g insight

About

Digitalization is leading to the transformation of the construction industry with the opportunities it offers to transform and optimize every stage and process of the asset life cycle. The magazine *g insight* provides influential knowledge and thinking on key digitalization trends inside the built environment, such as digital building, BIM, digital twins, sustainability, asset lifecycle management, etc. With our expertise and contribution of professionals, the magazine will show you a clear and feasible digitalization route through a global lens in both theoretical and practical ways, to make every project a success.

Glodon

Find us on:

🌐 https://www.glodon.com/en/

g insight

Glodon Company Limited

JANUARY 2023

Digitalisation in Construction Industry and New Roles of Quantity Surveying Profession

The pace of digitalisation across the built environments continues to gather momentum with significant opportunities for more efficient processes, business models and industry connections.

Industry experts argue there is a need to exploit the power of data to improve work efficiency and certainty. Real-time, accurate and structured data is the basis for establishing a reliable connection with clear responsibilities. With data and relevant technology, it is possible to create a digital twin spanning disciplines and life cycle phases for assets, giving situational awareness of what is happening and facilitating data-based decision-making. It is also important to think about a system or platform approach to creating a more comprehensive connection rather than fix eyes on short-term, case-based, one-off applications for solving different problems.

Quantity surveyors, as the principal custodian of project data, will remain central to all predetermined project outcomes and become the foundation of any asset owners' digital journey. It is time for Digital Cost Managers to position themselves and reconsider their value proposition. A focus on upskilling is an enabler, and cooperation with academia can help bring in more digital talents. Leaders in the sector must look to the future and consider how the workforce of tomorrow can drive the changes.

CONTENTS

VOICE

Thoughts on Digitalisation Trends of AEC Industry

By Jukka Nyman

Managing Director, MagiCAD Group

As we all know, during past decades digitalisation has been penetrating to all industries as well as to lives of consumers all over the world. The benefits from this trend has been of many: for companies, it has been enabling not only increased productivity, but also many forms of new business initiatives like introducing cloud-based service offering. For consumers, there has also been many improvements to everyday life, including online shopping, access to banks via internet etc.

For us working in AEC industry digitalisation has been enabling new ways of working, especially supported by the ongoing BIM trend. For architects and designers in MEP and construction domains, the use of digital tools has been a norm for many decades, but the change in workflows, especially in connecting previously separate silos has been a fundamental one. Again, this change has been driven by the need to improve the overall productivity of construction value chain, with a promise of shortening project implementation time and also offering better quality. Digitalisation, especially in construction, has been seeing an enormous boost in the past five years, leading to introduction of many innovations in the global marketplace.

Why is it then still so hard to see proper examples of truly digitised end-to-end workflows in construction, starting from conceptual design and ending to operations management? Are the still separate silos of architecture, designers, construction project management and operations management making it difficult to reach a common understanding of unified

workflows? Or is it because the tools used in any phase of the construction project are so focused on providing support only to a specific work phase? To tackle the latter question, the introduction of Industry Foundation Classes (IFC) has been improving the situation, but not making it perfect. But for the former question, the challenge lies in old ways of working and in the skewed value chain in construction industry, which does not support unified workflows.

To overcome the challenges of providing truly digitised end-to-end workflows in AEC industry, there must be then better solutions to be introduced to the marketplace in the future: solutions, which unify the current separate workflows in an optimal way, at the same time, enable data flow from the conceptual phase to operations management, facilitating the proper data to be used where it is needed. It is said that data is the new oil: it is valuable, but if unrefined, it cannot really be used. For this vision to become true, a common data platform is then needed.

There are only few AEC software companies, who can make it happen in the future. Glodon will be one of those, as it already covers multiple domains within AEC, enabling to gather data from all domains and therefore understanding better the possibilities in unifying the data flow between the different phases of construction. Having a clear focus on AEC and understanding the customer needs there thoroughly will enable Glodon to provide the proper data where ever it is needed and whenever it is needed.

NEWS

Historic Venue of World Cup, Built by China Railway Construction

Lusail Stadium, Qatar's biggest sporting venue, hosted this year's FIFA World Cup final, marking the first time a Chinese company served as a main contractor to build a FIFA World Cup pitch. The golden bowl-shaped 80,000-seat capacity venue was built by China Railway Construction Corp Ltd., cooperating with 110 large-scale subcontractors in more than 20 countries. The 307-metre-diameter 'spoke-wheel' cable net roof is one of the world's largest tensile cable-net roof in a stadium.

Image: CRCC

Grenfell Tower Inquiry Closes More than Five Years After the Disaster

The lead counsel to the Grenfell Tower Inquiry, Richard Millett QC, has accused the construction industry of a "long run-up of incompetence" prior to the Grenfell Tower disaster, saying "each and every one of the deaths that occurred in Grenfell Tower, on the 14 June 2017 was avoidable." And he said that companies involved in the refurbishment of the building were still blaming each other. There was, he added, a "failure to pay due respect to the idea of home as a physical aspect of human privacy, agency, safety and dignity".

UK Net Zero Carbon Buildings Standard Coalition Launches Call for Evidence

A coalition of construction industry bodies has launched a call for evidence to help develop the UK's Net Zero Carbon Buildings Standard (NZCBS). Once developed, the Standard will provide a single agreed definition and methodology for the industry to determine what constitutes a net zero-carbon building. The cross-industry group developing the Standard and championing this initiative includes representatives from the following organisations: Better Buildings Partnership (BBP), Building Research Establishment (BRE), the CarbonTrust, Chartered Institution of Building Services Engineers (CIBSE), Institution of Structural Engineers (IStructE), Low Energy Transformation Initiative (LETI), Royal Institute of British Architects (RIBA), Royal Institute of Chartered Surveyors (RICS), and UK Green Building Council (UKGBC).

Apollo Protocol Launched in UK to Unify Digital Twins Across Sectors

The Apollo Protocol, a white paper proposing a cross-sectoral framework for digital twins and the Apollo Forum, which oversees the framework, were launched in the UK. Currently, the manufacturing and built environment sectors are developing digital twins separately using different language and business models, yet many challenges, such as net zero and economic sustainability, require sectors to work together. The white paper, published by the Institution of Engineering and Technology (IET) and supported by a wide range of leading organisations, sets out a proposal to unlock the benefits of digital twins between the built environment and manufacturing sectors.

UK BIM Alliance Rebrands as 'nima' with Glodon Onboard

The UK BIM Alliance, the independent, not-for-profit organisation established in 2016 to champion implementation of building information modelling (BIM) in the UK, is rebranding as 'nima'. Nima is the Greek for thread, alluding to Dame Judith Hackitt's golden thread of information. According to Dr Anne Kemp OBE, chair of nima, the change emphasises the shifting debate from BIM to wider industry information management challenges. Following its announcement at the UK Construction Week in Birmingham, Glodon became the first international Platinum Patron and Technology Group member of nima. The move demonstrates the company's commitment to contributing to the transformation of the construction industry through digital technologies.

Orlando Unveils Digital Twin of Entire Region

The city of Orlando, Florida, has unveiled a "first-of-its-scale" digital twin of its metro region that will use real-time data to improve decision-making. Orlando's digital twin is said to be essentially a virtual copy of the entire region with different data sets layered throughout. "Using this technology, Orlando has the ability to demonstrate to established companies, start-ups, entrepreneurs and thought leaders from around the globe the possibilities available to them in our city – from real estate options and infrastructure to the proximity of other like-minded companies and our diverse talent pool," said Orlando Mayor Buddy Dyer.

Image: NEOM

Saudi Arabia's City of Future to be Assembled by AI

The futuristic city THE LINE, one region of NEOM, a giga project in Saudi Arabia, will be built using "a lot of artificial intelligence to design through a digital twin backbone". NEOM's executive director Giles Pendleton said in an internal interview that "we're not actually building THE LINE. We're assembling it from a series of modular pieces that are pre-engineered and predetermined as to what they do." The project is touted as a one-building city in the desert, which will stretch over 170 kilometres long, 200 meters wide, and 500 meters above sea level and will eventually accommodate 9 million people. The project design shows two parallel buildings with mirrors as outer walls. It is said to embody Zero Gravity Urbanism, where city functions are layered vertically.

Singapore Calls for Closer Collaboration of Built Environment Sector with Amalgamated Industry Transformation Map

The construction and facilities management sectors will be expected to collaborate more effectively to optimise resources throughout a building's life cycle - from planning and design, construction, to operations and maintenance, the Singapore Building and Construction Authority said in a press release. The Construction Industry Transformation Map (ITM) and Real Estate (Facilities Management) ITM, previously launched as two separate ITMs in 2017 and 2018 respectively, have been amalgamated into one Built Environment ITM. Three key transformation areas are Integrated Planning and Design, Advanced Manufacturing and Assembly, and Sustainable Urban Systems.

Glodon Solution Awarded as Global Service Best Practice at Int'l Trade Fair

Glodon's overseas project case from MagiCAD in MEP design was selected as one of the global service best practices at the 2022 China International Fair for Trade in Services (CIFTIS), the biggest comprehensive fair in global trade in services. The awarded case named "MagiCAD Adopted in MEP Design for Global Projects" includes two projects from MagiCAD, a Glodon company. Its election shows the recognition of CIFTIS that the case represents the trend and achievements of global service trade and has a leading role in new services, models, and businesses.

Glodon Leads Series of Talks on Digital Transformation in Built Environment at PAQS Congress 2022

Pacific Association of Quantity Surveyors (PAQS) Congress 2022 was held in Singapore in September, with the main theme on Disruption and Transformation in the Built Environment. Glodon Vice President Pierpaolo Franco shared his thoughts on digital transformation in the built environment with an angle on its impact on the quantity surveying profession as a keynote speaker; Country product managers Jason Wong and Myke Ong also joined discussions as technical paper presenters with their 5D BIM expertise. Glodon is a longtime partner of the PAQS, and hopes to facilitate digital transformation in the sector in Southeast Asia.

Quantity Surveyors Facing Competitive and Tough Market, Demanding More Experienced Talent Than Ever

By Sebastian Tang
IBD Director Research and Intelligence, Glodon

The RICS Q3 2022 Global Construction Monitor results point to a flatter profile this time around, with the deteriorating economic backdrop throughout much of the world leading to an erosion of momentum. Common key challenges facing the global construction industry continued, including:

• **significant increase in costs, as has been the trend for much of the past two years;**

• **disrupting supply chains and uncertainty for global deliveries;**

• **shortage of construction professionals and skilled workers to carry out existing and future projects;**

• **climate change and extreme weather events cause significant construction delays;**

• **and increasing levels of financial insecurity in the industry, including ripple effects for suppliers and contractors.**
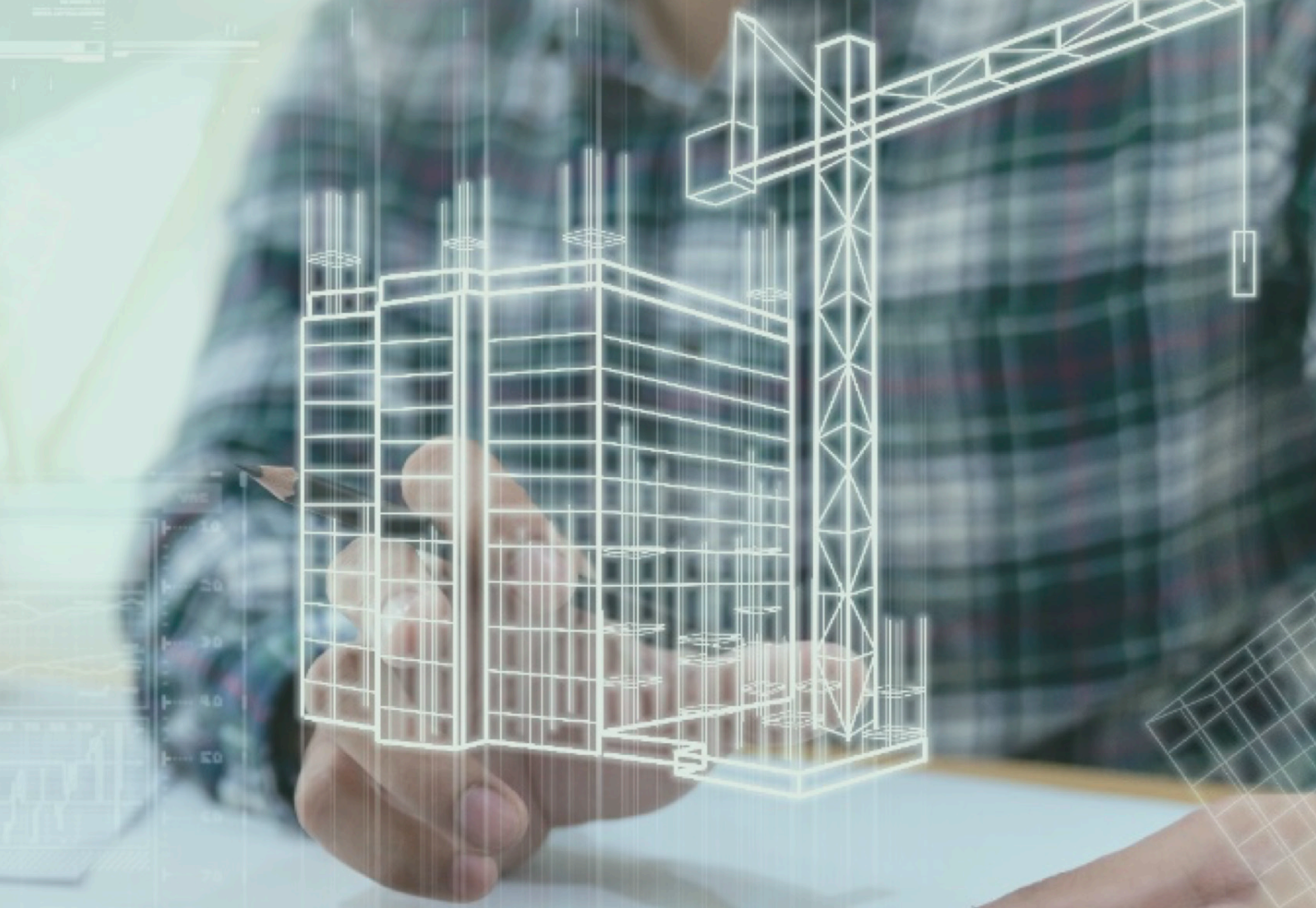
All of these downside risks are driving up construction prices and will not be resolved on a local level in the short term. Even though the ageing working population remains a problem across the construction industry in general, very few of the current senior personnel within the industry were employed when these conditions were last seen.


