.co.uk/bim)

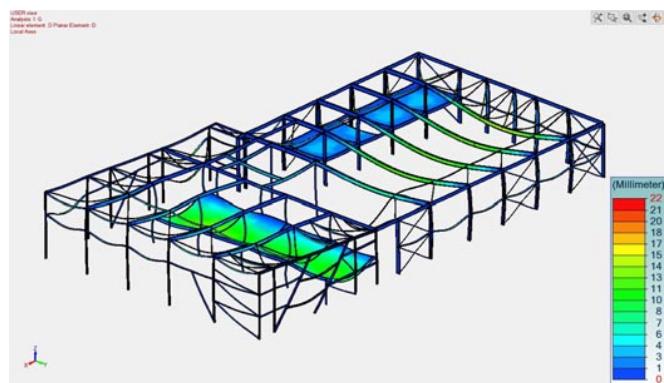
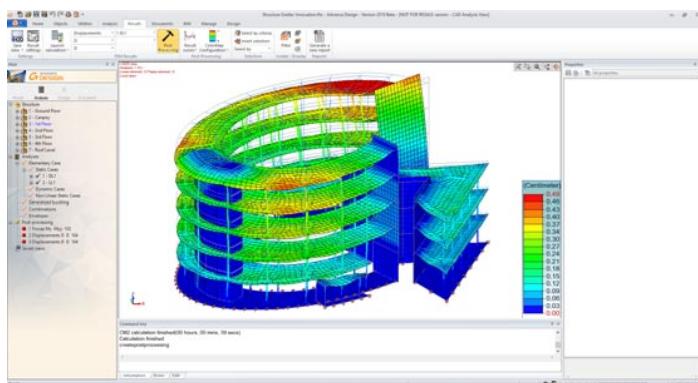


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# Smart buildings and wellbeing: Wearing your heart on your HVAC

**How long before your building “knows” more about you than you do yourself? BSRIA’s Dr Michelle Agha-Hosseini and Henry Lawson take a look**

How long before your building “knows” more about you than you do yourself? As ever-more processing is crammed into smaller, lighter and cheaper devices, it was only a matter of time before people would be able to wear them as they go about their everyday lives.

I am wearing a smart watch as I write this, which is collecting all kinds of information about my movements, the amount of exercise that I take, my heart rate and more. This information can then be transmitted to another device or computer. It can also tell me when, for example, I get a phone call or email. This shows how wearables can transmit information in two directions: information about the wearer can be shared with the outside world, while the same wearable updates the wearer on what is happening in the wider world.

## Comfort in buildings is “hot”

Perhaps not surprisingly, it hasn’t taken long for people to find ways in which wearables could be used to improve the inter-relationship between buildings on the one hand, and the people who live or work in them, or visit them.

One factor that is giving this movement legs is the growing emphasis on comfort and wellbeing in buildings, and the attempts to find ways that building technology can contribute to this. But how does one measure wellbeing, let alone optimise it? One way, of

course, is to ask people and there is good evidence that the mere fact of being consulted can increase people’s satisfaction and potentially their performance.

**“Experience suggests that, if the wearer has a positive incentive to share their data then they are more likely to opt in to a scheme where wearable data is shared. The fact that most of us now, almost half consciously, share a huge amount of personal information via our phones or PCs is an indication of how much people might be willing to share when there is something in it for them.”**

However, as anyone who fills in surveys will know, this can also become a tiresome distraction. So what if my watch can work out whether I am tired or too hot or too cold and tell the HVAC system, which can then adjust ventilation or temperature in my area without my having to ask?

## Use (and misuse) of wearables

It would also provide objective information about the physical wellbeing of people in buildings, which would potentially be both more precise and more objective than

what you might learn by asking them. This immediately raises some challenging questions. The most obvious one relates to data privacy. Where data is shared with a building system, what control can there or should there be over its being seen or used by the people managing the building or even by employers?

If I am seen to be “falling asleep” (or worse) at work, could this lead to intrusive questions about my private life? At the very least, there would need to be clear and accepted rules about who can use this data and for what purposes, and what procedures are required to secure it against illegitimate access or use.

Experience suggests that, if the wearer has a positive incentive to share their data then they are more likely to opt in to a scheme where wearable data is shared. The fact that most of us now, almost half consciously, share a huge amount of personal information via our phones or PCs is an indication of how much people might be willing to share when there is something in it for them. Employees could be incentivised by stressing the health benefits of smart wearables, while customers could be attracted by special promotions relevant to their interests.

## Making the building respond in the right way

There is also a practical hurdle to jump over. If I have detailed information about the state



of say 200 people in my building then this data will be of limited use unless the building system is granular and responsive enough to fine-tune conditions to meet individual preferences. Sensors will need to locate individuals accurately and, more importantly, the HVAC or lighting system needs to be capable of providing very localised conditions which can then follow a person round a building.

**"Ultimately, wearables provide valuable hard data about employees' health. If the data is studied along with qualitative data gathered through occupant surveys, a comprehensive picture of the workplace can be established."**

Without this granularity, data provided by wearables will have more limited value, for

example in setting a temperature that meets "average" preferences for a whole floor of a building.

BSRIA has already held two highly successful workshops on the subject of wearables and will be monitoring the development of this technology. The technology is definitely becoming available.

### **Wearables create and maintain a healthy workplace**

Ultimately, wearables provide valuable hard data about employees' health. If the data is studied along with qualitative data gathered through occupant surveys, a comprehensive picture of the workplace can be established. The BSRIA Occupant Wellbeing (BOW) survey can be used along with data from wearables to indicate whether, and to what extent, employees' health is correlated to and affected by the physical factors of the workplace. This information can help building

owners and operators maintain and control their buildings better.



**Dr Michelle Agha-Hossein**  
Building Performance Lead, BSRIA  
Sustainable Construction Group  
Building Services Research & Information Association (BSRIA)  
Tel: +44 1344 465600  
[consultancy@bsria.co.uk](mailto:consultancy@bsria.co.uk)  
<https://www.bsria.com/uk/>



# What does digital engineering mean to HS2?



**HS2 is the first major infrastructure programme to adopt digital engineering, with BIM at its core, at the very earliest stages of the project to allow future benchmarking to be delivered over the entire lifecycle – and in real time. Head of digital engineering Dr Sonia Zahiroddiny explains how it works**

Digital engineering within HS2 is an umbrella term used to describe the application of Computer Aided Design (CAD), Geographic Information System (GIS) and wider information modelling and management processes to enable a collaborative and efficient collection, sharing, integration and visualisation of engineering and asset data.

HS2 is too big and too complex to be managed using traditional static and document-based ways of working because we will be creating and need to manage large amounts of data. It is vital that the project's data is of a high quality, plus it needs to be accessible and can be visualised in the wider context of the programme to support better decision making.

From its very earliest days, HS2 has been committed to utilising digital engineering, with BIM at its core. This is not only to fulfil our obligations as a publicly procured project but also to go beyond the government's mandate to transform the way the industry has traditionally designed and constructed infrastructure projects. By doing so, we

are following the example of manufacturing, aerospace and other advanced sectors that have used the latest trends in technology to revolutionise their ways of working.

## How is digital engineering being used?

Digital engineering within HS2 supports engineering, asset information, environment, land and property and the railway's delivery phases. Its application falls broadly into four categories:

- For the overall strategy and its implementation, it is important to establish a clear vision, as well as setting clear objectives and requirements to deliver consistent implementation across HS2 and its vast supply chain.
- Our approach to Connected Data Environment (CDE) is to ensure coordination, validation and verification of engineering and asset data, resulting in good quality information that is exchanged between HS2 and its supply chain and multiple contracts and across different stages of the project. The CDE consists of three key components:

**- Geographic Information System (GIS):**

Management of location data and geospatial representations of assets.

**- Computer Aided Design (CAD):** Management of three dimensional (3D) graphical and geometrical data about our assets.

**- Asset Information:** Management of an index of core railway assets and all non-graphical and textual data associated with these assets.

Integration and visualisation platform is the start of creating HS2's Digital Twin and brings together GIS, CAD models, asset, safety and project controls data into one viewing platform. This provides multiple views of the railway as it is planned and designed. This makes it easier and quicker to access, discover and analyse data on which we make key design and assurance decisions.

The Digital Twin will mature with the lifecycle of the physical railway to provide a unified view of the end-to-end railway and how it functions as a system of interconnected systems.

Finally, as part of our strategic commitments we have also established an upskilling platform to provide access to education and training material to both support the HS2 supply chain in responding to our digital engineering requirements and the wider industry.

### **How is HS2 benefiting from employing Digital Engineering?**

HS2 has identified digital engineering, with BIM at its core, as one of the key enablers to unlocking substantial cost and time efficiencies, alongside better environmental and safety management. To realise these projected benefits, HS2 Ltd has established an extensive Digital Engineering Benefits Realisation Framework.

The framework seeks to maximise the investment that the HS2 digital engineering approach will deliver all the way from early concept design to operation at a project, programme and organisational level. It goes beyond a traditional performance management approach to provide an end-to-end assurance process that ensures the right capabilities are embedded at the right time and deliver the intended outcomes.

Mapping of pre-defined capabilities to the resulting changes and benefits provides traceability of what's

having a positive impact and enables real-time adjustment of working practice. For example, one of the core capabilities is to ensure that a clear set of information requirements and data specifications are incorporated into our contracts. These capabilities are grouped into four key elements of: People, Process, Technology and Data/Information.

In line with industry standards, comprehensive guidance, key performance indicators, maturity models, standardised reporting tools and metrics, risk-based auditing and upskilling materials all enable the capture of benefits as they happen, as well as sharing of best-practice and show areas for improvement.

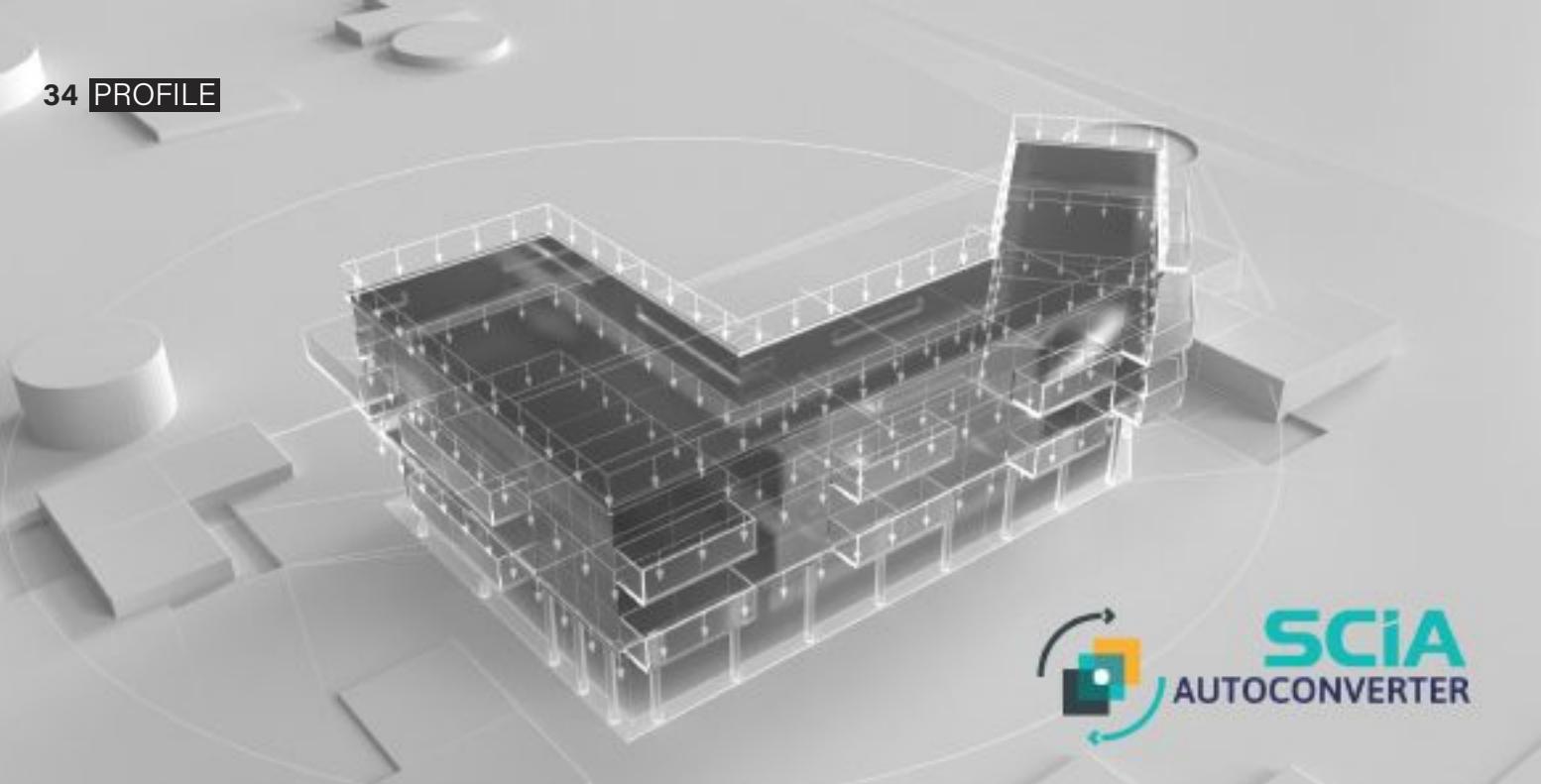
Built collaboratively between HS2 and its supply chain, the framework helps promote the cultural transformation required to deliver digital engineering benefits to HS2 and future projects. A unique approach to storytelling builds momentum for further change and is an effective way to move beyond conservative approaches and capture benefits that hitherto have been hard to quantify. For example, "performance" or "reputation" benefits are measured qualitatively and are therefore much harder to quantify, so storytelling becomes a powerful means of bringing the less intangible benefits to life.

Available research on the benefits of digital engineering has been predominately focused on real estate and construction projects and captured retrospectively, it is therefore limited to quantifiable data. HS2 is the first major infrastructure programme to comprehensively apply digital engineering/BIM from such an early stage in its development. Having done so will enable future benchmarking to be applied to "whole-life" and to be delivered in real-time. By taking such an enlightened and far-sighted approach to digital engineering, HS2 is providing invaluable lessons to an industry mandated to make fundamental efficiencies in infrastructure delivery.

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**Dr Sonia Zahiroddiny**  
**Head of digital engineering**  
**HS2**  
**Tel: +44 (0)8081 434 434**  
**HS2enquiries@hs2.org.uk**  
**www.hs2.org.uk**





# Open BIM for structural engineering

**Viktor Várkonyi, chief division officer and Nigel Rees, project lead at the Nemetschek Group, are challenging the status quo, explaining what the future holds for BIM and structural engineering**

Despite the various software solutions that industry giants like the Nemetschek Group – and its 16 brands – and other companies have developed over the last few decades, the construction industry is still considered to be one of the least digitalised industries overall. There is a lot to be learned by looking at automation techniques from other industries, such as the automotive and manufacturing sectors.

As modern buildings have become increasingly complex and processes increasingly more data-driven, we see the number of stakeholders involved along the value chain of construction projects growing proportionally. This means that handover phases – which traditionally carry the highest risk of losing data due to inefficiencies or incompatible software – increase in number, thereby making the seamless usage of data and ease of collaboration even more important.

**Based on your vast project experience with 16 brands operating all around the globe, what do you think is critical for improving collaboration among the various stakeholders involved in a project?**

Várkonyi: "For us, two things are of the utmost importance. Firstly, we are passionate ambassadors of open standards. Since our company was founded in the 1960s, we have been preaching the importance of open standards for the liberated usage of data. This is not just for architects and engineers, but for data usage across the whole lifecycle – from planning to operation.

"And secondly, our brand teams all share the same Nemetschek DNA: they value working closely with their clients to understand their specific needs. This also creates a tremendous amount of inspiration internally for breakthrough innovations. Understanding the synergies between our brands and

products is crucial to helping our clients improve and facilitate their everyday work. SCIA AutoConverter is a great example of this."

**We assume your development team have plenty of ideas about which processes and workflows could be improved. How do you determine which workflows to focus on?**

Rees: "Client-centricity is the key here again. For instance, a particular challenge structural engineers face is that exchanging data between different modelling tools and structural software packages can be difficult or incomplete. Information can be lost, forcing engineers to recreate different stages of the project and wasting time redoing work.

"A 2019 survey by the Institution of Civil Engineers shows that over 50% of engineering professionals are frustrated by receiving incomplete design data from other

disciplines, and 40% of those professionals are concerned by the risk of exchanging structural data between teams. But in addition to official surveys, where we learn the most is from the conversations we have with our clients. They told us that they needed a more reliable process that maintains the model integrity and associated data throughout in order to increase flexibility for design teams, making the process easier and more productive. In doing this, we ensure we reduce the introduction of manual workarounds, which are designed to overcome the current shortcomings but often just add complications.

"These client conversations point us towards those workflows that urgently need improvement and can create a huge benefit to the industry as a whole. Once identified, it is up to us to utilise the synergies within our group and come up with workable solutions that solve our clients' problems."

### **The theory sounds great, but how exactly are you solving those issues – for example, with the structural engineering workflow?**

Várkonyi: "Our brand teams at SCIA and Allplan worked on a solution specifically targeted at the workflow between architects and structural engineers. SCIA developed a solution called SCIA AutoConverter, which perfects the traditional reference model workflow. This means that the structural engineer and the architect are working on separate models, but they share a reference model with each other which is synchronised in a federated model environment.

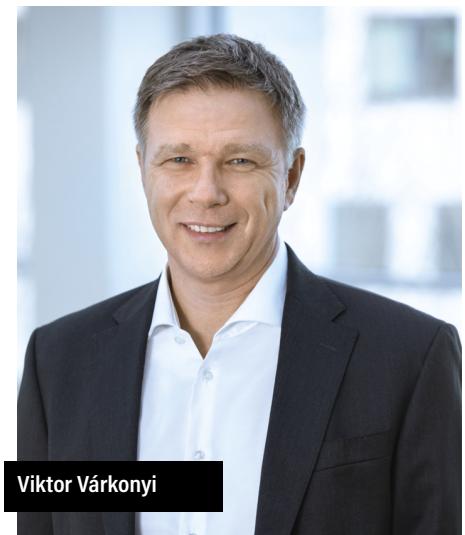
"Typically, structural engineers are often forced to recreate their analysis model from scratch. Some do it at every iteration, frequently losing valuable time to repetitive –

and often mundane – tasks. To address this, SCIA AutoConverter was designed to automatically create the analysis model using data from the centrally managed federated model. It also supports many different 3D design and structural design solutions.

"Throughout this process, the engineer keeps control over how the analysis model is created. I cannot stress enough how important this capability is for many engineers. With the current process, often up to 30% of the schedule is used to build models and keep them synchronised between the design teams. SCIA AutoConverter helps save this valuable time. In addition, the workflow is built on the cloud-based Allplan Bimplus platform, which has powerful change management features and other benefits."

Rees: "Exactly. With project teams being located across different offices or even countries, being able to quickly and easily share and access data at any time, in a managed way, is an absolute necessity. Using the Bimplus cloud technology and Open BIM, 3D models from a range of disciplines and programs can be brought together to create a unified, federated model and then exported to structural analysis solutions, all without losing data."

"Similarly, models can be imported back after structural analysis is complete and then integrated into the federated model with all data intact and enhanced where appropriate. Structural engineering thus becomes integrated within the BIM design workflow, rather than sitting outside the process. Not only does this provide a more efficient and cohesive way of working together by reducing manual rework and errors, it ensures that the workflow is controlled, information is retained and risk is managed."



**Viktor Várkonyi**

### **SCIA AutoConverter is not a prototype; the product is already available, correct?**

Rees: "Yes, SCIA AutoConverter is available directly from SCIA. In addition, we are very excited to bring the model conversion capabilities of this game-changing solution to Allplan in Allplan 2021. With this innovation, supported engineering clients will gain the ability to integrate Allplan models quickly and efficiently to their structural analysis tool of choice, including sister brands SCIA, Frilo and Risa, as well as other structural analysis tools using Open BIM."

**NEMETSCHEK  
GROUP**

**Alexander Siegmund**  
Manager Corporate Communication & PR  
Nemetschek SE  
Tel: +49 89 540 459 255  
[asiegmund@nemetschek.com](mailto:asiegmund@nemetschek.com)  
<https://www.nemetschek.com>





# The Forge: Quantifying the value of P-DfMA and digital delivery

**The Centre for Digital Built Britain, as part of the Construction Innovation Hub, is supporting a ground-breaking commercial development. Thayla Zomer, a research student embedded in the project team, reports on her work assessing the benefits to industry of applying Modern Methods of Construction and a digital delivery approach to a commercial development**

The construction site in Southwark, London, where two nine-storey offices, known as The Forge, are being developed does not look very different to any other building plot – but appearances can be deceptive. What is taking place at this 140,000sq ft development has innovation and digital tools integrated throughout every stage of the project, from design and procurement to construction and delivery.

While government adopted a presumption in favour of offsite manufacturing technologies as part of a transition to Modern Methods of Construction (MMC) and new business models, The Forge marks the first time design for manufacture and assembly (DfMA) and platform design for manufacture (PDfMA) has been applied to a commercial development. The “platform” uses a standardised and componentised approach to construction that essentially creates an onsite “kit of parts” assembly line.

The initiative features collaboration between partners Landsec (developer and lead partner), Bryden Wood (designer) and Easi-Space (prototype engineering and

consultancy), with contractors Mace and Sir Robert McAlpine working in partnership as the manufacturing and assembly managers (MAM). This is a highly innovative partnership and the Centre for Digital Built Britain (CDBB) and the Construction Innovation Hub (CIH) will be mapping the processes and evaluating whether they are delivering the expected benefits and the project learning will also be used to inform and refine the [Construction Innovation Hub's Platform Design Programme](#).

