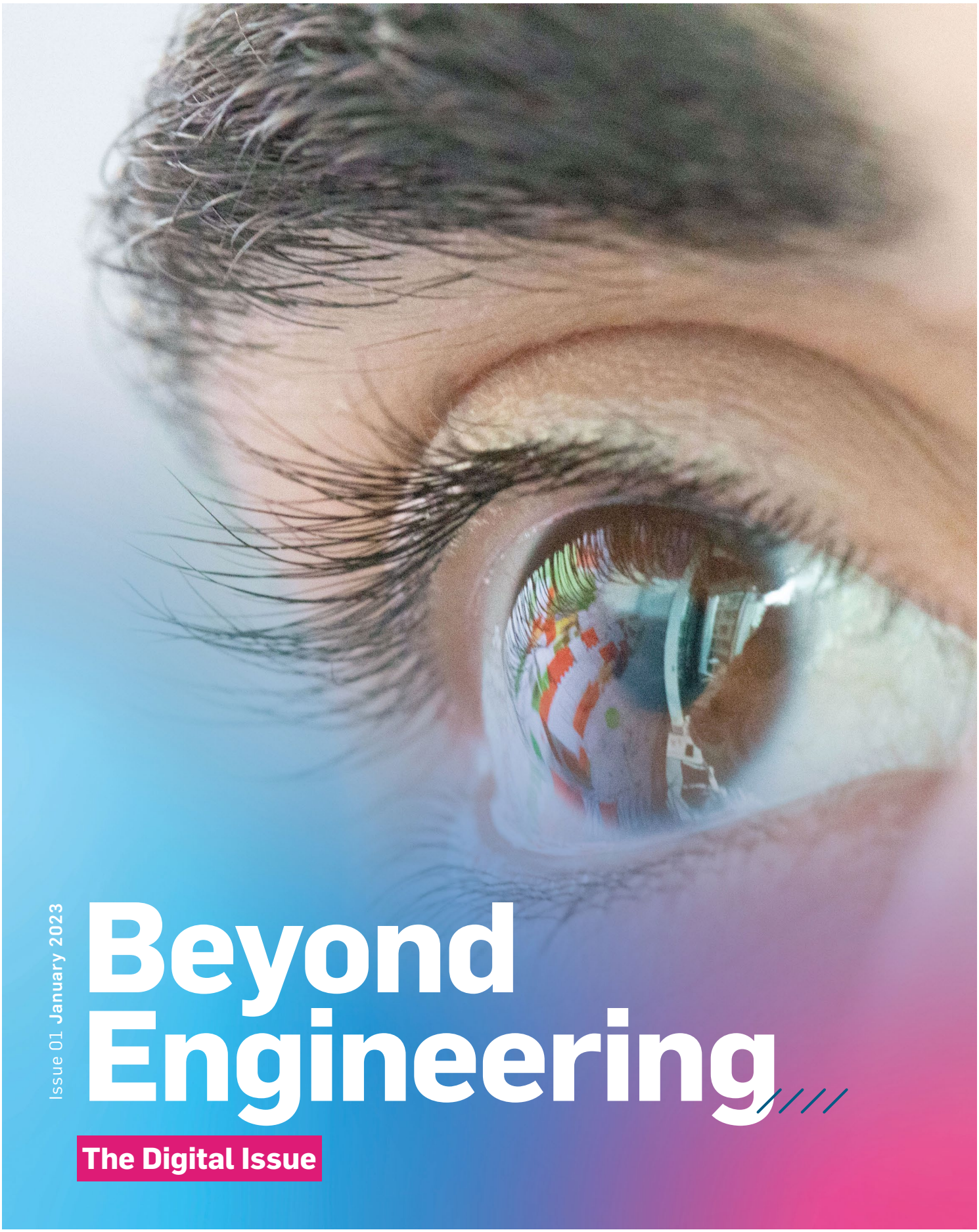

Issue 01 January 2023

Beyond Engineering

The Digital Issue

Eight reasons why data sharing brings benefit in infrastructure design

Using digitalisation to achieve net zero

Project showcase: Canada Line

SNC·LAVALIN

Beyond Engineering is SNC-Lavalin's print and digital magazine. Using a collection of some of the latest articles from across all our brands, the magazine's goal is to share with you our expert opinion and encourage discussion on today's big issues and the future of our industry and the world around us.

Inside this issue

Welcome to Beyond Engineering

Our industry is ripe for transformation, with proven and emerging technologies creating huge opportunities for us all to improve our performance.

For us, the true value lies in data and the ability to harness it across the end-to-end project lifecycle to deliver better outcomes for clients and throughout the supply chain.

Through data, we can connect people and technology to be the source of real-time insight, continually elevating decision-making, providing more on-site certainty, increasing industry productivity and improving commercial outcomes for all involved – while accelerating the transition to net zero infrastructure.

However, to be successful, we must keep evolving our processes and ways of working with data, putting proper data management at the heart of our strategies to unlock and create the maximum possible sustainable value.

Ceri-Ann Droog

GLOBAL DIGITAL DIRECTOR, SNC-LAVALIN

It's easy to talk about the value of data but what does that really mean in reality? To answer that, we must look across the lifecycle of an asset, from planning right through to the decommissioning strategy, and how data can enrich outcomes at every step.

We've been investing in embedding data and technology into everything we do and it sits at the very heart of the company's strategy: it's woven into everything we do, and is fundamental to our way of working.

This publication gives you a snapshot of the progress we've made to date and the difference we've already made – and continue to make – on projects all over the world.

As an organisation, we are determined to lead the industry's transformation, taking clients and partners with us on a journey of discovery and shared success as we look to engineer a better future for our planet and its people.

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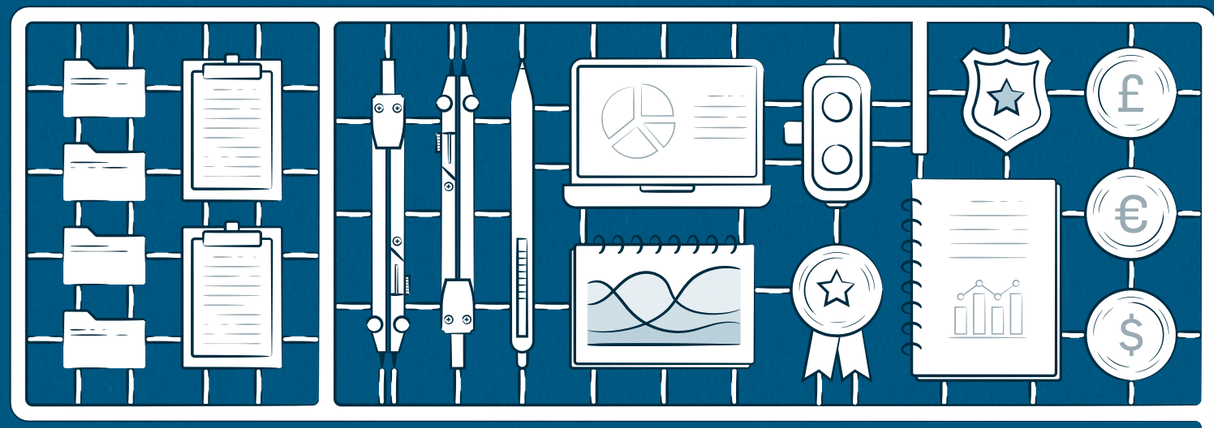
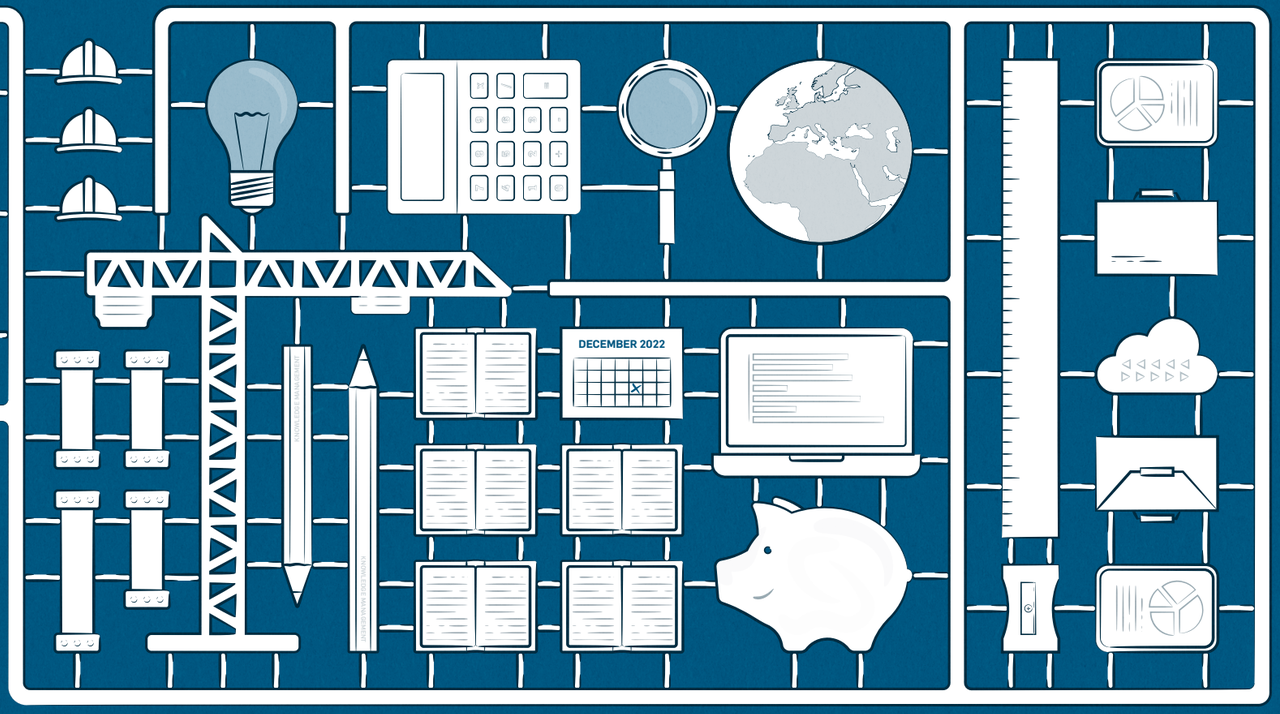