Construction Activity Index by Region (Image: RICS)
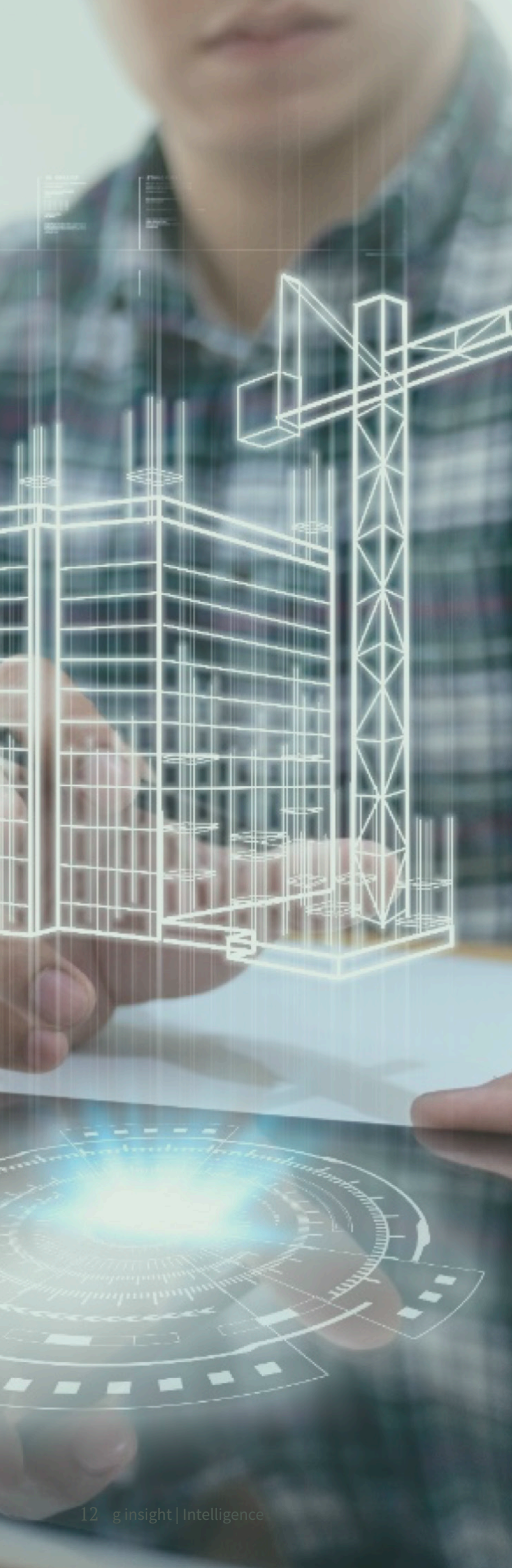
Globally, quantity surveyors are all reporting that they are receiving tender submissions in which costs are significantly higher than would have been expected last year. Although not unprecedented, the effects of these increases rethink the supply chain and development for construction work. Effective cost consultancy needs to be utilised from design stages and then throughout the construction and operational stages of a built asset lifecycle. As a result, the quantity surveyor's service will be recognised by different levels of services between basic quantity and cost measurement to the value creation experienced professionals and chartered surveyors can bring to a project.

In another survey conducted by RICS in May 2022, more than half of respondents (53%) said the shortage of quantity surveyors was one of the skills shortages affecting the construction industry this year. As Julian Smith, Senior Consultant at Stradia, puts it and quotes: "The need for quantity surveyors is significant. By 2024 a prediction of 24 billion will be spent on construction projects across key developing markets, therefore it is essential to have the skills to meet this global demand." Practical and skilled application of key techniques is essential to ensure that projects run smoothly and provide value for money.

Although confronted with more challenges and requirements, a recent global survey on quantity surveyors and cost managers by Glodon found the industry is still lagging in transformation. 30.4% of survey respondents are currently not using any estimating and quantification software. And the most adopted digital is still the spreadsheets tool among all respondents. They believe the primary barrier that hinders the use of data and technology in quantity surveying is the shortage of skilled persons, including the retention of trained staff.
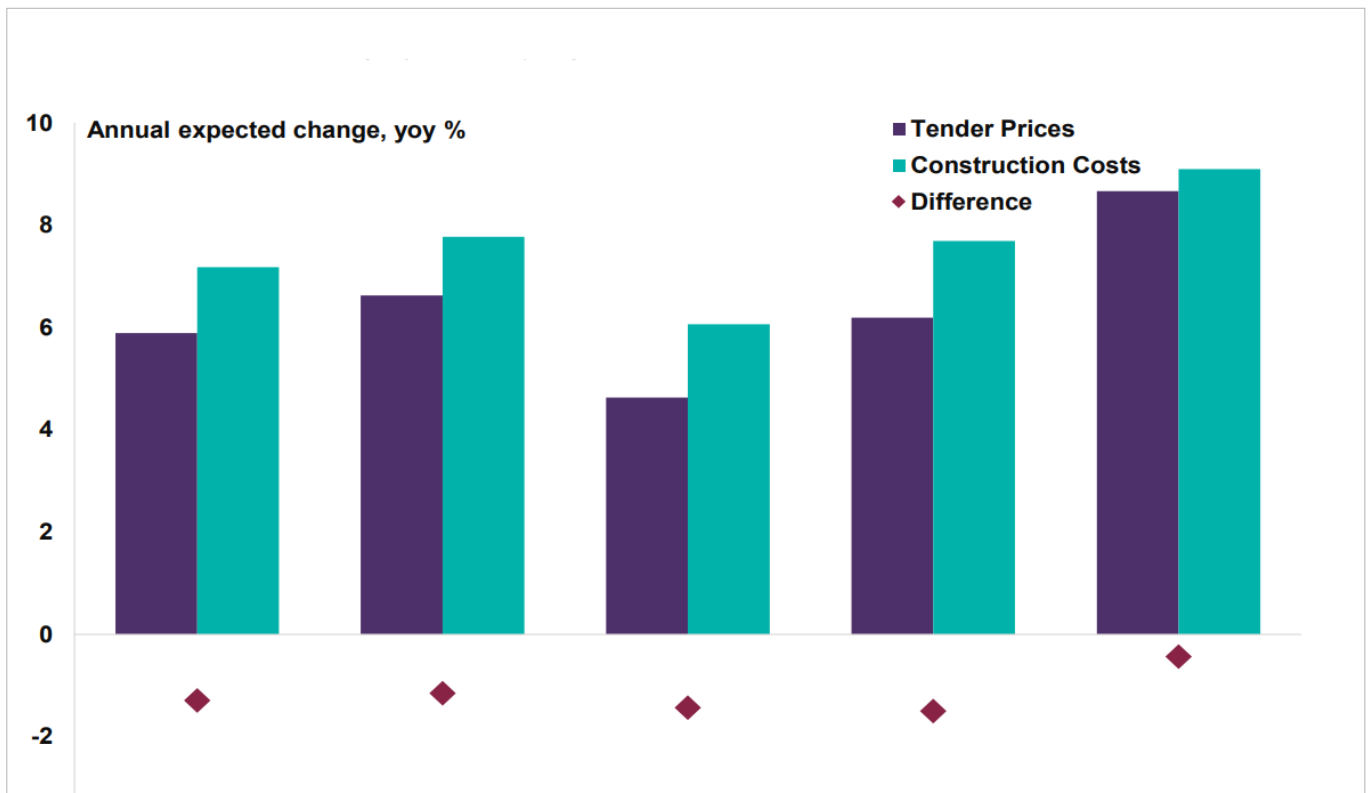
Twelve-month Cost Projections by Region (Image: RICS)

One crucial skill, for instance, is the capacity to embrace the changes to 5D BIM. The ability of BIM models to automatically generate quantities and cost estimates does not lessen the need for an expert to interpret the vast amounts of data produced, or to distil it into a form that clients, contractors and sub-contractors can use to make informed decisions. Quantity surveyors are particularly qualified to enter and analyse this output of data because the quality of the data from a BIM model depends on the data that goes into it. For the foreseeable future, producing quantities from models will require the professional insight and judgment of experts.

One of the biggest challenges is creating a culture that encourages and rewards the sharing of information. Adopting digital platform is critical for open exchange of information and changing relationships between clients, surveyors,

contractors and suppliers. The transparency of digitalisation should be a driving force for changing business strategies and attitudes. Yet, it will need a quantum leap in construction business culture to disclose sensitive information to the supply chain.

In summary, all of these described above have made quantity surveyors face a competitive and tough market, demanding more experienced talent than ever. In particular, medium-sized quantity surveyor firms are under pressure due to certain problems, such as competing with large practices' multiple disciplines and greater specialist knowledge base; and achieving a return on the necessary investment in technology.

SPOTLIGHT

The construction sector is witnessing an acceleration in technology adoption and can leapfrog to more efficient production processes, new business models and a sustainable industry ecosystem. Digital twins are expected to develop as a critical tool in all phases of the asset life cycle. Its impact will undoubtedly expand to the quantity surveying industry. Quantity surveyors play a critical role, with the opportunity, and responsibility, to be the creator and steward of data and be at the foundation of their asset owners' digital twin journey.

In this section, we keep focusing on the digital transformation in the built environment with an angle on its impact on the quantity surveying profession.

Improving the Built Environment Through the Power of Data and Technology

As the focus shifts to building a better-built environment, information management is being served as one of the key drivers to create a rewarding and productive construction lifecycle. There could not be a more excellent example of the shift of the focus within the BIM community towards the I in BIM than the recent rebranding of the UKBIM Alliance into nima.

Nima's new tagline is 'With trusted data, great things happen.' As a passionate advocate for the adoption of digital twins for our built assets, I couldn't agree more with this statement and I couldn't be more proud to have been chosen as an international ambassador for the organisation based on my strong interest and work in this growing field. And I am happy to learn that Glodon has just joined nima as the first international patron (link to announcement).

I strongly believe that purpose-driven data, when 'managed correctly', can produce powerful results, which is also why I believe that digital twins are at the core of the data-driven economy.

There is no doubt that 'managing data correctly' is the most challenging aspect of our construction process, but it is also the most rewarding if we achieve it correctly. We, as construction professionals, have a long history of being outstanding when it comes to building our world. However, we have also been proven not to be so great when it comes to keeping good records of the assets with disastrous consequences, as in the case of the Grenfell tower in London. If it were actually that good, there is no doubt that several professions, like surveyors, whose jobs are to continually collect data about the same assets, would be in short demand. Is job preservation what is preventing us from being able to manage our data effectively across the lifecycle of a project?

By Cristina Savian

nima international ambassador and Digital Twin expert at BE-WISE- UK and Australia

It is our responsibility as global leaders in this digitally built world to be the bold move the world needs. Let's all be dreamers who drive positive change across the industry so that the unimaginable of yesterday becomes a reality today.

I seriously doubt that this is the case. There has not been a substantial change in the way we procured built assets over the decades, and the procurement contracts have followed suit as well. You have a need for a new building or infrastructure that needs to be built, so you gather architects, engineers, and builders to build it, then either manage it yourself or hire someone to help you manage it. We focus on the physical asset, not on the creation of those digital records that can benefit us in the long term. We are still far from seeing widespread adoption and inclusion of digital information management requirements into procurement contracts, despite huge efforts from industry professionals and BIM advocates and international standards like ISO 19650 being around for some time. As a matter of fact, it's clear that asking for those digital handovers to be included in the contracts can have a long-term benefit; Digital data is being produced anyway; why not exploit it for other purposes in countless ways?

What are the reasons behind the low adoption rate that we experience today? As we have seen in the RICS whitepaper, which I authored and featured in the previous edition of this Insight magazine. I am curious to know why we are still debating whether or not an effective digital information management process is valuable. It is a fact that we all appreciate

the value of Google. Nowadays, Google Maps and your phone are all you need to get around effortlessly a new city without having to plan anything, and there are several search engines and apps that can assist you with finding all kinds of historical information within minutes.