## Learning from real experience

As the appointed researcher, I have been embedded as part of the project team from the start of the detailed design, with the aim of exploring the transition to digitally enabled manufacturing – the adoption of a platform strategy and digital system integration as a new business approach; changes in project delivery (processes and technological innovations); and the impact of integrating platforms, DfMA and digital technologies on project performance.

The project partners have successfully built a prototype model at Bryden Wood's Construction Platforms Research

Centre in Petersfield, Hampshire, and the learnings from this exercise are now being applied at scale. [This 'live' trial of a platform](#) is designed to deliver more consistency to the process of design and build with the aim to increase productivity, safety, accuracy and quality, decrease waste and embodied carbon, and reduce costs by as much as a third when applied to the whole build. [Targets set for The Forge](#) include a 10% cost saving, a 15% reduction in programme time, and a 35% improvement in onsite productivity.

**"The project benefits will be assessed across a range of impact pathways to measure: time savings; materials savings; cost savings; environmental impacts; improved health and safety; and reduced risk."**

This is an opportunity to learn from real experience. The integrated digital approach taken at The Forge establishes a new form of collaboration between a multi-skilled team drawn from different disciplines in order to capture a system view of the project, in contrast to a traditional linear approach often led by a single manager.

The principles of digitally enabled manufacturing have been adopted, with the production of information models and the use of a range of technologies creating a digital chain across all of the stages of the project to design, procure, build and check the building. My research will record and analyse the success in use of each of the integrated tools contributing to the project's learning legacy for industry. Changes in processes and workflows are studied, mapped and compared with the traditional delivery approach. At the end of the project, the team will be able to reflect on the workflows adopted and identify how they can be optimised to deliver greater value to new projects.

The P-DfMA approach, supported by digital technologies, requires a change in the way in which the work is planned and the sequencing of activities. To address this, the project team developed a more integrated way of working. For example, in the early stages of the project, the BIM Execution Plan developed by the project team did not only incorporate suppliers' methodology for delivering the project using BIM and digital technologies as in the usual delivery approach, but it incorporates both the BIM and DfMA implementation strategies. A digital delivery approach has been developed by the MAM team, and a model development strategy has been put in place considering the DfMA rules applied. A holistic design

process has also been adopted encompassing how structure and objects will be manufactured, assembled and guided with DfMA principles.

A number of innovative tools have been used and the project team has worked on how to integrate these different tools to achieve project objectives. For example, the team has focused on the identification of the outputs of each tool that should be monitored and reported by Power BI (a tool used for better visualisation and data management). The team has identified the measures and data from the tools (eg Qflow, T+ and Disperse) that will be used for monitoring (eg compliance of models) and that could give insights into what is happening, also allowing to track the productivity across the stages.

The use of such technologies is also particularly useful given the current Covid-19 situation. If the team is working remotely, they will be able to have access to the site and visibility of issues to discuss in real time, enhancing decision-making while saving time and resources.

### **Assessing benefit of combining P-DfMA and digital tools**

The project benefits will be assessed across a range of impact pathways to measure: time savings; materials savings; cost savings; environmental impacts; improved health and safety; and reduced risk.

The framework takes a system approach that captures the dynamic processes within the project as a whole, avoiding a silo perspective that brings limited focus to the assessment of one aspect in isolation. By measuring the benefits of combining MMC and digital technologies in an integrated way, it will be possible to establish new benchmarks on productivity and showcase to the whole industry the value of these innovations.

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**Thayla Zomer**  
Research student  
Centre for Digital Built Britain  
[ttdsz2@cam.ac.uk](mailto:ttdsz2@cam.ac.uk)  
[www.cdbb.cam.ac.uk](http://www.cdbb.cam.ac.uk)



# The power of documents in a construction project dispute

**When it comes to project disputes, being able to access to the correct records and information can be the difference between winning and losing. It is therefore crucial for businesses to document everything – and to ensure they can find it when it is needed**

Projects can easily be affected or delayed by amendments and scope changes at the best of times. But in these uncertain times surrounding the Covid-19 outbreak, the chances of delays, contract rewrites, difficult conversations and, ultimately, contract disputes occurring are even more likely.

This is particularly the case in the construction industry, where ineffective document management processes and solutions can easily lead to costly legal disputes. To explore this issue further, we summarise some of the insights provided by Graham Brown, a partner at Canadian law firm Cassels, Brock & Blackwell, and by Mail Manager, in a webinar we recently hosted.

## A proactive project management approach

Taking a proactive approach to project management can save huge amounts of effort, keep parties out of the courtroom and ensure a higher degree of success in potential cases. This is reliant on keeping a record of all project agreements, any changes in project specs, and retaining all correspondence both incoming and outgoing.

However, many businesses across the architecture, construction and engineering industry are currently lumbered by a number of inefficiencies, such as:

- Project managers not fully understanding contracts.

- Change control being open to interpretation and information frequently being tracked informally.
- Businesses have less visibility but more risk than ever.

## Documents win disputes

An important mantra to adopt when addressing these productivity shortcomings is "documents win disputes". Before any dispute gets anywhere near a courtroom, documents play a huge role in the litigation process. That's because both sides of a project dispute must present all of the relevant documents in order to prove their argument and enable the other side to fully understand the case.

The reality is that when judges are presented with two different stories, they look for evidence that goes beyond oral testimony and provides documented proof. It's therefore crucial for business to ensure that everything is documented, from contractual motives and change directives to site condition agreements, invoicing and progress draws, and prompt payment notices.

Businesses need to know what their contractual terms are, where their contract is and where they can find documents that may underlie that change. They also need to be able to access this information and collate it quickly to submit their request and respond to consultants' questions in a timely manner.

Unfortunately, many businesses don't think about how important documents are until they come to make a claim. And by that point, it's too late.

## The dangers of not being prepared

There's a common saying in law that states: "If it's not in a document, then it didn't happen." This is crucial for all businesses to remember, regardless of whether they are currently involved in a project dispute, and the absence of even a single key document could result in that business finding itself on the wrong end of a legal dispute.

Bad cases can sometimes win and good cases can sometimes lose. And, more often than not, the reason for a good case losing is that the parties don't have the required documents to prove their case. Frequently, a party has a strong case but can't support it with documents. Where this happens, and there's conflicting testimony, the court is likely to prefer the case supported by documents. If neither side has any supporting documents, courts often reach decisions where one might feel that "both sides lost".

Therefore, any time an agreement is reached on-site, it should be recorded in an email or other document that states what was agreed and when. This step ensures the business has a record of the agreement that can be used as proof at a later date.

These steps could be seen as trivial but they

can be vital if a dispute arises. Missing a limitation period or contractual notice period could mean that a business loses its claim. Similarly, getting deep into litigation due to a lack of documents will result in a risk of substantially increased legal fees.

In addition to the importance of documenting project information, it's also vital to retain that data. There are many cases where businesses have been sued for latent defects well after the initial two-year limitation period has expired, but within the "ultimate" limitation period. Those cases can survive because of the latent nature of the defects. A company making the incorrect assumption that it could destroy documents after two years could be left without any evidence about the project and no way to guard against the allegations in the litigation. You might say that it is no use carefully documenting a project if the documents are destroyed before they are needed. Although every jurisdiction has different business document retention rules, a reasonable approach in Ontario could be to retain project data for at least 15 years after project completion.

## Why are businesses unprepared?

One of the biggest underlying causes of poor document management practices is that employees believe they have more important jobs to do. They will frequently say "it's not my job" to put documents in the right place and ensure all of their emails are filed how and where the business wants them to be stored.

Other common reasons for businesses being unprepared to provide documents in the case of a legal dispute include:

- People being too busy.
- Employees filing documents in their own way or into folders on their desktop.
- Businesses not having systems in place for filing emails to a specific location.

- Employees thinking it's not important to file emails in a specific location.
- Businesses not having the right technology in place.
- Intentional or automatic destruction of emails and documents.

Employees often don't consider the effect that their actions could have down the line when their company ends up getting sued or a supplier refuses to pay them. For example, construction businesses' project managers will frequently say they are too busy or too focused on other tasks, such as on-site work, to also manage the tedious process of filing emails or searching for documents they sent five years ago.

The onus is therefore on the business to set standards for employees' roles in creating and preserving documents. Among other things, it is recommended that businesses update their destruction of document policies and implement technology to help their employees comply with the new rules.

## Best practices for effective document management

The different types of documents that a lawyer might require for litigation form a lengthy list. The tip of the iceberg is the contract itself, supplementary conditions, procurement documents, bids, quotes, estimates, drawings, specifications, requests for changes, photos, videos, emails, letters and text message correspondence. The list goes on and often includes almost every document created or maintained during the course of a project. It is therefore best practice to document everything pertaining to a project and store all documents created or received carefully.

It's also important to have a best practice for how and where documents are retained and how long they will be kept for. This will help people to quickly find the information they

need in the event of a dispute and prevent information from getting lost when an employee leaves the organisation or if they happen to be on holiday during a dispute. Employees also need to understand the reason that documents are required in the event of a company becoming the subject of a dispute. When employees understand the importance of their actions, it typically results in better buy-in from staff.

Nowadays, litigation is digital and every business needs to be able to confidently say: "I can go and find that specific email for you straight away." To do this, they need to ensure that documents are stored in the right location, can easily be discovered by anyone who needs access to them and can be exported without it taking days to download the data.

A dispute can often be settled long before the case gets to an expensive trial or even oral examinations. Businesses that have better documents will fare better in disputes.

## The role of email in disputes

The construction industry has a long-held myth that emails are not important. In fact, emails often play an important role in recapping important agreements, and can even act as the formal record of an agreement or amendment. Many businesses do not realise the importance of emails until they have to go back and find evidence of something that they allege happened.

Email is the most-used form of project communication but is also the one thing that every employee tends to manage differently. That's because there are many methods for managing emails, from storing them on a server, shared folders or in the cloud to people setting up their own subfolders in Outlook, creating rules that automatically move emails or simply leaving them in their inbox.

What's important is not necessarily the email

itself but the information contained within it. And often, when a project manager goes to find that key bit of information, they discover it's not there. That's because important information can easily become lost due to the various techniques employees use for email storage, messages get stuck in individual inboxes or due to duplicated copies eating up space on email servers.

To prevent this, businesses need to ensure that emails and documents are organised consistently and that important correspondence is always managed in the same way. This will minimise the chances of information becoming lost and ensure employees spend more time on fee-earning work.

Managing email consistently can help to avoid project disputes that arise out of comments such as "this isn't what we agreed", "when did you tell us this?", "you never sent us that" or "I wonder if we have sent that?" And it was these common situations that led to the creation of Mail Manager's technology.

### **How Mail Manager eases document management**

Mail Manager is a Microsoft Outlook add-on that was first engineered internally by Arup Engineering around 10 years ago. The company's 16,000 employees were all managing email in different ways, if at all. Indeed, more than three-quarters of project information was contained in emails but wasn't linked to projects or folders – instead, it was locked inside employees' email inboxes.

This led to employees wasting crucial time looking for key correspondence and resulted in Arup experiencing risk and disputes. The organisation went in search of a solution that would help all of its employees find any email on any project in seconds, without wasting time on filing. And, in the event of not finding one, they built their own.

In addition to preventing email from becoming locked in peoples' inboxes, Mail Manager also helps to solve common issues such as:

- Project managers being ill-informed when making decisions.
- Wasted time spent searching and filing emails manually.
- The risk of losing sensitive information.
- Staff being overwhelmed by email overload.

Mail Manager uses a simple but highly effective piece of Artificial Intelligence that helps people to file emails to the correct location. It looks at where they've previously filed emails, the other people copied on the message and scans the content of the message in order to ascertain the most appropriate filing location.

The tool also helps organisations to correctly file sent emails. Many companies generally do not file sent emails, yet they are just as important, if not even more important, than filing received emails when providing instructions on a project. Mail Manager automatically prompts users to file messages to the correct location every time they send an email.

Mail Manager contains a powerful search functionality that saves staff sanity. As discussed above, project managers are busy and don't want to spend hours or even days digging through their inboxes to find a particular email or document in the event of a dispute. Mail Manager does the hard work for them, and is capable of searching through a million emails to find the results the employee needs in as little as two seconds.

With Mail Manager, every employee in an organisation can now easily file emails and

documents in the correct location. It also ensures that any other person in the business can quickly discover that information as and when they need it. This saves people huge amounts of time and helps them to become far more productive on a daily basis.

In the event of a contractual or project dispute, the tool is absolutely vital. A project manager can immediately discover the particular document or an agreement made via email and provide their lawyer with the information they requested.

For more insight from Graham Brown and Mail Manager on this topic [watch the webinar here](#). And to discover how Mail Manager can improve your business' document management processes and help you avoid potential legal disputes [sign up for a free trial](#) now.

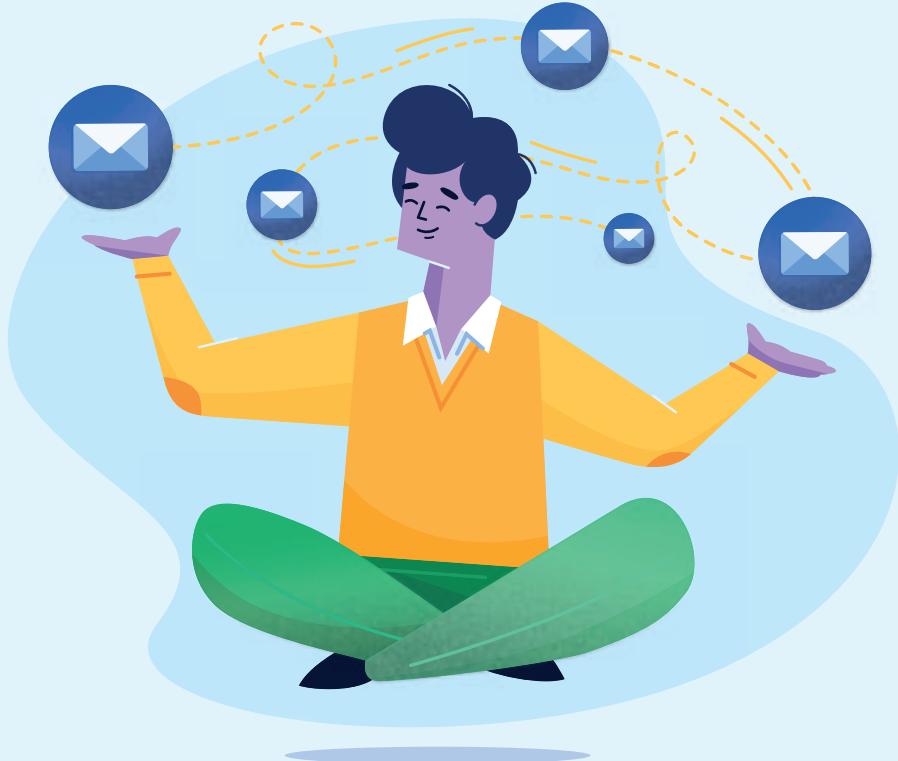


## **Mail Manager**

**Michele D'Andrea-Rodrigues**  
**Mail Manager Limited**  
**Tel: +44 (0) 20 7755 4970**  
**[sales@mailmanager.com](mailto:sales@mailmanager.com)**  
**[www.mailmanager.com](http://www.mailmanager.com)**



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# Building the foundations for AI

**The use of big data and reliance on machine learning capability are becoming standard project control tools. Niru Sundararajah, a data scientist for Aecom's Cost Intelligence Europe team, shares his perspective on how solid foundations for data management are crucial to successful analytical outcomes using AI in construction**

We see many discussions about big data, especially among data scientists, and we're seeing a shift in that rhetoric towards the untapped potential of Artificial Intelligence (AI) to revolutionise the AEC industry – particularly the construction sector.

AI implementation case studies in this field are more easily found these days touting successes regarding the improvement of cost prediction and risk mitigation – those alluring golden markers of success that are highly convincing – and it's understandable why the use of AI in construction continues to grow by leaps and bounds.

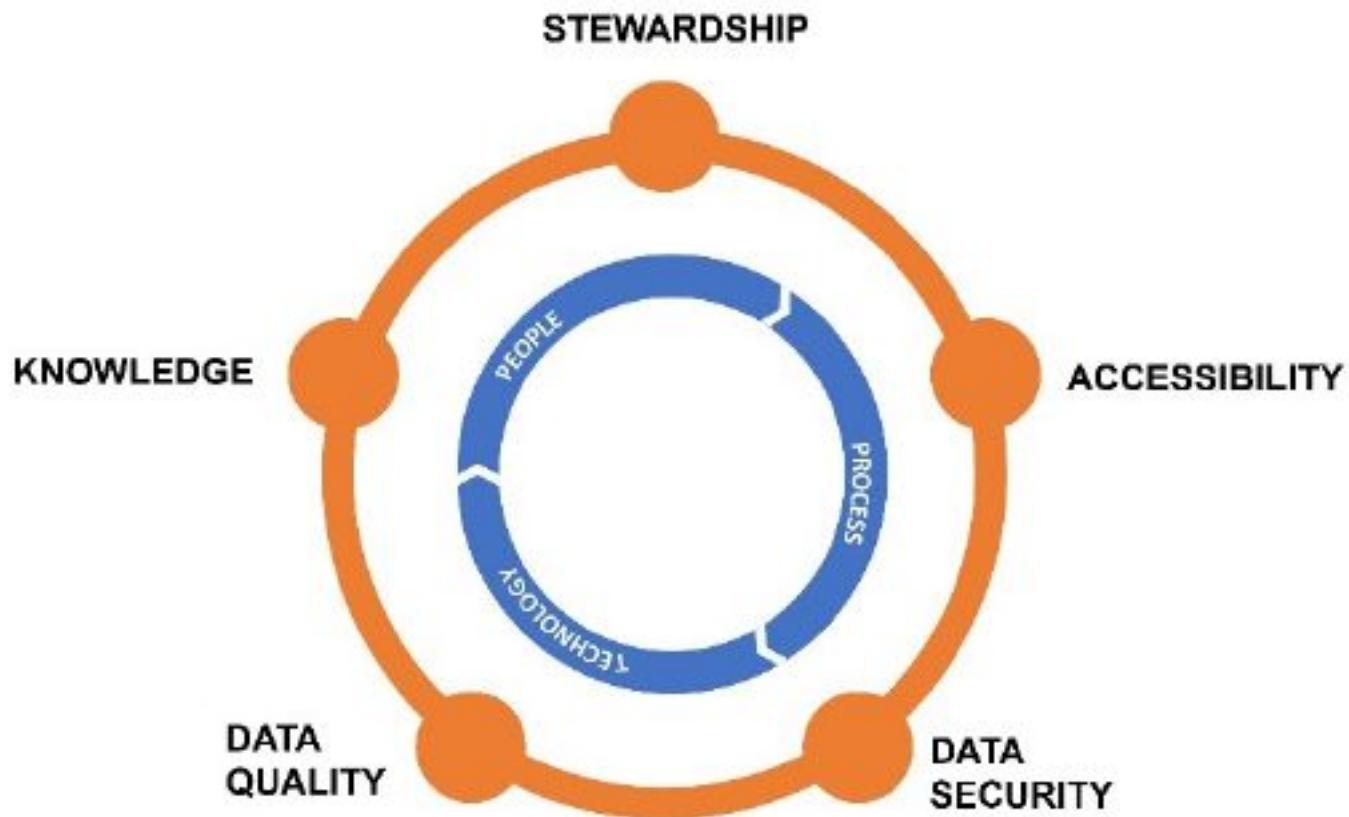
The lure of AI is justifiable and, within the Aecom Cost Intelligence team, it has improved both the quality and efficiency of our client services. Clients are leading the charge for intelligent data as they see the value proposition of becoming increasingly conscious about the use of their data to enable better prediction and enhance decision making processes.

Aecom has created AI tools to meet client demands and assist them on their full lifecycle digital journey to ensure their projects work for them to produce accurate cost predictions with less effort compared to current processes.

Despite the accolades and success stories within and beyond our organisation, the potential offered by AI remains largely untapped primarily due to the more traditional challenges surrounding data governance as it relates to where the data resides, the volume of that data and the quality of available data.

## The need for data

When using AI applications, we're relying on a clean dataset of consistent variables in order to infer trends and patterns before formulating predictive results. In order to perform optimally, we require large quantities of that clean or high-quality data. What we mean by that is any deficiencies in either data quality or quantity will prove to be a significant stumbling block for AI in construction.



Data stored outside of a common data environment or scattered across disparate software platforms are significant industry issues to overcome. An overarching data governance programme is the key to unlocking the value of organisational data in order to successfully navigate this hurdle.

### **What is data governance?**

At its core, data governance concerns the right mixture of process, technology and personnel to govern the input, storage and use of data in order to meet and exceed business goals. The Data Governance Institute dives into greater detail, describing data governance as "a system of decision rights and accountabilities for information-related processes, executed according to agreed-upon models which describe who can take what actions with what information, and when, under what circumstances, using what methods."

Traditionally, data governance frameworks have a wide

reach and vary based on client requirements and organisational needs. That said, there are several key aspects that are commonly present across data governance frameworks:

- **Stewardship:** Promoting accountability by assigning stewards/custodians to relevant datasets.
- **Accessibility:** Facilitating availability of data for relevant stakeholders.
- **Data security:** Ensuring sensitivity-based safeguarding measures are implemented on databases.
- **Data quality:** Maintaining and monitoring data quality to ensure its suitability for intended applications.
- **Knowledge:** Preserving and improving data knowledge within the organisation by ensuring documentation of data systems and related processes are kept up to date.

