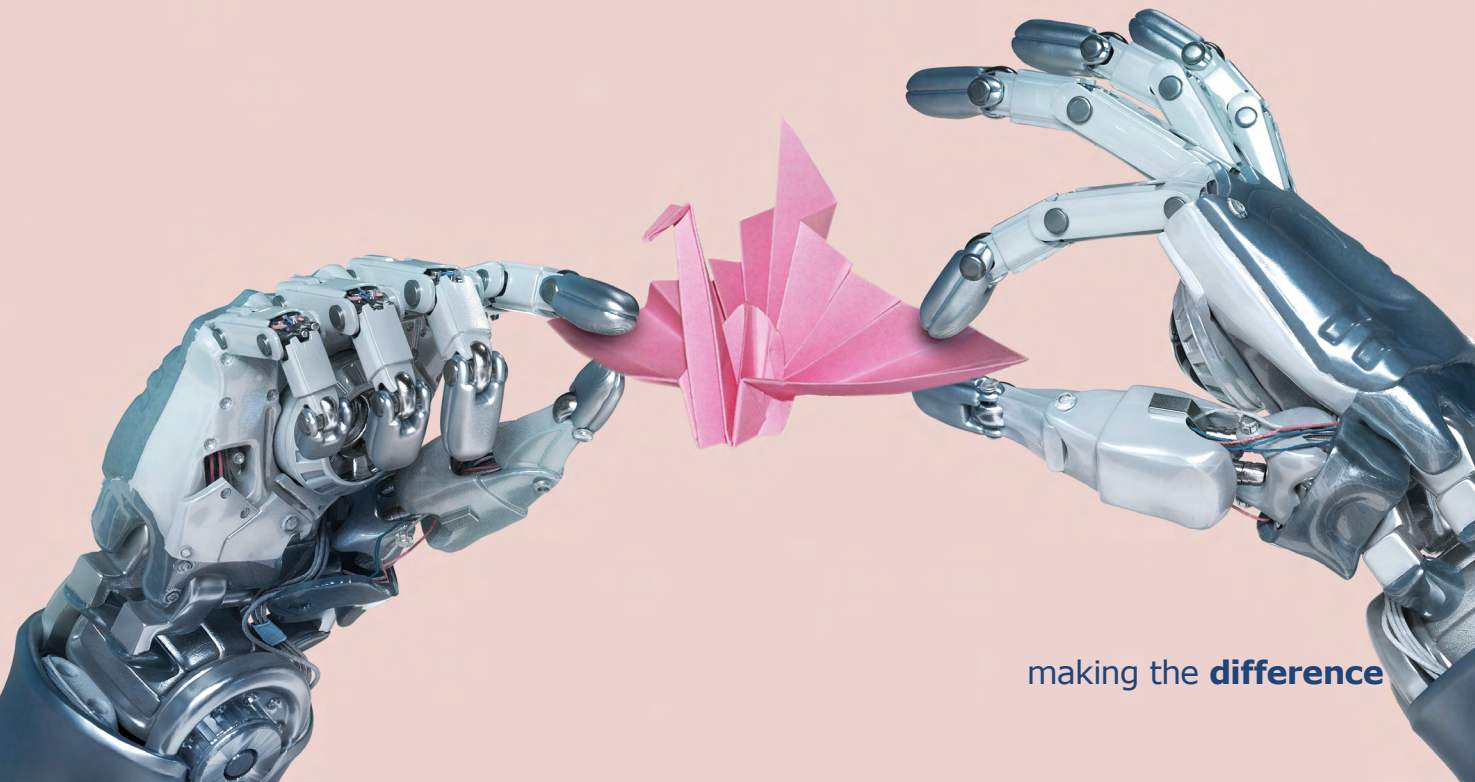
360° view

Turner & Townsend

Global thought leadership
Issue 15

Digital *and* innovation

A series of perspectives on the events and trends affecting our industry, communities and planet.



making the **difference**

Foreword

Construction's future is digital

The construction sector is starting to make progress in adopting advanced technologies, from building information modelling to drones and data gathering and analysis. Find out more about how these and other innovations are transforming our industry and built environment in this issue of **360º view**, introduced by our Chief Operating Officer, James Dand.

Digitally led approaches can drive improved management of risks, resources, timescales, governance and controls in projects and programmes to improve delivery and broader industry productivity. Tools such as digital project management information systems are helping to connect key project stakeholders across global time zones and are playing an integral role in boosting efficiency.

Digitalisation is central to the attainment of net-zero and environmental, social and governance (ESG) targets. For our sector, hitting these sustainability benchmarks is increasingly a priority, as our clients look to us to lead by example, combined with the increasing amount of decarbonisation legislation being introduced.

Data gathered through ever more sophisticated digital systems is continuing to improve our understanding of the embodied energy that is used in the construction of buildings and infrastructure. It is enabling indoor environments to be made more comfortable, healthy and productive for people, and giving cities the capability to better meet the needs of users as they go about their daily lives. We are seeing its potential in the commercial buildings, including offices, now incorporating smart technologies, and in the new mega-city of NEOM. The learning for the global construction industry emerging from projects like this will be significant in driving the deployment of innovation to equip cities for the future and enhance their resilience.

Innovative technologies are changing the landscape of the construction industry, with tools incorporating artificial intelligence (AI) already creating both opportunities and challenges. We spoke to four upcoming leaders across our global offices to see how they have started to see automation and AI being used, and what they predict the impact of this will be on both the sector, and wider society.

Across real estate, infrastructure, energy and resources, organisations are embracing digitalisation; some are blazing a trail, while others are plotting their route. We are working with organisations, including Hong Kong's MTR Corporation and Digital Realty in Africa, on their digital journeys, helping to improve existing, as well as embed new, digital processes – whether the aim is to achieve a seamless rail experience for passengers, or ensure reliable internet connectivity across the continent.

Whatever stage players across the sector are at, we all have one factor in common: we must all embrace digitalisation to drive a better performing and more sustainable built environment.

We hope that you enjoy this latest issue of **360˚view**.

James Dand
Chief Operating Officer, Turner & Townsend

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As a Director in our digital team, Guy's main focus is to enhance programme performance by applying data, analytics and technology solutions. This includes designing, developing and delivering solutions that better connect the physical work and built assets to deliver an optimised digital management environment.