There is no doubt that we all understand the importance of having something similar for our built assets. I think we all do, don't we?

What would it be like if we could know how many workers are currently working in a construction site and their real-time position with a simple search, or if we knew how many tower cranes there were and their current working conditions within a matter of minutes? If we improved the efficiency of our built assets, and at a higher level, of the entire city, we would be able to provide a better environment across the entire country for all users, starting from ourselves.

In the last 25 years, how has the industry progressed in terms of data and technology? We certainly have made improvements in some parts of the building process; we no longer have drawing boards, and it does not take us years to design a building; we now design digitally, and the process is faster and has been optimised thanks to technological advancement. We create plenty of digital records, so new apprentices will be searching through digital files instead of an unwelcoming environment. For some people, it might be a better working environment. Is this all the improvement we managed to achieve? Would you say we are satisfied with the results?

Joke aside, apart from producing tons of digital data, what percentage of that data are we actually leveraging and utilising in the long run? Wouldn't it be great if we could organise and search our building records in a more meaningful way so that we could make data-driven decisions more easily and benefit the entire duration of the building?

The Grenfell Tower disaster in London is a clear example of how valuable the golden thread of information can be in the long run when it comes to protecting the

community from harm. The new Building Safety Bill mandates a new digitally enable process to improve the health and safety of buildings and hopefully soon, other countries will follow.

But firstly, how do we enable a data-driven culture embedded into the entire procurement model so that we can all contribute to creating and managing the flow of information effectively to ultimately contribute to enabling the digital twin, the core engine, to find your way around the asset? How do we create a digital twin capable of generating meaningful insights at any given time, alerting you when you fail to take preventative action to improve the lifetime and economics of your asset?

Let's learn from those who have already successfully done it; the focus of Google's guide to establishing a data-driven culture is on three core factors: people, processes, and technology.

There is no lack of technological
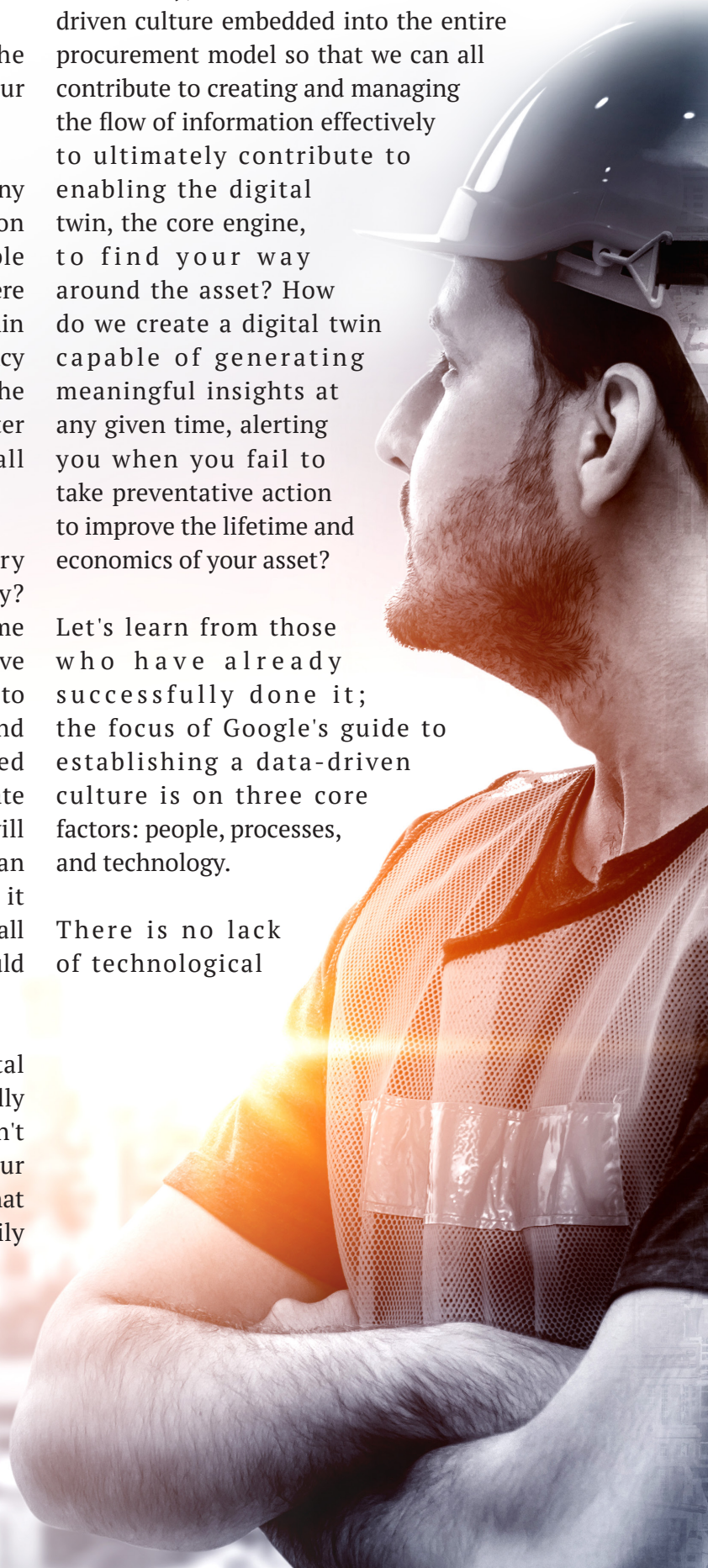
solutions, Glodon has abundant evidence of how data can be collected, managed and exploited across the construction lifecycle. In fact in the case of Glodon's R&D building in Xi'an, the digital twin lean construction is achieved. The Glodon Digital Building Platform helped collect data and monitor on-site people, equipment, material as well as construction process and environment in real-time by leveraging the power of BIM, Cloud Computing, Big Data, IoT, Mobile Internet and AI.

So what is preventing everyone else from adopting a better system?

First is the process, starting with the very established, cumbersome, out-of-date procurement model for data acquisition, combined with the people tasked with working across this very long lifecycle, which

needs to come together seamlessly.

We need to seek a construction economy in which activity and decision-making are driven by data that is collected, stored, and analysed but most importantly, we need to enable a data-driven culture by default.

My opening speech from the recent Digital Twin conference in Saudi Arabia, which I had the honor to chair, summarises what we need to tackle the people and processes pieces of the puzzle.

What is required is dreamers who think innovatively and make bold moves. As we are witnessing countries such as Australia and Saudi Arabia, who have initiated the journey of embracing the digital twin opportunity and successfully started incorporating those digital requirements and specifically mandating and sourcing digital twins along with the creation of the physical built assets.

The world deserves dreamers. - that think innovatively

We must think innovatively about how we design, construct and operate our built assets. We are far from leaving future generations a resilient, sustainable, efficient, profitable and sustainable built environment.

The world deserves dreamers who can make bold moves.

It is our responsibility as global leaders in this digitally built world to be the bold move the world needs. Let's all be dreamers who drive positive change across the industry so that the unimaginable of yesterday becomes a reality today.

Technology is already available, so what are we waiting for to improve the built environment through the power of data and technology?

The Evolution of the Digital Cost Manager in the Construction Industry

By Bola Abisogun OBE FRICS

Digital Director, BIM Academy
Founder & Chairman, DiverseCity Surveyors
Founder and President, Digital Twin Skills
Academy CIC

The global construction sector is witnessing an unrelenting acceleration in technology adoption and has the unique opportunity to energise, lack-lustre historic norms in pursuit of a more efficient, productive, transparent, and accountable, data-driven delivery process. At the heart of this ambition is the need for new business models, that are able to compliment and cultivate a globally acceptable and amenable ecosystem of sustainability.

Digital twins are expected to develop as a 'mission-critical' business tool in all phases of the built asset lifecycle, and become a constituent part of a growing sector set to reach almost 185 billion dollars by 2030 according to estimates by Research & Markets. The multifaceted impact of such scaleable yet inclusive, digitally enabled workflow based asset solutions, will undoubtedly expand towards and permanently impact the quantity surveying profession. Fast forward to 2030, where Quantity Surveyors will continue to play a uniquely critical role, but with growing opportunity and responsibility, as the custodian and steward of big data. It is time for the 'Digital' Cost Manager to position themselves and reconsider their value proposition that originated well over 150 years ago and positioned in the 'basic' quantification and measurement of the construction process.

HKA Consultants' Fifth Annual CRUX Insight Report is a distillation of their findings on more than 1,600 multi-year projects in 100 countries, up until the end

of July 2022. It found that the combined capital expenditure for these projects was more than US$2.3 trillion. The cumulative value of the sums in dispute exceeded $80 billion. Together, the extensions of time sought would stretch beyond 840 years. These are huge impacts in time and money to the global economy, industry and project stakeholders.

It is clear to see that there is a growing demand for non-contentious, collaborative leadership, with cost and value set to perform and inform a much wider landscape of project feasibility, particularly in the context of people and process. Akin to the Gemini Principles are the key tenets of purpose, trust and function, which in essence define the use-case for any digital twin solution.

In the context of achieving better project outcomes with the intention of battling the headwinds, there exists a clear and defining role for disruptive technology. The origins of an information management framework, working seamlessly with an ecosystem of common data

In seeking to avoid future Grenfell Tower Inquiries, it is important that we recognise our obligations to the public in the delivery and ongoing maintenance of built assets that are not only deemed fit for purpose but are also unequivocally assured of their legislative compliance to key stakeholders.

environments (CDE) can and will go some way to mitigate the most critical and fragile elements of any construction project, the sector wider Supply Chain and Material Logistics.

At a global level, the report distils causation into three key areas: change in the scope of works, design conflicts, and contract interpretation issues. The wider challenge of global teams operating

in a high-risk, low-margin environment can only lend itself to greater deployment and adoption of technology; thus, facilitating an environment that will mandate and unlock the demand for digital skills.

Today's economic turbulence is pointing towards a hostile and ultra-inflationary environment, fuelled by the legacy of the post-COVID 'great reset'. With such challenging headwinds, our 'traditional' co-existence is becoming untenable. The presence of 'intelligent' clients means that project outcomes are so much more demanding and design teams, who themselves, at least at one end of the spectrum, are delivering more complex projects, are more vulnerable to the wider stakeholder pool. The role of data in the Supply Chain challenge can only be enhanced by the presence, agility and visibility of digital twins in seeking to ascertain and de-risk project risk-registers and deliver more meaningful decision-making, ideally in real-time.

The indelible mark of our professional status is now required to be seamlessly engrossed within a data-driven process that will, by default, unlock and dispense with many of the historic and cultural barriers, that in truth have not served our clients or the wider built environment well. As custodians of an ever-increasingly fragile and tempestuous climate change emergency, it is important that we not only revisit our ESG-led service level agreement with society, but that we do so by pulling on data and information that can justify the scale of the disruption that is now required across our commercial offers.

Digitally enabled, structured data can accurately datamine relevant case law, and offer timely consideration of any potential for litigation. It is now referred to as a 'process-level' digital twin of the traditional and contentious, construction claims process. To further demonstrate the power

of data, we need a wide-scale adoption of digital twins during the entire lifecycle of a construction project.

As suggested in the joint RICS and Glodon industry whitepaper 'Digital Twins from Design to Handover of Constructed Assets', the idea of digital twins should be extended from the currently popular view of using digital twins for asset and facility management to the development, deployment and use of digital twins in the early-stage planning, detailed design, entire construction phase and asset handover. Digital cost managers can play a critical role, with the opportunity, and responsibility, to be the creator and steward of data and be at the foundation of their asset owners' digital twin journey. My foreword is an attempt to affirm the need for new use cases prior to the occupation phase, which will go some way to enhance value-based outcomes for clients and asset owners.

In seeking to avoid future Grenfell Tower Inquiries, it is important that we recognise our obligations to the public in the delivery and ongoing maintenance of built assets that are not only deemed fit for purpose but are also unequivocally assured of their legislative compliance to key stakeholders.

For those reasons articulated throughout this paper, the digital twin must now be embraced by all of us and deployed as part of our regulated day-to-day, professional services.

