# Connected Construction Technology - Transforming the Built World

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# Introduction

The AEC industry is poised—perhaps even overdue—for digital transformation to change how construction and infrastructure projects are delivered. While innovation has occurred to some extent on the enterprise or company level, overall productivity in the sector has remained nearly flat for the last 50 years.[1] With only a few AEC companies using digital as a tool to create new business opportunities and improve margins[2], many are missing out on innovative approaches to driving down cost and improving project execution.

Digital technology has the ability to transform how we design, construct and maintain our infrastructure. Real-time analytics help with predictive maintenance; drone intelligence helps to keep construction sites safer and transformative technology such as 3D models means teams have one version of the truth to collaborate on. Connected construction technology now enables true interoperability with all stakeholders in the chain, and the opportunity to streamline processes, save time and make assets work smarter.

With the global construction sector forecast to grow by up to 70% by 2025[3], it has a bright future ahead. But to capitalise on this opportunity, leaders in this field will need to reach beyond traditional tools, and embrace not only cutting-edge technology, but also the mindset and approach to collaborate. **The ones who embrace connected construction technology will not only survive, but thrive.**

> “The next stage in the digital revolution has begun, characterised by a fusion of technologies that is blurring the lines between the physical, digital and human world”
>
> World Economic Forum

**Source 1:** Boston Consulting Group - How Technology Is Revolutionizing Construction | **Source 2:** Deloitte - 2019 Engineering and Construction Industry Outlook | **Source 3:** HM Government - Digital Built Britain - Level 3 Building Information Modelling - Strategic Plan

# Digitising construction

Digitalisation – the development and deployment of digital technologies and processes – is key to transforming the engineering and construction industry and moving it into the fourth industrial revolution. Innovations of this kind enable new functionalities along the entire value chain, from the early design phase to the very end of an asset's lifecycle at the demolition phase.

Connected construction technologies —such as Building Information Modelling (BIM), wireless sensing, and AR/VR— have begun transforming the way that infrastructure, real estate, and other built assets can be designed and constructed. They're enabling builders to seamlessly connect construction, assets, suppliers and contractors; as well as automate processes and streamline resources. By embracing these tools, AEC companies improve their bottom line, optimise asset efficiency and ultimately create smart, connected job sites of the future.[2]

> "To significantly boost productivity, companies can start by making 3D building information modelling (BIM) universal within the company alongside the use of digital collaboration tools, drones, and unmanned aerial vehicles for scanning, monitoring, and mapping"
>
> McKinsey Global Institute

**Source 2:** Deloitte - 2019 Engineering and Construction Industry Outlook

# How digital construction will shape the world we live in

Robotics

Click an icon to the left for more information

Automation

3D Printing

Autonomous

Drones

VR & AR

## Robotics

From autonomous rovers and drones that can increase the efficiency of site inspections, to mechanical arms that automate highly repetitive tasks like bricklaying and tying rebar, the robotic revolution looks set to gather significant pace.

Source: https://www2.deloitte.com/us/en/pages/manufacturing/articles/digital-disruption-in-engineering-and-construction.html

One of the most significant technological breakthroughs is BIM which is gaining currency as a platform for central integrated design, modelling, planning and collaboration. It provides all stakeholders (architects, surveyors, engineers, building owners, facility managers etc.) with a 3D digital representation of a building's characteristics – throughout its lifecycle.

Sitting at the heart of BIM is digital technology which extends 2D technical drawings into 3D virtual information models, with project management and visualisation tools. This means that spatial relationships, light analysis, geographic information, and quantities and properties of building components can be identified.

Over the last decade, BIM awareness and adoption has grown from little more than 10% in 2011 to around 70% in 2019.[4] Yet despite early adopters seeing significant benefits, notably greater predictability of building performance, price and programme, there is a widening gulf between 'BIM engaged' and 'BIM laggards'.[4] And with the new ISO 19650 series, creating a standardised digital process across the world, those that shun BIM risk losing out competitively.

