



BREAKING BARRIERS IN INFRASTRUCTURE:

**INVESTIGATING THE CHALLENGES OF ADOPTING
NEW WAYS OF WORKING AND TECHNOLOGY IN
THE UK INFRASTRUCTURE SECTOR**



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FOREWORD

ANNE KEMP, CHAIR OF THE UK BIM ALLIANCE AND
TECHNICAL DIRECTOR, ATKINS, PART OF THE SNC LAVALIN GROUP

The infrastructure sector sits at a crossroads. The fourth industrial revolution, if we fully embrace it, will enable the radical transformation that is necessary to improve the delivery of infrastructure services that better connect businesses and people, boost economic growth and lead to overall improvements to our quality of life. Failure to do so will result in more of the status quo, low levels of productivity and innovation, that are unable to deliver better outcomes for the economy and society.

But how can this transformation be realised? The answer lies in the change process and mobilising our profession to act differently.

Recent initiatives like Project 13 and the National Infrastructure Commission's digital twin proposals have set out the principles for change and a vision for the future; in particular, the need for greater collaboration and enterprise

throughout the built environment, the effective use of emerging technologies and the need for greater investment in innovation. Industry leaders have mobilised around this need for change, but success will only be achieved if the profession as a whole is convinced of the significance of what is being proposed.

This report provides a snapshot of perspectives taken from across the civil engineering community, and acts as a valuable touchpoint on the journey to transforming the built environment. Through a range of primary research activities, it highlights areas where we need to think and act differently, and offers insight from those working at the coalface.

Together with ICE's partner Topcon, we invite you to reflect on the findings of this research and help us drive debate and action on how to address them. ICE exists to support



INTRODUCTION

WHAT ARE THE REAL BARRIERS TO CHANGING THE WAY WE DESIGN, BUILD AND PLAN?

DAVE BENNETT, MANAGING DIRECTOR AT TOPCON POSITIONING GREAT BRITAIN

I'm sure we've all had that feeling of déjà vu in a conference. We're listening to yet another seminar covering how we're failing to increase productivity in our industry. It's difficult not to feel frustrated at the pace of change.

From the oft quoted 2016 Farmer report (Modernise or Die) to the findings from the National Infrastructure Commission's report in July 2018, as an industry it would seem we're struggling to change at the same pace as others.

Despite this, I'm given a great deal of hope when I meet with peers and networks across the industry. From wearable technology, to the groundbreaking initiative "Design! Engineer! Construct!" which takes the latest knowledge and technology to secondary schools, there are pockets of innovation everywhere.

However, there's something stopping us from having this open mindset, sharing knowledge, embracing new technology and adopting new working practices. How can we go mainstream with all of this and apply it consistently across the whole sector?

We've worked with the Institution of Civil Engineers (ICE) to tackle the perception that the UK industry is averse to technology and really explore why the pace of change seems so slow.

In July 2018, the Infrastructure Client Group (ICG) published Ripe for Transformation, Ready for Change?, which provided a snapshot of digital maturity in leading UK asset owner organisations. As an independently commissioned piece of research, ICE surveyed 220 of its members (selected at random) in Autumn 2018, to canvass opinions on where we are as an industry in terms of digitalisation and productivity, and to better understand the barriers to change.

The research respondents represent a cross-section of our industry all over the UK, from graduates to long standing industry experts, and from freelancers to those operating within some of the largest companies. This report reveals the results, as well as providing commentary from independent members of the industry, exploring the roles of technology, skills and client demands and their relationship to

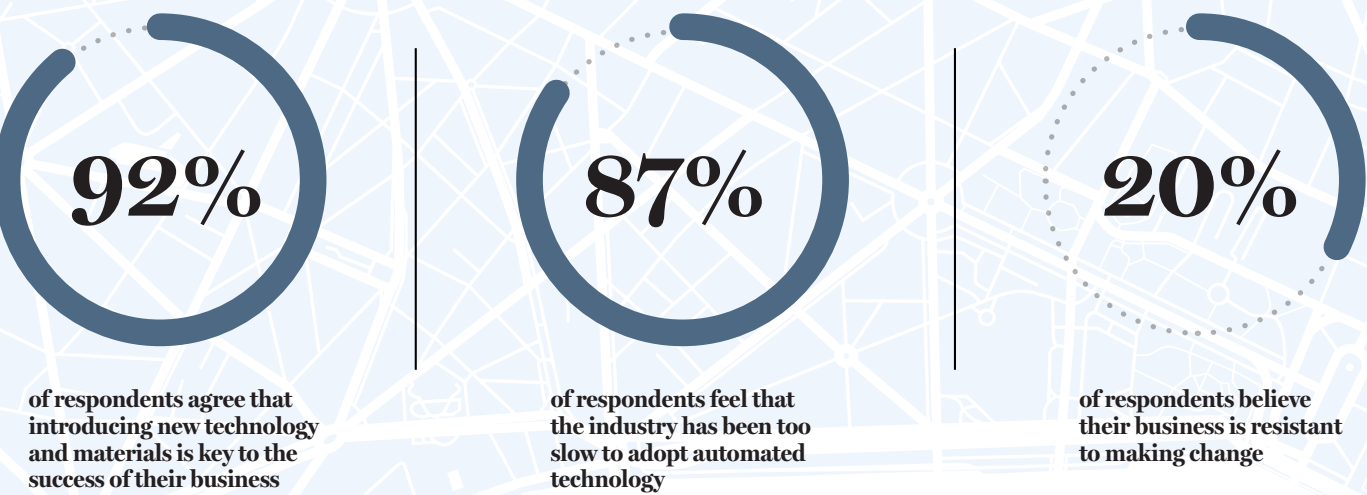
enabling change.