Why we need to overhaul our approach to knowledge management

Embracing new technology and data-sharing, and using the newfound knowledge we'll acquire if we do this, can set the right course for a new era of smart construction, says Lesley Waud of Atkins.

Historically, our industry knowledge has sat with the architects, engineers and construction managers who make up our workforce. Individuals who have built up extensive experience over time and are able to use their judgement to make effective decisions.

The downside to this is that if one of these individuals leaves an organization, then that hard won knowledge leaves with them. Yes, there might be a paper trail that new team members can use to surface information – but often it's just that, information, rather than knowledge. The richness of understanding how things fit together will be lost.

However, as we move to more digital and data-enabled ways of working, our approach to knowledge management is shifting. It is slowly becoming recognized as a proper job of work – both to capture the valuable knowledge contained within an organization and to share it effectively, to the benefit of everyone.

While we may already conduct lessons learnt sessions, what the industry has been less good at is lifting these lessons out of individual projects and understanding the collective learnings across a portfolio or sector – mainly because people very quickly move on to the next job.

This is a missed opportunity. But the more we start to work in a digital way, and the more data that's readily available for us to draw insights from at an enterprise level – rather than just within individual projects or programmes – the more this knowledge capture is becoming easier to formalize.

The role of technology in knowledge management

Is it possible, therefore, for us to entrust knowledge management solely to a computer from now on? In theory, you could codify all the standards that we work to as an industry, however the technology would still be lacking critical domain knowledge.

At the same time, the conclusions we might have drawn historically were based on gut feel, experience, and the insights we had to hand. Whereas with new technology, we have the opportunity to ground these in much more quantitative – rather than just qualitative – data, and model scenarios more readily than we could have done before.

We can therefore have far greater confidence in the likely outcomes. In conclusion, the combination of human experience and data insight is much stronger than the sum of its parts.

However, for us to properly manage knowledge as organizations, and take full advantage of the data we now have available to us, we must be able to share it (appropriately) outside the scope of individual projects.

This requires the cooperation of clients and partners, as well as our own stakeholders. At present, we as an industry, can still be quite proprietary when it comes to the project data we're happy to share publicly, so this will require both a process and a mindset shift.

How can we facilitate this shift?

People need to start recognizing the value of knowledge beyond themselves as individuals or a single project. They also need to properly invest the time and effort to capture it in a way that means it can be shared and used. In some instances, that's within our gift, but in others, our contracts with partners and clients might limit what we can do.

Unfortunately, these contracts are still being written the way they were 30 years ago. However, if as an industry, we can collectively recognize the value of shared knowledge – rather than using it as a differentiator to compete against each other – then can we write our contracts differently, to promote the sharing of knowledge. While at the same time accepting that certain data still needs to be controlled.

After all, there is a fine line between controlling data and stopping knowledge and the insights being drawn from it altogether. If we continue to do that, we're just going to keep repeating the same mistakes on future projects and we'll never learn and grow.

Next generation ambassadors for knowledge transfer

The good news is that new graduates and apprentices are entering our industry with a far more progressive, collaborative attitude.

This open approach is likely not only to encourage our industry to take a more collaborative stance but ensure it does so at a faster rate. After all, the best new talent might be put off starting their careers in a sector that appears restrictive and secretive.

We, as an industry, are on a journey when it comes to digital transformation. While we are well on the way to digitizing a lot of our existing processes and workflows – and using technology to automate tasks we used to do manually – what we've been less bold about is radically rethinking some of those processes altogether.

But by embracing new technology and data-sharing, and using the newfound knowledge we'll acquire if we do this, we can set the right course for a new era of smart construction.

Lesley Wauld
GLOBAL HEAD OF DESIGN TRANSFORMATION, SNC-LAVALIN

THIS ARTICLE FIRST APPEARED IN INFRASTRUCTURE INTELLIGENCE, 14 JULY 2022.

Innovation showcase

Digital transformation

Ceri-ann Droog
GLOBAL DIGITAL DIRECTOR, SNC-LAVALIN

THIS ARTICLE FIRST APPEARED IN NEW CIVIL ENGINEER, 18TH OCTOBER 2022.

Atkins' approach to digital transformation is as much about taking the whole industry forward as improving delivery of its own work, says Ceri-Ann Droog.

While Atkins' work to improve digitalisation is gathering momentum, global digital director Ceri-Ann Droog says that its ambition is much broader than just the firm's own work.

She says that the aim is to support the global infrastructure industry on its digital transformation journey too.

"As a starting point it was to build on our purpose as an organisation."

"We looked at our corporate strategy and purpose and within that we have a statement that we are underpinned by people, data and technology.

"But we want this to be wider than our business. We want to consider and develop our role in transforming the industry – there are all sorts of issues that the industry is facing, such as stalled productivity and the drive for carbon reduction – so in considering that, we want to play our part in leading the digital transformation and accelerating it.

"When you think about data and technology – digital solutions – people in the industry have been talking about it for a long time.

Atkins is now at the point where we're making an impact and creating some tangible change for clients around the world."

In terms of what digital transformation means on the ground, Droog says that the aim is to become more efficient and remove costs, but she says that the real focus is on improving the outcomes for clients.

"If you take engineering design as an example, what clients really care about is onsite predictability when the design moves to the construction phase," she explains.

"They want it on time, on budget and with a clear view on issues like their carbon footprint and social value."

Nonetheless, Droog points out that the need for digital change is not just in the construction phase – it can also be applied to the operational stages of projects to drive benefits through an entire project lifecycle.

However, she adds that no single company can deliver a digital transformation in the infrastructure industry alone and Atkins needs to work with the wider industry too.

Digital transformation is not all about delivering benefits for the client though. Droog believes that it will also bring benefits for Atkins' staff.

"This is a great opportunity in the sense of how we are helping people on their own personal journey," she says.

"We're looking at what the key enablers across our business are for this strategy and that's about upskilling our staff and looking at what training they need in the future."

According to Droog, the greater efficiency of increased digitalisation will not mean fewer staff are needed, more that it could automate repetitive tasks and create more time for creativity and developing innovative ideas.

Droog says that digitalisation will not be a one off change but the start of an ongoing evolution, although she has high hopes that the journey will deliver on the firm's aims.

How data driven decision making is transforming the construction sector

Major infrastructure projects are uniquely challenging but by using machine learning to crunch data from historic projects it's now possible to predict the outcomes of current and future initiatives. Atkins' Alejandro Lopez and Faithful + Gould's Anthony Reid explain how data science is transforming the construction sector.