**Source 4:** BS - National BIM Report 2019

# Rise of the digital twin

As governments around the world mandate digital modelling, the true power of 3D models becomes evident. The concept of a 'digital twin' isn't new (NASA first dabbled with pairing technology in the early days of space exploration) but cloud-based computing has disrupted the economics and now puts it in within reach of AEC companies. In fact, the technology is so advanced that large factories and cities can have digital twins, and the Centre for Digital Britain is already developing the information management framework that will underpin the creation of a national digital twin.[5]

And the hype appears justified: IDC predicts that 2019 will see companies who invest in digital twin technology improve cycle times of critical processes by 30%, while Gartner believes adopters see a 10% improvement in effectiveness. The German Association for Information Technology, Telecommunications and New Media (BITKOM), meanwhile, estimates that every digital twin in the manufacturing industry will have an economic potential of more than €78 billion by 2025.[6]

For AEC professionals, the digital twin of the asset sits at the heart of digital engineering and is paramount to its success. Throughout the building lifecycle, from design to construction and maintenance, engineers and surveyors, architects and facilities managers today need to accurately (and effortlessly) capture, manage and utilise 3D spatial information. For better modelling, planning and collaboration, a digital twin is essential and the demand for up to date, accurate 3D models is greater than ever before.

**Source 5:** Centre for Digital Built Britain | **Source 6:** Innovation Enterprise: Guide To Digital Twin Technology

However, a challenge for architects, engineers and construction professionals, is how to carry out fast, accurate 3D models themselves in the minimum of time. Most projects require information to be captured inside buildings and enclosed environments (tunnels, mines, power stations), as well as in complex and difficult to access spaces where there is no GPS coverage (such as bridge towers, underground stations and tunnels). Engineers will often have a very limited time on site to accurately create actionable 3D models; and for on-the-job quality control they'll need to continually compare as-built models against the design plans.

Access to user-friendly technology that can quickly scan multi-level environments and produce accurate and high quality 3D data can be a game-changer for engineers. Fortunately, with today's innovative scanning tools, highly detailed surveys are produced that would be almost impossible with traditional instruments and the real-time 3D information becomes the cornerstone of the asset – the "one source of the truth".

## Construction verification as-built

The increasing frequency for as-built point cloud scans as part of the delivery of a project is a sign that clients are no longer willing to rely on design models unchecked and issued as record information. Construction verification isn't new, but the wide adoption of mass data collection technologies means firms can now regularly provide as-built surveys to contrast with the design. This enables clients to mitigate some of the risk, time and cost impacts of complex construction projects.

By creating a digital twin of the asset and providing a central data source, greater collaboration and more informed decision-making can take place. Using digital tools such as 3D models, and aligning that data across multiple project stakeholders and project lifecycle phases provide a platform on which the model can be built. It enables smoother processes, better interoperability and improved data integrity.

Having access to regular updates of the digital twin, means that all the project team can make better decisions. And with the technology tools available today, which are accessible and operate in all environments, access to accurate, fast and cost-effective, real-time 3D information is possible. Costly mistakes can be avoided as the digital data mirrors the reality, and the construction process throughout is improved.

> “Connected construction can help keep projects on time and on budget, protect assets, and improve overall quality by enabling people to work smarter, communicate more easily, and track projects more effectively”

Deloitte, 2019 Engineering and Construction Industry Outlook

Case study

# Creating a real-time digital twin of a hundred-year-old school, only possible through connected constructed technology.

Transforming an ageing school in the Jazz District of Kansas City to a community arts centre required the power of today's real-time technology. The building, built in 1905 and renovated in 1922 due to overcrowding, has had several more developments to it over the years. For any plans to be approved on the site of the Attucks School, the commission needed substantial and comprehensive drawings – materials, floor plans, site drawings and elevations. But with several hazards identified - visible deterioration in the wood floorings, ceiling collapses, and air quality conditions including asbestos – a fast, accurate and safe survey technique was required. Civil engineering firm, BHC Rhodes, embarked upon the complex task of a 3D Revit BIM using GeoSLAM technology. Lightweight, handheld scanners, built for difficult-to-access spaces, were used to scan the property in only 4.5 hours, recording more than 43,000 measurements per second.