We're very grateful to those who took the time to take part in our research and our contributors for sharing their invaluable experience and insights. We hope that this report will stimulate further debate and help encourage action around the issues raised by the research, and look forward to further industry collaboration to help us drive the change we need.



FROM CONCEPT TO REALITY: EXECUTIVE SUMMARY OF THE FINDINGS

WHERE ARE WE NOW?

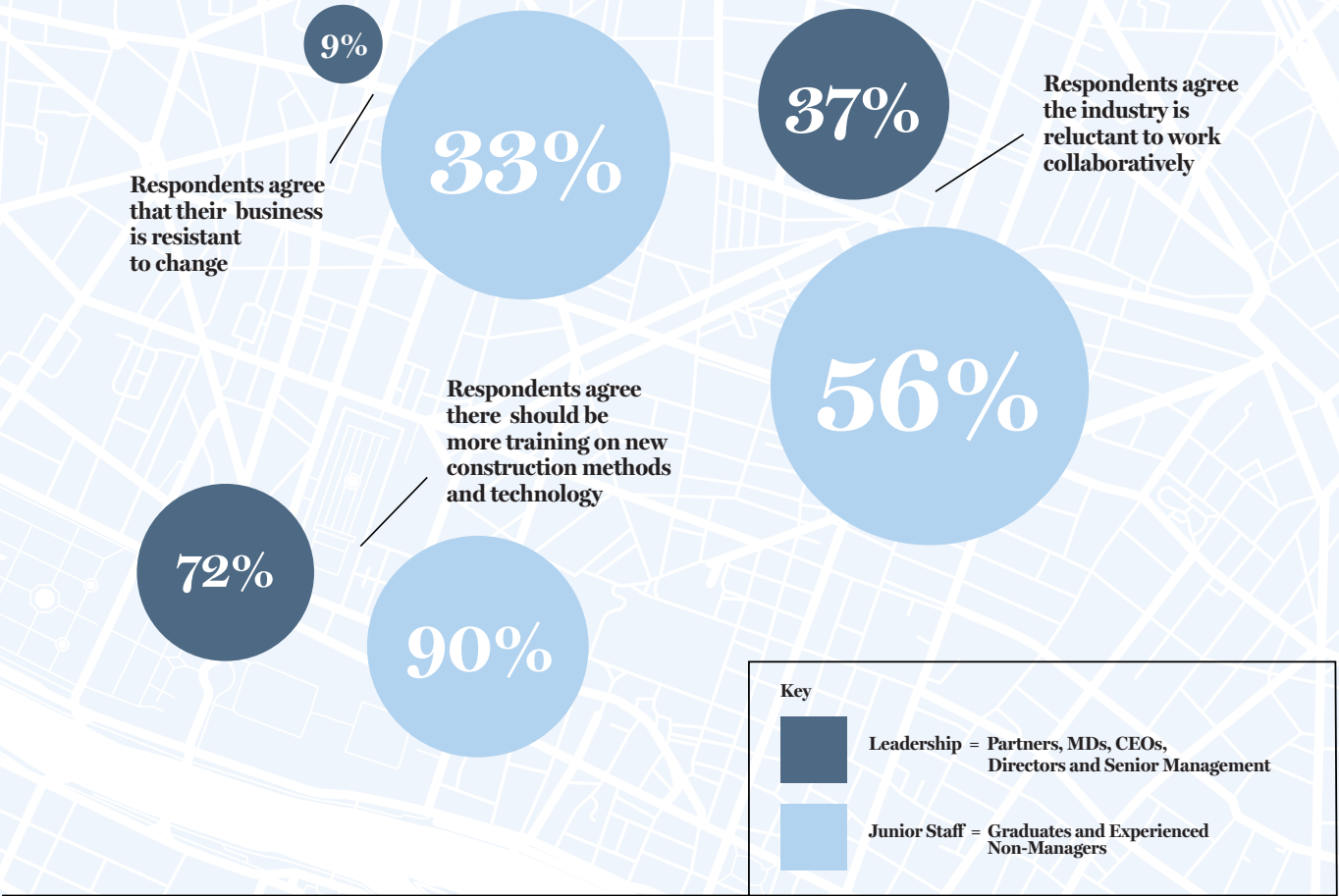


Respondents universally agreed that it's important for businesses to keep up with new technology and working practices. It's clear from the findings of the research that there is a strong appetite for the concept of change within the infrastructure industry. However, findings allude to frustrations at the slow pace of change.