## How is data governance relevant to AI?

While a strong data governance programme establishes baseline approaches to data use, the most critical aspect for the purposes of AI implementation is ensuring high-quality data is available for collection. This is achieved through various means; most critically through its emphasis on data quality.

By defining data quality requirements, an effective data governance framework will promote accountability and encourage initiative among stakeholders to maintain the useable of data both for ease of reporting due to a consistent data set and especially for AI purposes.

Pursuit of a robust data governance programme, like any quality programme, is best shared by all stakeholders – particularly those in leadership positions. The burden of storing and maintaining a clean dataset that is focused on the storage and transfer of data, as well as its consistency, ensures that everyone in the organisation has access to the data they require for each use case and assures continuity in the face of personnel changes.

## Who is responsible for data governance?

As we've already alluded to, data governance requires collective effort for successful implementation. However, it's the senior leadership that must firstly buy-in to the criticality of data governance policies and programmes, and drive this message across the organisation - embedding data governance discussions into wider business strategy. Further, a top-down intervention is pivotal to ensure data governance tasks are prioritised. By promoting data consciousness at the top of the organisation, it will be easier to shape the right data governance culture to produce the metrics and predictive analytics that can mitigate risk and increase profits. By doing this, the benefits offered by AI can be leveraged.

## What are the next steps?

At times the route to AI can be a tricky space to navigate due to the complexities surrounding data governance and the wide array of stakeholders who create and use data and data systems across an organisation.

Aecom works with clients across the AEC industry who are looking to improve their data pipeline and systems across diverse portfolio of projects. We work with clients to firstly develop a standardised data quality assessment framework based on recognised industry standards.



Niru Sundararajah

Secondly, as data quality is a key principle of data governance, we recommend the adoption of companywide best practices to enable clients to achieve their data governance objectives.

We're actively assist clients in reshaping their data processes and systems in order to build the foundations for AI; enabling our clients to begin the journey of fully leveraging the potential AI has to offer - a long journey of transformation but well worth the effort. The hope is that data and AI will not only help us navigate complexity in the future, but it will also help our industry achieve better environmental, social and governance outcomes that allow communities to thrive.

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**Niru Sundararajah**  
**Data scientist, cost intelligence, Europe**  
**Aecom**  
**Tel: +44 (0)20 7061 7000**  
**[www.aecom.com](http://www.aecom.com)**





# Tackling the housing shortage: Wind and watertight in a day

**With the Advanced Industrialised Methods for the Construction of Homes project reaching the halfway stage, project director Stewart Dalgarno provides an update on its progress to date and the next stage of the journey**

In 2019, the annual housebuilding target was missed by 138,978. The UK government wants 300,000 new homes built a year - a number not hit in 50 years. Traditional methods of construction simply fall short on delivering the volume of homes required.

The events of 2020 have emphasised the need to transform the housing and construction industries if we are to deliver the quality homes needed to meet current and future demand.

## Can you build a wind and watertight superstructure in a day?

This is exactly what the Advanced Industrialised Methods for the Construction of Homes (AIMCH) project set out to do when started 18 months ago, trialling a range of solutions that could help to tackle the UK housing crisis by building new homes faster.

Working with the UK's biggest housebuilders, the project is a national meta-study to compare new and old manufacturing methods on actual building sites, and the impact Modern Methods of Construction (MMC) has on the housebuilding industry.

We are now halfway through the three-year project and, more than ever, we are convinced that MMC, such as offsite panelised systems and digital working, offer unrivalled benefits.

The project is collecting findings across different sub-studies: on-site monitoring, productivity, cost, and digital and industrial innovation. Some of this innovation includes augmented reality, offsite panelised systems and roof trusses being lifted fully into place.

So the answer to the question is yes, we can build a wind and watertight home structure in a day. In fact, homes can be erected in under six hours using panelised MMC offsite construction technology (Category 2 MMC as defined by the government), and findings from the first half of the project are extremely encouraging, showing that we can build homes significantly faster.

Getting to wind and watertight stage is critical to building a home efficiently and cost effectively. The AIMCH MMC systems being trialled for mainstream uptake, ensure the building envelope is completed fast and to a high quality, using pre-insulated wall systems, factory fitted windows,



Stewart Dalgarno

pre-loading materials and roofing systems that can be pre-tiled, without the need for scaffolding or safety decking during the construction process. Optimising the crane to a single day ensures buildings can be progressed internally and externally immediately after the building envelope is completed.

From foundation level to completion can take as little as eight to 10 weeks, depending on house size and complexity, half the time of traditional masonry methods. This balanced approach ensures controlled processes with a high predictability of achieving completion dates on time. Weather risks are eliminated and follow on trades can work in parallel and in harmony, de-risking the reliance on bricklaying skills and availability of workers.

However, the fast delivery of homes does not result in reduced quality. In fact, AIMCH study findings so far support a reduction in defects using Modern Methods of Construction. This, coupled with the advantages of productivity gain, and the potential for cost reduction, while also reducing cash usage and development funding costs, demonstrates that MMC can deliver the transformation required by the industry.

Innovation and collaboration have been at the heart of the progress made so far and AIMCH partners have really embraced and enjoyed the opportunity to co-create solutions that will benefit the wider industry. As a result of the collaborative approach adopted by the project team, the scope of the AIMCH project has evolved, meaning new, innovative workstreams have been added including topics such as embodied carbon, the use of augmented and mixed reality and whole of life costing. The work we are currently pioneering has the potential to drive wider impact on the industry, on how we build, monitor and improve our homes.

A key success over the past year has been prototyping panelised systems on live builds. Several closed panel timber frame units were delivered on a live development near Warrington and Milton Keynes by AIMCH partners Barratt Developments and L&Q. On the Barratt development site, two of the units were also erected without any scaffold, as well as the roof being pre-tiled on the ground before being lifted into place - a first for Barratt as a company.

Prime Minister Boris Johnson visited the development in August this year and had chance to see the AIMCH prototype homes being constructed using advanced MMC. All six homes are now complete, sold and being lived in – a fantastic achievement and a great result for the AIMCH project, Barratt and partners.

Another AIMCH prototype build is progressing at L&Q's Saxon Reach development in Milton Keynes, where all 225 properties on-site – ranging from one-bedroom apartments to five-bedroom homes – are being constructed using Stewart Milne Timber Frames' offsite panelised systems. These offer a more energy efficient build and significantly lower running costs for new residents, helping to tackle issues such as fuel poverty and significantly reduce household bills. Several innovations are being trialled including pre-fabricated party wall system and a fire safe closed panel solution for apartments. Product testing is underway to validate the systems being trialled to ensure they meet all the requirements of future regulatory demands, such as energy, whole life cost, embodied carbon and building safety requirements.

The approach from both AIMCH partners has allowed better quality homes to be delivered quickly, particularly important in areas that are experiencing significant



Prime Minister Boris Johnson saw AIMCH prototyping in practice recently at Barratt's development in Warrington

population and employment growth over recent years. Something we hope to see rolled out across the whole of the UK, so the data that is being collected now by AIMCH is key.

Digital technology also plays a pivotal role in the AIMCH project, where automotive learning from around the world is being used to develop advanced manufacturing approaches, such as simulation, to build a model of the "future offsite factory" where digital technology and automation such as robotics drives productivity, lowering production costs and increasing capacity.

The development of BIM has also changed the way that construction companies interact with data and is helping them to understand its true value. The sector is growing more aware of the value of creating, gathering and analysing data. Access to more reliable and plentiful information helps companies make informed decisions about processes, materials and improve productivity, reduce costs and increase sustainability during construction projects.

The AIMCH project is at the forefront of change and we are well down the line on developing a guide to creating a BIM Housing Manual for developers, that will be specific to housing developments. Organisations will be able to use this manual to create a digital representation of the physical and functional characteristics of a building and we will be trialling this with partners towards the end of the 2020.

These technological changes mean we also need a workforce equipped with the necessary skillset to support the transformation in housebuilding and construction industries. This brings the opportunity to attract new talent with digital, logistics, engineering, design, robotics, BIM, supply chain and project chain management skills, making the sector more appealing and creating a diverse workforce. These new, smarter ways of working will help the industry to achieve more with less, the need for which has been highlighted even more this year as the industry adapts to working through ongoing Covid-19 restrictions.

It has been a challenging year for the sector, yet despite this, we are achieving fantastic outcomes. Much has been achieved since the AIMCH project started 18 months ago and we are incredibly excited about the next part of the journey, where we will be looking at creating a future factory model, design standardisation, studying productivity, commercial viability, embodied carbon and implementing new technologies. For example, one of the new technologies currently being tested by AIMCH partner Forster Roofing is the digitisation of an innovative roof tiling system using augmented reality that will help to improve productivity in terms of the speed at which roof tiles and renewable systems can be fitted. The opportunities for the sector really will be transformational and we will continue to collaborate with industry partners.

We will drive the adoption of MMC by de-risking it for small-to-medium businesses, making construction a more digitally integrated, manufacturing and assembly-based sector that delivers the required high volume of sustainable quality homes that society needs.

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**Stewart Dalgarno**  
**Project director**  
**Advanced Industrialised Methods**  
**for the Construction of Homes**  
[aimch@cs-ic.org](mailto:aimch@cs-ic.org)  
[www.aimch.co.uk](http://www.aimch.co.uk)

# Digital twin: Cities and their digital doppelgangers

**As cities around the world begin adopting digital twins, the AECO industry must examine how exactly they impact large-scale projects and how this impact will develop in the future**

Digital twins are capable of disrupting how capital projects and infrastructure globally are planned, built and operated.

This is attributed to their enhanced predictability and performance capabilities. The most significant use case of this innovative technology is on capital projects during the development and operation of cities. Cities have become early adopters of digital twin technology and, as such, city planners are using virtual models to gain a competitive edge.

As more global cities, including the world's largest cities, begin adopting digital twins, the industry must examine how exactly they impact large-scale projects and how this impact will develop in the future.

## Benefits for city developments

A digital twin enables more effective asset design, project execution and asset operations by integrating data and information throughout the asset lifecycle. As a data resource, it can improve the design of a new asset, the understanding of an existing asset,

run simulations and scenarios, or provide a [digital snapshot for future works](#).

For stakeholders across the supply chain involved in the operation of a city, this technology provides them with access to more tools and information, compared with traditional methods and techniques.

Digital twins provide the tools needed to operate a city as effectively as possible. Construction progress, energy consumption, environmental conditions, public safety, waste

**"While digital twins could vastly reduce errors and improve the planning, building and operation of a city, it is clear that data security and the sharing of information remains a challenge."**



management, security monitoring, mobility improvements and infrastructure management are just a selection of the areas which can be improved through the execution of [digital twins](#).

Away from construction and operation, digital twins also benefit city dwellers, who can use the technology to explore how different planning decisions will affect their day-to-day life. Through the use of visual simulations or derived data, citizens can tell how a planning proposal will [change the view from their apartment or traffic congestion on their commute](#).

### **A digital twin from the outset**

The benefits of adopting a digital twin demonstrate the advantage of integrating the technology at the start of a major project, such as the development of an entirely new city.

Cities around the world are beginning to recognise these benefits and, as a result, there has been an increase in the adoption of digital twin technology.

Announced at the World Economic Forum in Davos in 2019, Amaravati, the new capital of the Indian state of Andhra Pradesh, is thought to be the first entire city born with a digital twin. The city is the most recent urban hub to develop a digital twin, joining the cities of Singapore, Glasgow and Boston, which also use this digital technology.

Digital twin technology is being used for the city to be built as effectively as possible; everything that happens in Amaravati will be scenarioised in advance, optimising outcomes.

It is hoped this project will provide the industry with the push needed to revolutionise how cities are designed, built and managed.

### **Retrospective building**

As with digital twins of built assets, digital twins of cities can be created retrospectively. A calibrated model can be created through the interrogation of real-time data from a built

**"The benefits of adopting a digital twin demonstrate the advantage of integrating the technology at the start of a major project, such as the development of an entirely new city. Cities around the world are beginning to recognise these benefits and, as a result, there has been an increase in the adoption of digital twin technology."**

asset, which is used to determine the appropriate inputs for a simulation model that, in turn, is compared to measured sensor and meter data. This calibrated model then becomes a digital asset.

For cities, this means established urban locations can be recreated digitally to not only test and analyse city outputs and patterns but to also function as a simulation model.

Originally a research project between Newcastle University and Northumbrian Water, Newcastle was the first city to use technology to recreate the entire city digitally. Based on data, mostly being supplied by Newcastle University's Urban Observatory, from across the city, the virtual counterpart is being used to test how the city would respond to various challenges, such as climate change and population growth. The computer replica allows experts to perform real-time resilience testing to see how its infrastructure will respond.

The first project of its kind, the aim is to enable more cities around the world to respond quickly and effectively to future threats, including rising sea levels, freak weather events, drought and energy shortages.

### **What does the future hold?**

While digital twins could vastly reduce errors and improve the planning, building and operation of a city, it is clear that data security and the sharing of information remains a challenge.

To allow the use of digital twins in cities and realise their potential, the AECO sector needs to adopt an [interoperable, integrated and inclusive approach](#) to construction globally.

Should the sector overcome this challenge, digital twins will transform how our cities are planned, built and operated, creating more efficient and effective cities around the world.

Asite has been at the forefront of innovation in the AEC sector since its establishment in 2001. As such, we have recognised the potential digital twins have to not only transform and improve our industry but also transform and improve our lives on a whole. Asite's platform supports the collaborative nature of digital twins and provides stakeholders with the tools they need to collaborate and share information in a secure online environment. To find out more, email [sales@asite.com](mailto:sales@asite.com).



**Asite**

Tel: +44 20 7749 7880  
[sales@asite.com](mailto:sales@asite.com)  
[www.asite.com](http://www.asite.com)





# Driving innovation in infrastructure

**The Intelligent Infrastructure Control Centre is a new cloud-based platform developed by the TIES Living Lab that aims to harness digital to radically change the way the UK designs, delivers and manages transport infrastructure**

The Intelligent Infrastructure Control Centre (IICC) is designed to push the pace of digitisation and innovation to drive better, faster and greener delivery of UK infrastructure.

A demonstrator for the IICC has been developed by Costain, working with key partner SAP and the Transport Infrastructure Efficiency Strategy Living Lab (TIES Living Lab), a consortium that includes HS2, Transport for London, the East West Rail Company and Network Rail.

## TIES Living Lab

With the UK set for a wave of infrastructure investment worth £600bn over the next decade, the TIES Living Lab has been created to maximise the opportunities to drive efficiencies in the delivery of transport projects and to

build capability within delivery, innovation and managing construction risk.

There are 25 partners in all, working with government, i3P and the Construction Innovation Hub to use data, technology and Modern Methods of Construction within live transport infrastructure schemes to deliver significant value-adding benefits across the sector.

The UK has a modest track record on infrastructure delivery, with some programmes completed late, over budget, failing to deliver the expected benefits or being cancelled after significant investment.

With the increasing pipeline of major projects, capacity to deliver is being stretched and many programmes are



tending to avoid innovation risk. Such attitudes are deeply engrained and cultural, creating barriers to greater adoption of MMC.

The TIES Living Lab is designed to offer a strategic, scalable and sector-wide approach with government, client groups, suppliers and academia working in partnership. It works with i3P and the Construction Innovation Hub to tackle systemic issues that still obstruct the use, integration and adoption of innovations that could drive productivity and wider social benefits through major construction schemes and aims to be a catalyst for cultural change, shifting focus within infrastructure delivery decision-making from the costs of construction to understanding whole-life value.

### **The Intelligent Infrastructure Control Centre**

The IICC is one of the first initiatives to come out of the TIES Living Lab. It has been developed to harmonise the vast quantities of intelligence that infrastructure projects generate and drive greater productivity and resilience

through the capture of efficiency and innovation. This will contribute to a radical culture change in how the industry designs and delivers projects and will offer a completely different way of managing operations that will save money and time.

The system takes comprehensive operational data from an infrastructure project portfolio and then synthesises the information on to one platform. At a project level, this data is essential to effectively manage operations. At an enterprise level, it informs numerous processes including budgeting, talent acquisition and external reporting. For organisations with responsibility for national infrastructure across the UK, the IICC system can deliver complete visibility of enterprise performance.

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**With its built-in analytics functionality, it can also literally predict the future. Where data isn't easily available, it uses artificial intelligence to deep mine the existing data to manufacture data that means you can start to predict the outcomes and look at scenarios and decisions that are going to be made.**

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Tim Embley, director of research, innovation and development at Costain, said: "Many of our clients across all sectors we work in, whether it be energy, defence, water or transportation, face challenges with having consistent and accurate data on critical factors such as commercial, carbon, safety, as well as complete cost transparency. But, of course, optimising the design, delivery and operation of infrastructure schemes requires access to the right data at the right time to help inform decision-making and look for opportunities to increase the whole-life value of any programme or asset, including things like social value, which can sometimes remain hidden."

"Within the system, you can bring different datasets to life – what gets collated and tracked is decided collaboratively with the client. It brings full data transparency to empower the key decision-makers. With its built-in analytics functionality, it can also literally predict the future. Where data isn't easily available, it uses artificial intelligence to deep mine the existing data to manufacture data that means you can start to predict the outcomes and look at scenarios and decisions that are going to be made. This helps reduce the unknowns and significantly reduces risk, thereby cutting costs, increasing efficiency and giving greater delivery certainty."



Neil Robertson, chief executive of the National Skills Academy for Rail (NSAR) and TIES Living Lab programme lead, said: "It's hard to build or maintain a piece of transport infrastructure. A lot can go wrong, and it frequently does, so improving the information available and turning them into insight as well as foresight is incredibly useful. One of the potentials of the IICC is that we see things before they take a turn in a certain direction and the anticipation of problems is a real gamechanger."

### Rapid transformation

Another issue faced at both a company and industry level is that of "innovation siloes", where great ideas can become buried and are not shared. This represents a huge loss of potential value. Using the IICC, innovations can be identified and transferred on a live basis. For example, there could be an innovation on a road project where the use of 3D machine control has achieved 30% savings on the earthworks. Network Rail might be looking for some efficiency savings on a big new railway project, something like HS2, and could achieve 30% efficiency savings through the earthworks with the same innovation.

Embley adds: "The data collated into the TIES Living Lab's IICC will make it easier for organisations to understand and shape the business case for investing in and adopting that innovation elsewhere. This means it can be transferred more seamlessly from one supply chain or

sector to another, helping to drive those savings at scale a lot more quickly than ever before. This means more success for owners and operators of infrastructure and ultimately better results for our communities who need the critical infrastructure."

Costain's chief digital officer, Nathan Marsh, said: "What we'll see in the infrastructure sector, as this technology becomes embedded, is very rapid transformation: better data ensuring better, faster and greener delivery of infrastructure that will improve productivity and build resilience across the sector."

To learn more about the new IICC platform, listen to the [Engineering Matters podcast #74 Weaving a New Data Fabric for Infrastructure](#) or watch the [SAP webinar discussing Digital Disruption of the Infrastructure Industry](#).

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**BIM Today**

Tel: 0843 504 4560

[info@pbctoday.co.uk](mailto:info@pbctoday.co.uk)

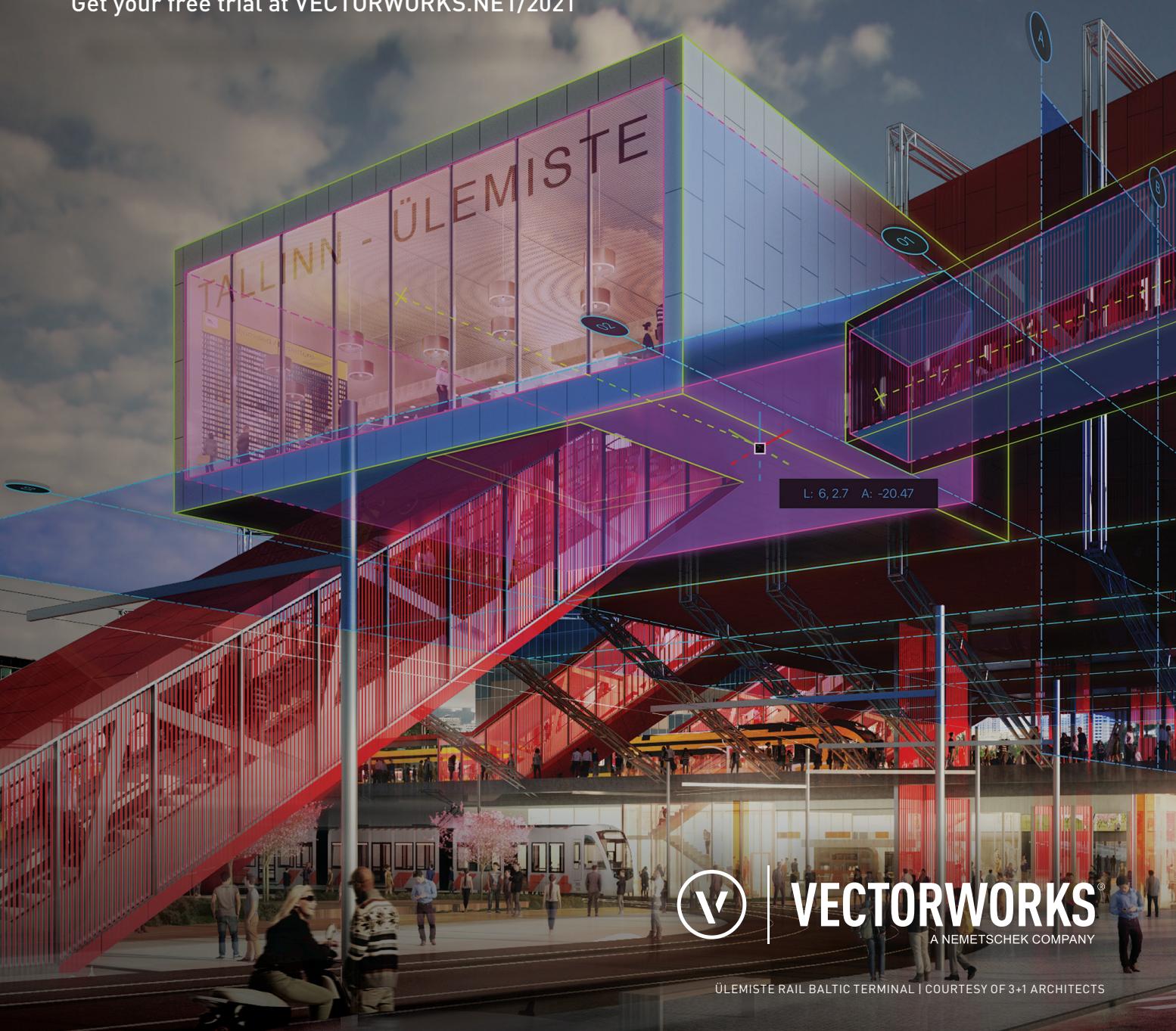
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# Good NABERS: How BRE is tackling climate change through collaboration

**Meeting ambitious sustainability targets requires us all to pitch in, says Building Research Establishment chief executive Gillian Charlesworth**

The government recently announced an ambitious 10-point plan for a green industrial revolution, which will help the UK forge ahead in its net zero carbon by 2050 pledge ahead of COP26 in Glasgow next year.