A 3D model was provided two weeks earlier than expected providing a comprehensive picture of the asset. Only with these modern tools could a real-time digital twin of the ageing building be created quickly, and safely.


# The benefits of connected construction technology

**Enable true interoperability** – with multiple stakeholders engaged at various points of the project lifecycle, "one source of the truth" enables greater collaboration by all parties and more informed decision-making. Critical to this is having a mapping tool that accurately captures the data in 3D model form, and provides an anchor for all data extracts. In the project process, designers, architects, surveyors and engineers will all be drawing off the same data source. In some instances, you could have as many as 100 different software tools mining the data for different purposes – all looking at the same data in a different way. With a central 3D model, all stakeholders can contribute information to and extract information from the digital twin. Delivery teams are unified and all parties have a clear view of the end client's objectives. This not only happens at project and programme level but organisational too.

Save money

Support the full lifecycle of the asset

Perfect the model virtually

Mitigate risk

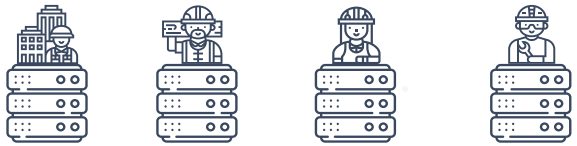
Enable true interoperability

# The case for open standards

Construction is not the only industry grappling to exchange large amounts of metadata. For Google Maps and Citymapper to provide bus, train, tram, driving and walking directions, public transport systems around the world need to work together, talking the same language. Open data standards, reusable agreements that make it easier for people and organisations to publish, access, share and use better quality data, enable this successful data exchange.

When we consider the number of stakeholders in construction (the below diagram represents the core players that exist across the project delivery supply-chain) it is no surprise that a common framework and language is required. Improving the flow of data is critical for all parties who need to collaboratively work together to develop standards that will enable better, more efficient ways of working.

**Data producers in the workflow**



Architect | Engineer | General contractor | Trade specialist

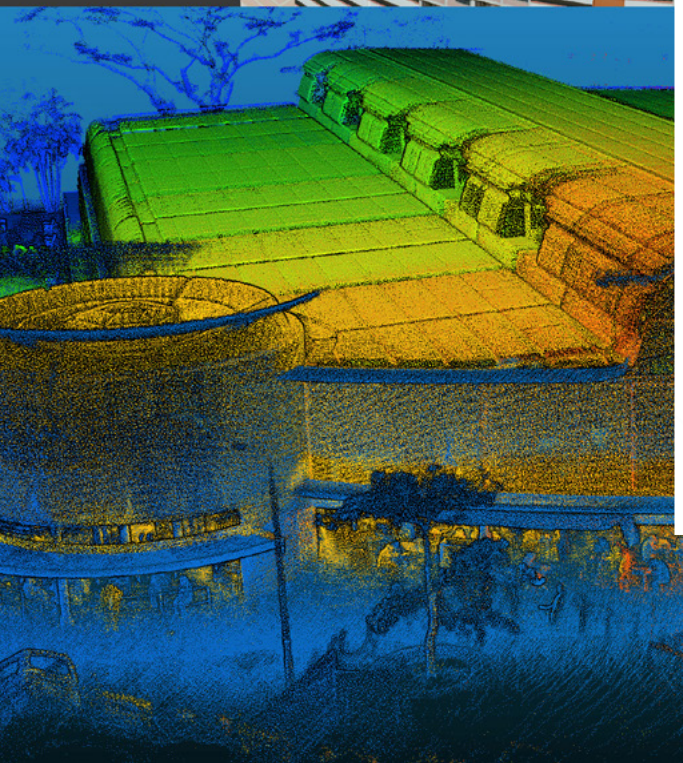
**Influencers over the piece of data**

Owner | Inspector | Facilities manager

A number of industry bodies are already forging ahead to promote greater interoperability. BuildingSMART International (BSI) and GS1 have come together to enable the construction industry to benefit from the combined expertise of both organisations through the use of standards and services they deliver. And the Construction Progress Coalition is trailblazing by seeking to transform project collaboration through a Common Data Exchange (CDX).