So, there is no doubt that the 'traditional' role of the quantity surveyor has had to evolve over time and has now reached a point of inflection. But what does the future of the 'Digital' Cost Manager look like and what tools will be required? With digital twins, there exist numerous benefits to the 'traditional' quantity surveyor, including, but not limited to:
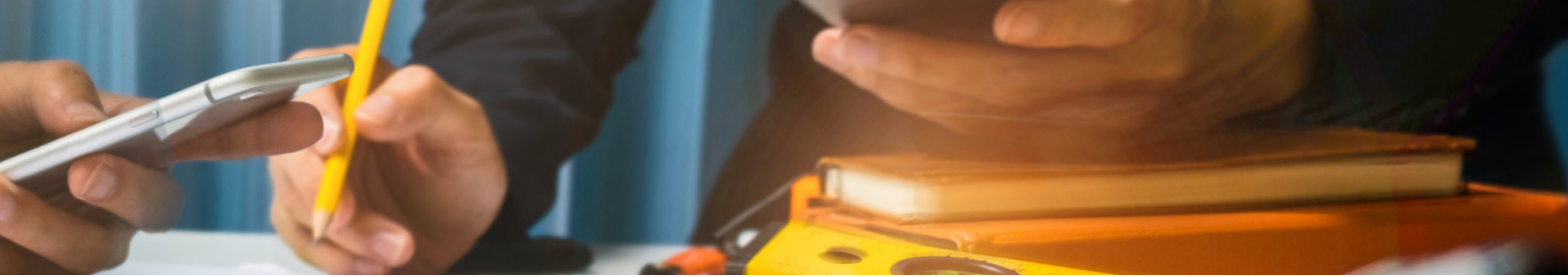
• Increased accuracy of the estimate and quantity take off

• More meaningful project-wide 'mental health and well-being' of project personnel

• Stakeholder transparency of the lifecycle carbon emission and other investment-led 'ESG' metrics

• Detailed handover and commissioning of the built asset, aiding a more holistic occupational phase and post-construction digitally enabled asset performance

• Decommissioning of built assets literally, were possible, becomes the complete mirror image of the construction process, with added visibility of risks encountered during the construction phase; supporting the circular economy

However, with any paradigm shift of 'structural and cultural' change, there are pressures or blockers to progress, especially for the 'traditional' quantity surveyor or cost manager:

• Shortage of skilled persons/lack of digital skills

• Lack of data standards (note the CDBB / IMF)

• Continued delivery of professional services in silos

• Difficulty in realizing and evidencing clear, tangible benefits

• Inconsistent approach to adoption by Supply Chain partners

• The ability to influence the BIM model or digital twin parameters

• No clear demand from clients/stakeholders (lack of understanding)

• Recent graduates not equipped with the right digital competencies/skills

*• Cost, effort and other project wider changes required (to be led by the client)*

A recent Glodon global survey on quantity surveyors and cost managers reveals that the industry is lagging in adopting digital tools. They found only 38.6% of respondents currently use estimating and quantification software with BIM or CDE. And the most adopted digital tool is still spreadsheets.

One key observation contained within the aforementioned HKA Report was a startling quantification of just how inefficient and unnecessarily costly the information gathering exercise can be. An estimated 13% of a construction team's working hours are spent searching for project information. When it comes to claims and disputes, missing records can compromise loss recovery or a defence. By project closeout, typically 30% of the initial data created during the design and construction phases is lost. For the record, a digital twin solution would not only mitigate such loss, but if the same digital twin solution was deployed alongside a blockchain solution, such inevitable risks, would be literally eradicated, potentially for good.

Disputes on projects are no doubt likely to increase in quantum and value if digital adoption rates do not increase in short to medium term. Isn't it time for the principal custodians of cost and value (i.e., the 'traditional' quantity surveyor) to raise our game and become the 'common data environment' for any successful project outcome?

Technical and Cultural Factors Influence Future of Digital Twins

The built environment sector has seen an explosion of technologies in the past decade, several driving the emergence of digital twins. The following emerging developments are critical to the future of digital twins. This article is part of Digital Twins from Design to Handover of Constructed Assets white paper published by Glodon and RICS.
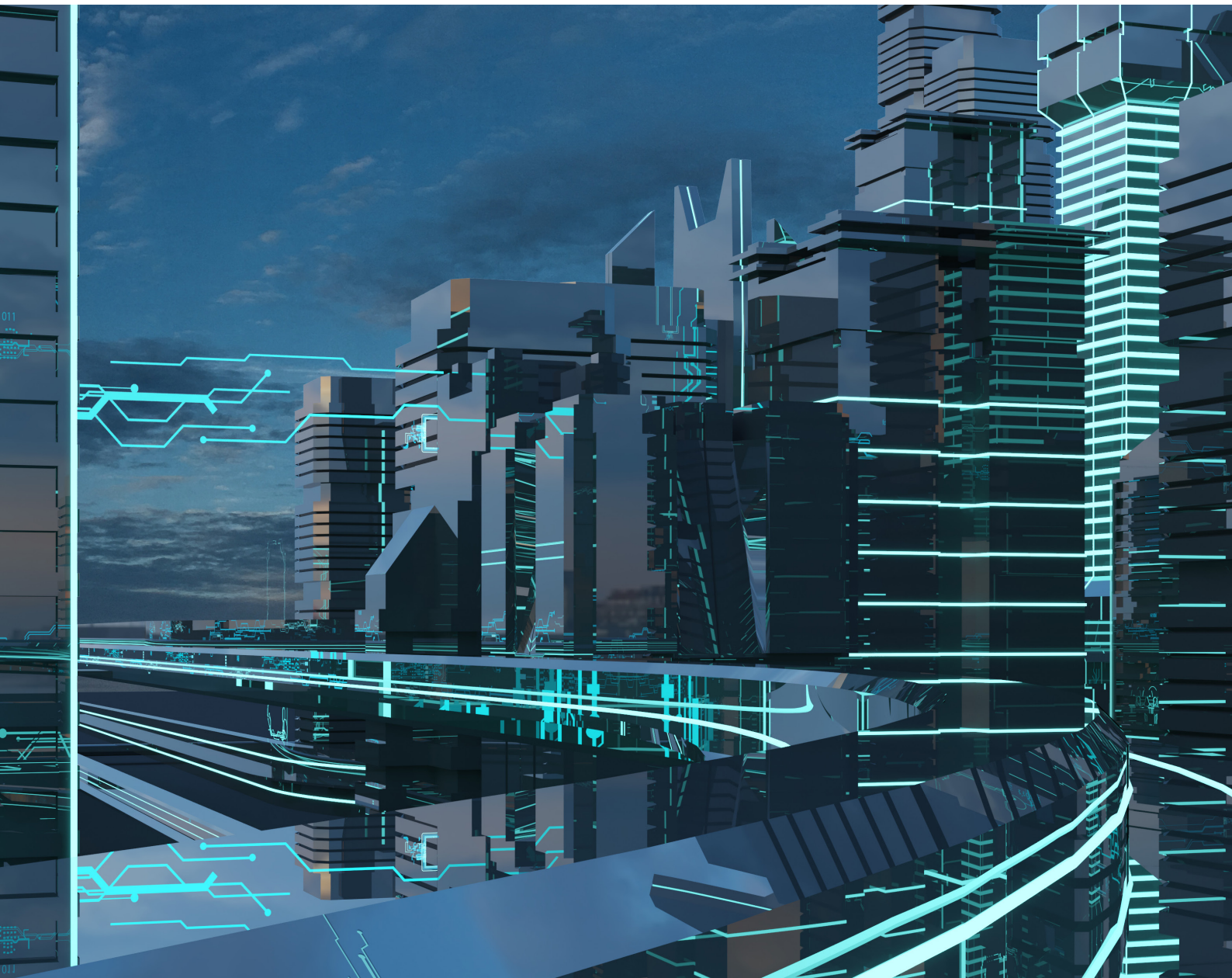
People will play a central role in the progress of digital twins. They will benefit from the development of digital twins, especially an ecosystem of connected digital twins for the built environment.

Computer Vision

Computer vision (or machine vision) is among the most promising technologies for creating, using and updating a digital twin. Computer vision is a set of techniques and methods that allow automated analysis of incoming video and imagery from the construction site or an existing asset. Video cameras are typically already on construction sites and completed assets, so a recent wave of breakthroughs have provided increasingly powerful machine vision applications that can interpret everything from the movement of workers to the completion of work, all of which provide the data that builds a digital twin. This flow of data is often real-time or near-real-time and increasingly forms the information backbone of the digital twin. Starting from simple object detection, modern machine vision solutions can be made more intelligent to speed the provisioning of data needed to populate and update a digital twin.

Data Fusion

Digital twins require multiple data sources to extract timely and actionable insights. Data fusion removes the burden of processing the raw data from various sources so the end-user can focus on the insights. It can help combine and process sensor data, data obtained from images, videos, asset management and facility management systems and models. Advancements in this technology are likely to impact the successful use of digital twin in the built environment sector.

Artificial intelligence (AI) and Machine Learning (ML)

The amount of data and information available within a digital twin system is not manageable by humans without the aid of computer tools to assist in data processing, analysis, and sense-making. AI and ML synthesise the data within a digital twin system and convert it into a human consumable format. AI and ML can be deployed to find patterns in data, translate from one format to another, recognise and classify data, and otherwise provide advanced data processing to gather useful intelligence. Advances in AI and ML such as deep learning, natural language processing, predictive analytics, and advances in quantum computing will influence how user-friendly digital twins can be made in the future.

Digital Platforms

No single out-of-the-box solution can be used to create digital twins. While a platform approach is preferable, and several are being developed. It is realistic to expect that full-cycle digital twins will include products and data connections to multiple products and phase-specific platforms. A digital platform (or ecosystem) combines products, software, concepts, ideas, or thinking that is open to end-users and other firms (complementors) to extend and create value-adding solutions. In the case of digital twins, a BIM-based platform (e.g. the openBIM initiative started by buildingSMART) may become the core product with boundary objects or modules (e.g. application programming interface, software development toolkit, etc.) available to develop complementary products and apps. A BIM based platform alone may not be adequate to provide a flexible, extensible and composable environment to build digital twins. Progress in the development, governance and use of such platforms is needed to progress the adoption and implementation of digital twins in the built environment.

| Whole-process	Engineering (E)	Procurement (P)	Manufacture (M)	Construction (C)	Delivery (D)	Operation & Maintenance (O)
Scenario	• All-discipline integrated design • Whole-process simulation • Coordination between all participants	• Smart supply & procurement • Digital credit information • Supply chain finance	• Digital marketing • JIT production • Automated production	• Process priority scheduling • Smart construction site • Twin building	• Digital delivery of completed works	• Predictive maintenance • Personalized and accurate services
Value	• Improving design quality and efficiency	• Integrating and optimizing supply chain • Constructing transparent value chain	• Demand-driven intelligent production	• Improving construction quality • Reducing project costs • Increasing efficiency	• Constructing project digital assets • Supporting smart operation and maintenance	• Improving quality of operation and maintenance services • Reducing operation and maintenance costs
Evaluation indexes	• Approximate 100% of building function rationality • 50% reduction in design cycle	• 80% increase in supply-demand matching efficiency • 60% reduction in credit service costs	• 65% increase in marketing efficiency	• 70% reduction in engineering changes • 50% increase in management efficiency • 80% reduction in engineering rework	• 50% increase in construction efficiency of operation and maintenance digital model	• Approximate zero equipment failure rate • 20% reduction in Operation and maintenance costs

Platform Approach to Digital Twins (Image: Glodon)

Internet of Things

IoT and sensors can play an important role in a digital twin. But currently, IoT sensors are complex for field teams to specify, install and maintain throughout an ever-evolving construction site and asset in use. As the value of the data and analysis that these sensors can support becomes more commonly understood, some of the resistance to installing and maintaining a network of sensors may subside, and direct and indirect costs will reduce. Many product vendors, technology vendors, distributors and system integrators operate in this field making it a very fragmented specialism. As the demand grows, the industry is working to resolve these issues by adopting system interoperability and integration protocols and this could have a significant impact on the future of digital twins.

Simulation

With an abundance of data available from a digital twin, the ability to conduct what-if analysis increases. For example, AI-driven what-if simulations of a construction project schedule based on historical project data can provide insights into any likely delays and related cost overruns that the project may encounter based on current performance. Simulation techniques can also play an important role in comparing options and understanding and predicting performance. Future developments in simulation methodologies and techniques are therefore crucial for the future of digital twins as they can help drive better decision-making. Progress in areas such as agent-based simulation, mixed-method simulation, multi-physics simulation, and integration with geographic information systems is something to watch.
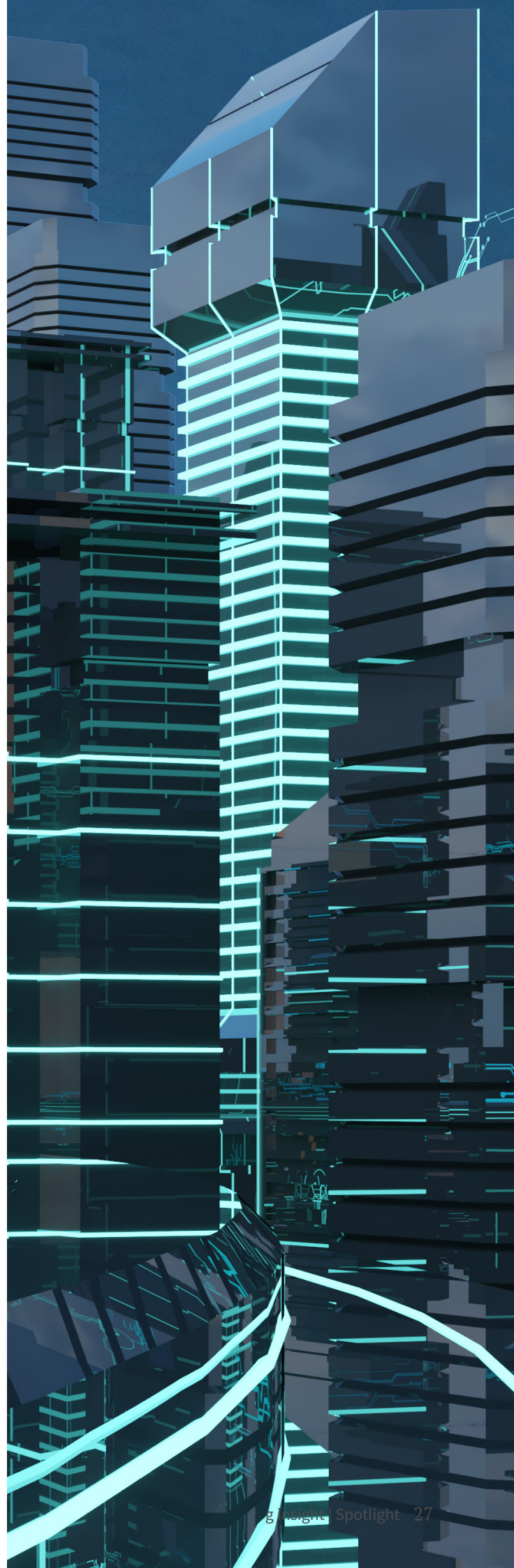
Supply Chain Management

Modern construction sites are seeing a wave of innovation and interest in how products, materials, components, etc. are supplied to the job site. Visibility of prefabricated components produced on-site, near-site, or offsite is helping enhance worker safety, productivity, and predictability. RFID, machine vision, and other label-based means of tagging and tracking large numbers of items play a crucial role in supply chain management. This real-time data when integrated into a digital twin system means project teams can use automated progress monitoring to manage risk and forecast performance. Therefore, advancements in supply chain management are likely to influence the future of digital twins.