Every infrastructure project is unique. Unlike, for instance, a car manufacturer, construction companies don't repeat the same task thousands of times in a row.

Each project has its own ground plan, its own geology, its own challenges with utilities and the surrounding built environment — and so on. At least, that's how it might seem to those of us on the front lines of infrastructure.

But the reality — from a data-science perspective — is rather different. The great majority of techniques, materials, project milestones and other variables are actually the same from one project to the next.

Data scientists estimate that 80-90% of the data points in any project are common to almost all projects. And this has huge implications for efficiency in construction. It means that by collecting and analysing data from hundreds of projects, it's possible to build accurate models of why some projects succeed — delivered on time and to budget — and others don't.

Atkins has used machine-learning algorithms to build predictive models based on many hundreds of major infrastructure projects from around the world.

Anthony Reid
ASSOCIATE DIRECTOR, FAITHFUL+GOULD

Alejandro Lopez
DIGITAL SOLUTIONS DIRECTOR, ATKINS

And once you have that model you can use it to predict the outcomes of future projects. Data scientists extract from project plans, proposals, engineering blueprints and other documents that infrastructure providers have. Feeding these into the Machine Learning (ML) algorithms, they develop a clear picture of how stakeholders intend to proceed at each stage of the project, the materials and technologies they intend to use, and so on.

They can then compare these to the data model built on historical data from many different projects and spot where potential pitfalls, over-runs, conflicts, and budget problems can occur. But this is not something which may happen in the future or that requires technology that's yet to be invented. The machine-learning required to perform this kind of predictive analysis already exist.

Atkins, for instance, has used machine-learning algorithms to build predictive models based on many hundreds of major infrastructure projects from around the world. We have already used these to help major infrastructure projects and providers predict and avoid potential delays, problems, and budget overruns.

Preparing for change

There are many advantages to using this kind of data-driven approach to project planning and ongoing operational optimisation. The kind of detailed analysis required to spot potential problems would — done manually — typically require a whole team of specialists. Using an ML and data-driven approach, often one or two people can get the job done.

Using ML to spot conflicts and sort these out before they make it out of the project plan and onto the site can also help to save time and money. And reducing the need for rework isn't just good for the bottom line and the project timeline. By reducing the amount of energy and materials required to finish the project, it also helps reduce that project's carbon footprint.

But to realise these benefits, organisations often have to change the way they work. Perhaps the most important change, is to engage fearlessly with what the data and the analysis is telling you. If, for instance, the data predicts a significant cost overrun, this is almost certainly highly inconvenient.

But the sooner the company faces and deals with it, the less it's going to cost and the less disruptive it will be.

Another barrier to realising the full potential of machine-learning, is the existence of data siloes. These can be technical, when data is distributed across different platforms, or they can be organisational and cultural. To maximise the accuracy and usefulness of the predictive models, it's important to break these siloes down and draw in data from across all the functions and experts working on a project.

Letting data take the strain

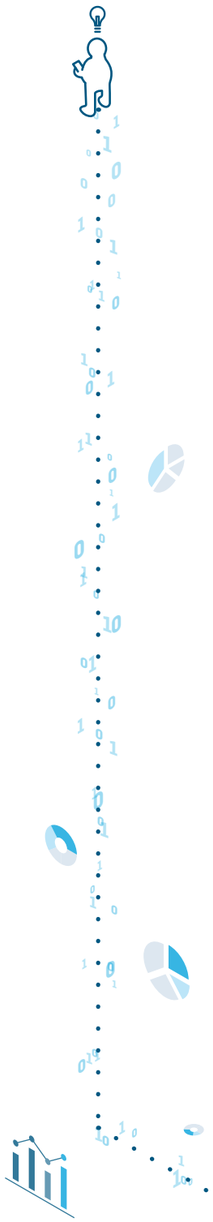
Often, the best way to do this is to work with external experts. By working with a partner that specialises in data- and ML-driven decision making for infrastructure projects, you get instant access to the technology and the expertise you need to start benefiting from these methodologies. Just as importantly, if you work with the right provider, you also get access to predictive models based on past data.

And indeed, it is the data that has to come first before exploring the intricacies of ML. Without a strong foundation of robust data that has integrity, businesses will always struggle to make the most of the insights that aim to improve the predictability of infrastructure projects. Any relationship with a expert partner should start with interrogating the data to see how it can contribute to a reliable ML solution.

Organisations such as Atkins and Faithful + Gould work on hundreds of major projects every year. With client permission, we can gather, anonymise and process the data from these projects to build highly detailed and accurate normative and predictive models for the widest possible range of different project types. This gives us the baseline models we need to predict project performance in advance, so that you can eliminate potential problems at the planning stage.

Far too often, projects end up being more expensive and time consuming than they need to be. Thanks to Machine Learning, we get to understand the inner workings of the project at every stage so that we can prepare to right the ship when needed. This can represent a change of working style for many, but when it presents us with the data to operate more efficiently, it can be worth its weight in gold.

THIS ARTICLE FIRST APPEARED IN THE ENGINEER, 6TH OCTOBER 2022.



Project showcase

Canada Line

How digital twinning is making Canada's trains run on time

As part of the Canada Line's ongoing digitalisation, the rapid-transit rail line that is part of TransLink's Skytrain network in Metro Vancouver has begun using a digital twin to optimise its operations and maintenance.

Working with Atkins, the rail operator has scanned the whole of its track using lidar, ultrasonic and other sensors. The information from these data-capture exercises is then fed into the digital twin — an exact digital replica of the Canada Line and all of its assets. Ronald Powell, General Manager, Rail & Transit Infrastructure, at SNC-Lavalin explains.

This twin isn't just a visual 3D model of the line. Each element within the model — every section of track, every switch, signal, and siding — is also a data repository. By selecting an element, users can see what it's made of, its specifications and tolerances, details of when it was last maintained, data that shows its importance to operations — and more. Using this data, engineers can then quickly decide whether maintenance is required and when. If urgent, it can dispatch a crew to the location immediately.

How the digital twin is helping to improve performance

The Canada Line has been in use since 2009. During this period, the team that runs it has been exploring using new technologies to optimise daily operations. As part of the digital twin initiative, this has included a lidar scan of the entire network, giving operators a model of the line as is, rather than as it appears on its blueprints.

This is important because to make the right decisions at speed, engineers need accurate, up-to-date and real-world data, not data based on outdated plans. Attaching sensors to key assets, such as switches, was the next step in the process. These ensure that the digital twin is kept constantly up to date with fresh data.

Ronald Powell
GENERAL MANAGER,
RAIL & TRANSIT,
SNC-LAVALIN

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Some switches are 'golden assets' – they are crucial to hitting the Canada Line's performance targets, which is for trains to run a schedule on time, 100% of the time. To that end, sensors have been installed on each switch to measure things such as the time of a swing, the smoothness of its swing motion, the pressure in the hydraulic fluids and so on.

Over time, they help to build a picture of what 'normal' looks like. As soon as a switch then trends away from normal or a certain variable passes a set threshold – for instance a switch takes too long to swing open – operators can react and create a maintenance plan designed to prevent any downtime. This process change is already helping to significantly improve performance across the line.

Using AI to automate maintenance schedules

With these first two stages of the digital twin's implementation on the Canada Line now complete, the team has begun to turn its attention to Stage 3. This is to train the artificial intelligence (AI) in the Canada Line's digital twin, so that it understands the thresholds set for 'normal' and can therefore make decisions in real time about what needs to be maintained and when.

This will prevent engineers from having to analyse the data outputs themselves, instead creating a fully automatic maintenance schedule, designed to guarantee maximum uptime and minimum disruption. Analysis is often done faster using AI and is more effective at identifying abnormalities that require intervention.