As part of this, ministers have pledged £1bn of investment towards making new and existing homes, and public buildings, more efficient. This includes an extension of the Green Homes Grant voucher scheme and Public Sector Decarbonisation Scheme. The government has also declared its intention to implement the Future Homes Standard in the shortest possible timeline, roll out heat pump installations and is consulting on the energy performance of homes. The range of measures and announcements are welcome progress towards recognising the contribution that the built environment must make in supporting the green agenda and reducing harmful emissions.

The Building Research Establishment (BRE) is an industry leader in this area, having spent nearly a century ensuring that the built environment is part of the solution and not the problem when it comes to innovation in sustainability. Key contributions BRE has made include: the rollout of

BREEAM, which is the world's leading sustainability assessment method for masterplanning projects, infrastructure and buildings; the Green Guide to Specification, which details the lifecycle environmental impacts of construction materials and components; key advisory services in energy management; and waste management tools such as SmartWaste.

## An important opportunity for sustainability

As the construction industry grapples with other key issues, such as the current housing shortage, our ageing population and reforms to the planning system, we have an important opportunity to ensure that sustainability is integrated throughout the lifecycle of a building. Effective standards are central in addressing these concerns and will be key to unlocking many of the challenges facing the built environment, especially the drive towards zero carbon and sustainability.

As the investor community takes an increasing interest in the environmental and social impact of assets, certification schemes like BREEAM have an important part to play in monitoring progress towards net zero. And with millions of workers likely to return to their offices as the pandemic

hopefully passes, committing to benchmarking and improving sustainability performance also provides a way for employers to send a signal to their employees about their commitment to improving the environment in which they work. The greater our understanding and measurement of the performance of buildings is, the more likely it is that our response will achieve real impact.

**"As the construction industry grapples with other key issues, such as the current housing shortage, our ageing population and reforms to the planning system, we have an important opportunity to ensure that sustainability is integrated throughout the lifecycle of a building."**

### Measuring the energy performance of buildings

That is why the announcement that BRE has now partnered with the National Australian Built Environment Rating System (NABERS) and the Better Buildings Partnership (BBP) to launch NABERS UK is so welcome. The NABERS UK scheme is based on the Australian NABERS programme and has been developed via the Design for Performance initiative, led by the Better Buildings Partnership and funded by a range of industry stakeholders, including British Land, Derwent London, Federated Hermes/MEPC, Great Portland Estates, Grosvenor Britain & Ireland, Landsec and Legal & General Investment Management.

NABERS energy ratings specifically measure and verify the actual energy use of existing offices, providing a rating from one to six stars, which can help building owners to accurately target, measure and communicate the energy performance of their buildings.

Through the adoption of NABERS, those responsible for commercial developments can therefore work together to play a vital role in bridging the performance gap between the design and in-use energy performance of offices in the UK, as well as reassure investors and occupiers that the buildings they own and occupy are on a net zero trajectory and are aligned with their climate change ambitions. This complements our more holistic BREEAM scheme, which incorporates energy efficiency alongside many other sustainability indicators.

### Working together to realise net zero targets

As well as having significant industry support, the programme has also been endorsed by the Department for Business, Energy & Industrial Strategy (BEIS). This comes at a critical time, as the government's consultation



Gillian Charlesworth

on energy performance disclosure for commercial buildings is expected before the end of the year. The partnership between BRE and NABERS demonstrates how two leading organisations within the global built environment can work together to help realise the British government's net zero targets.

By partnering with NABERS and BBP, BRE is delighted to continue to work collaboratively to tackle the unprecedented challenges presented by climate change.

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**Gillian Charlesworth**  
**Chief executive**  
**Building Research Establishment**  
**Tel: +44 (0)333 321 8811**  
**[enquiries@bregroup.com](mailto:enquiries@bregroup.com)**  
**[www.bregroup.com](http://www.bregroup.com)**



# Unibail-Rodamco-Westfield

## Model Checking & Clash Detection

Unibail-Rodamco-Westfield has three main ways in which they use the rules-based checking inside Solibri Model Checker; space and dimension checks, model revisions comparison, and data validation.

### – Space & Dimension Checks

Running space and dimension checks in Solibri Model Checker is a quick and easy way for the team to ensure that it is adhering to project standards and regulations, while coordinating various disciplines' models. For Unibail-Rodamco-Westfield, who are continuously developing multi-purpose facilities, this is an important aspect of model checking undertaken on projects.

### – Model Revisions Comparison

At each design gateway, the team at Unibail-Rodamco-Westfield issue a revision comparison report to Design Managers, as well as internally checking and verifying these results and displaying during the design review meetings.

### – Data Validation

A key topic when discussing model checking and configuration of rulesets for checking data is 'consistency' – and this is something Unibail-Rodamco-Westfield are grasping and nailing when it comes to the checks it runs internally. During our interview with Lucas and Lewis, it became apparent that there was a clear message being passed through Unibail-Rodamco-Westfield's projects, a message that ensures consistency and discipline at every stage to allow for a data-rich and accurate federated model.

The team has developed rulesets for checking naming and tagging within its models, with live feeds and referencing to a database of codes/tags in the pipeline, which allows for further checking and verification of the data.

“

*Unibail-Rodamco-Westfield's investment in BIM and technology goes far beyond keeping abreast with our competitors. We've seen real value and returns in its application which plays a vital role in facing the challenges involved in the design and construction of complex projects. The resulting information models allow us to harness the power of data giving greater control over our built assets as well as enabling collaboration within our diverse range of business units.*

**Keith Whitmore, Head of Design & Construction UK/Italy and Co-Director of Construction Management Europe**

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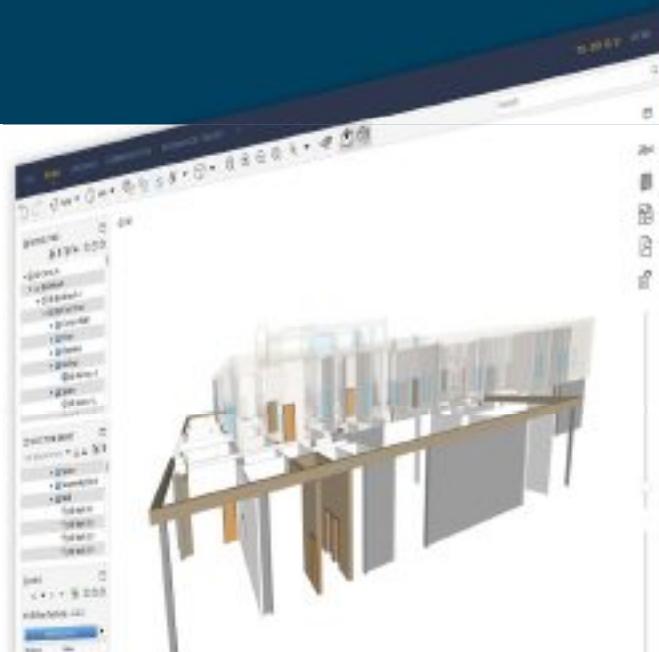
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# Engineering: From surviving to thriving with a digital strategy

**Many of the businesses that have survived – and even thrived – in these extraordinary circumstances are organisations that have digital technology at their heart. Or, at least, a plan to put it there, says Sam Stephens, chief engineer at Atkins**

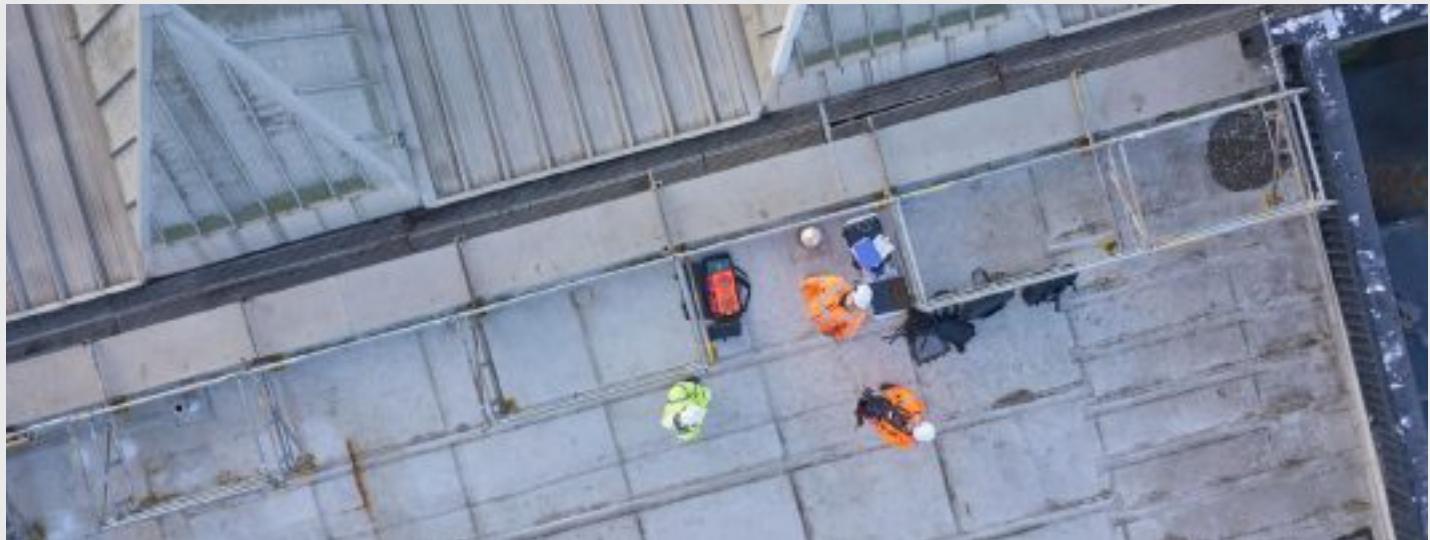
I think we would all agree that 2020 isn't the year we imagined it would be. In recent months, our lives have been changed by the Covid-19 pandemic. As individuals, we've had to find new ways to relate to people to keep ourselves and others safe. Organisations have been forced to adopt new ways of working, and entire industries have been reshaped by events that are outside of our control.

In the nuclear sector, we've faced the challenge of continuing our work on aging assets with limited access to up-to-date information on the condition of the site. We've also had to ensure we carry out the proper checks on new equipment so it can be delivered to clients on time, despite being unable to bring the relevant experts together in-person as part of the review, troubleshooting and approval process. In all cases, new digital tools have enabled us to complete the work on schedule and bring costs down. If having a digital strategy had been optional six months ago, it's certainly not now.

## A robust digital strategy

If organisations have a robust digital strategy, it will also help them meet the challenges of the future. As we all know, safety is the number one priority on every nuclear site. The environment we work in is unique and we have to ensure we do everything we can to keep the risks to our people as low as reasonably practicable. Technology has been, and will continue to be, a key part of our approach.

In the new build sector, the costs associated with building new nuclear reactors is significant and developers are under pressure to maximise the value of the investment. EDF is seeking to replicate much of the design from Hinkley Point C in Somerset in England to reduce costs at the proposed [Sizewell C power station in Suffolk](#). How the data from the design and build of the first plant is gathered, aggregated, stored and shared will be crucial to success of the second.



Similarly, the industry is seeing the opportunity to rethink its approach to decommissioning nuclear assets in light of increasing costs of maintenance and lower costs of capital compared to a decade ago. If the organisations responsible for that work, along with their partners and supply chain, have a digital strategy, it will enable them to gather the data they need to optimise projects and capture learning to improve delivery of future projects.

### **Embracing technological opportunities**

Fortunately, many of the companies we work with have already embraced the opportunities that technology offers and recent lockdowns have accelerated some of their moves towards a digital future. But given the pace of change, is there really a way to create a digital strategy that will stand the test of time?

Firstly, organisations need to recognise what their core skills and business priorities are and be prepared to collaborate with others to find the best solution to their challenges. A digital strategy can help organisations differentiate between the core capabilities they need to retain or develop in-house and the initiatives that should be supported by the supply chain.

It's easy to be side-tracked by new and exciting technologies, where you fall into the trap of looking for a problem that a new product can solve. There are plenty of gadgets and tech out there to test out, but the hard part is deploying proven technology that can be seamlessly integrated into ways of working so that everyone can use it.

Finally, companies should also be innovative in their approach to their digital strategies. Instead of focusing on the technology, they should think about how existing or

emerging tools can support or disrupt their business model, commercial approach or technical delivery. A digital strategy should not be a bolt-on; it should be at the core of how value is delivered to the customer.

### **New ways of working**

To bring all this together requires a shift in mindset towards new ways of working and business investments. While "agile" has become a cliché, there are lessons that can be learned from the tech industry, particularly the mindset towards deploying solutions that are then tested out and improved continuously. For an industry that is focused on getting things right first time this is a big challenge, which a digital strategy can help overcome. By using data more effectively throughout operations, we can better assess risk and therefore identify ways to reduce it, but also use that data to optimise solutions and experiment with different approaches.

With Covid-19 becoming part of everyday life for the foreseeable future, we have a window of opportunity to adopt these new ways of working. And with that we should be better placed to not only survive whatever challenges are faced, but thrive during and after the pandemic.

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#### **Sam Stephens**

**Chief engineer**

**Atkins**

**Tel: +44 (0)20 7121 2000**

**info@atkinsglobal.com**

**www.atkinsglobal.com/en-gb/uk-and-europe**





# Achilles Information and Causeway Technologies to develop streamlined supplier data system for the construction industry

**Achilles Information, the global leader and partner of choice for supply chain risk and performance management, has announced a partnership with Causeway Technologies, the largest specialist construction software provider**

The new partnership means customers in the construction industry who are registered with both Achilles and Causeway will now be able to access over 45 data points, including supplier details, commodity codes, insurances, audits and certifications, using the Causeway construction solution to access Achilles data.

A single point of access to standardised information results in a more holistic view of the supplier; this improved insight and live data

ensures there is more consistent information at key points of the supplier relationship. Whether onboarding or managing RFPs, suppliers and buyers can manage information from one standardised source, rather than accessing multiple systems with different types of information.

Doug Aris, head of construction at Achilles, said: "The partnership between Achilles and Causeway represents another step forward in

evolving and embedding better risk management, higher standards and more efficient procurement processes in the construction industry.

"From standardised pre-qualification question sets to procure to pay (P2P) processes, we're collaborating across the construction industry to create cost-effective, end-to-end processes that promote high standards and reduce the admin burden for suppliers. Together with



market-leading partners such as Causeway, Achilles is leading the way in developing a Common Assessment Standard that is efficient and accessible for everyone."

Rebecca Sperti, VP for trade at Causeway Technologies, added: "At Causeway, we understand that now, more than ever, boosting construction productivity is key to supporting the UK's wider economic recovery. Partnering with Achilles will allow our customers to streamline their procurement processes, allowing them to work more efficiently and enabling them to fully embrace the benefits of data sharing through the Common Assessment Standard."

To learn more, speak to [Causeway Technologies](#).

#### About Causeway

Causeway provides powerful cloud-based solutions that transform commercial performance across the frontline of its construction customers' businesses. Causeway gives customers the visibility and control to

make better decisions at every stage of the construction lifecycle.

**"The partnership between Achilles and Causeway represents another step forward in evolving and embedding better risk management, higher standards and more efficient procurement processes in the construction industry."**

The Causeway platform offers access to powerful software solutions, intelligent real-time data, smart development tools and Tradex, the construction world's largest connected supply chain network. All of these combine to empower our customers to more successfully plan, build and operate the buildings and infrastructure their businesses are built on.

Discover how Causeway can unlock value for your business at [www.causeway.com](#).

#### About Achilles

Achilles Information is the global leader and partner of choice for supply chain risk and performance management. Through supplier pre-qualification programmes, industry audits and risk management, Achilles has been a pivotal link between buyers and suppliers for 30 years. With offices across the world, Achilles has a network of over 800 buyers and 175,000 suppliers across industrial, infrastructure and natural resources sectors.

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# Do modular projects need digital twinning?



**Nick Cowley, managing director of Euramax, explores how digital twin technology could benefit the modular construction industry**

In 1991, David Gelernter published his book, *Mirror Worlds*, which sought to explore the technology of the future. "You will look into a computer screen and see reality," he wrote. His prediction wasn't far off and, just over a decade later, the digital twin was born. Since then, the technology has seen success in manufacturing and healthcare. With such varied applications already, we must explore its further uses.

A digital twin is a digital replica of a physical asset. Using sensors, a digital twin holds all data to do with the engineering, construction and operations of its physical counterpart in one place. It can also be created as a precursor to the physical asset to aid in the design process.

For the construction industry, harnessing the technology means creating a digital version of the final product, be it a house, hospital or hotel. The digital twin can then be used as a tool to lower project costs, reduce completion times and increase sustainability - all useful benefits, especially when considering the current demands of the UK's building sector.

The benefits of digital twinning echo those of modular construction, which is up to 20% cheaper, 50% quicker and more sustainable than traditional building methods,

according to a 2019 McKinsey & Company [report](#). By using digital twinning technology, modular projects could build upon their existing strengths and be completed in even less time, even more cost-effectively and with even more sustainable results.

## Clear communication

Designers can use digital twinning as an alternative to traditional line drawings to enable improved communication and transparency between a modular construction project's key players. Designers historically work with technical line drawings, which take more time to create and can lead them to become easily siloed from the rest of the project.

By using digital twin technology, designs can be digitalised and incorporated into the main project with ease. Digital twinning streamlines this process by collating all data related to the building, such as the quantities of materials required, the measurements of components and even factors such as energy efficiency, all within a 3D model. Any technical limitations, such as Building Regulations, can be integrated into the design algorithm, ensuring that designers have a full understanding of the project before they begin.

Combining the technical information with a 3D model means that the design is simpler understand than a line drawing, so any discrepancies between the design and expectation will be easier to identify. Alterations can be inputted into the digital twin and the designer can modify their existing model. This is considerably quicker than the traditional process, which often involves starting new line drawings from scratch if any changes need to be made.

## Better quality

Digital twinning can also improve the quality of your modular project. Since components are made offsite, modular construction requires the measurements and quantities of building components to be accurate. If the construction of a component differs even slightly from its design, the modules will not fix together correctly, which can increase project costs and cause delays.

A digital twin contains the exact measurements and quantities for each part of the building, be it a wall, roof or [windows and doors](#). Since the digital twin is an exact replica of the future physical building, the data it collates is guaranteed to be correct. This means project managers can be confident in the precision of their brief when communicating with contractors.

Constructing individual parts offsite in exact quantities will further reduce the build's completion time. It will also eliminate the need to order materials in excess, which is a strategy often implemented to offset any unexpected delays. By using digital twins to confirm component quantities and dimensions, your modular project will be more cost-efficient and less wasteful.

## Continuous improvement

Even once construction is complete, digital twinning can help maintain the physical building. The Internet of Things (IoT) uses sensors to capture data of a building's mechanical and electrical systems. These sensors can then be connected to the digital twin for continuous real-time monitoring of all information related to the building in one accessible place.

This data can then be used to predict part replacements, identify energy efficiency issues and act on potential security threats. If a completed modular building's windows and doors display large amounts of heat loss, for example, this data can be fed back to the building's manager, who may use it to consider purchasing replacement items from a reliable supplier. Not only is this useful for building

managers, who will be able to carry out maintenance more effectively, it can also be used to improve future designs.

Data captured from existing buildings can show designers how the building performs and they can use this feedback to design more efficiently in the future. This is particularly useful for modular construction because the same components are continuously being made by contractors and therefore data from previous projects will be relevant to future ones.

**"For the construction industry, harnessing the technology means creating a digital version of the final product, be it a house, hospital or hotel. The digital twin can then be used as a tool to lower project costs, reduce completion times and increase sustainability – all useful benefits, especially when considering the current demands of the UK's building sector."**

By using data from digital twins to improve the design of future projects, modular construction could be better able to tackle to demands of the UK's construction industry. In particular, the government's ambitious pledge to build 300,000 new homes a year by the mid-2020s could become a more attainable goal.