Skills and Competencies

People will play a central role in the progress of digital twins. They will benefit from the development of digital twins, especially an ecosystem of connected digital twins for the built environment. People will also play a central role in creating, deploying, using and updating digital twins. This will require new skills, competencies and pathways to entry into the profession. Without investing in people the industry cannot fully realise the benefits of digital twins.
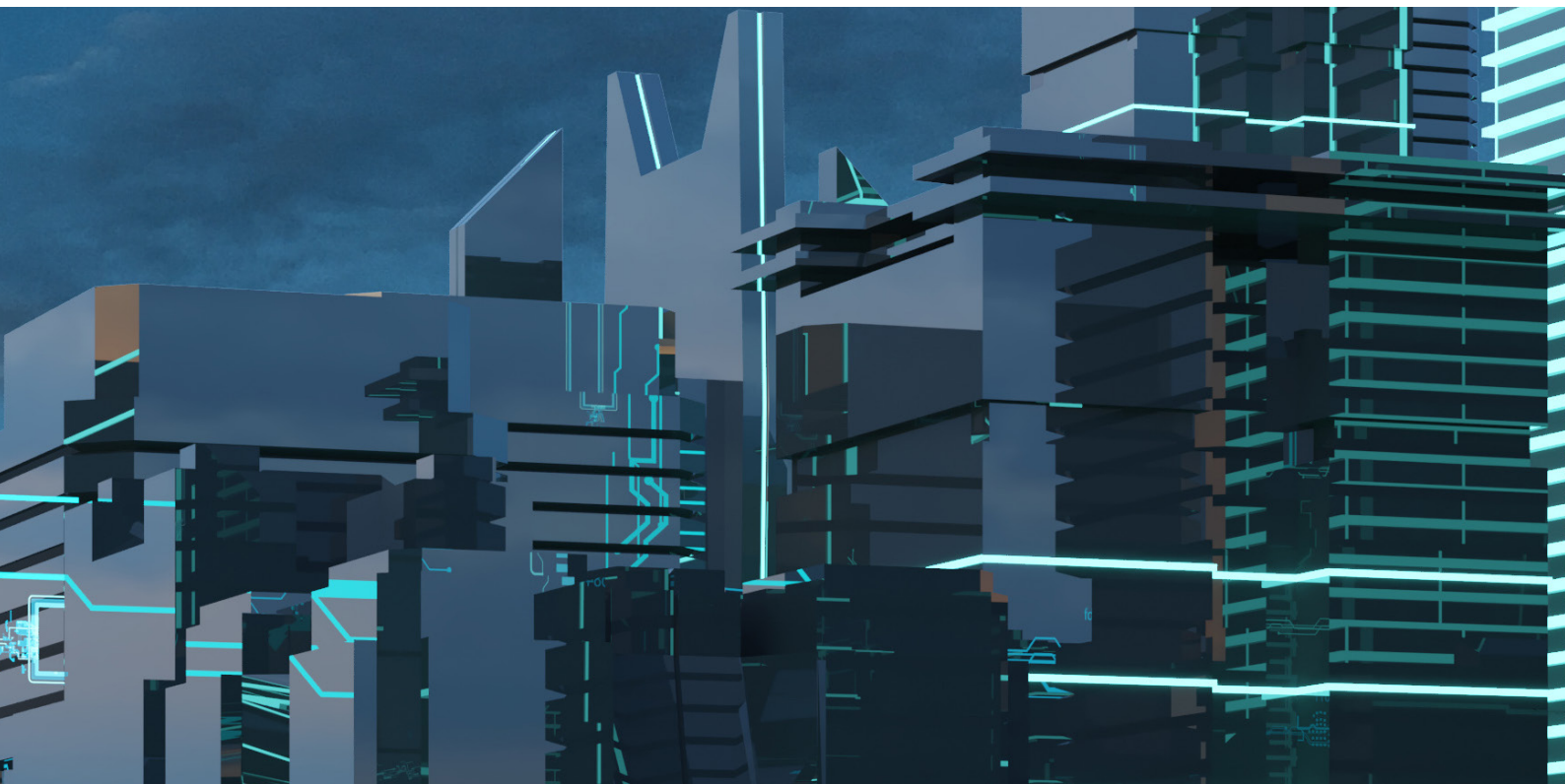
Collaborative Work Practices

Digital twins both promote collaboration and require collaboration. Previous studies have shown the importance of developing a collaborative culture in construction enterprises using integrated collaborative technologies. Considering digital twins are an integrated collaborative environment that use state of the art digital technologies, they can support superior decision making and better project, asset and business operations. Identifying, developing, and managing collaborative business relationships within or between organisations is crucial for digital twins' progress in the built environment sector to support information-based decisions and collaborative behaviour. With digital twins, the mantra of the right information, at the right time, and to the right team members can be achieved. This will require collaboration between team members to become pervasive.

Paper Beats Rock, BIM Beats Paper – Looking Back at 20 Years of Changes in Design Work

By Petri Luomala
MagiCAD

MagiCAD Electrical was released 20 years ago in 2002, which does not really seem like such a long time ago. The early 2000's may not yet have the same nostalgic sheen as the preceding 90's and 80's in our collective consciousness, however, the work of the MEP designer looks very different today than it did at the start of the millennium. MagiCAD Product Manager Johan Sörensson talks about the changes he has seen in design work during the past two decades.

If you think back 20 years, what was the normal workflow like for a designer?

The initial tasks for a project are quite similar. We are still starting with creating the main layout, selecting locations for technical rooms and panel boards, outlining the main routes, and defining types of systems to be used. The big difference is when you start to design in more detail.

Back then, we only had AutoCAD, or maybe some other application depending on the country. They were all two-dimensional, though, even though you needed to account for three dimensions when thinking about room layouts, for example. So what was done was lots and lots of sections for the places where space was tight. You would take a corridor, for example and then have sections to figure out where ventilation, piping and electrical should go.

And light tables were still heavily used for coordination. You had paper drawings and a table with a glass surface and a light underneath. You'd put the architectural drawing there and then the ventilation drawing, the piping drawing, and the electrical drawing to see that the systems are coordinated properly.

So for coordination you would literally put drawings on top of each other...

Yes, papers on papers, not all four at the same time, but switching and comparing between different disciplines. Sometimes you could also have everything printed in one drawing with different colors. Architects had one color and then piping, ventilation, and electrical had their own colors. So you essentially had a bunch of different colored lines on a paper and would try to spot the collisions.

Technology-wise, everything was AutoCAD-based and 2D-based.

Looking at MagiCAD, Ventilation was released in 1998, Piping in 2000, and Electrical in 2002, and these did introduce some 3D capabilities for drawing so there were some possibilities to do checking, for example in AutoCAD, but the paper version was still more common. There was some discussion about developing 3D and architects had been working in 3D for a while with AutoCAD Architectural already then.

What is done with VR and AR solutions today was maybe only imagined in some secret developer chamber somewhere.

Did people talk about digitalisation then, and what was expected to be the next big development in design tools?

It really was moving into 3D, being able to draw in 3D, getting everything in the proper place and easing the coordination workload. Back then, the focus in moving to 3D was not on visualization and presentation in that sense. Even though there was some visualization, it had much more of an "engineering look" to it and it was not very appealing to non-engineers or end-customers.

Did people a vision then of what design work would look like 20 years later and did it resemble what is done today?

Not really, what is done with VR and AR solutions today was maybe only imagined in some secret developer chamber somewhere. Even in MagiCAD Group, where we try to think ahead, this wasn't really talked about. And, of course, computers were not that powerful then. That's kind of the thing. It's hard to foresee how technology develops, because when some innovation gains critical mass then things really start to develop fast.

If you had to name something, what has been the biggest change for design in the past 20 years?

Overall, I would say it's simply moving to 3D design. Architects started to work in 3D first, then ventilation, piping, and electrical. Electrical was the last discipline to fully embrace it, because they have many things that are symbol-based. Electrical designs are presented to contractors in 2D more often than the other disciplines, which are maybe a bit ahead in using digital tools out on the building site.

One thing that has changed a lot also is how easy it is to make changes. The layout of the building may change constantly, and then you update and move things around because the architect has moved the walls or changed the rooms. The work is a lot more about editing now than it was when you just had the papers. Of course, this is good because you get a better building, but at the same time you might not think things through early enough because you know you can always change it later.

A lot of things have obviously changed in 20 years, but is there something that's stayed the same? Do designers still have some of the same worries that they had 20 years ago?

Yes, of course. You always have questions about cooperation between disciplines, because everything is connected in one way or another. Also, things like getting information in time to be able to produce what is needed, getting enough spaces for technical rooms and shafts, pressures with costs and deadlines, these are things that seem to persist even today.

Have the technological developments over the past 20 years changed the way that people approach design work?

Yes, one thing we have talked about in our BIM seminars as well is that design times have reduced a lot because it's so much faster to produce designs nowadays. This is good, of course, but at the same time people maybe would benefit from a little more time for the design work because it's cheaper to make errors during design than on the building site. Back in the days when you were using paper drawings, you maybe had more time to consider things because the work just naturally took longer. So even though modern tools allow you to produce things much faster, it might be good to reserve some time to consider your work, to coordinate, and to try out different solutions. In the end, it's about trying to find the best solution in the design phase and not when you are at the building site.

OPINION

5 Takeaways on Revolutionising Smart Buildings with Digital Twins

As buildings and the next generation of IoT technologies continuously evolve, increasing amounts of information and data are retrieved from sensors and management systems. In order to better understand the internal operation of the building, it is necessary to establish a system platform to monitor the internal and external components in real time. Hence the concept of digital twins, which is a virtual morphologic reflection of a physical building that can analyse IoT data collected from various sensors in real time. Artificial intelligence and machine learning software would be used to process and also analyse this information to make efficient decisions about energy, occupancy, maintenance and security for stakeholders.

In the Proptech - Revolutionising Smart Buildings with Digital Twins panel session during the RICS Smart Buildings Conference 2022, co-organised with REDAS and Glodon. Participants took a deeper look into the connection between smart buildings and digital twins and the benefit for decision-making as well as the urban environment.

Here are some of the biggest takeaways from the panel.

How does a Smart Building Related to Digital Twin or Smart City Masterplan?

Smart buildings can save resources and improve energy efficiency while reducing environmental pollution. Information can be collected with all types of sensors across the building. All data is then part into digital twins and modelled in the 3D to optimise energy consumption and maintenance workflow. Air conditions can be monitored based on real-time information, and maintenance personnel can only be sent when needed. The digital twin is constantly evolving, so it's good to start with one building and expand to a more

extensive system with more sensors deployed and stakeholders involved.

For property owners who outsource property management and only want an overall summary of operation information, digital twin helps get all the information and enables a comprehensive dashboard on things like the work performance of the property manager and incidents happening on the premise.

> **For businesses, it is crucial to articulate the actual value and purpose of digital twins to the customer and clients so that they are willing to make the upfront investments required to capture the future return on investments that digital twins claim.**

How Can We Collect Accurate Data from Various Devices and Make the Most of It?

Connecting to validated sensors and verifying information at its source can help avoid the problem of 'rubbish in and rubbish out. Historical data can also help verify the data for anything abnormal and ensure the data quality with the help of AI. And human intelligence of industry experts can also be encoded into the algorithm.

With forecast information, the digital twin can also facilitate the predictive dynamic adjustment. For example, with weather forecast information, the temperature in the facility can be adjusted accordingly in advance. It also gives actionable insights for maintenance work based on the collected information.

How Could Digital Twin Probably Solve the Problem of City's Resilience?

Digital twins can help with the city's resilience. But it is certainly not the only factor that will make cities resilient. Cities are resilient when they can promote sustainable development, improve well-being and create opportunities for inclusive growth. And it is also an environment that can anticipate, predict, and respond to dangers. The dangers can come from economic dangers, institutional dangers and natural events.