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Based in New York, Leila is a sustainability expert, working with clients across the US. She is experienced in data monitoring and has extensive knowledge of sustainability frameworks, initiatives and current environmental policies and laws.

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Gary leads the support of our infrastructure clients in the Middle East, transforming their performance in the delivery of the region's most ambitious programmes and projects, including acting as the main client contact for Saudi Arabia's NEOM development.

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Taking a digital-first approach to revolutionise major programmes

The increasing complexity of major programmes across real estate and infrastructure is being intensified by ongoing cost, labour and supply chain challenges. Guy Beaumont, Director and Digital Lead, explains how a digital-first approach across programme strategy, set-up and delivery will be critical to driving outcomes.

Guy Beaumont, Director, Digital Lead, Turner & Townsend

Major programmes around the world continue to contend with what can be seen as a perfect storm of sustained inflationary pressures, from post-COVID disruption through to the dislocation of global supply chains associated with the conflict in Ukraine. While the rate of cost escalation is forecast to ease through 2023, prices of materials, services, components and energy are expected to remain significantly higher than pre-pandemic. Exacerbating these rising costs is an ongoing skills shortage.

At the same time, major programmes in real estate and infrastructure markets have never been more complex, with increased scale, duration, economic and environmental impacts, as well as the intricacies of a global supply chain that will evolve over the project's life.

Managing this growing complexity and challenges which major programmes face requires increasingly sophisticated digital skills, integrated systems, and smarter use of well-secured and controlled data. For programme teams, contractors, investors and partners, these principles are now business critical.

A digital-first approach is about changing the way we work. It will not only improve programme performance, but also ensure the asset or scheme makes a positive difference throughout the project and after completion, delivering economic, environmental and social value.

To do that, it is fundamental to embed digital approach in the earliest stages of the programme strategy, through the set-up and finally throughout delivery.

Digital-first strategy

Building an accurate baseline for digital and data across the programme and supply chain

Defining the desired strategic outcomes must always be the starting point. The most effective programmes focus these outcomes not just on commercial success – of cost and timescales – but also on the social, economic and environmental value created throughout delivery and after completion.

An honest appraisal of digital maturity and capability will then help to define a robust baseline from which you can build digital across the programme to accelerate delivery when you are ready. Digital then needs to be embedded into the value case, vision and programme leadership.

A clear, programme-wide data and systems strategy is essential to help programme teams understand how systems, interfaces, integrations, data flows and resilience can dovetail to support delivery.

Getting set-up for success

Ensuring the systems, tools, integrations and ways of working are defined and understood before delivery.

Building on the solid foundations put in place in the strategy will ensure the programme is set up for success, focusing on the digital architecture needed to ensure teams and partners can lock into the overall design, and can plan and organise to do this. Assessing readiness is crucial here, defining the capabilities, skills and systems the programme needs across its lifecycle and supply chain.

These start to inform the digital operating model and how teams, systems, data and processes come together as the programme's delivery engine. Establishing the digital ecosystem of partners, suppliers, service providers and stakeholders brings a further layer of integration across a complex set of elements.

Bringing all this together into a data and information framework ensures potential issues can be flagged in advance and that relevant data can enable fast, accurate and high-quality decision-making.

Accelerating delivery

Providing the data and systems for fast, accurate decision-making.

Programme teams will now be well prepared to initiate the main delivery phases. This starts with robust digital project and programme management, whether taking a waterfall, agile or blended approach, and powered by a digital project management office (PMO).

Delivery must increasingly be driven by accurate data analytics and intelligent automation to help accelerate pace, improve accuracy, spot errors and maintain a 24/7 capability every day of the year. These should interface with the supply chain to enable machine-to-machine interactions.

The assets themselves will be building and using their information management strategy to create a data-rich picture of their design, construction and use. This type of smart asset, such as one with a digital twin, helps teams design for handover and use, and adds commercial value to the asset and the dataset.

The backstop to all of this is the programme's robustness and resilience that has been designed in, set up well and managed effectively – keeping the programme's systems, data and machines operating productively, safely and securely.

Leveraging digital platforms

Programme platforms like Digital Controls industrialise designing, deploying and embedding a robust controls framework across a programme's systems, data and decisions.

When working with complex outcomes and long timescales, rigorous governance, controls and reporting are integral to success. Project risks of all types – from supply chain to cost management – should be carefully integrated.

A controlled digital environment will also bring stability to risk management, allowing project teams to understand the interdependencies between different risks and to make not just fast decisions, but the right ones.

Capabilities such as our own digital platform HIVE enable programme teams to capture, organise and model critical cost, supply chain and performance data. It can also provide the portal for a suite of Power Apps that teams can use to accelerate delivery and maintain a high level of accuracy.

Getting digital first right does not just improve project outcomes and efficiency. There is also an increasing appreciation from investors and clients that a digitalised asset, such as a smart building or one with a digital twin and well-packaged data sets, offers greater value than its analogue equivalent. Investors and asset owners are now expecting the construction and operational phases to be digital first and to produce an asset with an accurate data set and models.

Though the built environment sector has come a long way in adopting digital tools and data – from PMOs to building information modelling – there is still ground to make up to embed a truly digital-first approach that runs throughout a project's lifecycle from the earliest design stages to post completion.

Across the sector, clients need to focus on driving digitalisation, not only to improve productivity and commercial outputs, but also to deliver tangible societal change, making crucial headway on environmental targets and supporting sustained economic growth and resilience.

The digital office: why buildings need to get smart

Emilia Cardamone
Associate Director - Digital
Turner & Townsend

Net-zero ambitions along with post-pandemic working patterns are prompting owners of commercial real estate to scrutinise how building performance helps address societal outcomes. Smart technology can respond to that demand, providing the data to inform new approaches and enabling buildings to be made more energy efficient and improve health and well-being.

Commercial real estate is changing as forward-thinking investors, owners and occupiers look to prioritise environmental, social and governance (ESG) objectives, enhance building performance and re-appraise their space requirements to improve the working environment. Buildings needs to get smarter by incorporating technologies that will help meet these goals and more.