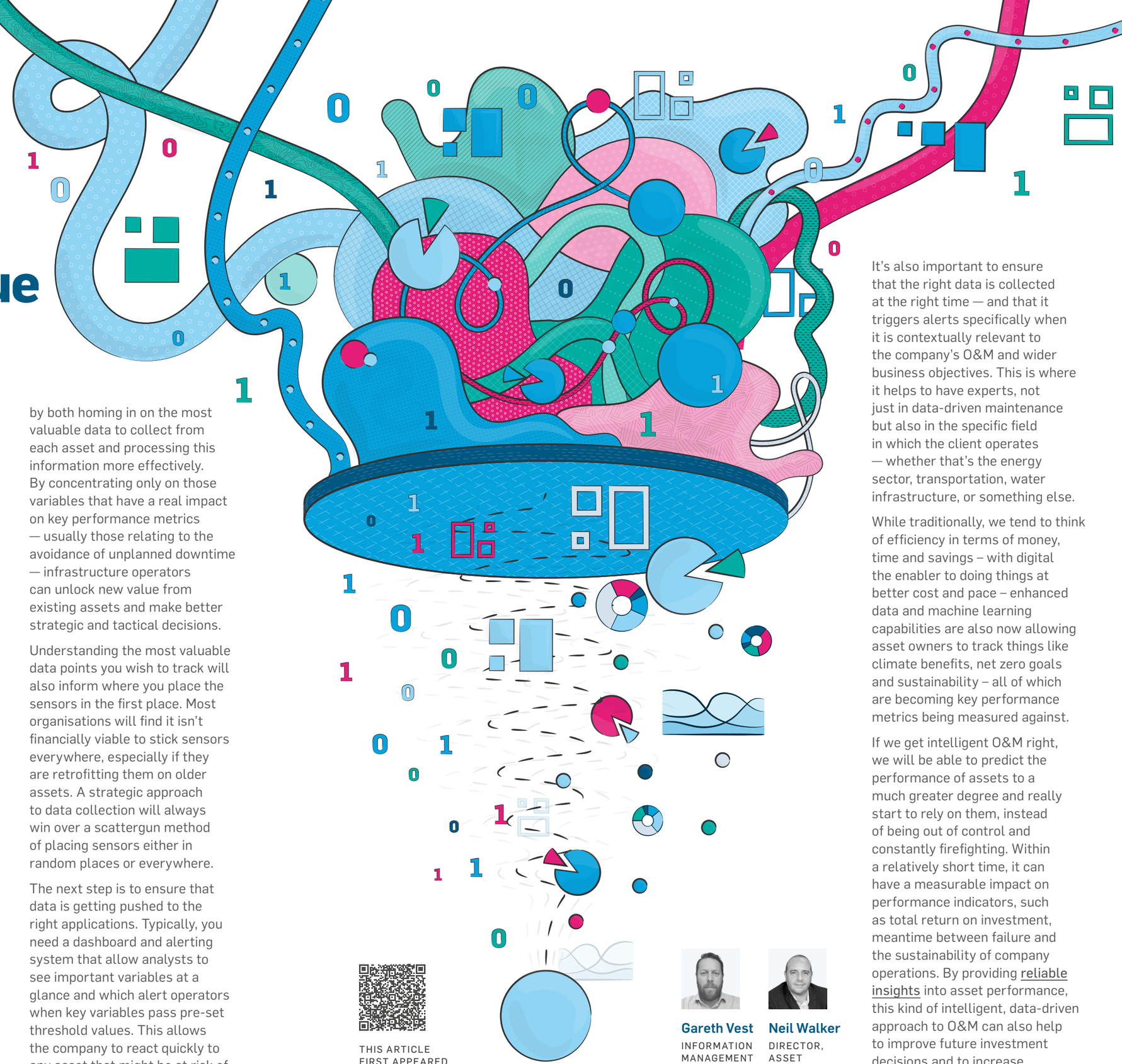
Moving to a system of automatic maintenance schedules will free up staff to work on higher-value elements of operations and maintenance. It will also ensure both that faults are detected and prevented before they cause outages, but also that assets that are still operating within their set tolerances aren't unnecessarily taken out of service for scheduled maintenance, which disrupts the service and sub-optimises asset life-cycle costs.

Digital twin technology, coupled with real-time data-streaming from connected sensors on key assets, has the potential to radically improve efficiency and cut downtime on rail networks worldwide.

This effect is already being seen on the Canada Line and as more operations are automated, and changes to AI are utilised to schedule maintenance automatically based on data-driven predictions, we expect to see an even greater uplift in performance.

This will not only have a measurable impact on operational costs, but also on the customer experience, making it a win win for everyone.

How intelligent operations and maintenance is unlocking new value for asset owners



By 2025, the amount of data generated globally by IoT devices will reach 79.4 zettabytes (ZB) — that's 79 trillion gigabytes. And nowhere is this data explosion creating more of a challenge than in the infrastructure sector. Atkins' Gareth Vest and Neil Walker explore the importance of a data-driven approach to O&M.

Almost every asset we're managing, seeing acquired or building now comes with connected sensors built in — or the ability to add them at a trivial cost. They're combining this data intelligence from maintenance reports and asset inspections. As a result, many infrastructure operators find themselves inundated with terabytes of data daily, covering almost every aspect of their assets' status and operations. It is true that aging assets with no sensors do face a barrier to entry because of the logistics of retrofitting an entire stock. This is a problem in itself because people are being left behind in an intelligence-led world.

But more and more asset owners are now adding sensors to their buildings and are unlocking access to reams of data as a result.

Without the right data schema, strategy and operating model, organisations are unable to use this data productively and much of it gets lost. Asset owners are, frankly, struggling to keep pace, often employing whole control rooms of analysts who spend their days watching real-time, or near real-time, data – often error alerts – to try to find priority maintenance tasks. And they still often miss the important things. In short, they become data blind.

It's almost impossible to efficiently pre-empt unplanned failure in this way. And in the worst-case scenario, the cost of increasing the number of data workers will have been offset by cutting the number of engineers and technicians working on site.

This means that even when the data team correctly identifies a problem in a timely manner, there may not be enough skilled workers on hand to address the issue within the right timeframe.

How machine learning can help

The goal of intelligent operations and maintenance (O&M) is to put the right information, into the right hands, at the right time, so that asset owners can make the right decisions. Machine learning capabilities can now enable this by both homing in on the most valuable data to collect from each asset and processing this information more effectively. By concentrating only on those variables that have a real impact on key performance metrics — usually those relating to the avoidance of unplanned downtime — infrastructure operators can unlock new value from existing assets and make better strategic and tactical decisions.

Understanding the most valuable data points you wish to track will also inform where you place the sensors in the first place. Most organisations will find it isn't financially viable to stick sensors everywhere, especially if they are retrofitting them on older assets. A strategic approach to data collection will always win over a scattergun method of placing sensors either in random places or everywhere.

The next step is to ensure that data is getting pushed to the right applications. Typically, you need a dashboard and alerting system that allow analysts to see important variables at a glance and which alert operators when key variables pass pre-set threshold values. This allows the company to react quickly to any asset that might be at risk of trending off peak performance.

It's also important to ensure that the right data is collected at the right time — and that it triggers alerts specifically when it is contextually relevant to the company's O&M and wider business objectives. This is where it helps to have experts, not just in data-driven maintenance but also in the specific field in which the client operates — whether that's the energy sector, transportation, water infrastructure, or something else.

While traditionally, we tend to think of efficiency in terms of money, time and savings – with digital the enabler to doing things at better cost and pace – enhanced data and machine learning capabilities are also now allowing asset owners to track things like climate benefits, net zero goals and sustainability – all of which are becoming key performance metrics being measured against.

If we get intelligent O&M right, we will be able to predict the performance of assets to a much greater degree and really start to rely on them, instead of being out of control and constantly firefighting. Within a relatively short time, it can have a measurable impact on performance indicators, such as total return on investment, meantime between failure and the sustainability of company operations. By providing reliable insights into asset performance, this kind of intelligent, data-driven approach to O&M can also help to improve future investment decisions and to increase returns on capital investment.

THIS ARTICLE FIRST APPEARED IN BUILDING, 12TH OCTOBER 2022.

Gareth Vest
INFORMATION MANAGEMENT DIRECTOR, ATKINS

Neil Walker
DIRECTOR, ASSET MANAGEMENT SYSTEMS, ATKINS

Project showcase

Inland Rail

How better Information Management is helping Inland Rail to stay on track

Robbie Pretorius

TRANSPORT HEAD OF SERVICE, SNC-LAVALIN

Robbie Pretorius, Transport Head of Services – Australia at SNC-Lavalin, explains how the effective use of Information Management is improving the outcome of Australia's Inland Rail project by ensuring all stakeholders get the assets and information they need, when they need it.

Access to information (as data) of the right quality and at the right time, in a format that is trusted by all parties, is increasingly recognised as a critical enabler of the construction sector's digital transformation, with the potential to both drive down costs and operation of built assets, and drive up quality.

While Information Management (IM) can often be forgotten in the rush to get a project underway, it is the red thread that runs right across the supply chain, not only acting as the checks and balances to ensure a project stays on track, but also increasingly forming the basis of the insights used to drive emerging technologies, such as digital twins and machine learning.