Digital twins can be applied at various stages in an environment's or city's life cycle. Within the cities, there is infrastructure – buildings, roads and bridges. Digital twins can be used upstream for planners or designers to test the what-if scenario. They can also be used when considering reducing errors and biases, and this is particularly important in the construction and commissioning of the infrastructure. And downstream, digital twins can be used for calibration purposes, such as condition monitoring and preventive operation optimisation.

Digital twins can be used if they are accurate. Accuracy depends on having a great sensing ability to collect and process what is happening to assets and, at a city level, a network of assets. So it's a system on a system for which people are able to monitor and govern the factors that are important to cities' resilience.

How to Handle the Challenge of CIM Modelling with Aligned Benchmark and Unify standards?

Data is part of the crucial information needed to make the best out of it to support the built environment life cycle or to operate the city in the future better. But the challenge is that data or possible city models are always collected in a not standardised or harmonised manner. It's always a problem when people work on a multi-discipline, cross-discipline kind of project that data are created in a very different way in terms of how it is restored and restructured. Although people can now better handle unstructured data with AI, the journey can be made easier with standardisation and harmonisation at the beginning of the project.

In a situation where there are already several standards for different buildups, data can be harmonised by grabbing common things out to harmonise how people create the information. And instead of one organisation taking all the responsibilities on its shoulder, the most important thing is the joint effort with all stakeholders to find common ground.
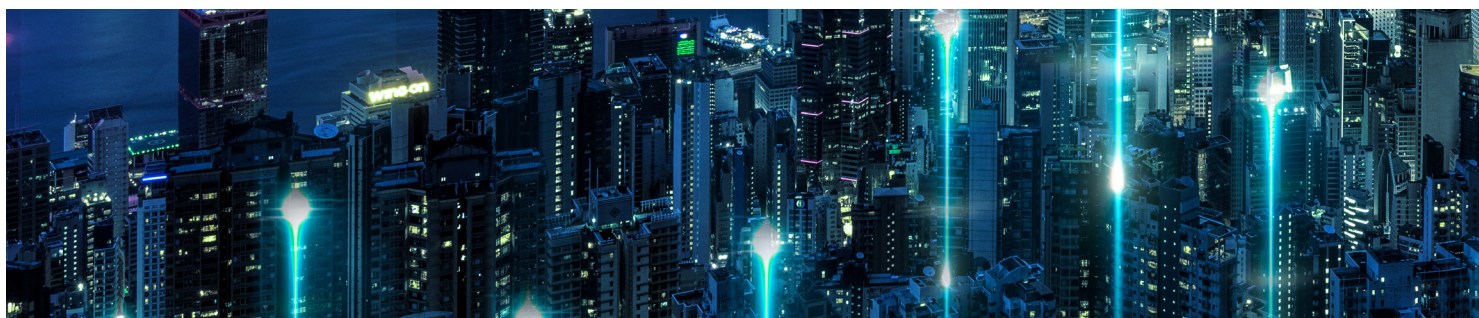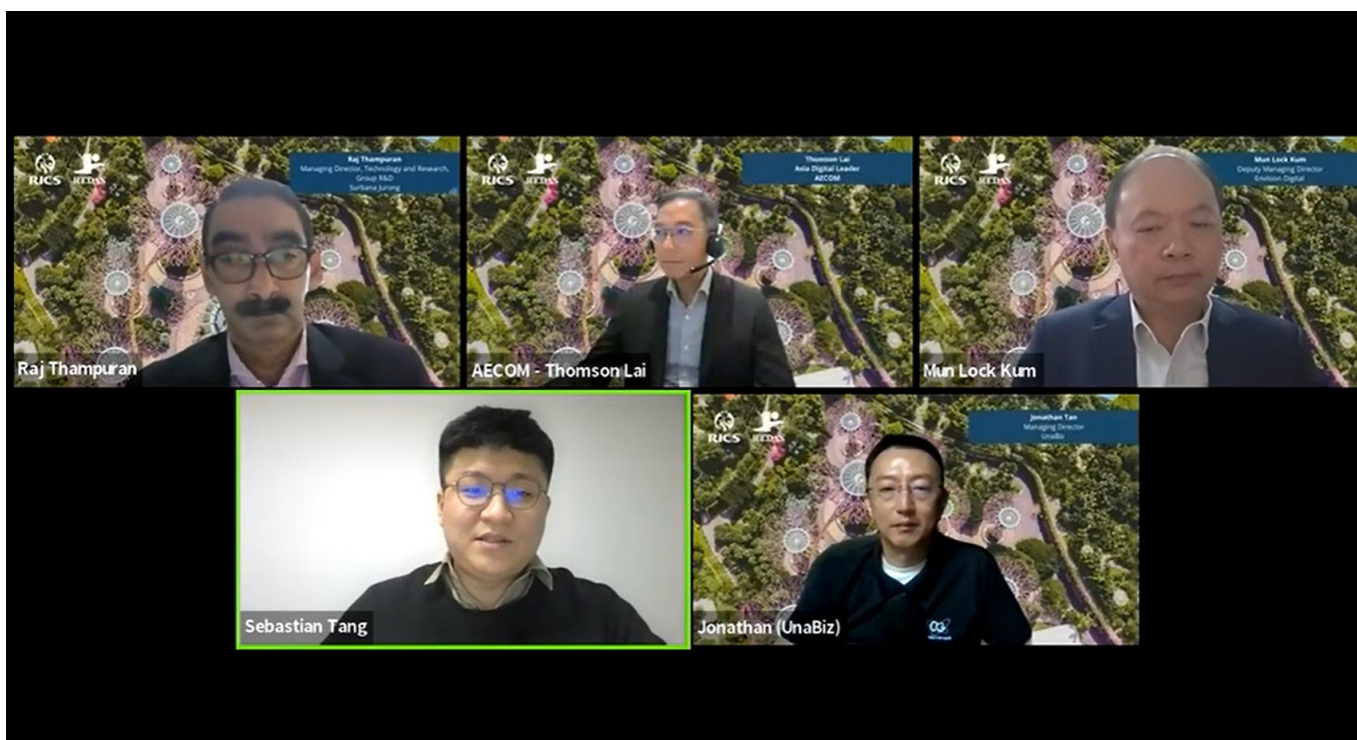
What Are the Values of Digital Twins and What Can They Contribute to Value-added Assets?

The value of digital twins can be condition monitoring, performance monitoring, or the ability to predict and then optimise. The key is the value has to be translated to the bottom line or top line that is very clear to clients and customers.

For businesses, it is crucial to articulate the actual value and purpose of digital twins to the customer and clients so that they are willing to make the upfront investments required to capture the future return on investments that digital twins claim. One of the major barriers to adopting digital twins is the cost considerations of developers and real estate companies. A good approach can be pilot projects with customers to demonstrate the value of digital twins.

Moderator:
Sebastian Tang, IBD Director Research and
Intelligence, Glodon

Panellists:
Jonathan Tan, Managing Director, UnaBiz
Mun Lock Kum, Deputy Managing Director,
Envision Digital
Raj Thampuran, Managing Director, Technology
and Research, Group R&D, Surbana Jurong
Thomson Lai, Asia Digital Leader, AECOM
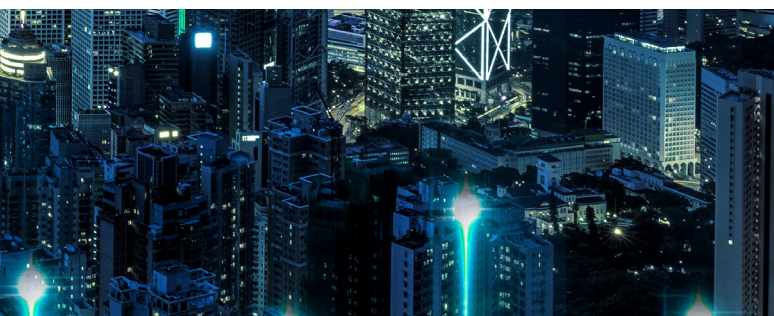
Technology, Net-zero and Role of Quantity Surveyors in Changing Built Environment

As the ever-important decarbonisation agenda becomes ever more critically important, the need for carbon assessment and management of building projects needs to evolve into a management system, which is akin to cost reporting and control.

The UK construction cost was already one of the highest in Europe, and now with increased global demand in the construction sector, material costs have reached a 40-year-high. At the RICS UK QS and Construction Conference, we discuss daily challenges, including how we can adapt to ensure that UK construction is actively supporting the path to Net Zero, how the value toolkit enables value-based decision-making and the need for surveyors to embrace the use of the data and information management processes.

As Bola Abisogun OBE, Chairman of Urbanis and Founder & Chairman of DiverseCity Surveyors, said the QS remains the largest cohort of professional membership across the surveying profession, yet it would appear that we are also facing the most compelling career challenges to remaining both an active and integral part of the client's design and delivery team.

Here are some key lessons from the conference shared by Tom Young, director at MagiCAD.

Economy

The UK economy like other regions is suffering from inflation which is causing cost of living issues, this will impact markets and demand reductions. After strong inflation (around 11%), it may also go into recession, and surveyors should be prepared for a challenging few years ahead.

There are also key challenges for main contractors who are dealing with some of the smallest profit margins of any industry (1-2%) which is unsustainable at the best of times. More businesses will likely become insolvent in the coming years.

It's very clear that the significant short-term economic challenges we are starting to face, while important, do not detract from the key challenges the industry faces in the medium and long term, namely achieving decarbonisation and Net Zero targets on time. As the greatest challenge and paradigm shift even for construction, the route to Net Zero provides both an opportunity and risk to Surveyors. QS must evolve or risk obscurity. A sizable shift, more cultural than anything,

that could take the best part of a generation to realise.

The key components of this evolution are the application and stewardship of data & data flows between technologies facilitated by a Digital Twin and 5D native approach. Digital Twins are not only a catalyst for stagnant productivity, but they also act as a platform to facilitate the role of the modern QS. A modern QS role that must now be centred on Digital Twin technology, data sciences and carbon quantification within the scope of the offering.

Net Zero

Net Zero is a highly important subject and the UK government have goals and milestones that must be met. The two key components are the immediate carbon load of construction and the ongoing operational carbon of the building.

Immediate carbon from construction can be reduced through better use and advanced materials, construction methods like offsite construction and well as specifying more efficient designs and products that may not be immediately cheaper.

As the ever-important decarbonisation agenda becomes ever more critically important, the need for carbon assessment and management of building projects needs to evolve into a management system, which is akin to cost reporting and control, so that the trade-offs between cost and carbon are systematically identified, predicted and managed; a role particularly aligned to the skills of the QS.

Role & Technology

The role of the QS, Cost Managers and PQS needs to change to be more in touch with digital trends, such as digital twins. Survey suggest that Surveyors are falling far behind when it comes to knowledge of advanced technology whereby other professionals, such as project managers, embrace the concept of 4D construction, many surveyors do not know where to start with 5D construction.

The role also needs to adapt to quantify and calculate carbon emissions, and the The Building Cost Information Service (BCIS) cost database is creating a carbon database in 2022 so that surveyors can create cost plans and carbon plans. It's said unless the role changes then it may be at risk of becoming less significant and many QSs will lose work.

Data management and APIs will be an integral part of a modern surveyors work and members should be looking at advancing these skills along with learning about emerging tech such as Blockchain, Smart Contracts and AI.

As a leading digital building platform service provider, Glodon's vision is to use technology to create a better living and working environment. For this purpose, Glodon has been working closely with partners on industry research. The latest study with RICS featuring a survey and a focus group discussion is developed to understand better the role and importance of data and technology in quantity surveying and cost management practice. The study is welcomed by industry experts, as it will provide much-needed insights for industry development. Research findings will be released by RICS and Glodon in a joint industry white paper later.

Interview: Digitalisation Benefits Construction Industry, Especially with Digital Twins

The construction industry is considered one of the least digitalised industries plagued by unstable supply chains, low productivity, project delay, cost overrun and environmental challenges.

In a recent interview with Glodon, Dr Fangyu Guo, assistant professor at Xi'an Jiaotong-Liverpool University (XJTLU)'s Department of Civil Engineering, said digital transformation is necessary for the construction industry. The adoption of digital technologies especially digital twins can significantly benefit the sector.

"Well-established standards and regulations are critical for directing an effective digital transformation and motivating stakeholders to invest more in various digital technologies and tools."

Digital Transformation with Benefits and Barriers

"By integrating digital technology with our traditional methods and experience. We can better manage construction projects. And effective adoption of digital technology and management of digital data can potentially help improve project quality and safety, reduce time and cost, and improve productivity and cooperation." she said.

For her, one of the important aspects of those tech trends and initiatives, like Industry 4.0, is that they lead us to think about what digital technologies can be beneficial to our construction industry.

The benefits of digitalisation are well understood by many market participants. However, digital transformation in the construction industry has been slow compared to other sectors.

At present, many companies and researchers are still at the stage of exploring various digital options. And there are many barriers to the complete digital transformation in the sector.

"The major barriers include a lack of mature standards and regulations, a lack of continuous support from the senior management and policies, and a lack of professionals and resources required for digitalisation."