THE TOP 5 GREATEST BARRIERS TO CHANGE IN THE UK BUILT ENVIRONMENT IDENTIFIED BY RESPONDENTS:



Delving deeper into the data, there's a real split in the findings between junior staff and the most senior infrastructure professionals.



WHERE DOES THE CHANGE NEED TO COME FROM?



Taking the research into account, three key accelerators of change seem to emerge:

- Change driven by clients through the way work is awarded
- Developing the necessary skills at all levels
- Openness to adopting new technology and practices.



WHERE IS THE INDUSTRY NOW ON THE ROAD TO CHANGE?

THE IMPORTANCE OF ADOPTING NEW TECHNOLOGY AND EVOLVING WORKING PRACTICES SEEMS TO BE A CORE BELIEF TO THOSE WITHIN OUR INDUSTRY

From self-healing concrete to autonomous technology and the goal of the fully digital construction site, there are plenty of technological and material innovations already available.

There's also plenty of investment and high-level support for the sector, one example being the Transforming Construction Alliance with £72 million of Government funding to drive innovation and boost UK construction productivity through its national Core Innovation Hub.

So, what do those working within the industry feel about change? It's crucial that we listen to perceptions and views from around the profession, to help drive change from the bottom up and maximise the benefits of high-level investment.

The importance of adopting new technology and evolving working practices seems to be a core belief to those within our industry, and new technology is identified as a key enabler for business growth. However, it's been well publicised that infrastructure lags well behind other sectors on digitalisation. While progress is undoubtedly being made, it's clear that there's scope for more improvement and for a true transformation of the ways we deliver and manage infrastructure.

The industry is behind the concept of changing and adopting new ways of working, but it's not translating to projects and day to day work. Why?

Our research identifies a few major culprits. One of the two most dominant seems to be the culture

of the industry. It's hardly surprising that innovation is shunned in practice when there's an inherent risk to trialling or implementing a new technology or process on projects that come with strict regulations and contractual obligations.

Another cultural barrier relates to collaboration, and data sharing in particular. As technology evolves and connectivity increases, defining data ownership and how to safely share it through project workflows become increasingly complex. Historically, some organisations have used

“Infrastructure is one of the least digitalised sectors in the world”

MGI, 2015

corporate confidentiality as an excuse for not engaging on solutions to this problem. Perhaps unsurprisingly, our survey listed cost alongside culture as one of the greatest barriers to change. The implication of cost – in terms of time and money – when investing in these aspects, together with the necessary training, can understandably be a scary prospect, particularly for smaller businesses, but we must shift from the short-term thinking of project-by-project profit and consider the wider benefits in terms of productivity and efficiency that investment will bring in the long term. Culture and cost would seem to go hand in hand.

A lack of investment and commitment to training and developing staff was also reflected

in our research, while collaboration across partners and sectors in terms of sharing knowledge and information also needs to be further improved to accelerate the change process. Over half of junior staff (graduates, experienced non-managers and junior managers) believe there is a reluctance to work collaboratively across the industry, which we know stifles opportunities to share knowledge and learn. Better and more collaboration would undoubtedly offer great learning opportunities at all levels.

Our research also identified project requirements as a strong driver of change, indicating the crucial role of clients.

The ICG's Project 13 initiative is geared at tackling many of these challenges. Project 13 is an industry-led response to infrastructure delivery models that fail not just clients and their suppliers, but also the operators and users of our infrastructure systems and networks.

It seeks to develop a new business model – based on an enterprise, not on traditional transactional arrangements – to boost certainty and productivity in delivery, improve whole life outcomes in operation and support a more sustainable, innovative, highly skilled industry.

Some UK infrastructure clients are taking this “Capable Owner” approach, proving that change, despite the barriers, is not impossible.

DIGITAL ADOPTION IS SIMPLY THE RIGHT THING TO DO

For me, within SMB (Skanska, MWH, Balfour Beatty Joint Venture), digital adoption is simply the right thing to do; it leads to safer, higher quality, more resilient solutions that ultimately save time and money.