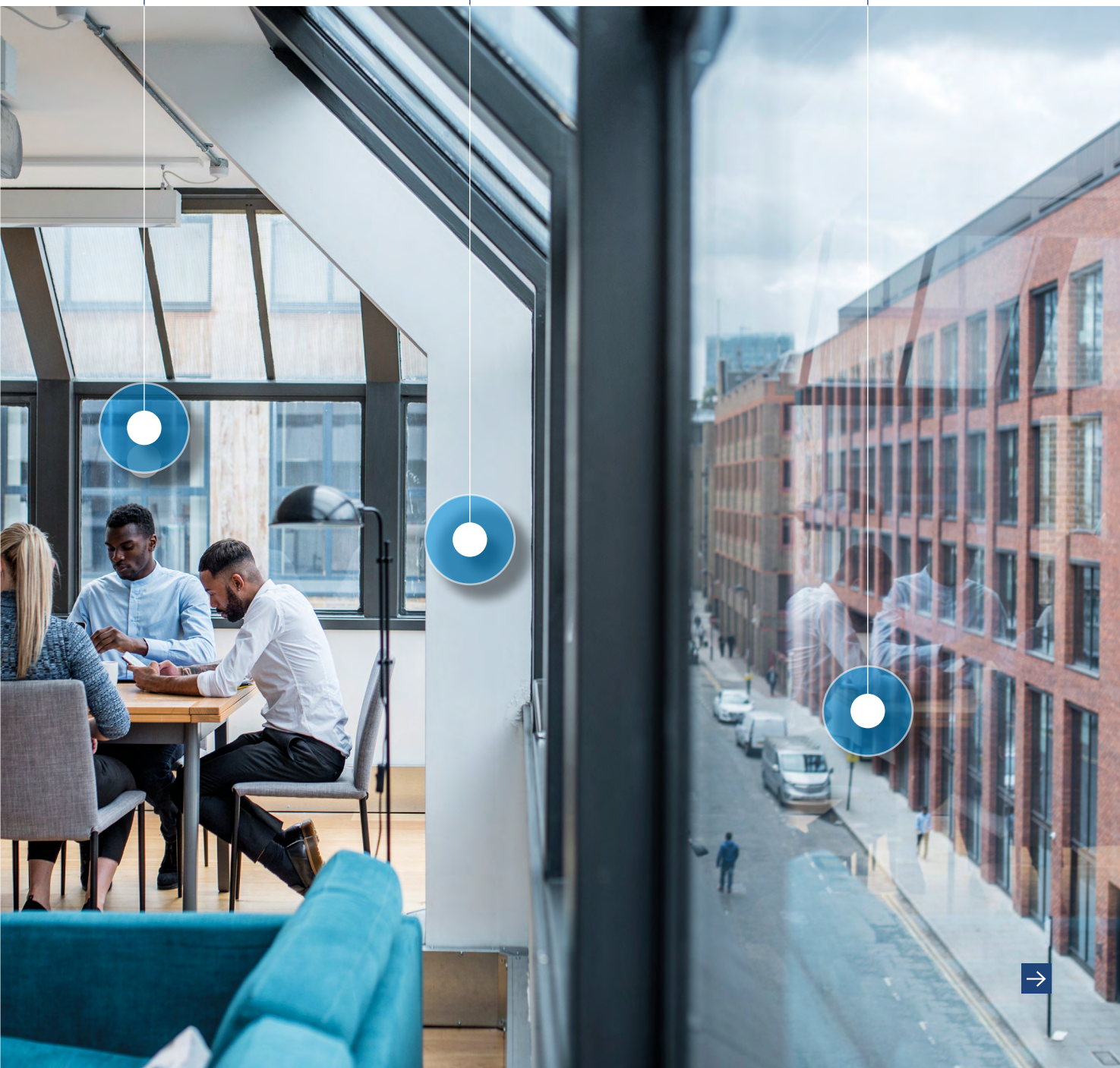
These factors have been brought into sharp focus by changes in working practices in the wake of the pandemic. That has prompted the increased focus on digitalisation, although organisations are likely to have very different technologies in their real estate and their own drivers for action and objectives.

There are good reasons for every organisation to embrace technology, but it needs to be a priority, putting users at the heart, to enable commercial real estate to remain relevant and resilient for the future.

Intelligent
meeting room

Intelligent
CO^2 and temperature sensors

Intelligent
visitor management



What is a smart building?

The term 'smart building' is commonly associated with the building management systems that control services, such as lighting and heating, and the array of sensors and monitors gathering data on how a building is functioning and being used.

Deployment of these technologies in an office fit-out is designed to deliver clear benefits for people, enabling more comfortable and productive environments to be created for building users, while also helping to drive more effective use of energy and other resources.

A smart building is much more than its IT hardware, software and sensors. Its intelligence comes from the connectivity of its systems and the data collected on a building's energy use, temperature, lighting and other everyday operations.

For example, CO^2 and temperature sensors can give building users a greater understanding of their workplace environment, while helping to give owners and occupiers a clearer picture of how efficiently the building is operating, allowing evidence-based decision-making and more effective facilities management.

Smarter buildings make sense

Inevitably, cost can be a barrier to making buildings smarter and there can also be questions around introducing new, unfamiliar technologies. But investment can be repaid in many ways, including:

Driving building performance and environmental objectives

Reducing energy consumption and carbon emissions helps limit energy costs and drive pursuit of organisational and regulatory environmental targets. It enables organisations to use resources more efficiently, minimising financial and environmental costs.

Enhancing comfort, productivity and well-being for users

Following pandemic shifts to online working, many organisations are rethinking ways of working and looking to make workplace environments more creative, collaborative and appealing, to help retain and attract talent. Smart technology provides the data to drive decisions around repurposing or enhancement and can be used to track interventions, enabling more comfortable, productive and healthier workspaces to be delivered.

Improving portfolio management

Organisations adapting to hybrid working patterns can apply technology to gain an understanding of how space is used to inform decisions around whether a building should be retained in full or part or otherwise sold. Investment in smart technology means any buildings brought to market are equipped for the future and so may have improved commercial potential. For those retaining buildings, technology allows portfolio performance to be easily monitored remotely via a dashboard.

Strategy matters

A strategic approach can help organisations to realise these benefits effectively. We work with clients to formulate a strategy, appraising their buildings' current technology level and business objectives to develop a tailored route map that drives targeted results.

Defining the strategy is important in ensuring buy-in for digitalisation at all levels of an organisation, providing boards with the evidence to support investment and facilities management teams with the confidence to embrace new technology. Once the strategy is in place, our set-up capability paves the way for new technology to be embedded in buildings.