Digital technologies have been slow to gain traction in the construction industry. However, this does not mean they aren't beneficial. With modular construction on the rise, technologies need to be implemented sooner rather than later to ensure the industry can keep up with demand. Gelernter's predictions have been realised elsewhere and now it is time for modular construction to use digital twinning to develop further.

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**Nick Cowley**  
Managing director  
**Euramax**  
Tel: +44 (0)330 1340290  
[www.euramaxuk.com](http://www.euramaxuk.com)





# 3D laser scanning for the process plant industry

**Marc Zschieschang, software product marketing manager at FARO Technologies, examines the growing use of 3D laser scanning to ensure safety and efficiency in the oil and gas sectors**

From field to finish, every opportunity to reduce risk and error has impact. That's why accuracy and safety are paramount at every stage of oil and gas exploration, production and distribution. Imprecise measures can produce safety issues or create scheduling problems that delay projects and increase costs.

"When things don't fit in an environment where processes are hot, lines could snap and guides could break - it could be catastrophic," says Mark Franklin, design and reality capture lead for Kleinfelder, an engineering, construction management, design and environmental professional services firm. "Even if nobody gets hurt, it's very expensive to change field welds and cuts. Delays and safety violations also result in expensive fines."

To counteract these challenges, many oil and gas companies are adopting 3D laser scanning. Not only is the technology fast and efficient, the digital record generated easily proves cost savings. Thus, when applied to the oil and gas industry, there are numerous advantages.

## 8 ways 3D laser scanning benefits process plants

Modelling with process plan: 3D laser scanning allows operators to quickly and accurately model in the point cloud, which is particularly important when performing conversions. Consider tie-in flanges on a pipe. In that example, you must know exactly where that is down to a sixteenth of an inch. The way it works is simple: operators pick two points on the scanned pipe and the software

algorithms analyse the shape of the cylinder and determine the size of the pipe run. The FARO As-Built™ software then models on the pipe using the predefined specification. Once the piping run is complete, it can be converted to solids.

Precision deployment: Scans uncover issues before your team can. Franklin explained that in one instance, his team analysed some scans on behalf of a client and noticed that fireproofing was falling off. With that information, the client's crew knew exactly where the issues were and deployed to those locations without manually inspecting the entire facility.

Planning: Laser scan data is valuable for planning maintenance, construction or



decommissioning activities. For example, one frequent problem is fitting large equipment into an existing plant. Accurate drawings need to be reviewed but, in many cases, the original plans don't show upgrades and changes. With laser scanning, you can take a point cloud, run a quick animation and deploy clash detection to guarantee the equipment will fit in advance of the project.

**Plant maintenance and expansion:** It can be impossible to know exactly what's in a processing plant, drilling site or pipeline facility before maintenance or expansion activities.

"We had existing drawings of a 42-inch line about three storeys up that needed to be replaced," Franklin recalls. "After the scan, we could see it was six or seven inches off. Our engineers did a stress analysis and looked back at construction records, and realised the crew put on come-alongs to pull piping over. That allowed us to warn them that the pipe could spring when unbolted, which could result in serious injury."

**Large-part inspection:** Consistent, accurate measurements are critical to maintaining design intent and performance of plant equipment but it can be time-consuming and dangerous if done manually. Laser scanning

takes precision measurements that minimise user variability and eliminates rework and scrap.

**Decommissioning:** Phasing out drill pads, pipelines and plants is a time-consuming project requiring extensive documentation and verification. Handling the process efficiently is more important as the industry's infrastructure ages. Consider the situation in Alberta, Canada, where about 100,000 individual well pads will soon need to be decommissioned. Once the project is underway, scanning can help owners and contractors document the entire process. And with environmental agencies watching these remediation projects closely, detailed documentation is key. It's a lot of work to do that manually. But laser scanning can get the job done in only a few hours.

**Regulatory verification and documentation:** Because 3D laser scanning creates an accurate digital representation of a site or project with a point cloud and photos, there's an added layer of verification. A company can show regulators what is there before they inspect

**Operator training:** Given all the data the scans generate, a company can create a virtual model of the entire plant to train employees.

"We worked with a gaming company to animate our scan data so operators can go through and feel like it's real life, not a game. They feel immersed. You can even see rust on a railing," Franklin says. "We never thought we'd be doing that."

## Fuelled for success

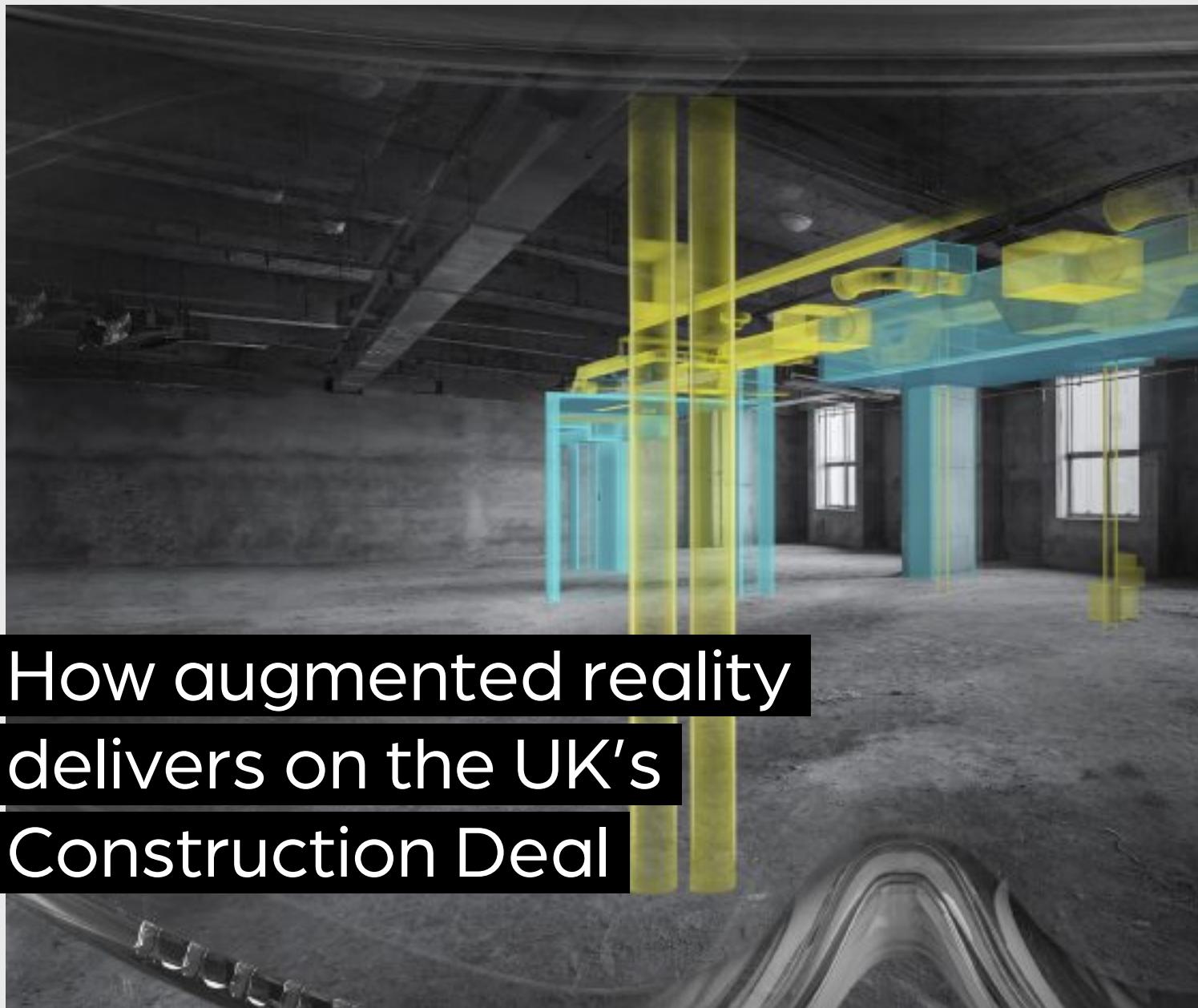
With so many applications for 3D laser scanning in oil and gas deployments, it's clear that now is the time to embrace the technology.

"I know some firms have been reluctant to adopt laser scanning, but it's the way of the future," Franklin notes. "If you're not doing it, you'll be left behind."

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# How augmented reality delivers on the UK's Construction Deal

Despite its size and contribution to the UK economy, the construction sector has been slow to benefit from the advanced technologies and digital transformation that have reinvented other industries. Here, David Mitchell, founder and CEO of UK construction technology start-up XYZ Reality, talks about the deep-rooted limitations of innovation in construction and how augmented reality is delivering long-overdue change

In the aftermath of Covid lockdown, the prime minister encouraged the nation to "build, build, build" to help restore our economy to working order. And yet, reports suggest that the construction industry could take more than two years to make up the ground lost already through lockdown, compounded by prevailing productivity issues and lack of modernisation. With economic and social upheaval continuing, there has never been a more critical time to address longstanding challenges and embrace technological change.

For decades, the industry has suffered from flat productivity. Mark Farmer's 2016 report Modernise or Die highlighted the inherent conservatism of the industry; an overreliance on traditional methods unchanged for decades.

What's been missing from the debate, however, are the reasons behind the slow uptake of advanced technologies. Since the advent of mobile computing, in particular, the industry has been restricted by the availability of technology with the power and capacity to



serve our work environment and obstructed in its pursuit of the "build it right, first time" goal.

### **Heavy duty innovation**

Laptops, tablets and mobile phones are designed to meet the data demands and computational tasks of the majority of professional users, supporting digital transformation across industries and equipping the masses for mobile working. However, while these tools may help construction engineers to see emails and spreadsheets away from the office, they are ill-equipped for delivering complex, large-scale design data where it is needed for use.

Until now, mobile technologies have been fundamentally limited in their suitability for the construction site. In fact,

computing hardware has only served to reinforce one of the biggest bottlenecks in our industry - the need to convert complex 3D design models into thousands of 2D drawings for use in the build field. In this way, hardware limitations have constrained the extension of an end-to-end 3D process in construction and withheld opportunities to address core issues of productivity.

You could say it is not the industry that has held back on innovation – innovation has held back on the industry.

### **The 2D bottleneck**

The widespread adoption of BIM in recent years has offered a significant step forward, addressing many prevailing issues in design and coordination. But it doesn't solve the build problems of on-site errors, rework and clashes, which are most often the result of the 2D conversion.

I saw this first hand during my time as a digital construction manager working on large-scale projects across Europe. Because the technology has not previously existed to take 3D BIM models on to site, we have been bound to converting 3D design into 2D drawings and back into 3D construction, with all of the resulting delays and errors that this process causes. In 2016, on a project with J Coffey Construction, I had an opportunity to explore a proof of concept for paperless construction which removed 2D from the process. The result was a massive 500% increase in productivity and validation that 2D was the problem.

2D is not a natural language for humans, we naturally see the world in 3D. Yet, industry professionals are required to interpret 2D drawings, conceptualise the 3D asset and then build on-site to within construction tolerances. What's more, validation of these works using laser scanners, 360 cameras and other similar reality capture solutions only show errors after they have occurred and reinforce a reactive mindset.

Savings of up to 20% can be made on construction project costs just by cutting out the inaccuracies, decision delays and rework on-site that is caused by the 2D bottleneck.

Ultimately, it supports immediate decision making by equipping construction managers with the knowledge they need to build it right, first time.



David Mitchell

## Design-build-validate in 3D

This is where advanced technologies like augmented reality (AR) are bringing big change to our industry. AR is a form of immersive technology that overlays a real-life view with computer-generated 3D imagery. Unlike virtual reality, where the user steps into the virtual world created by the application, AR keeps your feet firmly on the ground and projects digitalised text and images through a smartphone, visor or heads-up display.

We've been the first to combine AR with the power of today's mobile computing capabilities so users can view hyperscale BIM models on site, in real time and within construction tolerances. This is what we call "Engineering Grade AR" and is the foundation for HoloSite, which is the only product to custom-integrate Engineering Grade AR within a safety standard-compliant hard hat to take the full power of advanced technology to the field.

Engineering Grade AR also delivers a fundamental change in mindset, enabling teams to shift from a reactive

approach of fixing errors that are out of tolerance to proactively preventing inaccuracies and issues occurring in the first place.

Tackling inaccuracies at the lowest value stage enables rapid, low-cost corrective action. Our technology is uniquely able to deliver 3D information on site to within 5mm accuracy, so there are no deviations from the design, no need for rework and no knock-on clashes or delays.

## Opening the door for construction innovation

It's fair to say that we, as an industry, are acutely aware of our poor reputation in delivering on time, on budget and to specification. Many of us will have experienced the challenges of translating complex 3D models into 2D plans, and the frustration of errors and inaccuracies revealed when it is costly and complex to fix them.

We have also seen technology bring change to industries around us, though limitations of mobile hardware prevented us from bringing similar benefits on to the construction site. Today, with many of these limitations overcome, I believe we will see an exponential increase in innovation.

But beyond the technology, the mindset shift from reactive to proactive is equally important. Being able to design, build and validate in 3D, coupled with the capability to access hyperscale BIM models on site and in real time, fundamentally changes the nature of construction and we expect to see it becoming a much more forward-thinking industry. This is a game changer that unlocks productivity, expands capability and stops errors before they occur.

After all, why wouldn't we build it right first time?

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**David Mitchell**  
**Founder and CEO**  
**XYZ Reality**  
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# Rapid Capture: Using smart technology in the wake of Covid-19

**Covid-19 has introduced a new set of challenges for businesses and workplaces to ensure staff can work flexibly – both at home and in the office. Lee McDougall, geomatic director at building consultancy and architecture practice AHR, explains how technology can help us safely attend our workplaces where we are required to do so, as we all adjust to the “new normal”**

The latest round of changes to the coronavirus restrictions saw the UK government advising us to work from home wherever possible. However, not all employees can work from home all the time, and those who can may need to visit their workplace from time to time for a range of reasons. In these cases, cabinet minister Michael Gove has said: “If you are in a Covid-secure workplace then you should be there if your job requires it.”

At the height of the pandemic almost 40% of people reported that their working arrangements involved working from home. While this dropped to 20% in late August and early September, the fact that many people still need to visit their workplace during the current restrictions – which look set to be in place for at least six months – means that employers now more than ever need to ensure that their workplaces are Covid-secure.

In addition to offices, there are many other buildings that will continue to be in use and occupied throughout the current measures. Obvious examples include schools and universities.

The government has repeatedly stressed the importance of keeping schools open, and the Children's Commissioner for England has argued that if necessary, pubs, restaurants and non-essential shops should close first. Meanwhile, the government has stated that it expects HE providers to be open for the academic year 2020-2021 with measures put in place to ensure that risks are minimised to students and staff, in accordance with public health guidelines.

## Providing reassurance

In early September, around 89% of pupils had returned to school, which was seen as a sign of confidence among parents and children. It is clearly critical not only to

Lee McDougall  
Geomatic director



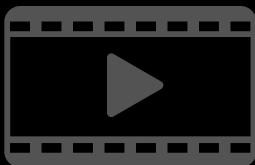
implement measures to ensure the safety of workers, teachers, students and pupils, but also to be seen to be doing so – by informing people about the changes made to their working, teaching and learning environments and also reassuring them that it is safe to be there.

Providing reassurance to staff, employees, pupils, students and others helps to encourage people to visit workplaces and places of study or learning, and – by facilitating flexible working practices – benefits mental health and wellbeing.

So, what can workplaces, schools and universities – and others – do to demonstrate the measures they have put in place? Building consultancy and architecture practice AHR has demonstrated an innovative method of doing this by scanning its own office environment and creating an online 3D interactive model.

## Benefits

This approach, using AHR's Rapid Capture technology, has numerous benefits.



AHR's own staff have been able to visit the office virtually, viewing a revised office layout and seating plan, as well as items such as signage, locations of facilities, screens and hand sanitisers. Items were tagged to explain the measures implemented and how they sit within the company's own Covid-19 policies and procedures. This has helped reassure employees of the measures in place to facilitate safe working where it is necessary to do so and has helped staff understand and adhere to the guidelines and office procedures the company has put in place.

Rapid Capture models reside entirely in the cloud, allowing access to imagery and site information from any PC, tablet or smart phone. This negates the need for specialist software or storage and requires no training for people to view buildings online. Aside from the rewards AHR has reaped, it can also enable organisations – for example schools, universities and other building owners – to embed virtual tours directly into their website, which users (not only staff and employees but also students, visitors and parents) can navigate around in a similar way to Google Street View.

In a world where guidelines on Covid-19 restrictions change regularly and in which employers need to reassure people quickly, the Rapid Capture process provides 3D imagery and virtual tours and in a remarkable timeframe. This could be considered as the first step towards creating a digital twin – a digital record of an existing building which can be used for a range of applications.

Additionally, with organisations often struggling to find budgets to implement Covid-19 measures, cost is understandably a driving factor – this approach produces deliverables in an extremely cost-effective way.

### **Virtual site visits**

This technology enables us to swiftly capture current building stock, in a much quicker way than more traditional approaches. Rapid Capture is particularly relevant to the 'as built' environment and development of accurate building records and portfolio management. It means that estates teams no longer need to be on site carrying out maintenance checks and can instead undertake this task remotely and across multiple sites. In the wake of the Covid-19 pandemic, benefits like these allow teams to continue to carry out their role in a safe manner.

The information obtained by Rapid Capture technology can be used for a variety of purposes, including assessing and ensuring safety, identifying fabric repairs needed and recording the fabric condition of a building.

There are a range of other benefits to Rapid Capture. Maintenance teams, for example, could benefit from a walkthrough database of an organisation's buildings, site inductions could be enhanced or it could provide an interactive virtual tour for an interior design team – reducing the need for site visits.

Key assets and points of interest can be tagged with information and directly linked to more detailed documentation, spreadsheets or other web locations. This can prove invaluable to estates teams who need remote access detailed, live information about their buildings.

With benefits above and beyond reassuring people that measures implemented to guarantee workplaces are Covid-secure, AHR has demonstrated that technologies such as Rapid Capture can help organisations, building owners and estates teams - together with staff, students and other visitors – to adjust to the "new normal" and find new better ways of working.

---

**Lee McDougall**

**Geomatic director**

**AHR**

**Tel: +44 (0)1484 537 411**

**[buildingconsultancy@ahr.co.uk](mailto:buildingconsultancy@ahr.co.uk)**

**[www.ahr.co.uk/Rapid-Capture](http://www.ahr.co.uk/Rapid-Capture)**



# A detailed approach on how you could make sustainable buildings hot property

**Sustainability in building design is a hot topic, with developers doing all they can to build more energy efficient buildings. Simon Fielden, Sales Director at SFS UK, discusses what specifiers should consider in order to make building envelopes as thermally efficient as possible**

Under the [Climate Change Act](#), the UK Government has set a legally binding target to reduce national greenhouse gas emissions by at least 80% by 2050. The challenge architects and specifiers face today is to ensure all buildings meet the energy efficiency levels and sustainability required, whilst providing comfort, aesthetics and safety.

According to [Designing Buildings](#), badly insulated houses experience 35% of heat loss through their walls, and around 75% of an industrial unit's heat is lost through the building fabric ([Carbon Trust](#)).

The often used idiom 'The devil lies in the detail' is apt here as although the desired thermal performance (U-value of a façade) may seem relatively easy to achieve, the requirement of numerous rainscreen subframe components such as brackets into a design can adversely affect the insulation performance hugely.

## Rating the thermal value

Thermal transmittance is commonly known as the U-value, which is the rate of heat transfer through a structure, measuring heat loss and thermal performance. U-value is the measurement in which a building is deemed energy efficient.

Often, the choice is to increase the external layer insulation to combat this issue and help retain heat in the building. However, this solution isn't quite so simple, as it means that

brackets need to be larger to accommodate the thicker layer of insulation which impacts on the structural integrity of the envelope as well as costs.

The most effective way to reduce heat loss is through the robust design and construction of a well-thought-out building envelope, with careful attention to the selection of rainscreen subframes chosen to produce the appropriate and optimum level of thermal performance.

By doing so, the thermal performance of both commercial and domestic properties can be increased considerably, without the need for additional or thicker insulation. Which in turn may add to the cost further and won't be possible due to space or footprint restraints of the building.

## Thermal bridging - a leading cause of heat loss

When subframe assemblies are under specified it can lead to excessive thermal cold bridging. Thermal bridging happens when there is a thermally conductive connection i.e. a rainscreen subframe bracket, between the inside and outside of a building which penetrates the insulation layer. The additional heat loss caused by a thermal bridge is called the 'point thermal transmittance' or 'Chi' value which is measured in (W/(m<sup>2</sup>K)).

This 'bridge' results in wasted heat transfer across the connection, changing the internal surface temperature. Thermal bridging can

also cause condensation, as warm, damp internal air is meeting the cold surface, causing further issues such as mould growth.

Recent research by the BRE (Building Research Establishment) has shown that thermal bridging may be responsible for up to 30% of a dwelling's heat loss. As legislation becomes more stringent and energy awareness more acute, the drive to ever more thermally efficient facades becomes increasingly important.

To minimise this thermal bridging effect and to not have to use oversized brackets and thick layers of insulation, specifiers can either look to use alternative bracket materials or use insulated thermal pads attached between the bracket and the fixing structure.

In doing so, they will be reducing thermal bridging, improving their U-value rating and prolonging the lifespan of the building. By doing this, contractors can also inherently comply with Part L 1A and 1B of the Building Regulations, legislation that focuses on the conservation of fuel and power in both new and existing dwellings.

## Optimised thermal solutions & superior performance

The ideal thermal design for a project can be achieved by the selection of the most appropriate rainscreen support or subframe system, optimised for performance and budget.