It needs to be driven by strong leadership rather than solely driven by Government or by our clients. To think that digital adoption should be mandated or enforced alone is a narrow view of things and a disservice to the organisations that have embraced it. It's a question of positive change. Businesses that don't evolve are going to find it difficult to deliver to a similar standard which will allow more agile companies that have embraced the importance of data and digital adoption to thrive.

And there's never been a better time than now. If you took on new technology 15 or 20 years ago you had to change age-old, tried and tested ways of doing things to suit the software. Now it's the software that adapts to the existing, proven ways of working. Everything can be done on a mobile device.

That's not to say there aren't challenges. The industry typically requires a bespoke approach – every project is subtly different and there's been a reluctance to standardise processes and procedures. For many that's a step into the unknown and as we know, this can

be a risk averse industry.

In the past, organisations have tried to adopt new practices with mixed success, but rather than see it as a cost, they need to re-frame this as an investment to achieving improved efficiency in time and money. Psychologically and behaviourally, digital to some can be seen as a threat. It is a common misconception that digital is replacing jobs within our industry or aking food off the table.

What opportunities does 'going digital' present?

Digital tech is an enabler to meet the increasing infrastructure and industry demands with the resources we currently have. Through early collaboration and simple visualisation, digital adoption is creating one version of the truth that is providing better solutions and empowering innovation between designer, contractor and operator. On an individual level it makes people's jobs more rewarding because it cuts down time spent on necessary but time-consuming tasks, freeing up the head space to process the information we do have and make better decisions, to be more creative, solve problems, project manage and ensure client satisfaction. In short to do what engineers do best.

This is all about changing the mindset, the behaviour and the culture. Digital is key to business success. In

an industry with notoriously tight profit margins this is a way to improve health and safety without compromising on quality, increase efficiency, save time and make more money.

To do this we need to break down the silos that are created across every stage in the life cycle of an infrastructure sector project (and beyond). We must work out how technology can be used to promote innovation and integration in a collaborative environment. When this is done correctly it increases productivity, saves time and money. When we have demonstrated return on investment and how tech delivered tangible benefits and positive outcomes, we have got support from key stakeholders – customer, client, supply chain, engineer and operative.

Offsetting the skills gap

There are around 9,000 college leavers, graduates and apprentices coming into engineering per year. With all the projects going on – Crossrail, the second crossing, HS2, housing, infrastructure, nuclear, alternative energy – we need more like 40,000. However, it is possible to offset this with the use of technology

This requires education across the board. It is a common misconception that the older generation are a barrier to digital adoption – in my experience that's simply not true. It's a question of engaging with

an experienced and competent workforce and aligning them to our young graduates and apprentices.

How we do it

Although examples of 3D modelling have been more visible within the tall buildings sector, the water industry has embraced the whole range of digital tools across every aspect of what we do. There are pockets of excellence everywhere and through our conversion projects we have delivered a full digital capability. This also influences the partners we work with, spreading that expertise across other organisations on the frameworks.

At MWH Treatment we actively recruit digital natives. They're tech savvy young people where digital intelligence is at the core of their base competency who need to develop the practical application of their skills, such as good engineering practice, construction techniques, and the softer skills of how to manage projects and ensure client and customer satisfaction. We have experienced engineers who are great at delivering projects safely and efficiently, but who also need to learn how to use digital tools. We create a taskforce for every project and make sure that there's

a mix of seasoned engineers and graduates/apprentices on site that mentor and upskill each other. This mixed and diverse approach supports the more experienced workforce in becoming more digitally enabled and supports the development of our younger workforce. In short, we are using technology and our business culture to enable our people to do what they do best.