The pace of technological change makes it important for strategies and approaches to smart building technology to be reviewed and updated. There are relatively few standards for smart buildings because technology is rapidly evolving, but clauses in ISO standards can provide the foundation for a smart strategy and route map, helping to confirm action and enhance asset values.

Time for action

Organisations developing new projects have the potential to integrate technology into buildings from the outset.

80 percent of buildings that will make up our towns and cities in **2050** are already built.

It is essential that smart technology is central to office fit-out strategies in existing buildings, with user benefits at the centre, if global environmental goals are to be met.

Technology is moving fast. There's scope for all commercial landlords to make their buildings smart and for the broader real estate sector to secure tangible benefits, including ultimately making the built environment better for people and organisations.

Two approaches to smarter real estate

A major tech company was able to move its staff rapidly to digital working when pandemic lockdowns struck and, like many businesses, has now moved away from the five-day-a-week, office-based working model.

1

This shift in working patterns raised questions about the future use of its real estate portfolio, which is extensive, worldwide and has traditionally been regarded as an expression of the brand. By reviewing facilities management and technology capability across the portfolio, it has been possible to identify where key savings could be achieved by either selling an individual asset or by managing it in a better way. The company is now considering its way forward.

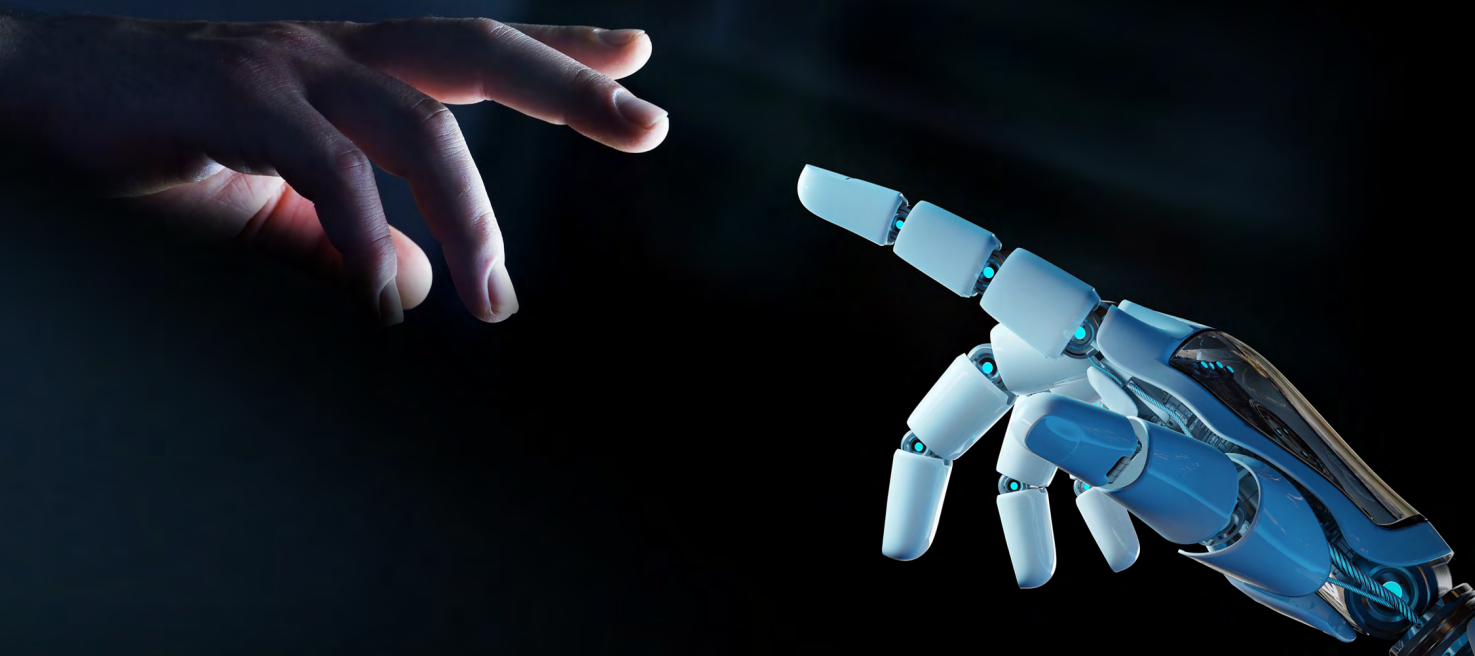
2

By contrast, a second client wanted to equip their IT system to help drive progress towards their organisation's demanding net-zero target. The resulting strategy provides a stronger IT infrastructure for the building, with sensors – for such key indicators as temperature and energy – and the required level of security, and an implementation plan that aligns with their carbon-reduction targets.

Construction management: where human meets machine:

New technologies and tools are driving increased automation in construction, leaving organisations asking where they go from here. A Digital Maturity Assessment framework helps answer that question, providing a route map for the future that integrates both digital and human capability.

Kaarin Kalavus, Director, Turner & Townsend



Construction is digitalising as it looks to increase productivity and performance, with technologies, data, tools and platforms playing an increasing role in driving improved decision-making and ways of working for projects, programmes and enterprises.

But progress among some organisations remains slow and levels of technology adoption vary widely. A survey by the Royal Institution of Chartered Surveyors found that 40 percent of global industry respondents were not using building information modelling (BIM) or digital twin-driven processes and practices for six key functional areas and that, where they were being deployed, adoption levels varied significantly across individual functions, with technologies being most commonly used to enhance progress monitoring and health, safety and wellbeing.

Having rapidly accelerated digitalisation to respond to the disruption of the pandemic, many organisations are now considering where they go from here in order to continue their digital journey. There are many potential routes, options being extended by the continuing growth in software, processing power, innovation, access and affordability.

The time is now right for organisations to reflect on their investment decisions and reassess where they are and want to be.

A Digital Maturity Assessment is the essential roadmap for organisations, projects, programmes, enterprises and built-asset systems, such as smart systems, providing a framework for identifying strengths and key areas for improvement while aligning human and digital capability. It gives the in-depth understanding needed to inform both a high-level digital vision and strategy and a targeted improvement plan, providing a benchmark against which readiness to adopt digital solutions and ongoing progress can be measured.

Whether organisations are just starting on their digital journey or have reached an advanced level of maturity, assessment sets out the next steps in integrating human and digital capability to drive automation of construction management processes and practices.