THIS ARTICLE FIRST APPEARED IN GLOBAL RAIL REVIEW, 26TH JANUARY 2022.

Successful IM requires that all the information and data produced and received throughout a project's lifecycle be categorised, maintained, used and stored appropriately, so that project leads can make the most of it to improve project outcomes. However, this can be easier said than done.

IM in action on the Inland Rail project

A good example of IM in action is on the Inland Rail project, a freight rail network project that began in 2017 to connect Melbourne and Brisbane, Australia, via regional Victoria, New South Wales and Queensland. The project involves building or upgrading 1,700km of railway, with the aim of enabling cargo and containers to move cross country within 24 hours, providing a huge boost to the economy, as well as creating new hubs across the Outback.

SNC-Lavalin – supporting Turner and Townsend – took on the Program Management Office (PMO) function two years into the Inland Rail programme, which is made up of 13 separate projects and therefore needed a mechanism to efficiently monitor and control deliverables.

In partnership with the Inland Rail IM team, SNC-Lavalin began by installing an information deliverable management framework that aligns to Standard ISO19650, which included a deliverable register, agreed as part of the contract. Any delays are now able to be logged for project managers, who can then check if they will lead to any critical milestones missed and help direct negotiations. This ensures that contractors understand what they need to do by when, and all stakeholders get the assets and information they need, when they need it.

For example, if a contractor requires information from a client's team in a particular order, this information will be listed with the client's name against it and the date and transparent for all project stakeholders.

Key benefits of improving IM across the project have so far included:

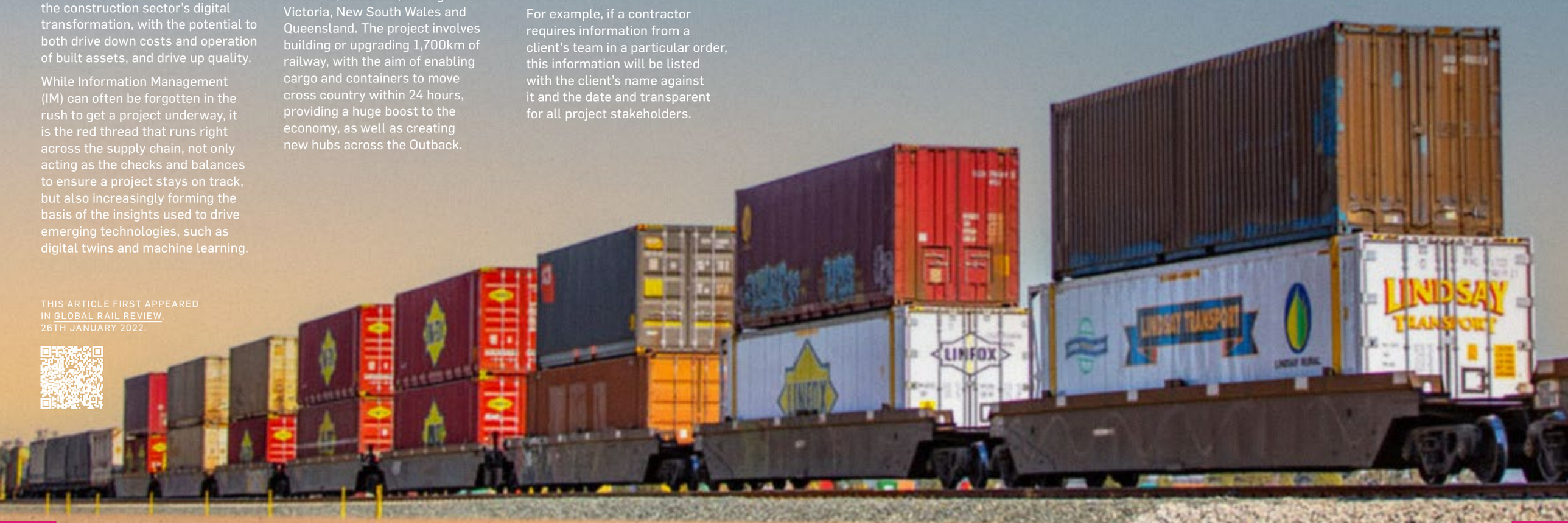
- A deliverable register that helps to ensure each party receives what they need and clarifies when they need it
- Early warning triggers for missed milestones
- Value for money for the Australian government because Inland Rail is able to categorise, rationalise and prioritise the information they ask for, as well as ensuring its contractual requirements are being met
- Proactive control and decision-making, thanks to connected dashboards and reporting that provide relevant insights
- Better resource planning, including on the client's side to streamline review and acceptance of deliverables coming from contractors
- Innovation and continuous lessons learned that can be fed through to each of the 13 project parts, so teams can optimise and improve their ways of working all the time
- Improved compliance in terms of contract management by making commissioning more efficient.

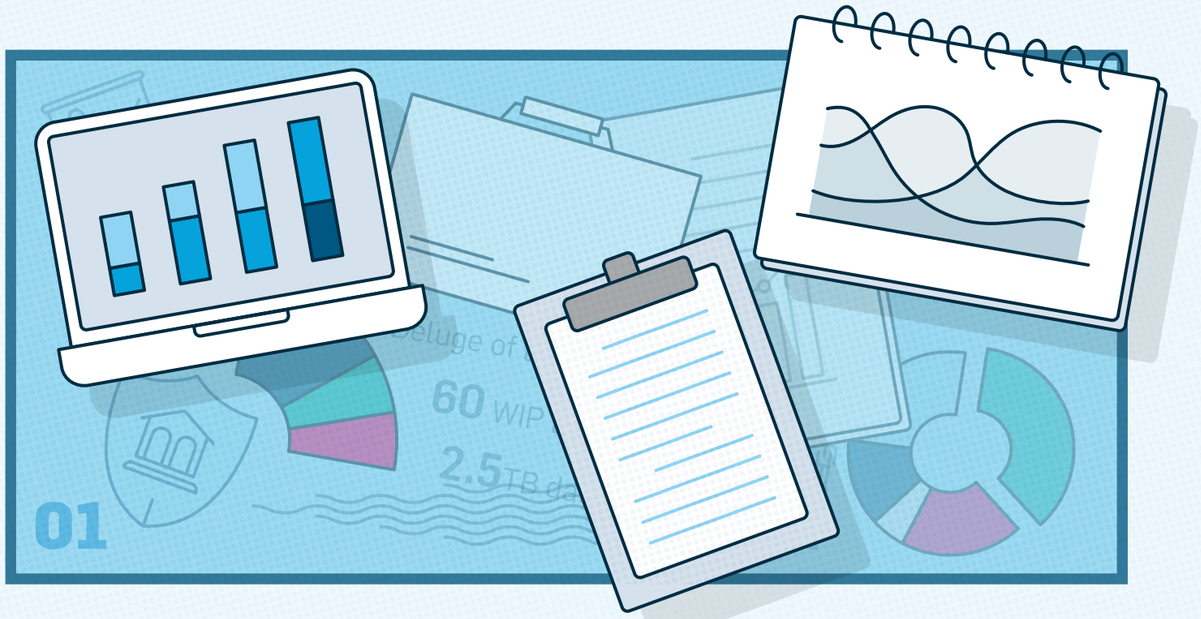
Putting an information deliverable management framework in place has also opened the door for all the different project stakeholders to understand more about IM, and how they can better leverage its power and increase their BIM maturity. The PMO team are now looking at creating a deliverable loaded schedule, which links deliverables to the P6 schedule. In this way, critical deliverables are linked to activities and progress can be objectively assessed.