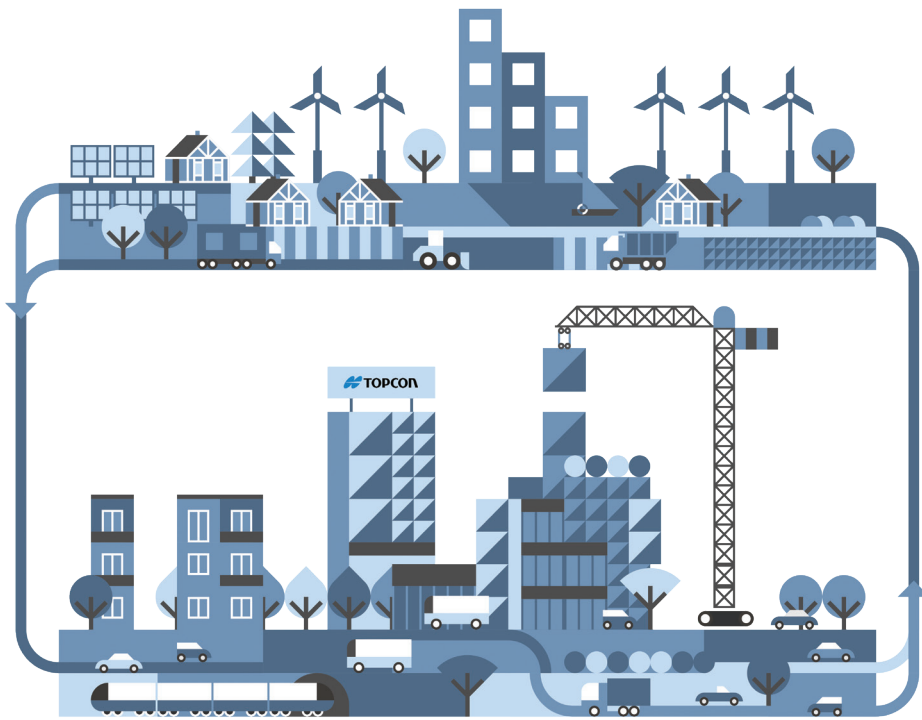
This gives them all the headspace to do a great job – safer, quicker and more efficiently, creating a culture of collaboration and mutual respect. And what's more, the digital revolution means that we will be recruiting a broader spectrum of skills into construction and engineering such as data analytics, computer science, economists, visualisers etc. And that can only be a good thing.

It will take time – this is a big industry with a huge supply chain, with some embedded behaviours but it will change, it has to change and we are proud to be right up there with the leaders, not only in the water sector but in the infrastructure industry as a whole.



GRAHAM FUNNELL, ENGINEERING LEAD, MWH TREATMENT FOR SMB JOINT VENTURE





I think that the industry in general has been slow to adopt new processes and technology but not necessarily through an unwillingness to change.

The rate of adoption depends on the project, its specific requirements, unique challenges and pressure points, and whether something new or a new way of doing something would solve the problem. The key is to make sure everyone buys in – identifying and sharing opportunities and making sure that they are implemented.

How we do it

At Balfour Beatty we have a continuous improvement programme called My Contribution. Its role is to encourage everyone, at whatever level, to share their ideas for new ways of working or new tech – anything that could save time and hence money. My Contribution came from top but is driven by individual Project Champions, like me, who promote the scheme within their team and make sure ideas are escalated to the right people.

As an example, one of our graduates worked out how many clicks it took to upload certain documents onto an internal portal every month and figured out a different way of doing it. The result is a potential saving of £60k on the lifetime of this single framework alone.

Success is shared and celebrated on our internal comms channel. There's an annual selection

“Another way of sharing new ideas and practices is through collaboration with forward thinking partners”

of the best contribution, but it's not really about the prize, it's the company-wide recognition and seeing the change get implemented that people value.

This kind of scheme really helps to retain and attract talent – it's good to be part of a company that takes people's opinions seriously and one

of the reasons I came back to Balfour Beatty after graduating.

Another way of sharing new ideas and practices is through collaboration with forward thinking partners. On any framework there are other organisations, with new and different processes and technologies, that each of us can learn from. This creates a very positive culture that we all buy into and makes me feel optimistic about the future.



HARRY GRAYWOOD, GRADUATE CIVIL ENGINEER, BALFOUR BEATTY

The skills shortage has been a point of debate and concern in the infrastructure sector for many years. Our research demonstrates this remains a critical issue, with 82% of those surveyed believing that the skills shortage is the main challenge for the future of the industry. ICE's July 2018 Professional Skills review identified a shortage of civil engineers as well as particular skills that are in high demand, such as coding and offsite construction.

The findings of this survey echo the messages of the ICE review, identifying that the skills issue is complex and will not be solved solely through changes to the education system. In fact, less than 10% of respondents identified changes to university courses as being the number one factor in increasing productivity, compared to 17% who felt that increased training of the

existing workforce was the number one factor. Clearly, a focus on lifelong learning is imperative to overcoming the skills problem.