3D thermal modelling is used to calculate thermal point loss in the data, from which it is utilised to dynamically calculate the required insulation thickness needed to achieve the desired U-value for a design. Such calculations must conform to EN 10211:2007.

Requirements for each rainscreen cladding project are often different and depend on various factors such as wind load, building height and substrates used. SFS' Project Builder calculation tool is designed to submit project specific data and provide an NVELOPE® subframe solution which includes indicative m<sup>2</sup> rates and preliminary static calculations.

There are a number of methods and materials that can be used to counter thermal bridging effects caused by brackets. These include thermal insulation pads, brackets made from higher thermally resistant materials, or a combination of both.

At the heart of SFS' NVELOPE® Thermal Solutions is a high performing thermal pad which insulates the bracket from the primary wall structure, created to minimise thermal

point loss. The unique design guards against thermal degradation caused through the compression when fixed to the façade, ensuring no loss in thermal performance.

### **The race to improve buildings' thermal performance**

For global warming and climate change to slow down and even reverse, the way buildings are constructed must change too.

As architects and specifiers strive to meet stringent building regulations and improve energy efficiency, they must work together to ensure a successful construction in the details of the building envelope. SFS is committed to this cause and helping you find the perfect rainscreen and building envelope solution that meets your needs and secures the future of our built environment and our world.

In our upcoming whitepaper, entitled 'The effects of rainscreen subframe systems on the overall performance of external walls' we have analysed the performance gap of different rainscreen systems, and the effects that real life installation has on thermal performance. Our white paper covers:

- The effects of compression on thermal pads
- Avoiding conservative predictions and assumptions
- Post occupancy evaluation (POE)
- Adjusting U-values to account for rainscreen subframes

For more information about SFS and NVELOPE® Thermal Solutions, please visit: [www.nvelope.com](http://www.nvelope.com)



**Simon Fielden**  
Sales Director  
**SFS**  
Tel: 0044 113 2085 500  
[uk.info@sfs.biz](mailto:uk.info@sfs.biz)  
[www.sfsintec.co.uk](http://www.sfsintec.co.uk)



# The smart city: Why the silo mindset will limit its full potential



**Jens Strinsjö of Axis Communications analyses the barriers to smart city innovation and why cybersecurity and sustainability will be critical to demonstrate long-term value**

The smart city offers significant benefits. These urban constructs are capable of reducing waste, driving efficiencies, optimising resources and increasing citizen engagement. Such benefits are reflected in the \$189bn that is [anticipated to be spent](#) on smart city initiatives globally by 2023. Public safety remains a priority area and the use cases most likely to see the money will include [surveillance systems, intelligent traffic management systems and smart grids](#).

Smart cities offer both the business and public sectors the opportunity to embed improvements that can not only transform citizen engagement but also reduce top line spend. However, for the vision of the smart city to be fully realised, there are challenges that must be overcome. While smart technology, at its core, enables the collection and analysis of data to create actionable and automated events which streamline operations, its effectiveness can be limited by the silo mindset. To deliver at scale, interoperability is key. Not just in terms of the technology, but the entire smart city vision.

## Change behaviours and break the silo

Too often, city leaders think of smart city initiatives as individual strategies, for example, smart parking, smart security, smart traffic. Each area is treated as a standalone project rather than part of a comprehensive whole. The result is that the solutions, while smart and capable, are being implemented as silos and therefore limited to a narrow focus. The smart city vision cannot be realised by using technologies in isolation, with no thought given to how they might relate to, or work with, one another to achieve a common goal.

Success in smart cities is dependent on maintaining the balance between the technology, the level of integration, the data collected and how this data can be leveraged to deliver the right intelligence. Smart cities must move away from the traditional operating model, which involves silos and departments only focusing on one area of operation. Instead, collaboration between teams and systems is critical to the development of the fully scalable and smart city, where data can be shared horizontally for the benefit of multiple teams.



Jens Strinsjö

## Making informed decisions on technology investment

The smart city cannot achieve its potential without a clear and holistic strategy that takes into account multiple requirements and determines how technologies can be used to deliver the required outcome; a centralised smart city mandate that feeds into every initiative and investment. This will involve siloed teams collaborating and sharing their learnings so that data and analysis from integrated cloud-based services can help them to achieve their combined goals and visions. Only then can connected systems, cameras and sensors come together to make the truly smart city a reality.

However, there is a natural dispensation towards purchasing low cost solutions that are perceived as offering the same value as their more expensive equivalents. While some have taken the decision to implement such solutions in an attempt to unlock the required benefits while saving their bottom line, the limited lifespan of these technologies puts a heavier cost and reputational burden on to organisations by their association.

## End-to-end value: Focus on the total cost of ownership

Others have wisely looked towards solutions that are manufactured using ethical approaches and sustainable practices by companies with appropriate credentials. The concept of Total Cost of Ownership (TCO) is well established and offers strategic buyers a mechanism to consider all of the aspects involved when purchasing, setting up and operating a new system, evidencing the complete end-to-end value that is otherwise difficult to ascertain. In relation to the physical security of the smart city environment, ensuring comprehensive protection of people, premises and assets begins with the integrity of the systems deployed and the pedigree of the vendors behind those technologies.

TCO can highlight labour costs and identify what percentage of the overall total these equate to. Labour costs that make up a significant percentage of the total cost of a project could indicate a need to invest in automation to reduce these costs. TCO can also introduce vendor assessments that allow full visibility of the costs that the system will occur over the long term. Cheaper



technology that is not sustainable can result in a false economy, where continued maintenance and repair is necessary to keep it operational.

**"While smart technology, at its core, enables the collection and analysis of data to create actionable and automated events which streamline operations, its effectiveness can be limited by the silo mindset. To deliver at scale, interoperability is key. Not just in terms of the technology, but the entire smart city vision."**

### **Security and sustainability: critical smart city factors**

In the future, a focus on cybersecurity and sustainability in the enabling of the smart city environment will be critical. TCO can be assessed against multiple sustainable metrics that include energy consumption, power demands, product lifespan, maintenance and risk. For example, a system employing low power cameras and low-light image capture technologies can result in a reduction in overall power consumption, which will contribute to a low carbon footprint as well as an overall reduction in the TCO.

From a security perspective, evidence of a technology provider's cybersecurity credentials and service agreements provide assurances around the integrity of the technologies themselves. The right technologies are

those that are deemed secure and fit the requirements of the [NIS Directive](#).

In the physical security arena, Secure by Default accreditation and Cyber Essentials Plus are accolades that evidence a manufacturer's security credentials.

The implementation of secure cameras and sensors will bring peace of mind to smart city officials. Such systems, capable of delivering data that can drive and support operations for multiple stakeholders, will form the cornerstone of the smart city. Breaking away from a silo mentality and embracing collaboration allows multiple teams to use this technology for a mutually beneficial purpose: to finally make the smart city a reality.

To learn more [Download](#) Smart City Security: The Real and Total Cost of Deployment.

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**Jens Strinsjö**  
**Segment lead, smart cities**  
**Axis Communications**  
**Tel: +46 46 272 18 00**  
**[www.axis.com](http://www.axis.com)**



# How is BIM an enabler for digital processes?

**Roy Danon, CEO and co-founder of Buildots, explains why BIM is the single enabler for many modern technologies that are being developed for the sector, making it critical for companies to adopt BIM so they won't fall behind in the race**

While portions of the construction industry are fluent in BIM, IoT, CDEs and more – with 3D modelling one of the main methodologies and processes that are changing the landscape – there is still great hesitation from some areas of the sector.

The construction industry's digital journey encompasses many aspects including apps, AI, IoT and other bespoke software. They are becoming increasingly more important across construction projects as businesses are realising that complex processes are made easier with the aid of technology. With digital solutions risks are being avoided and mitigated, and once-arduous programmes of work are now far more efficient and seamless.

But the technology that is making the most transformative difference is BIM, which is at the core of the industry's digital offering. BIM is the first time that the industry has an agreed end-product that it is aiming to create through its delivery process - it's the first time the different pieces of the puzzle are properly coordinated. It is therefore creating (well, in most cases) an agreed goal for the first few years of construction's process.

HILTI, for example, recently announced its JAIBOT, a robot aimed at replacing some of the repetitive and dangerous works conducted on site. It requires good and final plans to operate, otherwise it will not be able to drill holes properly.

Other technologies, such as AI-based programme generation and optimisation, need BIM to fully grasp the complexity of the project it is planning and provide the best course of action.

Buildots puts BIM at the centre of the site's day-to-day operations. It leverages the capacity of off-the-shelf 360-degree cameras to inject as-built data into BIM models, creating a perfect view of the status of works. On top of the live model, an advanced dashboard system creates the construction control centre, showing progress reports, monthly valuations and flags any divergences from designs or programme.

Once the model becomes live, other technology vendors can tap into the model to receive real-time progress information to trigger shipments, streamline payments or generate better execution plans for the following week.



Construction companies that invest in creating workflows around BIM are well positioned to quickly leverage new products that can directly affect their bottom lines.

**"The construction industry's digital journey encompasses many aspects including apps, AI, IoT and other bespoke software. They are becoming increasingly more important across construction projects as businesses are realising that complex processes are made easier with the aid of technology."**

#### BIM as the enabler: What are the other benefits?

The NBS's National BIM Report 2019 highlights a 60% increase in BIM adoption from 2011 to 2019, which suggests that BIM is being used more widely across construction projects. The government's Construction 2025 targets will further help BIM to raise its profile. To fulfil the government's targets, many contractors and

asset owners are turning to smarter and greener methodologies and processes. BIM's enabling value plays an important role in this case, as these parties will want to be able to predict their footprint prior to construction and measure it once an asset is in use.

BIM's value will become further recognised as the industry strides towards greater quality and traceability. Dame Judith Hackitt's golden thread of information has been lauded as one of the most prominent methods the industry should adhere to in order to ensure best practice across the board.

To align with this process, there will be a higher demand from companies to know and understand the role of visible data within an asset or project. Having a clear audit trail of what has been done, who did it and how it was installed will create this all-important golden thread of information. It will also highlight the value of data and



information on a digital sphere; data that isn't gathering dust in a filing cabinet or stowed away on a server but essential to informing the decision-making process regarding the performance of a building.

This is where the concept of connected data comes in. Historic data stored across multiple, disparate silos can be of use to the asset owner, yet the way in which it is held often renders the information inaccessible and inefficient, if it needs to be referenced. Neither can this data help to craft a reliable like-for-like image of how a building is performing; old data is a reference of what occurred and not necessarily a tool that confidently reports on how an asset is currently operating.

In the case of the data created using Buildots the collected historical data of multiple projects can be combined. A construction company could use that to benchmark its projects and activities, decide how to better plan its next projects, or focus on construction methods that are more suitable for its workflows and expertise. It creates opportunities to identify repeating issues or common bottlenecks throughout the entire company's projects portfolio and develop new workflows and processes to avoid those in the future.

Both an enabler and enhancer of processes, BIM is changing the terrain of a technology-resistant construction industry. We expect many of the new technologies to only work on BIM-enabled projects, where it will widen the productivity gap between companies who have adopted change versus those that stayed behind.

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**Roy Danon**  
CEO  
**Buildots**  
Tel: +44 (0)20 3984 9580  
[info@buildots.com](mailto:info@buildots.com)  
[www.buildots.com](http://www.buildots.com)



# INTRODUCING VIEWPOINT CONSTRUCTION SOFTWARE



**Viewpoint, a Trimble company, has been a construction software leader for more than 40 years. Viewpoint offers award-winning solutions to connect your office, team and field.**

Viewpoint's Common Data Environment (CDE) product - Viewpoint for Projects (VFP) - is a cloud-based document and information management solution which enables customers to share, control and collaborate on project documents with dispersed projects teams. VFP customers realise benefits such as streamlining documentation, reducing errors, mitigating risks and avoiding duplication of efforts.

According to the 2020 BIM Report by NBS, VFP is the most used common data environment in the UK.

This powerful document control solution integrates with Viewpoint Field View, a cloud-based and offline mobile solution that replaces pen and paper in the field for quality, safety, project delivery and closeout/commissioning.

## Viewpoint Construction Software

Share, control and collaborate on project documents with dispersed project teams in a cloud-based document and information management solution.

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## Benefits of Full Control Over Your Projects



### Achieve True Collaboration

Realise a real collaborative partnership with project stakeholders regardless of native software.



### Mitigate Risks

Reduce your potential for project delays, mistakes and costly claims.



### Immediate Results

Easily access critical business information at any phase of the project lifecycle.



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# Automated scan-to-BIM inspection tech helps deliver green construction in Sweden

A project in one of the trendiest neighbourhoods of Stockholm has invested in automatic 3D scanning to track progress and detect construction deviations in real time

**Location:** Stockholm, Sweden

**Project team:** Byggstyrning (construction management), Vasakronan (owner/developer), Imerso (technology provider)

**Completion:** 2022

There is a lot going on in the heart of Södermalm, the trendy neighbourhood in south Stockholm. One of the most densely populated areas in Scandinavia, the region is considered by many as the creative hub in the city.

It is in this place, where charming cafés and art galleries share space with modern business offices, that the real estate company Vasakronan is developing one of the greenest buildings in Sweden.

The new building comprises 23,000 sq m spread over seven floors and has several ambitious goals. The design promotes integration with the surrounding area, including an active ground floor with restaurant and café, and the facade along the street level opens up so that activity in the house spills out on to the street, creating a new public open space. The building has several environmentally friendly features. The implementation of innovative technology solutions to ensure water efficiency, rational use of materials and resources and indoor air quality will give the new office building the Platinum level on the LEED certification - the greenest classification that a structure can get.

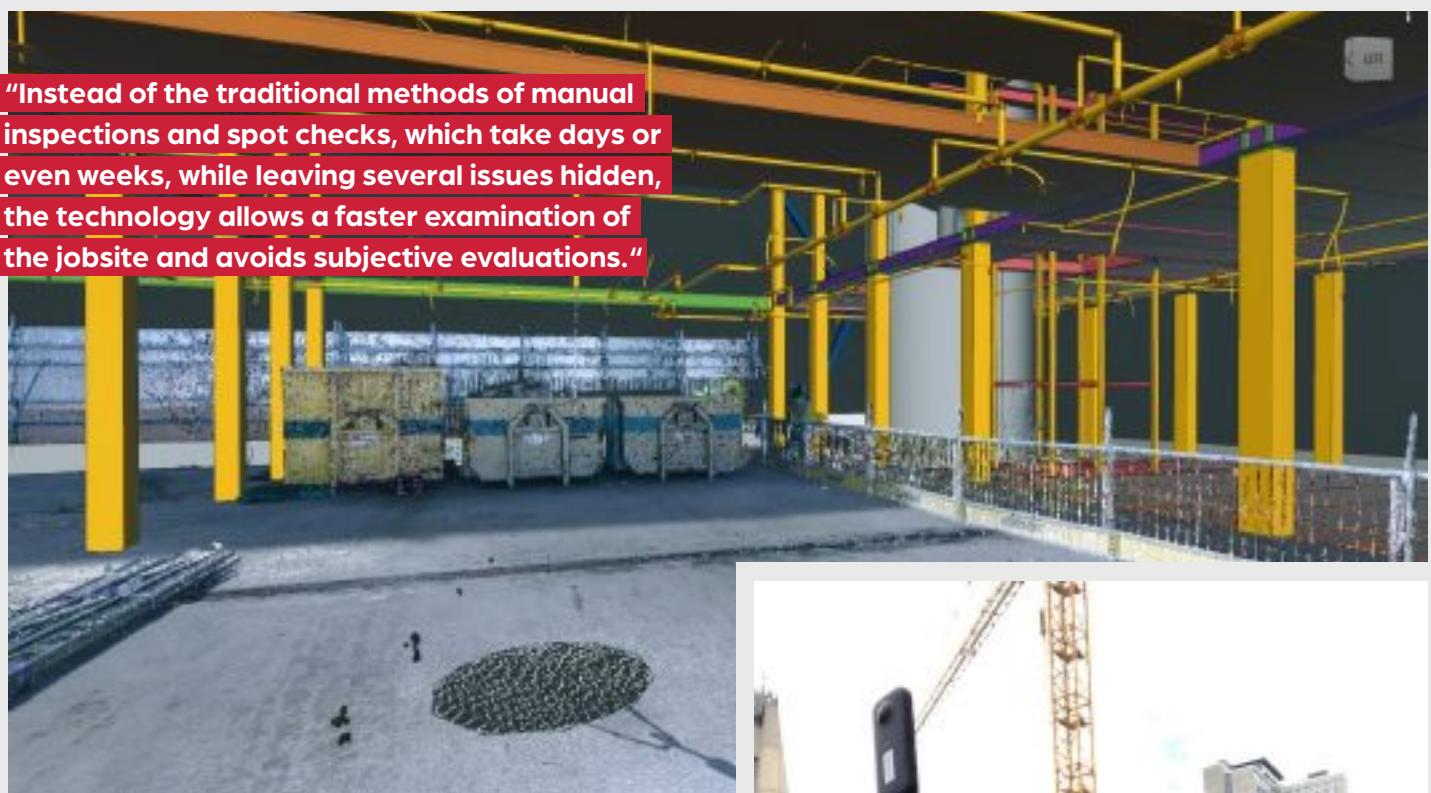
The tight schedule of the project is also quite bold. The teams plan to have everything ready by 2022 - not an easy task, given that the building will be located at Folkungagatan, one of the major and busiest streets in Stockholm.

In order to prevent delays, Byggstyrning, the construction consultancy firm in charge of managing the project, invested in cutting-edge technology to track fieldwork in real-time and reduce the chance of costly mistakes and material waste.

The solution comes from the neighbouring country, Norway. Byggstyrning has chosen Imerso's software to capture the work status and check it automatically against the building plans. By using 3D scanning data, the platform benchmarks the onsite reality to the BIM plans and immediately catches any hidden problematic discrepancies.

Instead of the traditional methods of manual inspections and spot checks, which take days or even weeks, while leaving several issues hidden, the technology allows a faster examination of the jobsite and avoids subjective evaluations.

"With a short deadline, we needed to prefabricate the superstructure at the same time as we demolished and prepared the site for assembly. But due to the complexity



with existing building structure around the two ground floors, with tight margins to the new building, we were worried that problems would happen when the prefabricated elements arrive, stopping the whole project", explains Johannes Ris, CTO at Byggstyrning.

To avoid setbacks, Ris contacted Imerso and started to scan the jobsite nearly every week. The investment paid off. Using Imerso, the team is able to identify problematic areas and fix issues before they had the prefabricated elements arriving at the site. For example, using the platform data the team was able to adjust prefab elements offsite before these were sent to the construction site while correcting misplaced onsite elements to ensure a frictionless fit.

This way, the construction team is able to place prefabricated elements without hassle - making sure Byggstyrning kept the schedule and avoiding material waste. Right now, 40 people are working on building the structure but in one year, at peak times, around 200 people are expected to be working at the site.

"As a result, we had a clear understanding of problem areas that we needed to fix. Because we had identified the issues in an early stage, we could also plan and order things we now knew that we would need. It saved a lot of time and cost in making sure production kept flowing", says Ris.



With this 3D copy of the construction site accessible online, all people engaged in the project can navigate the virtual jobsite together remotely to get many eyes and comments on potential issues as early as possible. Discrepancies between the onsite reality and the building plans get corrected on the spot or can be quickly updated in the BIM models to ensure correct as-built documentation. The team can also take measurements, screenshots and prepare upcoming work packages from their browser in a collaborative workflow.



"In the past, only CAD engineers could really understand and analyse point clouds to detect future problems. But now we have a fast and easy solution available to check reality against BIM. People onsite don't need any knowledge of complex engineering CAD software to run the Imerso software. It is a tool for everyone," says Ris.

The collaboration has been ongoing since June, and the Byggstyrning team adopted the complete 3D control method, scanning the jobsite with a Leica BLK360 scanner by themselves and uploading the results to the Imerso platform for instant inspection.

The team had no previous scanning experience but did not need any special training before getting started. Some tips and tricks, and a few trials and errors were more than enough, according to Ris.

"Johannes and his team in Byggstyrning are truly role models for modern project management. They are proving that transparency and digital interaction are key factors for a better production flow. We are proud to be supporting Byggstyrning in this project and how they are leveraging the ease-of-use and fast results of our software to improve how buildings are built," says Mads Lohne, BIM leader at Imerso.

In just over two years, this technology was deployed in over 50 projects in Norway, Sweden, Denmark, Germany,

Switzerland and Italy. The projects range from public civil works, alongside commercial, residential, renovations, and industrial applications.

Imerso's software is based 100% on international open standards to ensure interoperability with any other industry tools, including Revit, ArchiCAD or Solibri. The company's mission is to introduce frequent 3D control as a new building standard in any project to improve collaboration, eliminate unnecessary costs and keep all stakeholders on the same page.

"We believe remote site monitoring is here to stay and we're focused on using automation and making advanced tools easy to use for everyone to change the way our world is built," says Frederico Valente, CEO of Imerso.

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**Imerso**  
[info@imerso.com](mailto:info@imerso.com)  
[www.imerso.com](http://www.imerso.com)

# Crystal clear innovation: How innovative design and digital technology led the way at the University of Birmingham

**Following its completion earlier this year, the University of Birmingham's Teaching & Learning (T&L) Building has become a symbol of innovation and collaboration across the city**

**Location:** Birmingham, UK

**Project team:** Willmott Dixon, BDP & RLF

**Completion:** 2020

Overlooking the recently developed landscape of the Green Heart, this educational hub provides state-of-the-art teaching, learning and study environments for students at the heart of the university's Edgbaston campus.