Barriers to progress

Clients face a number of challenges along their digital journey:

Cost

Digital investments are regarded as a cost, rather than as an investment that delivers value in increased efficiency, improved decision-making and other advantages. Many organisations in construction lack a dedicated research and development budget to support implementation of technology.

Traditional mindsets

Within organisations, teams and individuals can perceive the implementation of technology as damaging to existing roles and expertise, rather than as an opportunity to enhance expertise and performance.

Lack of capability

Where digital transformation is delivered on a project-by-project basis, progress may stall once a project is complete because the hero individual or team leading that change moves on and their knowledge has not been transferred adequately through the organisation.

Making the right choices

In this world of fast-paced digital innovation and trends, it is easy to be attracted by new technology. Organisations and projects need to ensure digital capacity grows in line with broader business objectives.

A framework for human-digital integration

Our framework enables human and digital resources to be developed, aligned and integrated, as the assessment process measures each resource against nine key criteria, including people culture and leadership, and product and technology fit. This human-centric approach recognises that the navigation of people, talent and culture is critical for successful implementation of digital transformation.

Technology adoption across an organisation is far from uniform, with onsite applications commonly trailing those of office-based functions, such as communications. The framework's five-point grading approach allows key gaps across functions to be identified and prioritised.

The assessment's recommendations will depend on an organisation's degree of digital maturity and individual gaps, but commonly extend beyond technology solutions to investment in areas such as training and governance processes.

Comprehensive and independent

Assessment represents a point in time along the digital journey and organisations are likely to have their own objectives: some may want to be fit-for-digital while others will want to be fully fledged digital-first businesses. Whatever the destination, the framework gives a comprehensive understanding of the current level of maturity, how it compares with leading digital practice, and how it can be improved.

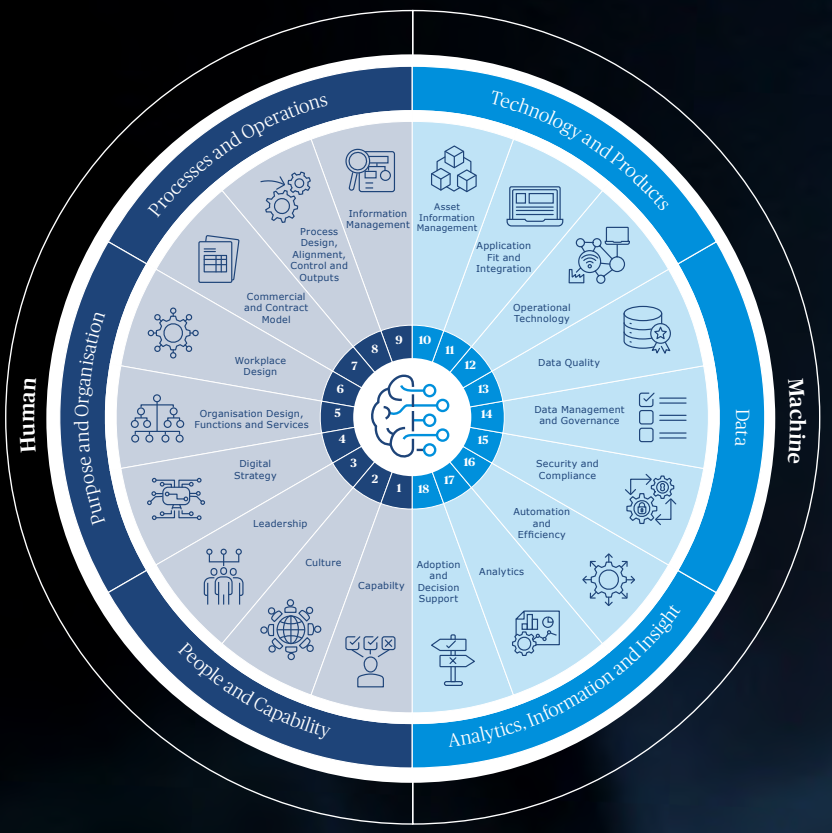
It equips organisations for the future by:

- Giving an independent perspective: Action is not driven by a software provider or an internal technology and data team, but by the organisation's own purpose and objectives
- Increasing understanding: Assessment enables organisations to understand the level of effort and investment they need to commit to build the right level of digital maturity to deliver on their objectives
- Recognising value: The comprehensive view enables the value of digital ways of working to be fully understood, so that they are not seen purely through the lens of first cost
- Aligning human and digital resources: Assessment recognises the crucial role of both leadership and workers in delivering digital ambitions
- Providing a benchmark for continuous improvement: The process enables clients to chart progress through regular assessment and to compare their digital maturity against peer organisations or projects.

Ready for change

The construction industry is experiencing many changes as new technologies and solutions emerge, collaborative ways of working take hold and organisations invest in their digital future.

Both organisations and their people need to be prepared to embrace the change. A Digital Maturity Assessment is a vital tool that enables organisations and projects to step into construction's new, more automated world with digital and human resources fully aligned, integrated and ready to make the most of the opportunities ahead.



Taking steps in facilities management services

An infrastructure client in the Middle East with a portfolio of assets set out to achieve best-in-class facilities management (FM) services, with BIM and geographic information system (GIS) integration. Before taking action, they needed to understand where they stood and establish how to go about achieving their objective.

The client was at a relatively early stage in their digital journey and so needed to make several enhancements, which were scheduled for implementation in a roadmap spanning a number of years. These included upgrading software and systems, cleaning up existing data, and building the processes and team to handle the transition, as well as maintaining business as usual. The key enhancements were:

- procurement of a new maintenance management system to enable integration and address other business needs
- development of new standardised data structures, which were communicated to the supply chain for use on all future projects
- development of new standard operating procedures and guidance documents and roll-out of training programmes to familiarise staff with new ways of working and systems.

New systems are now in place and in use by all FM service providers. The client is already seeing positive results, as systems are well organised and managed and allow its FM team to gain meaningful insights, enabling assets to be optimised. Its digital journey continues.

Client interview

Transforming digital project delivery at one of the world's leading urban rail operators

Interview with

Lyndon Jerome Adolphus
Project Director at MTR Corporation

With Turner & Townsend's support, Hong Kong's MTR Corporation has been using a period of operational stability to overhaul its digital systems and processes as it seeks to move the business forward. Lyndon Jerome Adolphus, project director at MTR Corporation, explains how the organisation's evolution will improve project outcomes, and result in a more engaged workforce.