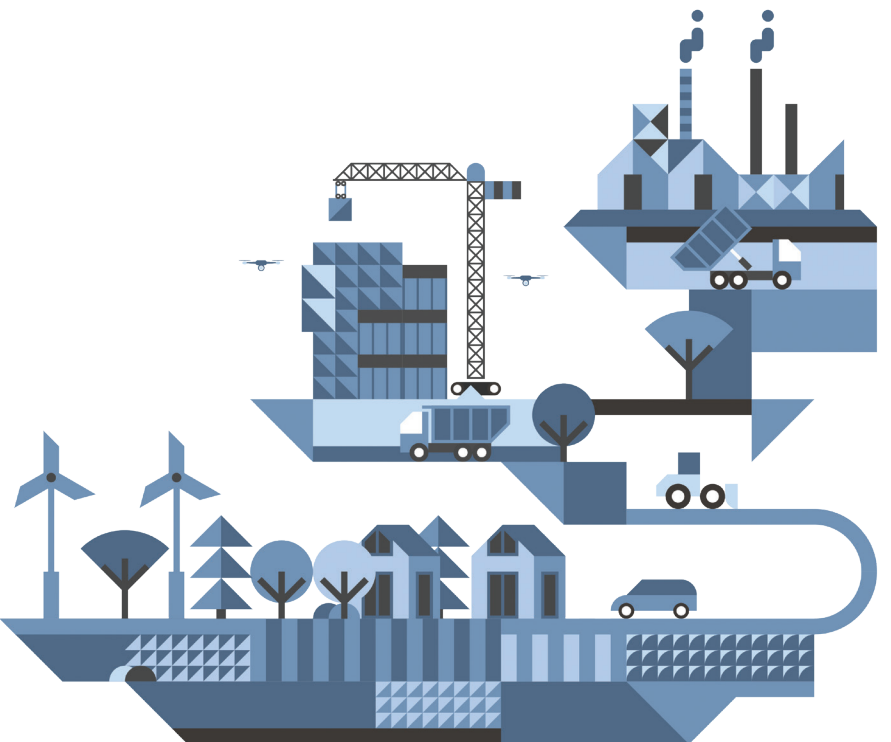
There is a real disparity demonstrated in the research between junior members of staff and those in leadership positions. Our research shows that 58% of junior staff believe adopting new technology could proactively overcome the skills gap compared with only 23% of senior decision makers believing

“82 % think the skills shortage is the industry's main challenge”

this could be a key solution. It would appear that the change isn't coming from the top and that more needs to be done to encourage buy in from the

senior level of our industry.

Practical knowledge and skills will continue to remain vitally important attributes to the civil engineer, but as advances in technology and automation continue to accelerate, the skills required to adapt to changing roles require continuous professional development. Learning and adoption of new skills needs to be constant and based on the realities of the latest technology and working practices to provide real change. This must be addressed at all levels, from senior decision makers to those just starting as graduates. This should also apply to tenders: from clients making more demands for innovation to engineers pushing for new approaches and being able to champion the benefits in efficiency, cost and health and safety by adopting smarter working processes.



TURNING INFRASTRUCTURE INTO AN INFORMATION-BASED INDUSTRY

HOW DO WE BREAK DOWN THE BARRIERS AND TURN INFRASTRUCTURE INTO AN INFORMATION-BASED INDUSTRY?

So how do we break down the barriers and turn infrastructure into an information-based industry?

There's already a lot going on. HM Government has published its Industrial Strategy, there have been reports from Infrastructure and Projects Authority (Transforming Infrastructure Performance) and the National Infrastructure Commission (Data for the Public Good). The latter set out two main recommendations, tasking the Infrastructure Client Group (ICG) and the Digital Framework for infrastructure data established by the Centre for Digital Built Britain (CDBB) and cultivate a shift towards minimum levels of commercial confidentiality.

The ICG's working group – the Digital Transformation Task Group (DTTG) – is a collaborative and mutually supportive group for its members at all points of their digital transformation journey. During 2018 the ICG reported on commercial confidentiality and regulatory enablers. Whilst regulation was not seen as a barrier to data sharing, one of the most significant recommendations of the Commercial Confidentiality report was the requirement for clear responsibility and accountability for data quality and security, and that Information Management be integral to any corporate strategy.

The issue of confidentiality has long been used as an excuse not to share data, preventing the transparency and standardisation of data and holding back the entire digital transformation process. Some of this is due to a fear of

openness, some a misguided need to hide behind commercial contracts.

However, much of it is down to established commercial practice. With standardisation, the procurement and tender processes should become more realistic and level the playing field for main contractors, Tier 2 and Tier 3 and clients alike.

Whilst the Government can mandate the likes of BIM in the public sector in England and Wales, it cannot tell the industry to innovate. The ICG's Project 13 Digital Transformation Workstream produced the benchmarking report on the infrastructure sector (Ripe for transformation, ready for change?). One of the four key findings was the need to keep aspirations high – but get the basics right first. The focus was on embedding good business practice as business as usual and getting the quality of data right.

Essentially, doing more with what you already have and do what you're doing properly, 100% of the time.

That means that you have to understand what already exists and what will be needed in the future. This will involve stakeholders across the business and not just restricted to IT. It will include examining current working practices, procedures and processes, identifying methods of governance, the extent of the IT infrastructure – hardware, software, licences and support, obligations and contracts already in place, and the interests of other third parties such as regulators and clients.