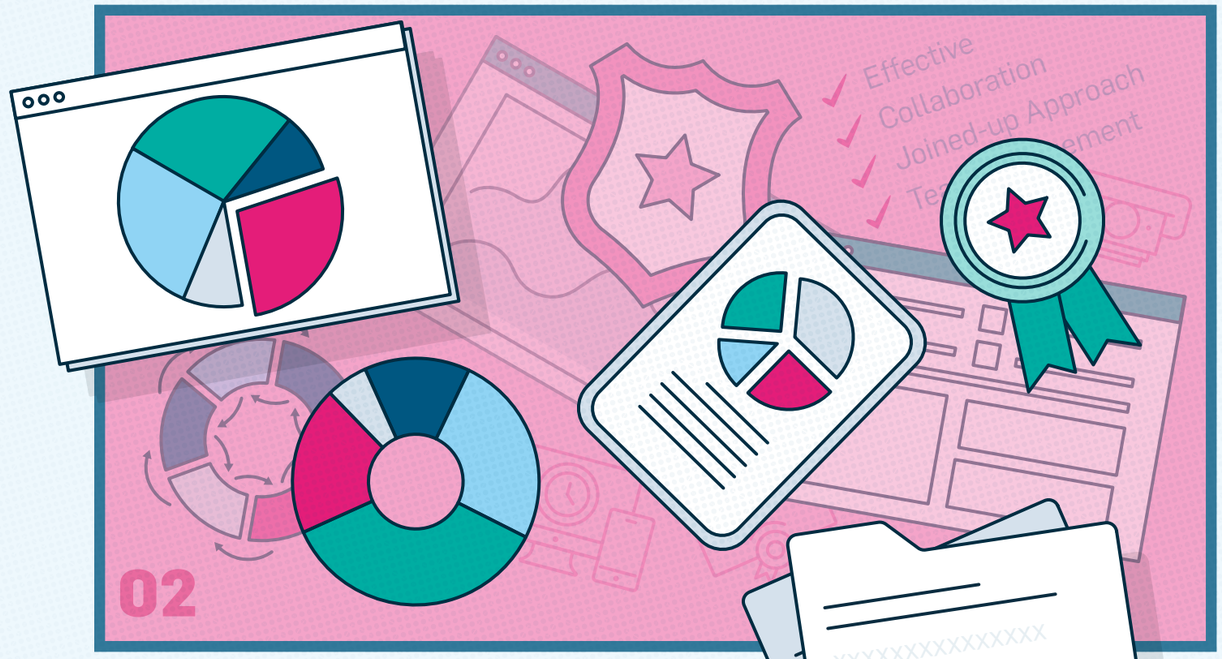
Having a deliverable loaded schedule means, to a certain extent, stakeholders will already be doing BIM 4D.

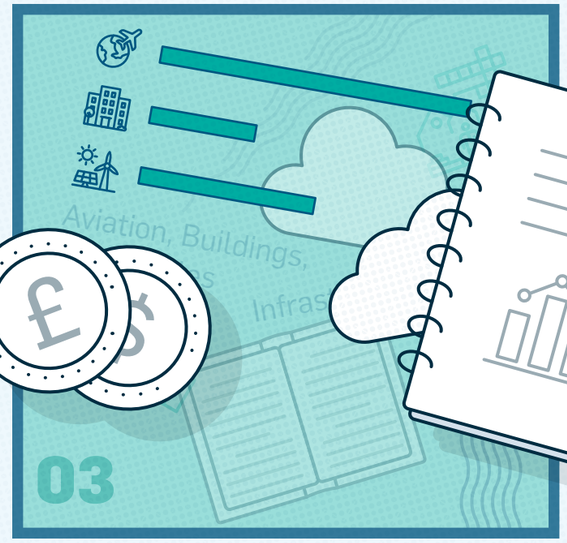
It also helps them to understand that they can do earned value, which is part of BIM 5D. In other words, to validate the progress they've made against the price that's been paid. This is generally thought of as a better indication of progress than looking at the schedule alone.

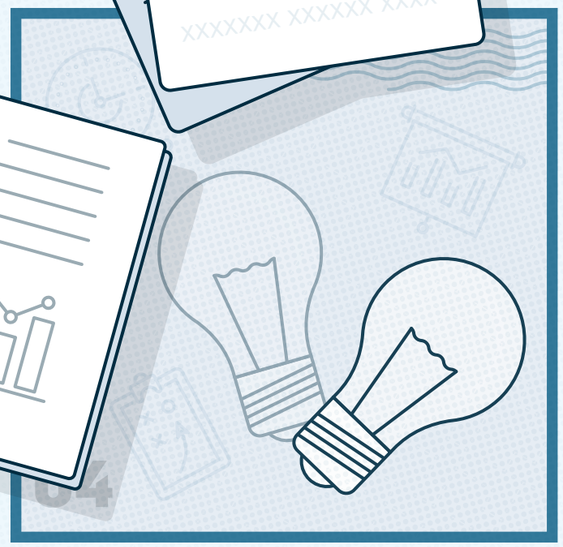
By providing a more practical translation of the more theoretical ISO19650 and educating teams on the benefits they stand to gain, the PMO resources embedded in the Inland Rail IM team can support greater adoption of IM best practice across the project lifecycle. Not only that, but they can also inspire teams to make build suggestions on existing IM functionality and ensure more efficient project delivery for ARTC to then operationalise.











8 Reasons why data sharing brings benefit in infrastructure design

Infrastructure projects typically involve budgets in the billions of dollars and have large populations relying on their timely completion. While building new transit lines, bridges or ports has always been a major technical challenge, companies that make effective use of data are better able to deliver new projects on time and within budget.

Atkins' SY Liu shares some of the reasons we need to start working more collaboratively and the benefits that data-sharing can offer us:

SY Liu
DIGITAL TRANSFORMATION LEAD FOR ASIA-PACIFIC, ATKINS

1 The amount of project data we need to manage is growing every day

Major projects generate terabytes of data, not to mention multiple models with associated databases. For example, our MTR Corporation Tung Chung Line Extension project in Hong Kong has generated approximately 2.5TB of data and over 60 Working In Progress Building Information Modelling (BIM) models to date, not including the multiples of shared, published and archived models in the process. In order to keep on top of this data deluge, we must use shared data environments to store, sort and interact with it effectively — while maintaining strict security access.

This approach also allows designers and engineers to make informed decisions using a global ecosystem of data, as opposed to that which is only available within and across a single project.

2 Data helps provide a joined-up approach from contract to design to execution

Key stakeholders, right across a project, should be sharing their data and insight, starting with those working on the contract, so that everyone has a clear understanding of the full scope of work and the plan for delivering it. Engaging all players — from design to delivery teams — upfront and ensuring a steady flow of information will help to fully integrate teams and ensure there are no gaps, so projects run more smoothly and produce better outcomes.

3 We are behind other industries when it comes to digital transformation

There's a lot that infrastructure can learn from industries that are further along in their digital journeys — automotive manufacturing and aviation being just two examples. By understanding more about how these sectors are using data and technology to optimise processes and adopting some of these ideas into our own design transformation, we can improve overall industry productivity and stay competitive.

4 It's time-consuming to reinvent the wheel on every project

We've already seen greater efficiencies across infrastructure projects in recent years, thanks to reusing or standardising designs, but there's even greater potential here. By changing our mindsets to automate by default, we can free up valuable time for designers to focus on the more creative elements of their work.

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5 It reduces the amount of time spent looking for the right information

Employees can reportedly spend anywhere between 1.8 and 2.5 hours a day searching for information. However, Electronic Document Management Systems (EDMS) can take away the frustration of having to hunt for the most up-to-date design files, instead empowering people with the right information, to make the right decisions, at the right time. Better data storage and distribution, according to access rights, not only saves time but improves communication with clients too. And with real-time design data available at their fingertips, engineers can ensure their simulations always run true to life.