The MTR Corporation was established in 1975 with a mission to construct and operate, under prudent commercial principles, an urban metro system to help meet Hong Kong's public transport requirements.

Today, the company operates rail lines serving Hong Kong Island, Kowloon and the New Territories, as well as buses, an Airport Express service, and intercity services. It is regarded as one of the world's leading railway operators for safety, reliability, customer service and cost efficiency, carrying 5.9 million customers on an average weekday.

Bringing digital capabilities up to date

A number of years ago, we commissioned a far-reaching report to take stock of our digital strategy with a view to bringing the organisation in line with what others were doing from a digital perspective," says Aldophus.

"At the time, MTR was in a quiet period, with no new projects being approved or executed. This meant our systems, processes and procedures remained unchanged, even as the world was moving on. While we weren't stuck in the doldrums, we were keen to explore ways of improving, particularly with regard to introducing things such as modern project controls, different performance metrics, alternative value analysis techniques and new contract mechanisms. This, we felt, would help us improve our overall reporting and delivery," he adds.

Focused improvements

Adolphus joined the MTR Corporation in 2022 to head up the Capital Works Project Management Office. "When I came on board we focused this initial aspiration on three pillars or lenses: project controls within commercial management, project management within construction, and digital within engineering."

The digital engineering pillar was primarily focused on BIM, 4D and 5D initiatives, as well as document management and workflows, across the design and construction stages.

> "The improvements in digital construction were about gathering contemporaneous time management information and merging it with the contract programme information and cost, and bringing it together for performance metrics. The project controls and project management arena were where the largest changes were required, as we sought to introduce a number of new digital systems to better manage our status information and provide better decision support information."

Streamlining reporting

A key issue for the organisation was the separation of costs reporting and programme reporting. "Because we were reporting those two things in silos, we were not always able to get an accurate status of a project's health, and this was affecting our ability to accurately budget for and manage work.

"We introduced Prism software to bring those things together, breaking down each project cost to its component level and related that to certain activities. On a simple basis, this helped us to see how projects were progressing in terms of budget and timing, and in the future will allow us to identify potential sticking points before they become problematic. Equally, we will be able to identify where we are already achieving efficiencies, helping us to bring those learnings into other projects."

Making data accessible

One of the major improvements MTR has brought about has been the introduction of integrated digital tools and ways of working, including dashboards and KPIs, which has enabled the company to visualise many of its metrics.

"Adding analysis and KPIs to our reporting has given us an additional dimension to our reporting, showing us whether our deployment of the workforce and resources are effective or not – a crucial component to our future success."

"We now have precise and accessible data on the health of our projects, marking a step change from our existing method which involves reading large amounts of text with little visualisation of progress. We hope the changes we have made will improve our ability to quickly see how a project is performing from a quality, safety, time and cost perspective," he explains.

Evolution of the organisation

Budgets have become tighter, and Adolphus recognises the need to evolve, as there is less funding to do more. "It is therefore essential that we streamline our processes so that we can be more effective and economic in the way we do things."

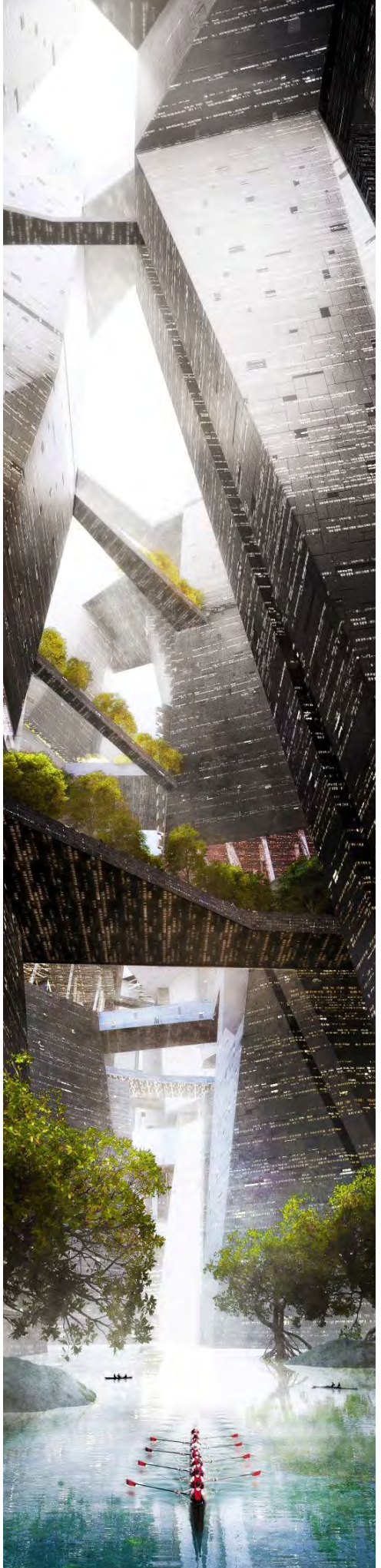
But as well as overall cost reduction, he hopes the changes the company has made will result in a more engaged workforce as information on projects is made more accessible to stakeholders, both internally and externally, with access rights according to role. He explains: "It will become easier for our project managers, cost managers, quantity surveyors and others to interrogate the information relating to their work that we hold. This will allow them to drill down and understand where delays are and where costs are escalating, resulting in a more streamlined, more effective service.

"We have worked hard to educate members of staff to bring them on this journey away from old procedures and processes: as we revamped workflows, we needed to change years-old ways of working to ensure that the changes could take effect."

Investing for improvement

> "Although adding new digital systems involves front-end investment, we believe there is a significant long-term gain. The work we have done will give us a single source of truth for our projects: a database where all our information is stored, providing transparent information with a high level of integrity.

"As MTR continues to grow and we look ahead to a number of exciting extension projects in the years to come, having a digital system fit for the 21st century will help us retain our position as one of the best transport operators in the world," he concludes.



NEOM: a vision for smarter cities

Gary Haldane
Director, Middle East, Turner & Townsend

The Kingdom of Saudi Arabia has a mission to address global sustainability challenges through its planned NEOM mega-city with innovations that are redefining city-making and living. The application of new technologies and approaches provides an unprecedented opportunity to develop learning and drive a paradigm shift in city design, construction and operation.