Delivered by national contractor [Willmott Dixon](#), the £22.7m project incorporated a range of innovative building techniques to create an extraordinary structure that is both practical and aesthetically pleasing.

At its centre, the building features a crystal structure that houses a 500-seat traditional lecture theatre and a 250-seat collaborative lecture theatre set underneath a Glulam ceiling. This structure is surrounded by 10 seminar rooms and open learning spaces for up to 1,000 students – providing areas for individual study and collaborative work – and a new café.

Nick Heath, Willmott Dixon's director of delivery for the project, said: "The T&L Building was an incredible project to work on – it tested the inventiveness and creativity of the whole team who worked hard to find new solutions that allowed the construction of this multidimensional structure to succeed."

"Despite some of the challenges we faced due to the complexities of the building's design, we were able to utilise modern construction methods to make sure that

the delivery of the project was in accordance to the architect and customer's vision of contemporary and collaborative learning."

## A myriad of design elements

This project's unique combination of one structure inside another meant that the design and construction of the build had to be carefully navigated.

The inner crystal structure – which houses two lecture theatres and rises through the centre of the building – is surrounded by a cluster of smaller, concrete learning spaces to encourage students to use university facilities beyond their timetabled hours.

These seminar rooms and self-directed learning spaces are connected to the crystal by a network of bridges and can be accessed by roman steps, which give the structure transparency and allow free-flowing movement throughout the building.

Accessibility was a key aspect in the building's design, ensuring that 1,000 students could flow through the space with 10-minute turnaround every hour – as well as catering for full accessibility in lecture theatres and seminar space.

Experts from [BDP](#), [RLF](#) and Willmott Dixon worked closely together to ensure the project was structurally sound.

Heath explained: "The crystal interior is a flexible steel structure, clad in 730 unique pieces of Stoventec glazed panels that have a 5mm tolerance for installation. These



panels were made in Bulgaria with extensive lead times and so needed to be manufactured prior to the steel structure being completed.

"The seamless installation of the crystal within 5mm tolerances is testimony to the collective planning, collaboration and shared understanding from all those involved. It had the right design delivered at the right time, installed in the right way.

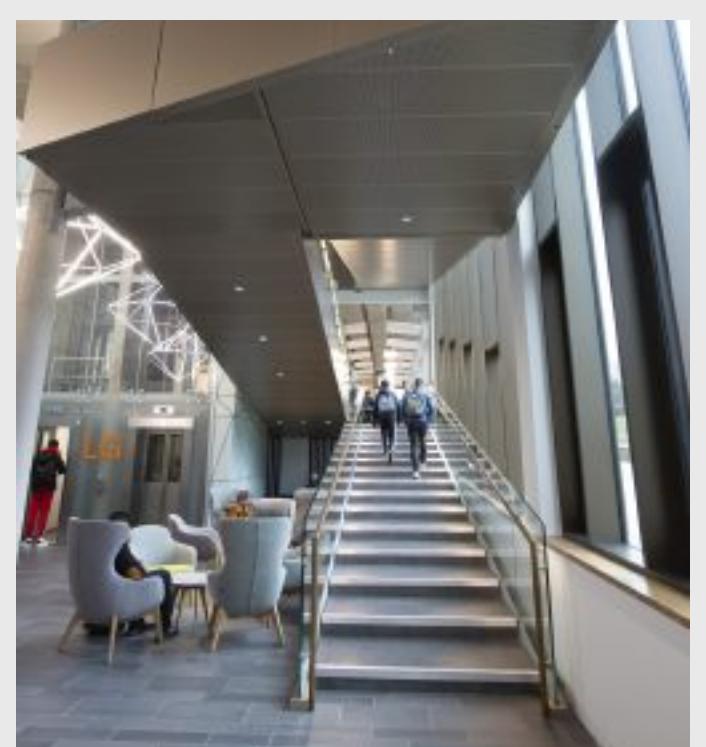
"This was the first major project at the University of Birmingham to fully coordinate AV and FFE within the contractor's package, and detailed commissioning, installation and planning was needed to successfully transition the building to an operational facility.

"Sensory disabilities were also considered during the project through the finalisation of colour, fabric and finishes, along with the creation of enclosed, quieter spaces to provide pockets of comfort within the open-plan design."

### **Innovation through digital technology**

The intricate details and design elements of the crystal and surrounding structures created challenges that were met by the Willmott Dixon team, who collaborated to provide solutions through their innovative use of digital technology.

The Stoventec glazed panels were measured off the federated model for manufacture. While the team were



building the steel structure, a cloud point survey was undertaken at each level to overlay back in the model to ensure accuracy of fabrication and final positions.

Heath said: "The use of digital technology provided more than just a visualisation tool at the front end of the design process – it was integral to planning the project and ensuring everything was completed to a high standard.

"Without the federated model, we would have not been able to procure all items in appropriate lead times to successfully deliver the project. We also undertook construction rehearsals which enables us to refine the sequencing of works."

The steel frame was then adjusted to ensure that it matched the model perfectly to manage 5mm tolerance in the glazing. This process was undertaken at every step of frame's construction, before the glazing arrived in batches with a unique reference, fitting onto the structure like a jigsaw puzzle.

The innovative internal scaffolding solution mirrored the outward and inward slopes of the inner crystal to enable safe access during the installation of glazing. This meant the internal scaffolding was on site for a longer period and internal works had to be correctly sequenced to continue with the programme.

### Social and environmental value

The contractor didn't sacrifice its high sustainability standards to accommodate the T&L Building's innovative design, instead delivering them hand in hand.

Heath said: "Throughout the build, we prioritised the use of responsibly sourced materials and optimised elemental lifecycle costing to advise on material specification. For example, the atrium balustrade fitted with a robust timber cladding material to reduce maintenance and replacement costs, and a glass balustrade specified for the main staircase to minimise redecoration costs."

The design also included the provision of a 300m<sup>2</sup> PV array helping to reduce the building's energy demand that will lead to a saving of 21 tonnes of CO<sub>2</sub> per annum. The project was not only environmentally sustainable but also added social value to local students and communities.

Heath said: "Student engagement was key throughout the completion of the scheme and two engineering students played an integral role throughout its lifecycle by providing input through site visits, product manufacturing assessments and advising on final selections."

"Our team was joined by 233 other students who visited the site and 971 students who attended workshops about the project. The scheme also supported 22 university research projects, offering experiential learning to supplement academic research on a range of courses."

Throughout the project, 45 weeks of on-site apprenticeship training and 107 weeks of work experience were completed and an additional 26 NVQ students were supported, and a new job was created for one local candidate.

The project also worked alongside the local community, supporting the industry-wide initiative of Open Doors that enabled the public to see behind the schemes of the project in its early construction stages.

This social value was limited not only to local students and members of the community but also extended to the contractor's supply chain.

Following the closure of the steel frame company just days before work was due to commence on the project, Willmott Dixon worked tirelessly to purchase the steel and hire the fixers that were due to be erecting the frame, providing them with work when they would have previously been left unemployed, all without hindering the project delivery time or budget.

### The impact of design

The forward-thinking design of the University of Birmingham's new T&L Building provides students with more diverse, high-quality learning spaces on the Edgbaston campus.

From day one, the social learning spaces have been near full capacity during term time with students adapting seamlessly to the new environment. Study spaces are being used as intended, encouraging students to inhabit the building beyond the formal timetable supporting the 'sticky campus' concept.

Through a combination of complex design and digital technology, the Willmott Dixon team was able to collaborate with BDP and RLF to create a scheme that enhances progressive learning and encourages interaction between students and teaching staff.

The structure not only promotes collaboration and innovation through its design but also houses the right environment and resources for these skills to be exercised by its users.

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**Willmott Dixon**

Tel: +44 (0)1462 671852

[www.willmottdixon.co.uk](http://www.willmottdixon.co.uk)





# Digitising quantity estimation to win more projects

**Dublin-based engineering contractor ClearTech has won 50% more jobs with enhanced estimation efficiency from BIM software**

**Location:** Dublin, Ireland

**Client:** ClearTech Engineered Solutions

ClearTech Engineered solutions is a Dublin-based specialist engineering contractor that designs and installs post-tensioning for bridges, buildings, roads and other civil engineering projects.

Post-tensioned structures require less concrete and reinforcement, which has a smaller environmental impact than traditional or pre-tensioned concrete. And as demand for these services rose, ClearTech had more RFQs than it could answer.

As a result, [ClearTech](#) started using Bluebeam Revu to increase the speed and precision of its project estimations. This became the digital centre for ClearTech's practices, encompassing estimations, design and revisions, QA/QC and document management. Digitisation has saved ClearTech thousands of euros by cutting the cost of paper printing for design comparisons and revisions. Additionally,

use of the overlay tools resulted in faster annotation methods and reduced work hours per project.

CEO Feargal Cleary started ClearTech in 2010, in the depths of a major industry downturn.

Cleary knew that the traditional operations and models in design and construction would soon give way to technology-driven and environmentally sustainable models that would require leaner operations.

While large companies cut budgets to steady their businesses, Cleary aimed to build something more flexible: the first concrete post-tensioning service in Ireland.

Post-tensioning is the process of casting concrete with steel cables in ducts, then tensioning the cables to compress the cured concrete. The resulting slab has the compressed strength of concrete and the tensile strength of steel.

"Sustainability — it's a big focus for ClearTech," Cleary said.

"So, what we do is we reduce the concrete depth, reduce the reinforcement and this gives the client a sustainable solution over the lifetime of their building."

ClearTech's post-tensioning process has benefits for the environment and the company's profits - it uses less concrete and earns tax incentives and rebates by lowering environmental impact.

### Digitalising quantity estimation

In 2018, ClearTech's reputation led to more tender estimation requests than ever. Everyone was using PDFs for releasing design information but there was no easy way to quantify material measurements digitally.

Furthermore, the ClearTech team was still using A3 and A1 prints, often losing half a day waiting for designs from the printers, only to spend hours marking and measuring drawings by hand. This time-intensive process was also prone to errors, resulting in inaccurate estimations and rework. ClearTech needed to speed up its estimation process.

The team at Powergreen Software introduced ClearTech to Bluebeam Revu and trained the team on doing digital estimations with its automatic measurements and exportable metadata.

The results were immediate: the printing budget was cut by two-thirds, saving thousands of euros. And since proposals weren't trapped in administration, there was more time to look at new projects.

### Expanding use of technology

The overlay tool in Revu was soon discovered and put into constant use by ClearTech engineers in the design revision process. Designs change rapidly; tracking those changes and keeping every stakeholder aligned can be challenging because a single project might have hundreds of different designs. ClearTech engineers use overlay tools to compare plans and quickly spot design differences.

Leticia Siqueira, a ClearTech structural engineer, uses the overlay tool to track the change that happens on site and at the construction stage: "So, when new revisions come in, I can easily see the difference and work on them straight away."

"We used to print the two drawings — the newest one and the previous version — and look at them," added Thiago Tamm, another ClearTech structural engineer.

"It would take well over half a day to go through these drawings to compare changes. But, with the overlay tool, you can just do it now in fewer than 25 minutes and you're done with comparing."

ClearTech also uses Revu to set key performance indicators (KPIs) for engineers on site to track how long each task requires, as well as to input that data into custom column sets in Revu. By analysing this information, ClearTech can more accurately estimate the cost of labour, concrete and steel in subsequent budgets.

Using the overlay tools, engineers can also share revisions almost instantly, creating a trustworthy and up-to-date single source of truth for all parties, increasing transparency between stakeholders. Communication between the office, jobsite and contractors is also faster, simpler and more precise. The benefit comes in the form of cost savings by minimising delays and mitigating risks for rework and injuries, as fewer hours are necessary to complete a job.

"We have the cloud-based system so that we can communicate with the guys on site," Tamm said.

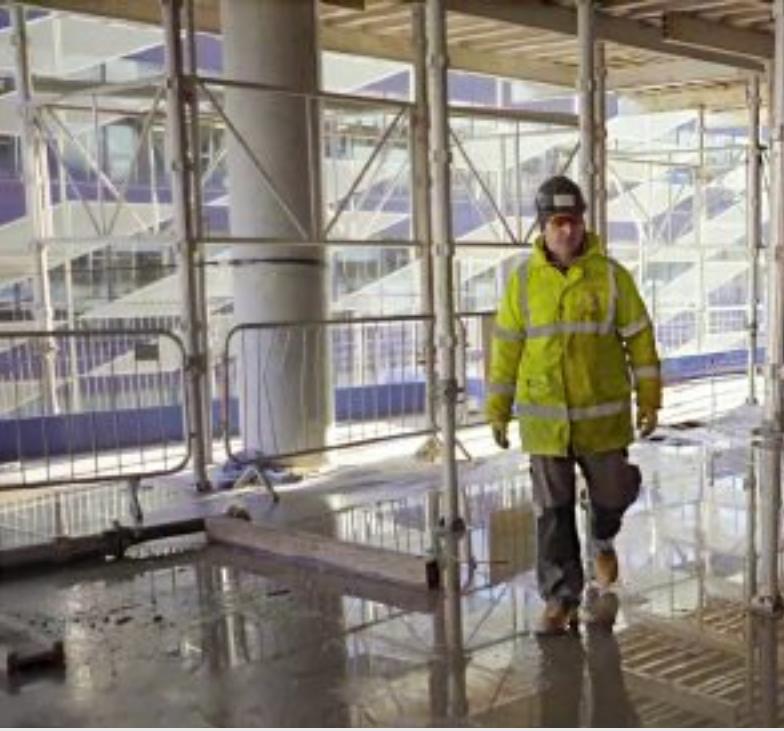
"We are always making sure that the newest drawings are in there for them to follow the current revision."

Siqueira added that Revu helps her track "any change that happened on site and to communicate in an easier way, in a personal way as well, with all our employees and other contractors."

Every project's completion adds data to the company's business intelligence, so ClearTech can continually refine and improve its operations and estimates, and reduce waste in both material and wages — all of which fits the company's larger lean approach.

Cleary said that by using customised columns "we're able to get accurate understanding of what we're using on site, what's being used, what's required and what we need to order. We use that insight in the office to create our orders to look ahead".

Because Revu is at the centre of ClearTech's data operations, it's also used for the company's QA/QC processes — partially for its own meticulous record-keeping but also in fulfilment of an Irish legal requirement,



the Building Control Amendment Regulations (BCAR). The regulation requires tracking materials used in building and renovations, and is designed to increase transparency between builders, owners and residents.

"It's important that, through the BCAR, we have an accurate understanding of every part of the systems that we're putting into the concrete," Cleary said.

There's also the advantage of better communication with partners and clients.

"The other companies that we work with, they use Bluebeam as well," Tamm said.

"And we communicate using the same software so we have more concise and accurate comments and reviews on the drawings."

### **Cutting waste, saving money, expanding frontiers**

Since ClearTech started using Revu for its estimations, it has cut waste, improved record-keeping and communication and increased transparency among stakeholders.

The company has won an additional 50% of projects, thanks to its much-improved estimation and communication process. It has also gone on to complete work for clients such as Salesforce, Facebook and Amazon.

Still, the most important difference might be cultural, as the entire ClearTech team has used the technology to improve its performance, raising the company's ambitions.

ClearTech has since taken its business international, completing projects in Saudi Arabia, Vietnam, the Philippines, Malaysia and Indonesia. Growing the business at home, to be sure, has also become a bigger priority.

"We want to be a leading light in the industry," Cleary said, "and we're pushing the likes of Bluebeam to demonstrate there is an opportunity for innovation in the industry here in Ireland."

Today, ClearTech is faster, leaner and more successful than ever. It has become the company that Cleary envisioned when he first started it 10 years ago.

"What we're seeing now is that we can think ahead and we can look forward and that there's a consistency of projects that are coming in now that we didn't have before," Cleary said. "And that's what we are seeing now that we've started to use Bluebeam."

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Image: © ICA

# BIM blends the old and new in Edinburgh

**Using a BIM model streamlines collaboration and provides benefits in the successful building design of the first Virgin Hotel in Europe**

**Location:** Edinburgh, Scotland

**Project team:** Will Rudd Davidson, ICA

**Completion:** 2020

The new Virgin Hotel in Edinburgh is a flagship project that involves the redevelopment of three existing Grade A listed buildings and a new build to create a five-star hotel with 225 bedrooms. The project will transform the India Buildings on Victoria Street and create a modern building to enhance the streetscape of Cowgate in the heart of Edinburgh's Old Town.

Part of Edinburgh's historic old town and next to the National Library of Scotland, the site is high profile and full of history. Will Rudd is delivering the project with

architect ICA and is responsible for the structural engineering to achieve the design intention of all the buildings in the proposed hotel development.

The design principle is to blend the old and new and be true to the historic heritage. The old was not considered Bronze Age, until surveying began underground. Will Rudd started a BIM modelling procedure at the site to design appropriate foundations and create a new service basement area. As excavation took place, the archaeologists discovered old walls and structures.

Will Rudd Davidson had temporary works design responsibilities throughout the project, including the archaeology phase and developed innovative solutions to



Leo Shand

allow archaeologists a safe space to work and minimise the risk of damage to artefacts during the excavation process. Building works were halted on this part of the site for several months as objects including jewellery and a drinking vessel, dating back 1,000 years, were unearthed.

### 3D design as an aid

Apart from the new Bronze Age discovery, another challenging aspect of the design for this project is the geography of the site. Survey data was used to map out the varying levels and the slope. A 3D model of the design gave the design team the tool they needed to visualise the building and overcome the difficulties created by the different levels and access points.

Using the high level of detail provided in the BIM model, all parties could appreciate and realise the design intent despite the challenges. The slope from Victoria Street down to Cowgate results in the ground floor entrance on Victoria Street to be five levels up, or 15m, from the same level on Cowgate. The ninth floor of the new hotel building on Cowgate will share elevation with the third floor on Victoria Street.

This multi-level required walkways to link and unify the hotel building and is one of the striking elements of the project. A 3D representation allows for a full spatial

coordination and understanding to aid the creative process. It also allows for integrated structural analysis and design to produce better outcomes.

### Collaboration and conservation

The refurbishment of derelict existing Grade A listed buildings is challenging, especially when initial plans are based on past survey data. Once on site, it became clear the level of accuracy is not fully captured. To create a model to communicate the structural design needs in the early stages of a project, the design team needed to capture the detail of all the internal building elements ranging from the location of beams and thickness of walls to the location of cornicing, stairways and pipework.

**"The steel framework for the new hotel building and the granular detail of the model are the subject of daily meetings. The 3D modelling interface allows for clash detection at an early stage and this helps to minimise errors, reduce risk and improve construction planning and design."**

BIM is used here to create a model to depict the design intention of the architect and allow the complex structural design elements to combine. It also ensures the engineer can ensure the safety of the building as internal works are carried out. The use of BIM helps the collaboration and coordination with the architect and other designers involved.

### Big benefits to clients

3D models also allow vital initial feedback on design. One of the key features of ICA's design is the multiple pitches of the roofs of the buildings using steel frames. This style is sympathetic and reminiscent of the original skyline of the Edinburgh Old Town. The model allows everyone to see how the design will work alongside the original buildings and architecture. Client teams can also understand the design process in more detail as models can be shared in virtual meetings.

BIM also creates a fluid approach to design. The model used shows the steel frame, precast concrete floors and window framing, and planned access points for utilities. Any changes to the design by the client can be reflected quickly in changes to the model. Being able to view models so rapidly and easily in client meetings allows people to visualise and appreciate the project as it takes shape on the ground. It is a popular tool with clients and allows them to be engaged in the design and construction process.



### Minimises risk and ensures quality

The BIM model is essential in a project of the complexity of the new Virgin Hotel. It is important to understand and accurately survey the building geometry. It also allows a high level of detail in the construction design to allow fabricators to create the frameworks and determine the precise accuracy of the prefabricated elements.

The design team on this project is in constant contact to make sure all elements of the design are fit for purpose and structurally sound. The model provides the visual focus and allows the architects and other designers to identify issues before the construction phase. The steel framework for the new hotel building and the granular detail of the model are the subject of daily meetings. The 3D modelling interface allows for clash detection at an early stage and this helps to minimise errors, reduce risk and improve construction planning and design.

The use of the BIM model has been a key part in merging the old and the new in Edinburgh to create a flagship Virgin hotel to add to support Edinburgh's thriving economy and innovative and exciting built environment.

In addition to core civil and structural engineering design services, Will Rudd Davidson supplied specialist design

services for temporary works at both archaeology and main works phase, conservation of listed buildings works, light steel framing and full façade engineering including curtain walling.

MJ O'Shaughnessy, managing director from the Glasgow office, said: "Developing our BIM model for the project was critical to the coordination of such a complex build but it was equally fundamental to its success having the expertise of Leo leading this aspect of such a high-profile project."