Setting standards across a complex and distributed industry may appear daunting. But the benefit in streamlining data across the workflow means better collaboration, and safer more efficient constructions. With an estimated $15.8B wasted due to poor data interoperability between project delivery stakeholders[10], the onus is on all stakeholders to take an active role in shaping the construction standards of the future.

**Source 10:** Construction Progress Coalition – Transforming Project Collaboration through a Common Data Exchange



Case study

# Smart cities - creating a dynamic 3D city model to future-proof Singapore

Limited by space, but still demanding growth, Singapore has embarked on one of the most ambitious digital twinning projects the world has ever seen – creating a dynamic 3D city model and collaborative data platform, including 3D maps of the region. Titled “Virtual Singapore”, it will be the authoritative 3D digital platform allowing users to simulate both present and future scenarios.

But early in the project a significant challenge was thrown up. It quickly became clear that aerial imagery would not adequately capture information on ‘void decks’, open spaces typically found on the ground floor of the region’s apartment blocks. Also, semantic 3D modelling was required which comprises detailed information such as texture and material representation of geometric objects.

With GeoSLAM’s handheld scanners, field teams could quickly capture a dense and accurate point cloud of an entire void deck, which was then used to model the deck geometry and incorporate this into the existing building models. 376 buildings with void decks were scanned, taking approximately 100 hours – a huge time-saving exercise which would have ordinarily taken up to 40 times longer if using traditional surveying methods.

GeoSLAM’s scanners are often used alongside terrestrial hardware as the products are highly complementary. The data output can be easily combined through geo-referencing or scan to scan matching and then used to build a complete 3D models. In this instance, the combination delivered highly detailed and rapid results and significant cost savings too.

# Building the future

It's predicted that the AEC industry will see more change in the next 10 years than we have seen in our lifetime. Digital technology is changing the way we design, construct and maintain our infrastructure. A combination of cloud and edge-based technologies, including high-performance computing, IoT, and advanced analytics are changing the way we work. By enabling us to digitally connect and model physical assets or products, we can conduct sophisticated analysis, advanced simulation and improve performance of the asset throughout its lifecycle.

The 3D spatial information model is the solid foundation to success and coupling the complex, data-rich technology along with drones, 3D augmented reality, ubiquitous connectivity and most importantly, a collaborative way of working, will unlock the true value of digital engineering. Connected construction technology isn't only about creating models. It's about unlocking intelligence, creating data and a platform for true project collaboration that is set to be the building block for 21st century construction.

> "Connected construction can help teams imagine, create, and build the spaces, structures, and cities of tomorrow—at higher volumes and higher profit"
>
> Deloitte, 2019 Engineering and Construction Industry Outlook

GeoSLAM is a market leader in 3D geospatial technology solutions. Our unique “go-anywhere” technology is adaptable to all environments especially spaces that are indoor, underground or difficult to access, providing accurate 3D mapping without the need for GPS or bulky equipment. We design and manufacture world-leading technology solutions that deliver rapid results and save time and money. Easy to install and use, within minutes you can build a highly accurate 3D model of any environment. Keep up to date with the latest news from GeoSLAM by signing up to our mailing list.

ConstructionProgressCoalition

Construction Progression Coalition (CPC) is a non-profit organization uniting AEC Professionals, Technology Solution Providers (TSPs), and governing organizations to collaboratively address the need for project data standardization. By focusing on the ’Shared Pains’ facing project delivery stakeholders, we seek to communicate best practices for the adoption of current data and performance standards through a Common Data Exchange (CDX) framework. CPC is parterned with the US Institute of Building Documentation (USIBD) to focus on connecting reality capture standards back to the Common Data Environment (CDE)”

www.constructionprogress.org/

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