6 Clients are hosting design data on their own platforms

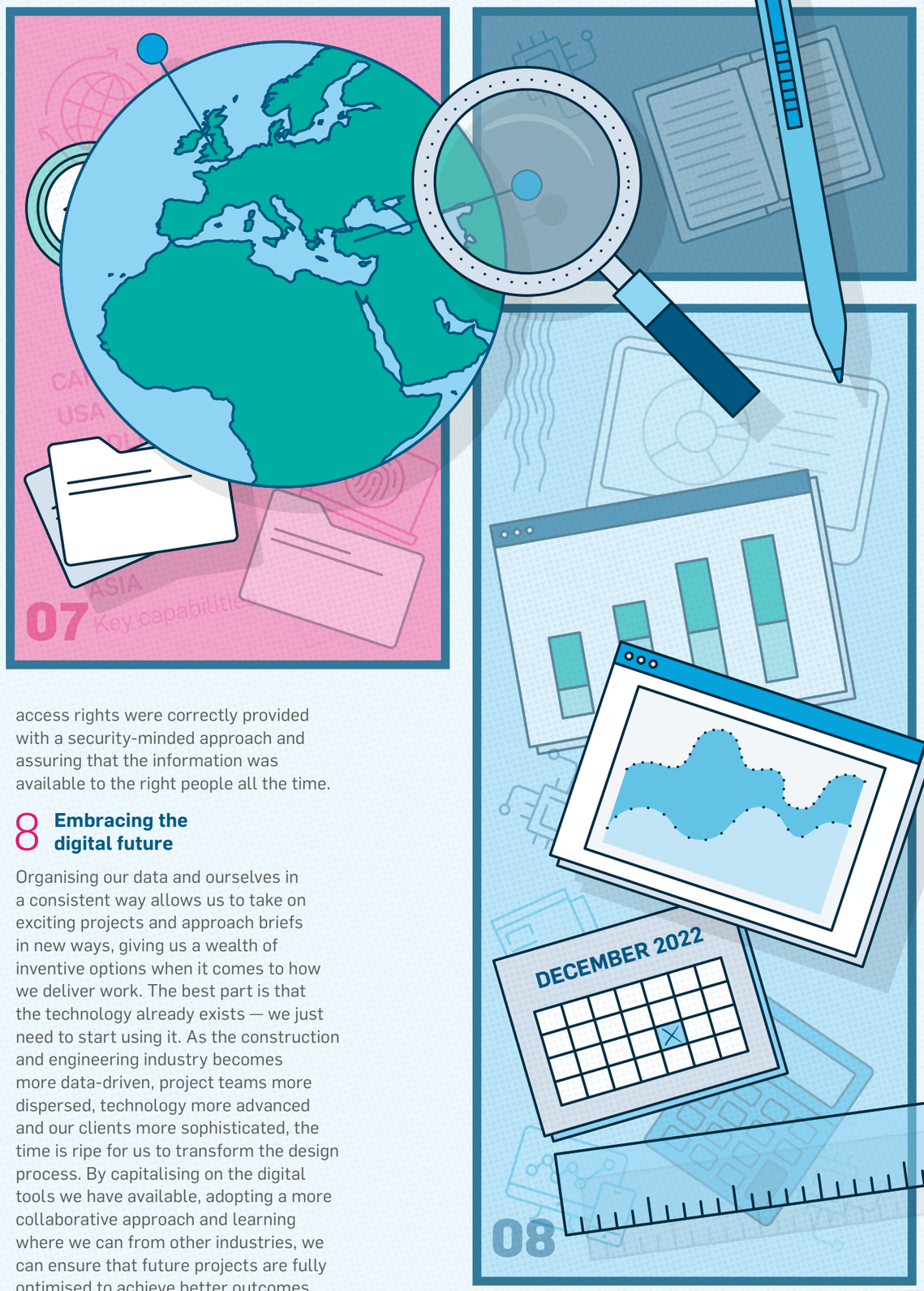
Clients are increasingly hosting project data on platforms addressing key concerns important to their needs. One of our clients from the rail and infrastructure industry is merging multiple stand-alone management systems into a single EDMS to organise data and provide a review space in both 2D and 3D. Colleagues can discuss virtually and make decisions and provide feedback.

As clients become more sophisticated in their data management and their expectations increase, we must have the right technology in place to meet their needs.

7 Global projects demand a more connected approach

Atkins's current Tung Chung Line Extension project in Hong Kong is a two-year endeavour during the pandemic, forcing adaptation to connect discipline teams and stakeholders digitally through online communication platforms such as Microsoft Teams for design reviews where traditional face-to-face meetings were no longer feasible.

The collaborative design approach through digital platforms allowed our design teams to author online with teams locally in Hong Kong while at the same time allowing our Global Technology Centre access to the same information models. Spanning different time zones, it was critical that the common data environment (CDE) was maintained to ensure that access rights were correctly provided with a security-minded approach and assuring that the information was available to the right people all the time.



8 Embracing the digital future

Organising our data and ourselves in a consistent way allows us to take on exciting projects and approach briefs in new ways, giving us a wealth of inventive options when it comes to how we deliver work. The best part is that the technology already exists — we just need to start using it. As the construction and engineering industry becomes more data-driven, project teams more dispersed, technology more advanced and our clients more sophisticated, the time is ripe for us to transform the design process. By capitalising on the digital tools we have available, adopting a more collaborative approach and learning where we can from other industries, we can ensure that future projects are fully optimised to achieve better outcomes.

Using digitalisation to achieve net zero infrastructure

Sébastien Mousseau

SENIOR VICE-PRESIDENT AND MANAGING DIRECTOR, POWER, RENEWABLES AND LIFE SCIENCES, SNC-LAVALIN

Sébastien Mousseau of SNC-Lavalin, explains how digital twins, data-led decision-making and 3D virtual environments are changing the face of construction in the power and renewables industry.

THIS ARTICLE FIRST APPEARED IN POWER ENGINEERING INTERNATIONAL, 4TH MAY 2022.

With the ongoing effects of climate change, countries worldwide have announced ambitious targets to reach Net Zero emissions – including the UK and Canada, both of which are hoping to reach this goal by 2050.

However, according to SNC-Lavalin's Engineering Net Zero Technical Report, achieving this in Canada would require the country to triple its power production over the next 30 years.

This additional production must also be accompanied by the corresponding transmission and distribution infrastructure, as well as the electrification of all corresponding loads.

The methods that have been used for the last three decades to design, execute, operate, and maintain large infrastructure projects will be completely inadequate when faced with a challenge of this magnitude.

Automated processes

The Canadian workforce will not triple either, in the next 30 years. Infrastructure companies will therefore need more automated processes, less rework, better interdisciplinary coordination and live collaboration between the field and the design office, if they are to achieve this.

They are also going to need to do more – a lot more – with the same resources, and the key to this lies with the integration of advanced, data-driven, digital technologies into the construction world.

Reaching the Net Zero emissions target set out in the Glasgow Climate Pact requires a potential doubling of current global hydropower capacity, according to the International Energy Agency. Now, try to imagine all the disciplines that contribute to a new hydroelectric plant: architecture, civil, mechanical and electrical engineering, construction, and project management, to name just a few.

All these disciplines traditionally execute the project on the basis of static 2D plans. By the time that work gets initiated on the construction site, conflicts and clashes start occurring – and usually lots of them. That wastes a lot of time and money.

By contrast, if the design is performed based on a single dynamic 3D system – such as a digital twin – this will be avoided. No one puts a pipe where someone else has put a stairwell. Digital twins, data-led decision-making and 3D virtual environments are changing the face of construction in the power and renewables industry.

They are especially advantageous on large-scale, multi-year projects, such as the John Hart Generating Station Replacement Project in British Columbia. Such a project could easily take ten years to complete.

But by creating a database and starting the workflow in a digital environment from day one, you also get ten years' worth of value and more from it. And that value extends to far more than just clash avoidance, important as that may be. It creates significant efficiencies for the client too.

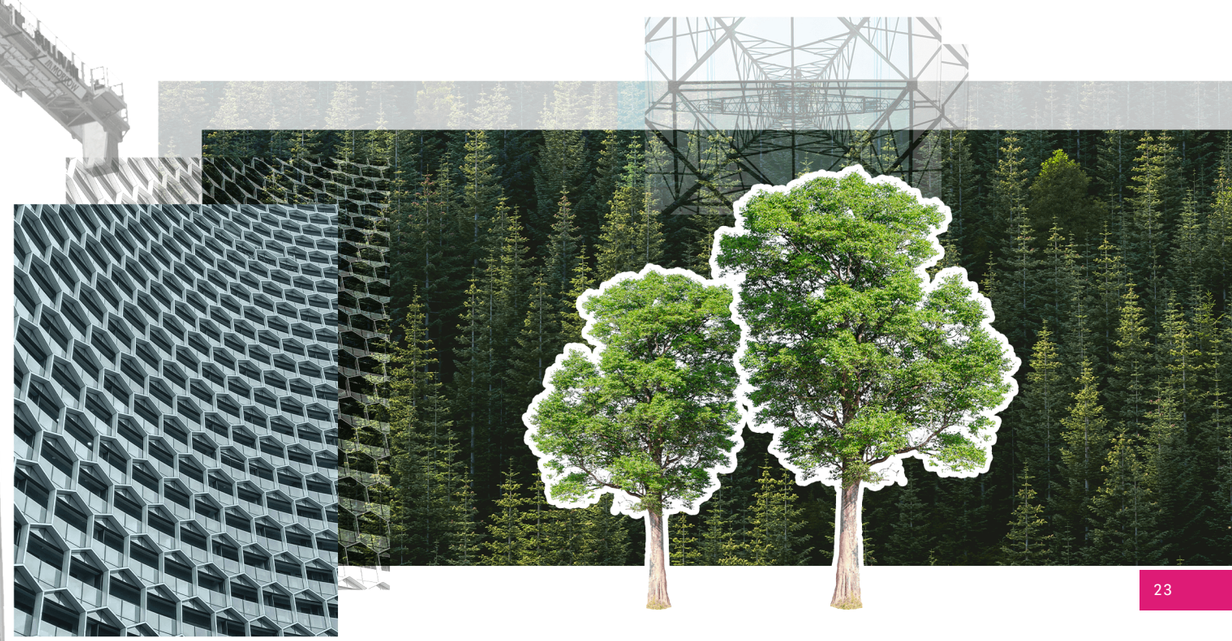
Completing the project and leaving a client with a complete 3D model also greatly facilitates the transition of the operations and maintenance activities to the digital world.