---

**Leo Shand**  
Senior BIM Coordinator  
Will Rudd (Glasgow Office)  
Tel: +44 (0)141 248 4866  
[www.ruddconsult.com](http://www.ruddconsult.com)





# Proof of concept: Digital twins take off at Museum of Flight

The Museum of Flight has explored the unlimited potential of 3D laser scanning with Datum Tech Solutions. Sean O'Keefe takes a look

**Location:** Seattle, Washington.

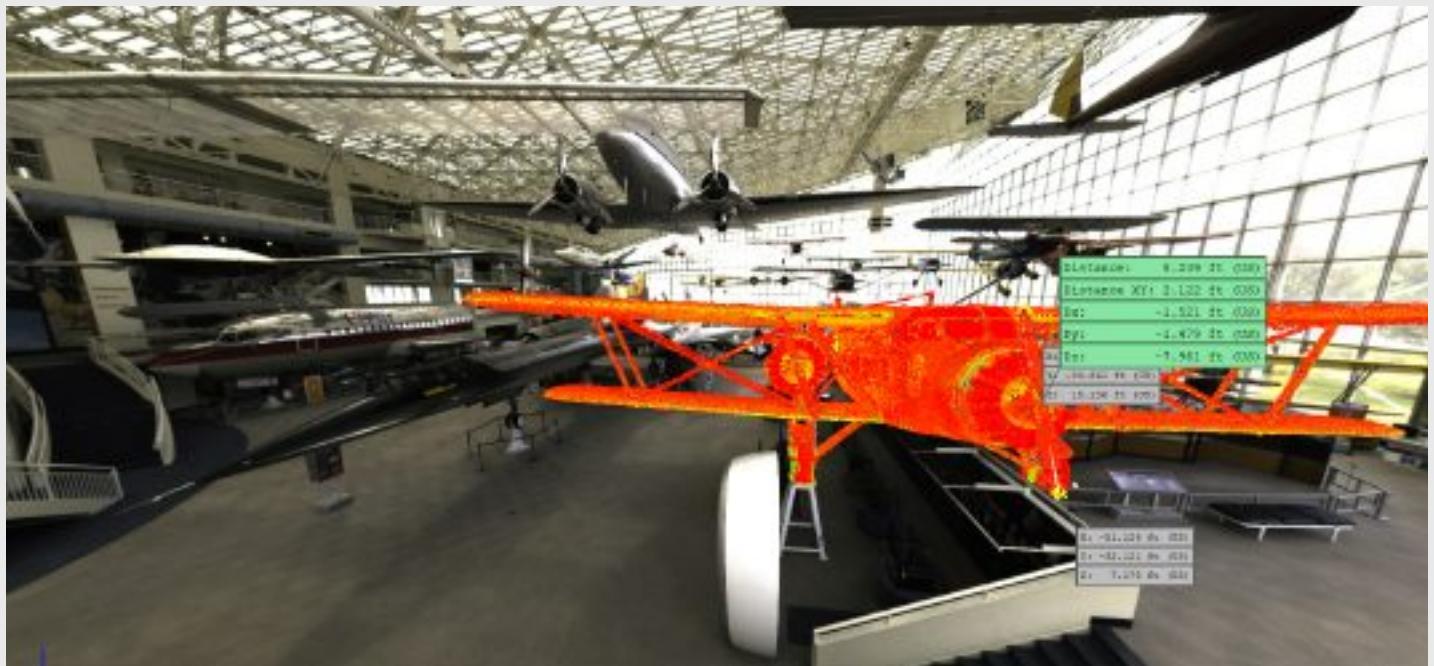
**Client:** The Museum of Flight.

**Technologies:** 3D scanning, digital twin.

At the intersection of history and technology, Peder Nelson has found a sweet spot. He is the digital engagement manager at [The Museum of Flight](#) in Seattle, Washington, where he finds a thrill in blending his love of technology with his expertise in history and museum studies in innovative ways. As an exhibit developer focused on creating interactivity that allows museum users to experience history in new ways, Nelson finds himself on the forefront of what could be the next big thing – virtual archaeology.

"My work at the Museum of Flight concentrates on using emerging technologies to create new access points to the museum's many large, historical artefacts," says Nelson.

The Museum of Flight is a 23-acre complex adjacent to King County International Airport – Boeing Field in Seattle that takes pride in being the largest independent, non-profit air and space museum in the world. Hosting more than 640,000 visitors in 2019, the museum showcases a collection of more than 175 different aircraft and spacecraft, along with tens of thousands of related artefacts, millions of rare photographs and dozens of interactive exhibits and visitor experiences within roughly 430,000 sq ft of gallery space. As the digital engagement manager,



Nelson is on the frontlines of merging the digital world of virtual reality and 3D modelling with the large-scale history of human-powered flight in new and exciting ways.

"In telling the exciting and complex story of aviation and space flight, we deal with extremely large, yet somewhat delicate artefacts," says Nelson of the museum's work. "Creating 3D models of these planes is an important next step in the process of historical documentation and interactive programming but not something that is easily done on artefacts of this size."

In the spring of 2020, Nelson and his colleagues at the Museum of Flight were experimenting with ways to capture some of the planes and galleries using 3D technology when an unexpected call came in from [Datum Tech Solutions](#). Commonly employed in many ways throughout the architecture, engineering and construction industry, point cloud generation involves the use of precision [3D laser scanners](#) to create identically accurate surface data points and high definition images of an object, interior space or exterior environment.

### Fully integrated 3D laser scanning

Amy Lawrence and her husband, Stanley, founded Datum Tech Solutions in 2014 to meet a growing need for accurate digital representations of the built environment among Seattle's AEC community.

"We offer fully integrated 3D laser scanning, equipment sales, training and support," she says.

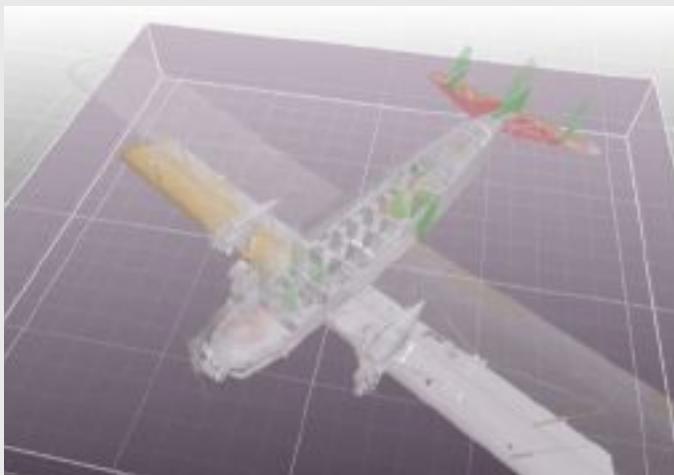
"However, our main focus is pushing the edge of possibility in this exciting field. The chance to work with the Museum of Flight is an excellent example of what the future holds."

When the call came in to consider the use of reality capture at the museum, Nelson had some questions but was genuinely excited at the prospect of being able to create a digital twin of some of the museum's most prized artefacts.

"Datum Tech was invited in to do a proof of concept demonstration," says Nelson of the initial scope of work, which involved laser scanning two of the museum's most unique aircraft.

"We were not sure of exactly what could be captured in our situation. The museum has massive open-span galleries in buildings made almost entirely of windows and some of the airplanes are made of very reflective metal. We weren't sure what the lasers would be able to capture but Datum was certain of their capabilities, so we gave them a shot."

In giving Datum Tech a shot, the museum allowed them to laser scan two of their rarest artefacts. The first is a [Boeing 80-A](#), a trimotor passenger aircraft made of wood, steel and fabric that was built in 1928 and is known to be the only one in existence. The second, a [Lockheed Electra Model-10A](#), is an all-metal, twin engine-plane with a highly reflective metal skin that is the same model aircraft flown by Amelia Earhart in her 1937 circumnavigation attempt.



The plane had been in commercial use for more than 60 years when it was modified to be a near-duplicate of Earhart's plane and subsequently flown on a similar route around the world in tribute to Earhart's mission.

With the opportunity to have Datum Tech help create digital twins of the two planes, the Museum of Flight was opening the door to a sort of archival artefact recreation they had never attempted. Using a highly precise [Leica RTC360 3D Laser Scanner](#), the team from Datum Tech spent an entire day capturing data on each of the planes to produce digital replicas of each. Creating a digital twin through premium quality 3D point clouds and high dynamic range imaging provides the Museum of Flight with unobstructed access to the digital twins in ways that are not even possible with the actual planes themselves.

"Having a digital twin of these planes allows us to study them in ways we simply couldn't before," says Nelson. "In fact, the doors of these planes have very rarely been opened since they got to us. We certainly have not let visitors into the interior of either, because they are so rare and unique."

Asked about the uses of a digital twin in their work at the Museum of Flight, Nelson shares that the possibilities beyond simply having an archival record are immense.

"The digital twin is an invaluable way to extend public access to these artefacts," Nelson says. "We can create a 3D walkthrough of the interiors for educational programming that could put thousands of people through each airplane in a way that simply isn't possible with the originals. Having a digital replica greatly enhances our capacity to study these aircraft. We are also able to share the digital twin with other museums or air and space researchers around the world very easily."

Building on the success of the proof of concept phase, the Museum of Flight has invited Datum Tech back for another round of scanning. While the first set of scans focused on just the two aircraft, a second round of scanning intends to capture the overall gallery itself to understand what can be done at a macro-scale. By generating 3D data points of the entire facility, Nelson envisions many possible uses of the larger gallery scans that range from improved facility and event planning, building operation efficiencies, and full-scale virtual tours from remote locations.

"At the Museum of Flight, our work is about inspiring others. We dream big and look to the future," says Nelson.

"Datum Tech Solutions has demonstrated the unbridled potential of this incredible technology and we are thrilled to just be scratching the surface on what can be captured and what can be done with the digital twins."

---

**Datum Tech Solutions**  
 Tel: +1 (888) 232-8664  
[info@datumtechsolutions.com](mailto:info@datumtechsolutions.com)  
[www.datumtechsolutions.com](http://www.datumtechsolutions.com)





# 4D BIM visualises complex mining plant in Peru

**4D BIM has been used to visualise and report on the construction of a tailings reprocessing plant at South America's biggest tin mine**

**Location:** San Rafael, Peru

**Client:** Minsur

**Main contractor:** Cosapi

San Rafael is the main tin-producing mine in South America and the fourth largest in the world. It is located in the eastern Andes, producing about 10% of the world's tin.

The site has maintained a high standard of sustainability and environmental responsibility for many years, including with its tailings management.

The company planned to build a new greenfield tailings reprocessing plant, known as the B2 project. The process of managing a significant quantity of tailings requires a complex configuration. It included many different processing spaces, mechanical and electrical systems and extensive pipework, requiring the engagement of a wide variety of disciplines and specialist engineers.

## Visualising construction complexity

The company felt that the development of this physically complicated project and its many subsystems would be better understood if construction progress could be fully

visualised at every stage, with information easily exchanged between the owner Minsur and its main contractor.

Although the original feasibility programming for the B2 project at San Rafael had been created in Primavera P6, and this remained the tool of choice for the main contractor, it would not easily enable Minsur to maintain a continuous as-built 4D visualisation.

The company set out to bridge that gap. It chose Elecosoft's Powerproject, not only because of its interoperability and ease of data exchange with Primavera, which would be used as the programme platform throughout construction by Cosapi, the main construction contractor, but also because Minsur could easily take progressed information and visualise it in a 4D BIM programme, via the Powerproject BIM module.

## Preparing the groundwork

The first step taken was to convert all the original 3D modelling for the plant into full IFC (Industry Foundation Class) files, regarded as the base interoperability standard for BIM data.

The second essential step was to convert the original baseline schedules from Primavera P6's .XER format into Powerproject files.

Carlos Peñaloza, senior lead planner at the B2 project, said: "The conversion process was effortless and fast. Converting the thirteen hundred tasks in the construction contractor schedule from P6 into Powerproject took only seconds. We reviewed the dates and links to ensure the data had converted correctly, and all of them matched perfectly."

The final foundation step was to create an easily repeatable and time-efficient process to update the 4D schedule with the weekly progress updates from Primavera – because inputting this information manually would have been effectively impossible.

Jose Luis Hurtado, project controls manager at the B2 project, said: "We could not force our contractors to use our chosen tool, Powerproject, but we knew that updating progress manually would take too much precious time for our team."

### **Reducing the demands of reporting**

To enable the weekly reporting, APP Consultoría recommended using a Powerproject add-on from Elecosoft that could automate the updates from the .XER file directly into Powerproject files.

Peñaloza explained: "We just had to let the macro work – then it only takes 60 seconds each week to update the entire schedule."

This meant that each week the 4D schedule could be rapidly updated to produce 4D BIM reports in various formats.

Using Powerproject BIM and another Elecosoft tool, O2C, the team was also able to generate flipbooks to show weekly progress, videos comparing actual progress with the original baseline and 3D files so that managers could see progress in an interactive format.

O2C is a compression tool that enables you to present 3D objects animated at high speed in a compacted format that can easily be embedded in presentations and reports. Although Minsur's business technology was able to handle the processing demands of 3D modelling, the same could not be assumed for all parties.

### **Setting a new reporting standard**

These functionalities, together with the 4D scheduling data, enabled the project team to show progress not just weekly to the management team but also monthly to senior executives. The rich 3D visualisation, animations and detail about progress that these reports now contain has shifted expectations and become a new standard for reporting quality that the team expect to be required on future projects.

The project team leaders were satisfied with their selection of tools. Hurtado concluded: "Among several 4D solutions in the market, we chose Powerproject because of the sheer simplicity of connecting the main schedule with the 3D models. We are sure we will replicate this on forthcoming projects."

Peñaloza concurred: "Using BIM and adopting digital technology is essential for any forward-thinking organisation in this market. However, as the owners, Minsur doesn't have the time or resources to generate 4D schedules as the main construction programming, but with Powerproject we found a perfect complement which was easy to use and highly effective."

Minsur SA is a Peruvian mining company that has been operating in the region for more than 35 years. It extracts and refines tin and copper, and engages in exploration for gold, silver, lead and zinc ores.

Construction of its new tailings processing plant at San Rafael was so complex that it wanted full progress visualisation in 3D throughout. With the aid of Elecosoft Premier Partner APP Consultoría de Gestión de Proyectos and regional Elecosoft Approved Partner Metacontrol Ingenieros SAC, it turned to Powerproject BIM to complement its existing approach, ensure interoperability and generate informative visualisation of the as-built status throughout the project.

### **Elecosoft**

Tel: +44 (0)1844 261 700

[info@elecosoft.com](mailto:info@elecosoft.com)

[www.elecosoft.com](http://www.elecosoft.com)





# Dyer & Butler uses BIM technology to complete Brighton Valley Gardens

**Dyer & Butler has completed a major highways and public realm improvement project within Brighton Valley Gardens on behalf of Brighton & Hove City Council (BHCC)**

**Location:** Brighton, Sussex

**Sector:** Highways and public realm

**Completion:** 2020

Valley Gardens comprises 23 acres of green space that runs from St Peter's Church to the Palace Pier in the centre of Brighton.

Dyer & Butler's team of highway engineers focused on two strategic routes between St Peter's Church and Edward Street in the centre of Brighton, with the aim of simplifying the existing highway network through Valley Gardens and enhancing the cycle and pedestrian networks to improve levels of safety.

As Valley Gardens is a critical hub for public transport in the city, the temporary traffic management employed had to maintain essential bus routes flowing throughout the scheme works.

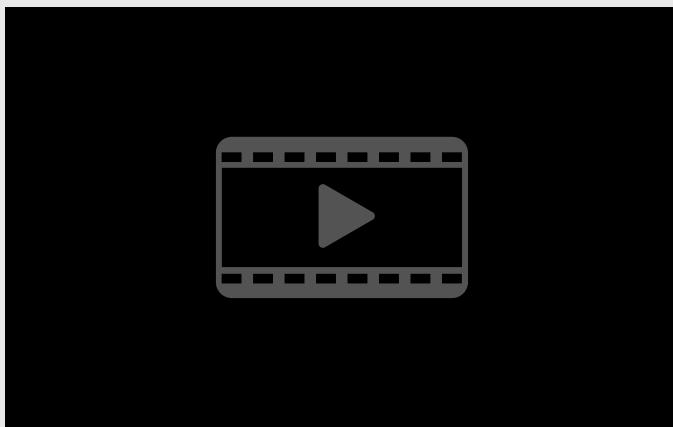
In order to do this (and also to accommodate for weekly community events held in the city) bespoke temporary traffic and pedestrian management designs and equipment were deployed in 34 separate phases.

**"We have transformed this and created an accessible and enjoyable space for the Brighton and Hove community."**

The team pioneered an innovative traffic management solution to connect all of the temporary signal heads to the wider [Brighton MOVA system](#), ensuring continuous traffic flow during the works. This system mimicked BHCC's permanent traffic light operations and was half the cost of the commonly used alternative.

## **Use of BIM technology**

Existing infrastructure lead to technically challenging design queries. These issues were overcome through



collaborative working and the specialist knowledge of the project team who implemented innovative solutions to reduce delays, disruption and client costs.

A good example was the use of BIM technology, which was implemented to allow on-site engineers to identify areas requiring attention and draw up a solution instantaneously on a virtual 3D model.

Dyer & Butler also worked alongside surfacing specialists to install an innovative surfacing solution which provided an ultra-high-performance asphalt.

**"Existing infrastructure lead to technically challenging design queries. These issues were overcome through collaborative working and the specialist knowledge of the project team who implemented innovative solutions to reduce delays, disruption and client costs."**

This offered the council significant benefits, including reduced maintenance costs through greater durability and productivity benefits which accelerated installation time, reduced programme times and minimised disruption and road closures.

### **Collaborative working**

Paul Hartley, Dyer & Butler senior contracts manager on the scheme, said: "We worked closely with stakeholders through our full-time community liaison officer throughout to ensure transparency of ideas and, in turn, this public area has been rebalanced in favour of agile travel for the public."

Simon White, highways director at Dyer & Butler, said: "Before these works, Valley Gardens was neither a place nor a link.

"We have transformed this and created an accessible and enjoyable space for the Brighton and Hove community.

"This scheme benefitted from Dyer & Butler's experience of running similarly large and complex inner-city redevelopment schemes which ensured the project team was able to understand and anticipate issues before they arose.

"The success of our traffic flow management was a true feat of collaborative working, and I expect our innovative method will be imitated across the UK in the ongoing effort towards delivering unobtrusive roadworks."

---

**Dyer & Butler**  
Tel: +44 (0)23 8074 2222  
[southern@dyerandbutler.co.uk](mailto:southern@dyerandbutler.co.uk)  
[www.dyerandbutler.co.uk](http://www.dyerandbutler.co.uk)



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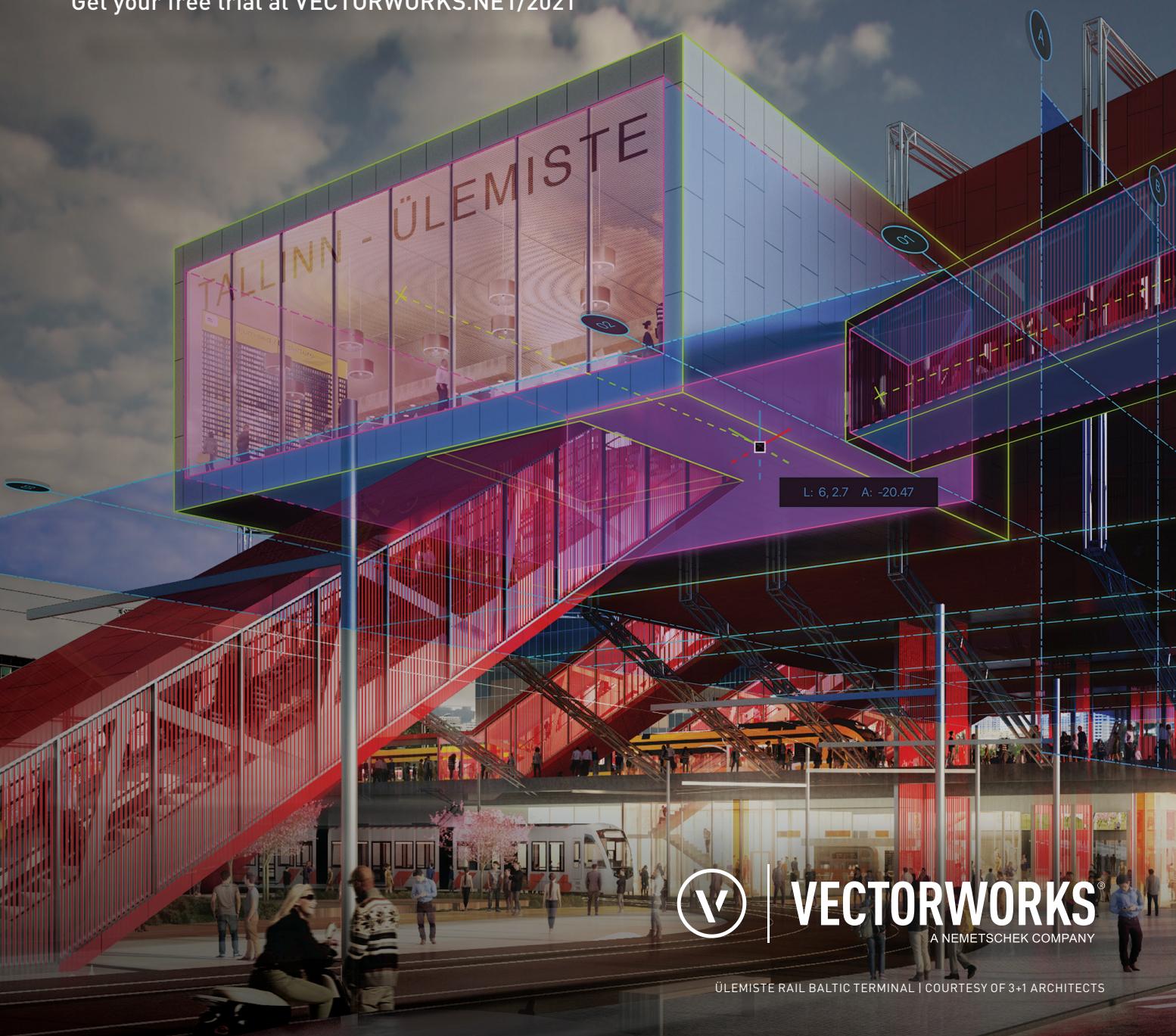
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