It recognised that change will happen in small steps, not overnight. And change happens as a result of people. It requires leadership to drive and inspire a culture that embraces best practice and welcomes change. Leaders are convinced by proof that



PETER VALE, ENGINEERING INFORMATION MANAGER FOR THAMES TIDEWAY AND MEMBER OF INFRASTRUCTURE CLIENT GROUP (ICG) AND RELATED WORKING GROUP, THE DIGITAL TRANSFORMATION TASK GROUP (DTTG)

it works. There are now enough case studies to demonstrate ROI for digital transformation projects. But there is always a need for more.

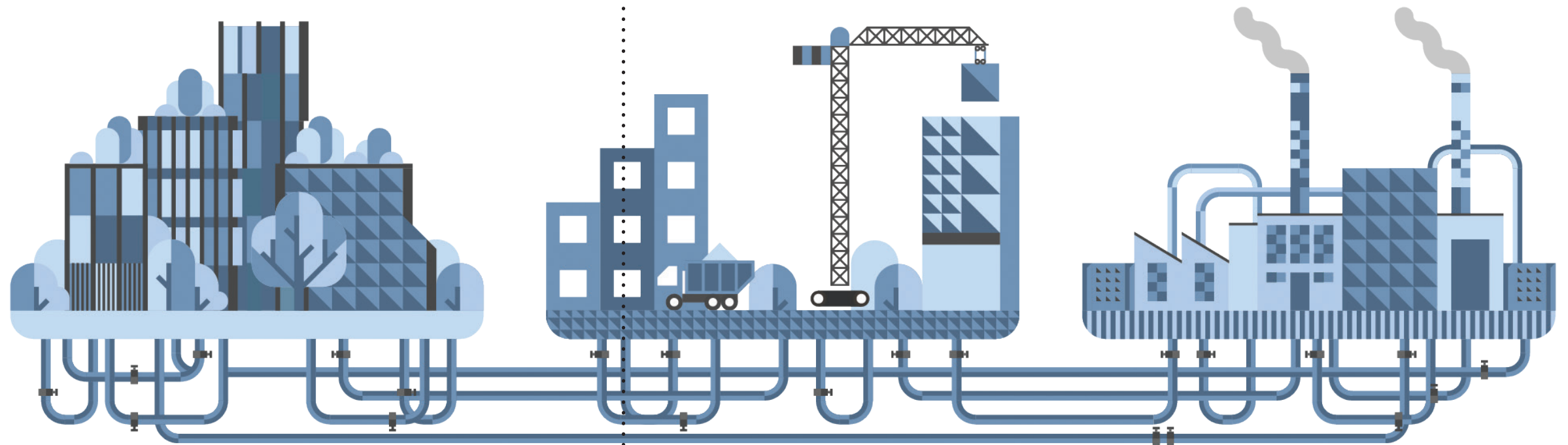
Businesses need to invest in the education of all the people who will both implement and maintain change. They will need upskilling and consistent support to embed and develop their digital skills. This should be an integral part of CPD for engineers.

Having grown up in a digital world, young people are an important asset in the process but they are outnumbered and not all older people are lacking in digital skills.

This means that a high level of peer support is crucial at all levels, within a culture of personal empowerment and active encouragement, and with formal allocations of time and budget. Without these, innovation remains stifled in silos and will ultimately fail.

The training itself needs to be tailored to the organisation and to the individual. People have different ways of learning and one size definitely does not fit all. People need the time and the headspace for training, so this needs to be mandated at the highest level. One of the most effective training sessions I observed was from the Crossrail Bentley Academy. The

trainers weren't 'professional trainers' from an outside organisation, they were employees doing a real job at the proverbial coalface. They understood the practical applications of the technology and could share the benefits that they themselves had experienced. Crossrail were re-investing the money that had been spent training their staff to create more champions. Engaging all levels of the business to enable an information-based industry is where the real transformation will be realised.



UPSKILLING AT EVERY LEVEL: HOW WE BRING ABOUT CHANGE

DAVE BENNETT, MANAGING DIRECTOR AT TOPCON POSITIONING
GREAT BRITAIN

This report demonstrates the need to bring about change in the way we learn and develop as a profession. It's something I'm really passionate about instilling within our business at Topcon, ensuring as a technology provider we're supporting the industry with the skills needed to understand and adopt new technology and the required associated ways of working – from finding the next generation of civil engineers to engaging with the most senior levels of the industry.

One of the issues we're facing

“The onus is on all of us to keep learning and challenging ourselves and each other”

is a real image crisis as an industry when it comes to recruitment. As just one example of this, our global HQ in

Livermore, California is competing for the brightest and best talent against the most exciting tech and social media companies in the world. How do we make a career in the built environment a desirable choice in this context? The reality is that our industry will be at the centre of some of the most exciting and monumental changes to the way society lives and works over the next fifty years. Take autonomous vehicles – a hot topic in the media currently – they can't go mainstream if we don't have the right

infrastructure to safely support the adoption. That's a huge area for us as a geopositioning technology provider

which we're working on solutions for, but it's also a new challenge for civil engineers on how road projects are tackled. This is just one example of the types of innovation we need to celebrate as an industry. We should do this internally to facilitate learning among peers as well as to communicate externally to attract the best talent to our industry.