The evolution of digital in Canada

Canada has been at the forefront of the digitisation of major infrastructure projects. In 2003, SNC-Lavalin Hydropower Group became the first team in SNC-Lavalin to use BIM for the engineering of the Mercier Hydroelectric Powerhouse using CATIA for our client, Hydro-Québec.

The industry did not have drawings derived from a 3D model at the time but could benefit from data to significantly optimise project management and the use of materials.

Since then, we have witnessed a general push towards digitisation, data-led engineering, and the use of digital twins.



Even recently, many engineers could have used 3D environments, but they preferred to work on paper, or at least in a 2D environment.

That's no longer the case. The younger generation sees the advantage of virtual environments and data-led working methods. Put simply, it's easier and more collaborative, it allows us to leverage talent from anywhere on the planet, it gets the right results faster — and it's more fun.

Digital construction as a competitive advantage

Data-led and digital construction techniques can be a huge differentiator for those working in the power and renewables sector. That's primarily because when you're working in hydro or other types of renewables, there aren't many 'standard' projects, so the cookie-cutter approach doesn't work.

Every project is a prototype, so to speak. In that situation, if you can use a dynamic platform to draw on a range of libraries and reduce clashes and over-runs, that will hugely benefit project outcomes.

In an ideal world, you'd have one digital platform on every project. Sometimes, that's not possible because different parties work within their own systems.

However, these systems can almost always be made to work well together. Collaboration is key to realising the full value of digitisation and common, virtualised working environments. By working across disciplines and project partners, it's possible to realise benefits across the entire project, helping to cut costs and ensure that all disciplines hit their milestones on time and on budget. The technology to facilitate this is already here, and it can yield massive value for consumers, contractors, and project owners. It's now up to us as an industry to be bolder and start taking full advantage of it.

So, should we all just dive into digital? Well, yes – but perhaps not headfirst. If you haven't used these digital tools before, you may not want to start experimenting with a $15bn project.

Better to start small and work your way up. As your people and processes adapt, apply digital and data-led techniques to bigger projects. In this way, you should still be able to digitise fairly rapidly, but in a sustainable way.

Meeting net zero targets

Right now, the biggest trend in our industry – perhaps in every industry – is the drive to Net Zero. Digitisation and data-led construction techniques are key to this goal.

By using them, we can model current and possible future states, discover efficiencies, and eliminate waste in ways that just aren't possible with traditional techniques.

One approach to reaching Net Zero targets would be to incorporate BIM modelling and Lean Construction into engineering activities. Lean Construction is an approach that improves construction processes with minimum cost and waste, and at maximum value. By coupling this with a 3D BIM-compliant model, tasks such as interdisciplinary coordination, prefabrication, automated work packages and resource levelling can be accomplished, while reducing on site presence and minimising waste.

The end result:
a reduction in energy consumption and removal of overall ineffectiveness.

4D modelling

Taking it a step further, a 4D model can be developed and used to simulate an optimised planning schedule for construction activities.

This allows for the continuous updating of the model to reflect existing and projected schedules, to visualise site progress and have foresight to potential coordination issues.

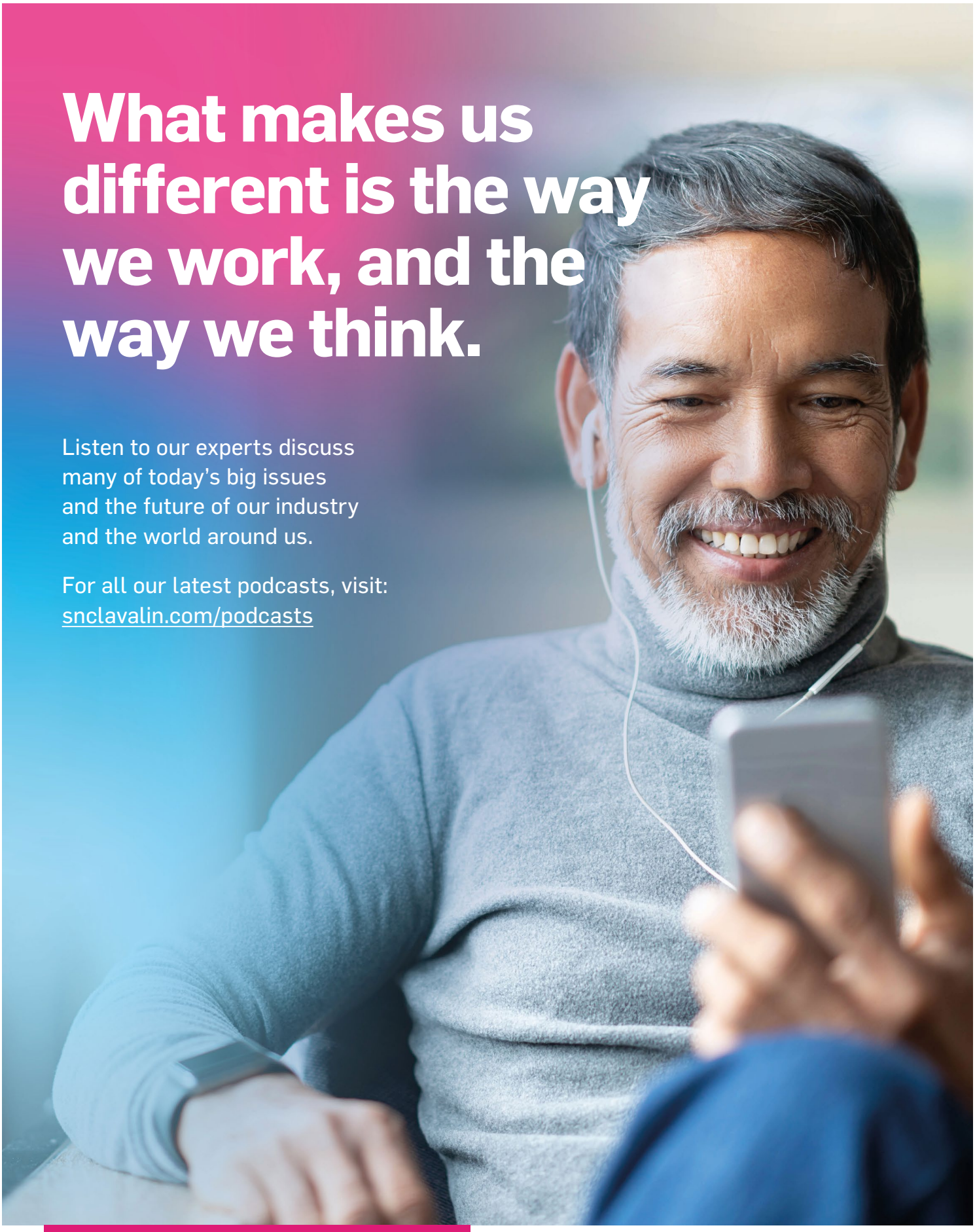
In addition to allowing for rapid turnaround with coordination issues, the 4D model also enables the comparison of various scenarios to determine the most efficient way forward, removes any uncertainties and provides confidence for all stakeholders involved in the project. Overall, the incorporation of BIM and Lean Construction into projects can leverage data produced in the engineering activities and mitigate risks.

The design and engineering can be done with construction activities in mind, which allows for optimal planning and a reduction of project schedule and energy consumption, in line with the Net Zero initiative.

The scale-up of engineering and construction efforts required to meet Net Zero targets may be daunting. More projects are going to require more people and in many areas of the world the current workforce is, or is going to be, stretched thin.

To meet its goals, the construction industry is therefore going to have to overcome its historically weak productivity growth record and embrace data-driven technologies. If you're serious about net zero, now is the time to digitise.

What makes us different is the way we work, and the way we think.



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