In a paper recently published in the journal Engineering, Construction, and Architectural Management by Xi'an Jiaotong-Liverpool University and the University of Lincoln, Dr Guo concluded the lack of laws and regulations is the most significant among the barriers identified.

"The lack of laws and regulations has a negative effect on digital transformation because construction companies need governmental regulations as guidelines to determine their

strategies and adapt their organisational structure.

"Well-established standards and regulations are critical for directing an effective digital transformation and motivating stakeholders to invest more in various digital technologies and tools," the corresponding author of the research said.

She told Glodon, the industry should summarise and document some successful experiences, effective workflows, and areas for improvement while enhancing communication with other industry practitioners and researchers from academia, so that we can share and document the lessons learnt to facilitate the high-quality development of digitalisation of the construction industry.

"Data is very important. With accurate data collected in the process, I think we can better monitor the project's progress, cost, safety and quality so we can take necessary preventive measures before serious problems occur. And this data can be stored and used throughout the entire project life cycle and even used for other projects as well, which will support us to make further analyses, predictions, and important decisions."

In this perspective, Dr Guo believes digital enablers like Glodon can help with more investment in the methods to effectively collect, use and manage the digital data resulted from using digital technologies.

"This can be possibly achieved through the development and implementation of a comprehensive digital management platform. This platform can be established based on the key users' needs, like the operators, project managers, senior managers and so on, and developed to support the adoption of various digital technologies and integration of digital data throughout the entire life cycle.

"It will be better for the platform to support not only the project-level process, control, and management but also support organisation-level analysis and management," she said.

The Role of Digital Twins

Digital Twin Consortium defines a digital twin as "a virtual representation of real-world entities and processes, synchronised at a specified frequency and fidelity". As a way to deal with historical and real-time data, it holds large potential for upgrading the construction sector.

According to Dr Guo, digital twins can potentially benefit various prospects throughout the entire life cycle.

"It can improve the visualisation, communication, design quality and efficiency, evaluate the environmental impact of design and simulate the construction plan methods in the design phase. It can help stimulate and optimise the construction site layout, monitor the construction progress, check labour, materials, and equipment in real-time and improve worker safety, health and well-being in the construction phase. And in the operation and maintenance phase, it can help monitor and analyse the building operation and predict the maintenance demands."

But with all these benefits, a digital twin journey is not always easy. Dr Guo suggested the priority

of developing a digital twin would be defining the expectation and needs and then determining proper technologies and tools based on currently available resources and capabilities.

She praised Glodon's Xi'an R&D building project as an excellent example of implementing digital twin technology.

"Digital twin was effectively applied with positive outcomes. BIM, IoT, and AI technologies were applied together with data-driven lean construction methods, which enable process-level in-depth design, scheduling, resource procurement and supply, and also ensure the dynamic optimisation of progress, timely payment, cost, quality and accident prevention."

"With the assistance of big data, stakeholders were better connected to provide data services like material selection and pricing. Furthermore, the completed intelligent building analyses the indoor environment such as temperature, humidity, wind speed, and monitors health status and provides people-centered services. "

Prepare Workforce for Digital Future

Digitisation means the construction industry is rethinking how it works. Besides technology, human also play a critical part. The need to upskill and reskill the workforce has never been more urgent.

The assistant professor believes the digital era requires the workforce to present more knowledge than ever.

"The workforce should be not only professional with their traditional construction methods and workflows but also be able to use new digital technologies and tools, so they can select and use more appropriate methods and tools to effectively solve different problems in different occasions. Meanwhile, they should also hold the long-term perspective and intelligence to facilitate a healthy, sustainable, and high-quality development in the construction industry."

Speaking from her own experience, Dr Guo agreed companies and universities could better cooperate in this regard.

XJTLU signed a Memorandum of Understanding with Glodon earlier this year. The two sides agreed to enhance collaboration between industry and academia, increase digital awareness in the sector, and contribute together to a better built environment.

"The training program will be necessary for upskilling of the workforce. On the one hand, I think the university can integrate both traditional and new digital construction techniques and methods in their teaching and learning. On the other hand, companies need to provide more specific skill training that fits their demands. In addition, it is worthwhile to enhance the communication and collaboration between industry professionals and researchers in the university through different forms, such as guest lectures, seminars, research projects, and student internships."

Project Management Digitalisation Key to Tackle Cash Flow Challenges

By Aaron WU
Digital Construction Product Director, Glodon

The construction industry is confronting unprecedented challenges, the biggest of which is the ever-tightening cash flow. You could get a glimpse of the larger picture of Europe through the labour and material price statistics in the UK. Due to supply chain disruption caused by the pandemic, rising energy prices thanks to the Russia-Ukraine conflict, and tariff and non-tariff barriers to trade caused by Brexit, the UK building material price index has been surging since 2019. Until 2022, it reached the highest level in 12 years (121). Additionally, the labour cost indices of the industry rushed to the highest point among 5 years in 2021 Q3 as well.
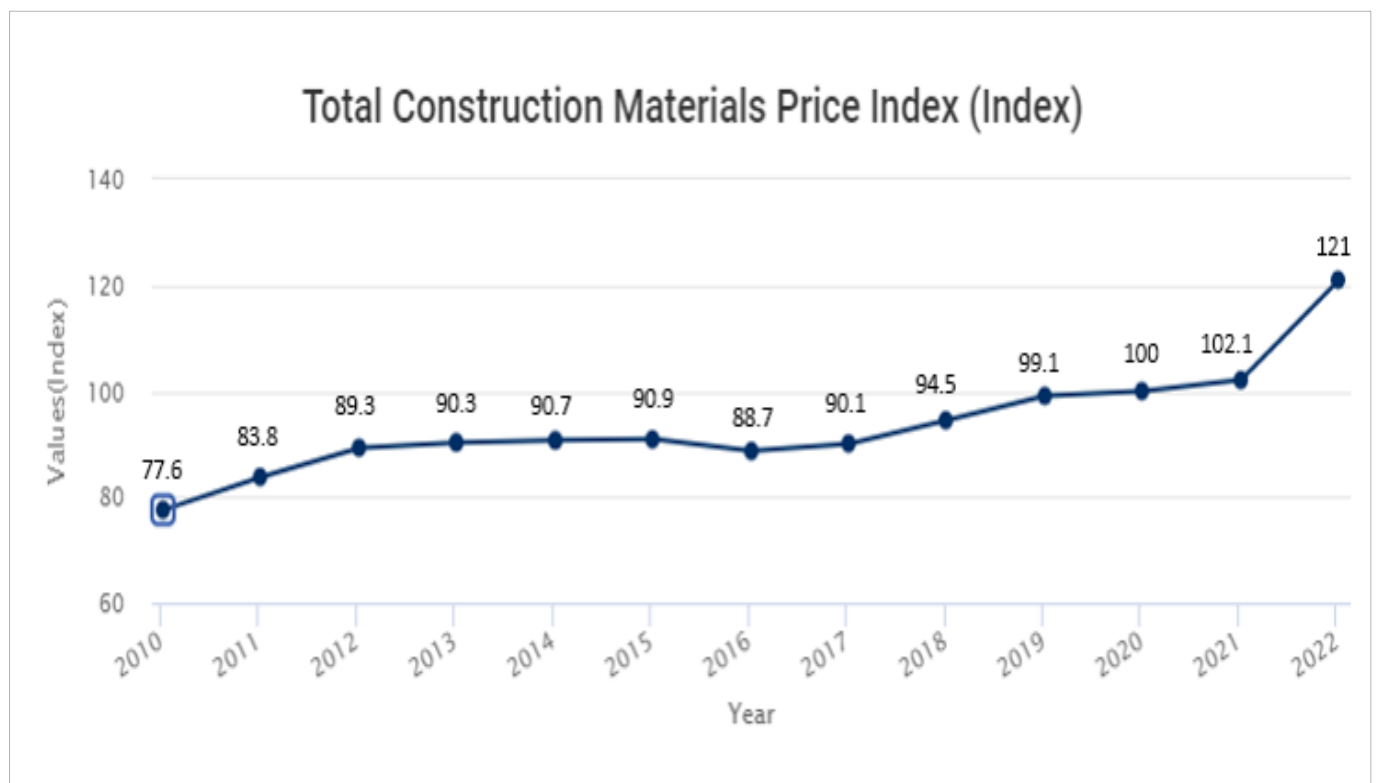
2010-2022 Building Material Price Index in the UK (Image: Ibisworld)

Real-time, accurate, unmodified data is the basis for establishing a reliable connection with clear responsibilities. With the advancements of technologies such as AI, this goal can be achieved automatically with minimum cost.

Usually, there are two ways to increase cash flow, increase income and reduce cost, respectively. However, the global economic downturn limits the increase of total project numbers and revenue by undertaking more projects, which means reducing costs now plays a more significant role in the current economic environment.
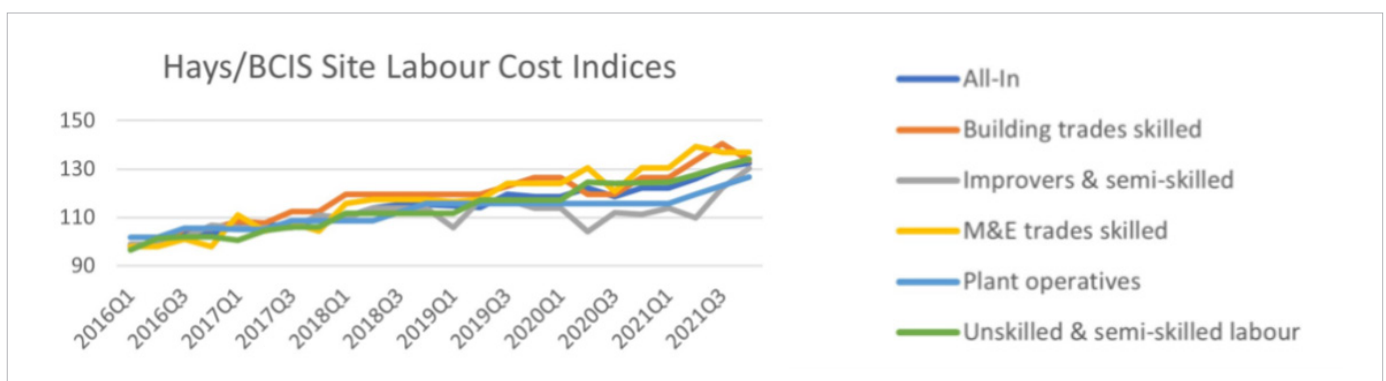
2016-2021 Construction Industry Labour Cost Indices in the UK (Image: Hays/BCIS)

Benefits of Project Management Digitalisation on Costs

The key to reducing cost is to improve project management capability. Firstly, it means rework and waste will be significantly reduced. Rework incurs additional time, costs, materials, and labour. Reducing rework is beneficial to lowering costs. Secondly, it increases work efficiency, including maintaining a streamlined and efficient workflow, increasing productivity and accountability. Last but not least, improved project management offers robust risk control in safety, progress, and supply chain. Risks not detected and not handled in time will pose a great danger and leads to significant losses in life and finance.

Then how to improve project management capability? Digital transformation is the answer. Technologies and data do empower projects' cost reduction and efficiency. However, there are still some common misunderstandings about digitalisation.

Misunderstandings and Essence of Digitalisation

The first common misunderstanding is that people only pay attention to the 'tip of the iceberg'. Digitalisation is a systematic project. In practice, many companies pay more attention to data display (tip of the iceberg) but overlook the importance of data generation, integration, and analysis (larger part underwater). Data is an 'ore' which needs to be extracted to keep the essence. Enterprises should build effective analysis systems so that there is a solid foundation behind data display.

The second usual misunderstanding is reversed investment priorities. There are two directions when a construction company invests in digitalisation, operational digitalisation and core business digitalisation. The former includes HR, finance, IT, etc., while the latter focuses on the projects. Apparently, the projects are real income sources, providing the primary value to the company. Digitalisation of core business will drive the overall enterprise development. However, many companies do not see it and put too many resources into operational digitalisation, resulting in reversed investment priorities.

Research by McKinsey Consulting shows that the failure rate of digital transformation for general enterprises is extremely high. The main reason for it lies in the failure to recognise the essence of digitalisation — data and connection.

Real-time, accurate, unmodified data is the basis for establishing a reliable connection with clear responsibilities. With the advancements of technologies such as AI, this goal can be achieved automatically with minimum cost. And connection means not just technical connections. The ultimate goal of connection is to realise a reliable business connection with clear responsibilities and rights. In this regard, enterprises in transition must grasp the 'fineness' of data connection. In simple terms, the fineness of data connection is the smallest unit of management involved. For example, the management unit in project management should go into details such as quality, safety, documentation, and progress instead of just focusing on contract settlement data. In addition, all these fineness data should be interconnected, for only the connected data can link each part of the project into a wholeness, facilitating collaboration and driving efficiency.

Advice on Digitization of Project Management

There are two most important aspects to consider before implementing any digital systems.

The first is to have an integrated system rather than multiple softwares for solving different problems. Companies often encounter obstacles in implementing digital software for the project team, as they find it difficult to change their original habits and to adopt new technologies, which are likely to cause reworks and increase their workload. Moreover, when more software is adopted, the data becomes scattered as the data cannot be interoperable.