Another aspect of recruiting the right talent into our industry is engaging activity with educational establishments. We've been a long-time supporter of Design! Engineer! Construct! – an initiative which brings the latest learning and technology into secondary schools to get young people excited about careers in engineering. It's these types of programmes which connect

educational establishments and the industry which will increase positive perception of a career in engineering, giving us a diverse, digitally native and talented new generation of skilled workers. These will help us to take on the required change within our industry. We're always completely astounded by the ability of secondary school students to use industry level hardware and software to create their own designs. It's just one example of how engaging with those outside our industry can inspire us and help us to keep an open mind.

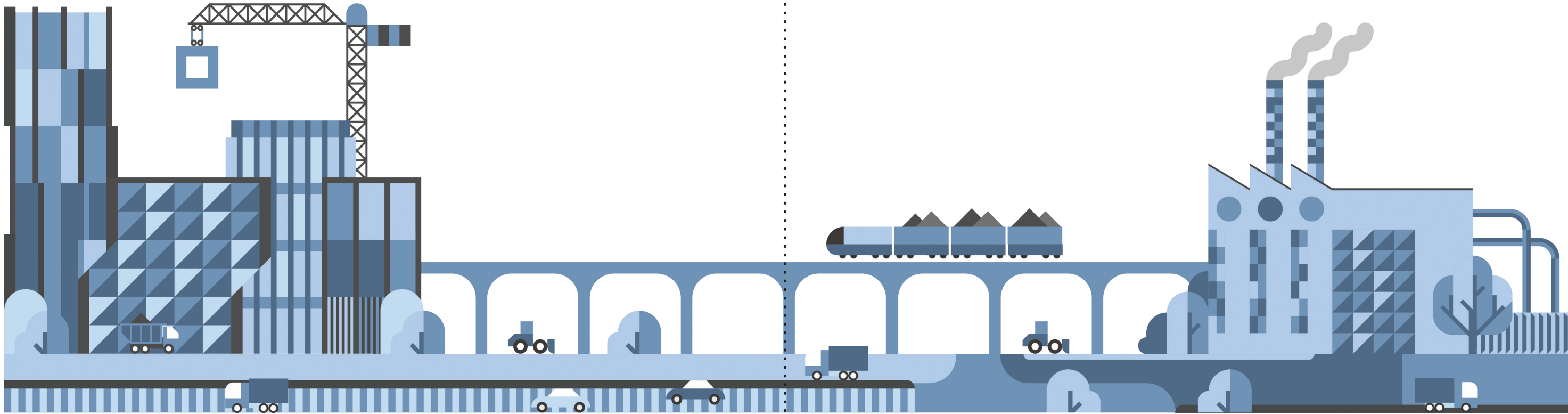
We also work to encourage education of those already working within the industry at all levels, which is an issue our research demonstrates as a particular barrier to change. We launched our Constructioneering

Academies in 2017 with our partner Bentley Systems, a global training initiative designed to engage the industry to facilitate adoption of fully automated workflows. The sessions are attended by surveyors, civil engineers, contractors and clients and are centered around

“Technology can't solve our issues alone”

collaborative learning. While we are keen to share our technical expertise, we also want to engage the industry to learn about what challenges they are facing when adopting new work processes and technology. We feed these learnings and ideas into the next academy sessions so it's a mutual learning process.

Technology can't solve our issues alone. We need to constantly change the way we think and tackle our work to unlock the productivity potential of digital construction. The onus is on all of us to keep learning and challenging ourselves and each other - every day we come to work. No matter which area of the industry we work in and no matter which level of seniority we are at – we can't stop learning. This report demonstrates that the appetite for change is real but the challenge is creating the culture and learning opportunities to make the move towards digital construction, greater collaboration and most importantly, increased productivity, a reality.





About Topcon Positioning Great Britain

Topcon is the positioning partner for construction and geo-businesses in GB, offering precise and integrated hardware and software systems to deliver increased efficiency across the workflow. Topcon provides tailored support across a number of specialisms to drive the industry forward and reap the benefits of digital construction.

About ICE

The Institution of Civil Engineers (ICE) is a registered charity and professional body, supporting the development of 92,000 civil engineers and technicians worldwide. ICE exists to share knowledge and best practice, ensuring that engineers learn throughout their careers, while also fostering debate and driving action on the critical issues facing the infrastructure sector. Visit ice.org.uk to learn more about ICE.