Imagine a city that is designed to meet your every need; where the elevator is waiting for you as you arrive at the office in the morning, your freezer is re-stocked without needing to place a grocery order and your avatar attends a meeting when you can't be there in person. This is the vision for NEOM, the mega-city now under construction in Saudi Arabia.

Although often described as a city, NEOM is in fact a series of settlements spanning an area of 26,500km – 33 times the size of New York City – all constructed from scratch and concurrently in a remote north-west corner of the Kingdom in the Tabuk Province. This innovative project in Saudi Arabia is a key element of the country's Vision 2030 strategy, which looks to reshape the Kingdom's economy for a post-oil world by growing new opportunities for people and business.

The Kingdom's ambitious vision for NEOM aims to demonstrate how innovation and technology can help address global sustainability challenges for the world's increasingly urbanised population, while also enabling better lives and lifestyles.

Mohammed bin Salman Al Saud, Crown Prince of Saudi Arabia, said:

> "We cannot ignore the liveability and environmental crises facing our world's cities, and NEOM is at the forefront of delivering new and imaginative solutions to address these issues."

NEOM's string of giga-projects and mega-projects includes the world's largest green hydrogen plant, the ultra-efficient, car-free linear city of The Line and the floating industrial hub of Oxagon – with its automated port and smart supply chain network.

The sheer size, scale and complexity of these projects is also demanding fresh technologies and approaches in design and construction. This gives NEOM |the potential to provide valuable learning about the application of innovation at scale, which could ultimately redefine not only city living but the delivery of urban buildings and infrastructure.

Beyond the smart city: using big data

While many existing cities are looking to become smart by applying big data and the internet of things (IoT) to urban challenges, NEOM will be the world's first cognitive city. Platforms here will collect data about users' behaviour, like their work arrival time or grocery order, and apply AI to that data, enabling people's needs to be anticipated and facilitated.

As NEOM's residents go about their daily lives, their data will be fed into the city's platforms, growing its cognitive capability. The collection of vast quantities |of personal data inevitably raises questions around data privacy, ethics and security. Recognising this, NEOM is working to build trust in data sharing through tools such as its consent management platform.

The aim of this planned, cognitive city is ultimately not to replace human capability, but to increase potential, liberating people from everyday challenges to enable them to lead healthier, more enjoyable, sustainable and productive lives. As a pioneer, the planned city is expected to attract willing early adopters.

Innovating for delivery

With its large-scale, complex and pioneering projects, remote location and shortage of local resources and capability, NEOM will be one of the world's most demanding environments for construction.

Technology and innovation are helping to address challenges throughout delivery, with initial approaches including:

Collaborative communications platforms

These are allowing the Kingdom to bring together top global teams to deliver these remote projects.

Drones

Extensively used for projects in Saudi Arabia, drones allow construction progress to be captured, facilitating updating of project schedules and digital twins. Innovation will in time enable data to be directly transferred from drone to software to automatically update schedules.

AI for compliance checking

Engineering plans and drawings are being checked for compliance against building codes using AI.

Innovation campus

The projects' scale and innovation demand skills and equipment that are far from commonplace, so NEOM has created its own innovation campus to develop new competencies, technologies and methods.

Because of the highly innovative nature of so many aspects of NEOM's giga-projects, we have been carrying out early research to establish the feasibility of some of the pioneering approaches, as well as focusing on cost and programme management throughout delivery.

Exploring the potential of the metaverse

NEOM extends the concept of the digital twin with its virtual city –XVRS, which is described as a 'cognitive digital twin metaverse'.

The digital model will enable the public to engage with NEOM – whether by touring the resort of Trojena or attending a business meeting – as an avatar or hologram. The digital model may have a part to play in driving NEOM's delivery, enhancing the customer experience when choosing homes, for example.

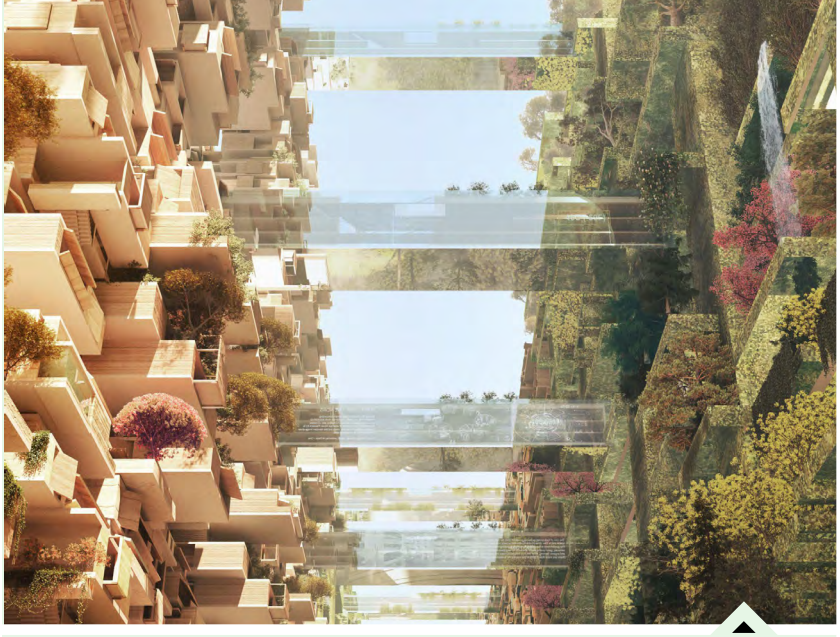
A game changer for city-making

NEOM presents a learning opportunity for the global construction industry and has the potential to create a paradigm shift in the application of the new digital and sustainable technologies that will be in demand in tomorrow's cities.

While few nations may go as far as building their own version of The Line, the innovations being deployed here and elsewhere across the megacity have the potential to influence the construction industry for years to come, challenging the conventions of city making and city-living.

The ambitions for NEOM are extraordinary and the timescales for delivery intense, but construction is now in progress across the region and this new and remarkable city is emerging.

NEOM's projects: developing on a giga scale



The Line

The Line is a linear city comprising two buildings – each 500m high, 200m wide and extending a length of 170km, separated by central public space. By building up, rather than out, The Line is designed to accommodate around nine million residents without sprawling like conventional cities, giving it a footprint of just 34km^2 and so safeguarding the natural environment.

The city is designed to be car-free with no conventional street network; the central space is reserved for pedestrians, while an underground chamber alongside The Line houses transportation systems for people, freight and services.