It would be a challenge for project managers and senior production managers to make decisions based on the data from each software than having all information integrated, displayed and ready at the same time, reducing the real value the digital system can bring.
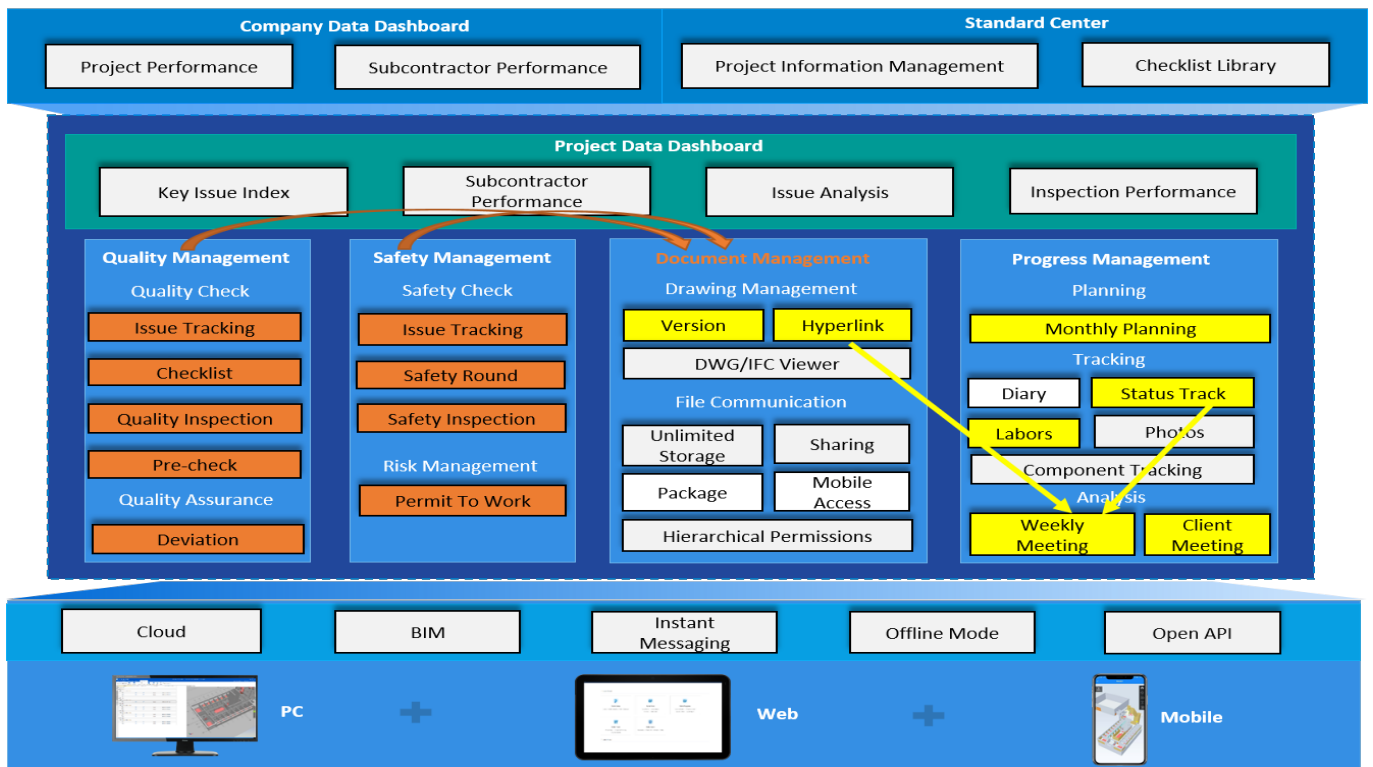
Glodon Gsite Architecture (Image: Glodon)

For instance, the issues/ quality defects found during construction are recorded and tracked with Excel, emails or other software. Drawings and design problems, such as RFI or change orders, are being communicated with document management software. The information is stored in multiple places, but the defect records or other inspection sheets, such as checklists, and weekly reports, also form part of the project documents and should be compiled easily and ready for handover.

Another example for project and production managers is that understanding various information and data is often necessary to make the most appropriate decisions. If the information is scattered or omitted, it is easy to make a deviation in the decision-making. For example, deciding whether the

current progress schedule should be adjusted requires an explicit awareness of the current situation, such as materials supply, labour, and any outstanding RFIs or pending drawing-related issues.

Therefore, a well-integrated system should cover more than just the core area of the project, such as quality, safety, production and document management. For other businesses or works, the system should have an open platform to provide SAAS applications and connect with other product solutions or services, eliminate data silos, and achieve digital transformation. But also, the data between different modules/ applications should be standardised and unified to ensure internal data channelling.

The second is to realise the business change during the enterprise's digital transformation. It is necessary to focus on management

issues before thinking about digitalisation. For enterprises, it is essential to strengthen the management responsibility consciousness of each business and team leader and boost the management capability to promote transformation.

With digital systems, the senior managers and project managers should also monitor the quality of the data captured from the project. Otherwise, the result comes out way mislead the decision makings. For example, traditionally, the data are collected manually from the site and processed into dashboards and charts in the report for the management team to review. To make authentic decisions, the managers need to ensure there are constant valid data input from the site, otherwise the system would be useless.

PROJECT OVERVIEW

LOCATION
Beijing, China

CONSTRUCTION PHASE
Tender & Bid, Construction

PROJECT TYPE & DESCRIPTION
Sports venue reconstruction, the newly added function of "ice" involves the Independent Ice Magic System, Desiccant System, Sports Lighting System, Power Distribution System, etc., transforming the "Water Cube" into a "Curling Venue"

RECONSTRUCTION AREA
50,000m²

CONTRACTOR
China Construction First Group Construction & Development Co., Ltd. (CCFGCD)

GLODON PRODUCTS INVOLVED
Glodon BIM 5D Platform, Glodon Quantity Takeoff Software

> "This is the largest curling venue in the histroy of the Winter Olympics, which was reconstructed from the Aquatic Sports Venue without shutdown and achieved challenging ice-water conversion."
>
> ——Glodon Recommend

KEYWORDS

BIM

Smart Construction Site

Sports Venue

Ice Magic System# Green and Frugal

Winter Olympics 2022 Complex Sports Venue

The Curling Venue at the National Aquatics Center in Beijing is the largest in the Winter Olympics history. The venue served as the Indoor Aquatic Sports Venue at the 2008 Summer Olympics and the Curling Venue at the 2022 Winter Olympics and Paralympics. Aside from this, it is also the world's first double Olympic venue with freely convertible aquatic and ice sports, as well as a temporary ice rink for the curling competition at the Winter Olympics.
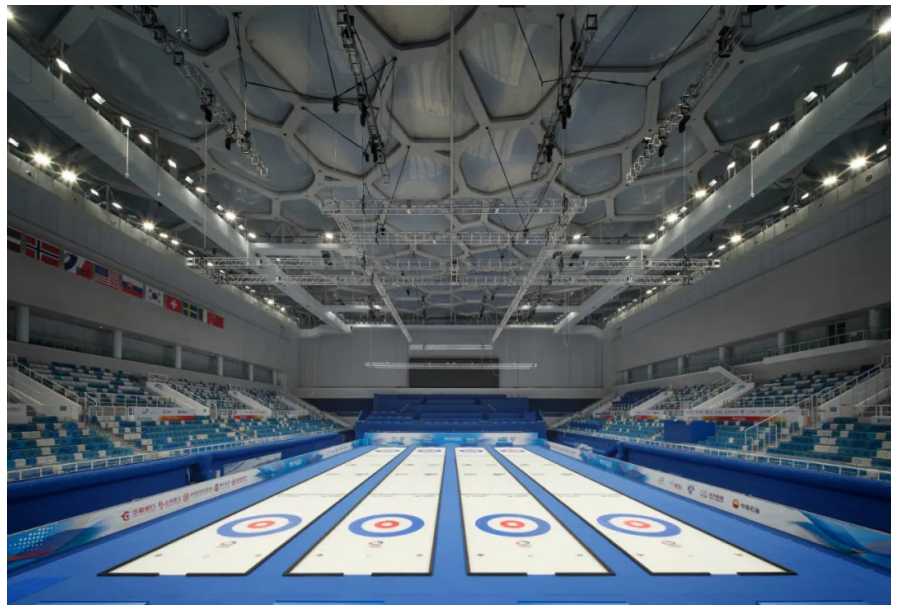

Image: Beijing Institute of Architectural Design BIAD

Image: Beijing Institute of Architectural Design BIAD

Construction Challenges

i. Ice-Water Conversion

A high level of accuracy was required for the control systems of the ice ring to monitor the overall height difference of the ice in millimetres, and the support structure had to be capable to be disassembled and converted repeatedly so that the ice-making duct and the support structure can be conveniently stored together.

ii. Environment Conversion

As part of the preparation for hosting a winter game, the venue had to be converted from a high-temperature and high-humidity environment to a low-temperature and low-humidity environment suitable for curling competitions. Two sets of air supply modes were required to meet the requirements of the World Curling Federation to of the World Curling Federation.

iii. Conversion without Shutdown

Owner requested that certain areas of the Aquatic Centre remain open to the public, as well as all electromechanical systems and existing office areas remain operational. To allow this, strict boundaries had to be established between the conversion works and the regular operation of the centre, thus ensuring a high level of safety. However, it also increased the complexity of the project exponentially compared with more traditional internal facility conversions.

iv. Smart O&M

To maintain a high level of efficiency, the team required a smart platform able to monitor in real-time the status of the various controlled equipment and components on the operation and maintenance platform at the ice ring event floor, as well as monitoring in real-time the ticketing areas and the flow of spectators at all venue seating areas and communal areas.

v. Complex Ice Ring Monitoring System

As part of the conversion works, a very complex Ice Ring monitor system had to be installed requiring seamless connections between the Ice Magic system, the desiccant system, the ice surface temperature, the wind speed and the humidity control systems.

vi. Planning & Organization

This project encompasses 70 separate construction areas of about 50000 m², as well as a scattered reconstruction environment involving the construction of buildings, structures, waterproofing, electrical equipment, machine rooms, and functional rooms, as well as the centre membrane maintenance.

vii. Expectations for Green and Frugal Olympics

There was an expectation that during the entire design and construction process, the venue conversion project would be capable of delivering the concepts of a Green and Frugal Olympics, by reducing the environmental impact and reducing the costs through the re-use and recycle of existing infrastructure. To fully use the existing space and systems in this venue, it was decided that the project would convert the original convert the original pipelines for new uses instead of removing and modifying them.

Implementation

i. Integrated Application of BIM

By integrating the BIM process in all disciplines, problems such as unreasonable and unclear design expression between the various disciplines were identified in advance.

ii. Construction Simulation

Through the use of BIM among all disciplines, it was possible to perform visual construction simulations of personnel, material, machine, and other resources before construction, which led to better on-site arrangements, earlier reservation of materials, and more effective budget planning.

iii. Lean Management of Schedule

Through Glodon BIM5D Platform, on-site construction personnel were able to receive tasks through their mobile applications and provide feedback on the on-site schedule, including the number of workers and materials used in real-time. In order to make more informed decisions, all of the information was collected in a dashboard on the site, which was available for supervisors to monitor in real-time and act promptly.

iv. Quality & Safety Management

If any potential risks were detected on-site, Glodon BIM5D Platform automatically notified the relevant individuals of specifications and rectification requirements in order to mitigate and control potential dangers as soon as possible.
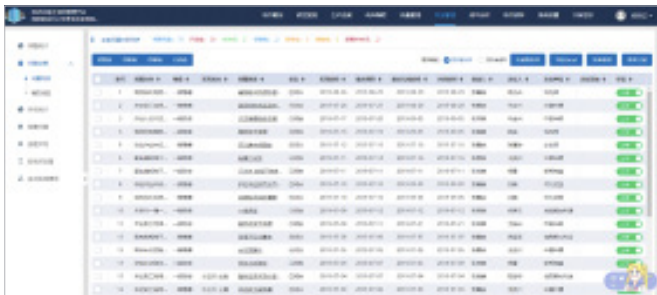

Image: Glodon

v. Innovative Actions

a. Ice-Water Conversion
In order to address this challenge, the team utilised a variety of BIM technology in order to carry out special designs for support structures, environment conversions, and for the installation of the Ice Magic System.

b. Reconstruction without Shutdown
The use of BIM technologies was essential to the successful completion of the venue conversion while maintaining the running of the operations of the aquatic centre.

c. Smart O&M
By integrating the operations and maintenance platform with BIM, the project team was able to monitor indoor air quality, energy consumption, equipment operation status, and work order processing in real-time, which reduced significantly the difficulty of operation.

Summary of Benefits

Using BIM technologies the project team significantly enhanced the lean management approach and ensured the smooth construction works required to convert the venue into a Winter Olympic Curling Venue. Thanks to the use of these technologies, construction time was shortened, the overall cost was reduced and the overall project quality was improved.

Glodon BIM5D Platform enabled all-around integrated control, enhanced information management for construction projects, enhanced project quality, safety, and green construction, and significantly increased work efficiency for personnel.