Trojena

The Sarawat Mountains, where winter temperatures can drop below zero centigrade, are set to be the location for Trojena – a year-round tourist destination hosting everything from skiing to arts festivals. The project includes the construction of a freshwater lake high in the mountains, while at The Line, residents will be housed in a vertical village called The Vault to minimise land-take.

Oxagon

Neom's planned industrial hub is an innovation showcase. Oxagon will be the world's largest floating structure, with around half the city perched over the Red Sea. It will have an automated port and smart supply-chain network – enabling goods to move from container ship to factory in 12 to 24 hours, rather than the same number of days. Designed to provide a base for advanced, clean industries and with a population of 90,000, the city will be built using modular construction, with buildings designed to be accessible to wheeled robots.

Market focus

Decarbonising New York City
brick by brick

Leila Niknam
Consultant, Turner & Townsend

New York City has gone big with its carbon reduction ambitions. A raft of legislation, collectively known as the Climate Mobilization Act (CMA), looks to achieve a six-million-tonne reduction in greenhouse gas emissions by 2030. At its heart is Local Law 97 (LL97) which governs and regulates carbon reduction efforts for tens of thousands of buildings and sets out ever more exacting criteria for compliance with the holy grail of net zero until 2050.

For the architecture, engineering and construction industry, placing ESG (environmental, social and governance) considerations front and centre is a novel concept.

However, with LL97 drawing into its orbit some 50,000 buildings and accounting for 60 percent of New York City's total building area, it is acting to focus minds, since failure to meet the thresholds of financial compliance by the requisite deadlines will result in stiff financial penalties determined by the extent of any shortfall. To put a figure on it, it's USD$268 for each metric tonne over the building's established limit, levied annually.

Avoid complacency and offset carbon

The first of these deadlines is May 2025 and although most will meet that initial benchmark, after an introductory five-year warm-up period designed to allow asset owners to get their premises in order, come 2030, the emissions cap bar will be set much higher. At present, it is estimated 75 percent of buildings would not reach it without corrective action.

> "For those quick off the mark, however, public funds exist to help ease the financial burden.

Essentially, operating on a first-come, first-served basis, rebate and financing programmes, such as those linked to the New York State Energy Research and Development Authority and the Inflation Reduction Act, are available. However, in being fuelled by finite resources, this will reduce to nil over time.

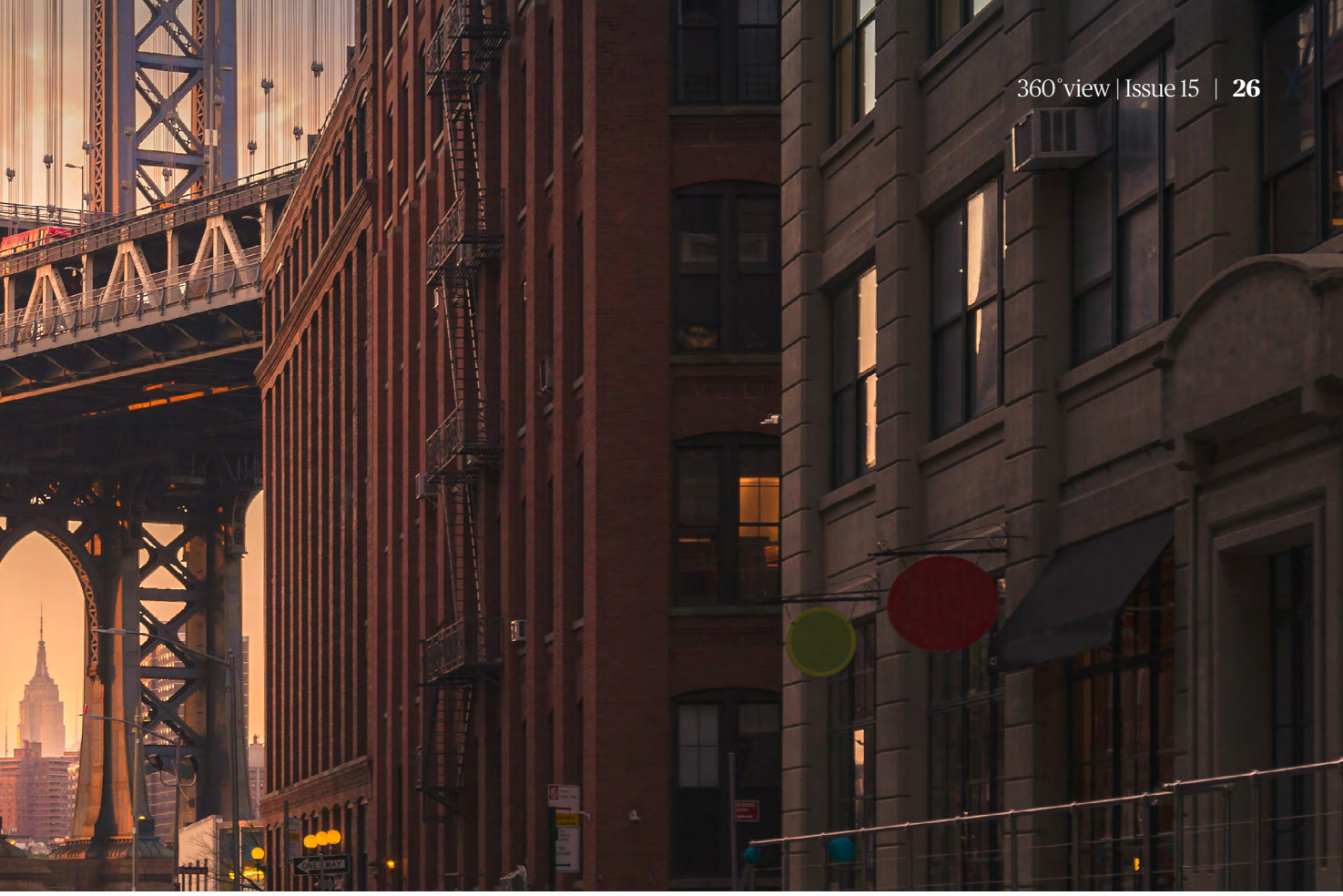
Using energy to achieve compliance

While a proportion of stakeholders will be hard-wired with a laggard mentality, there is some logic in the apparent procrastination of others implicated by LL97, given the anticipated advances in lower carbon technologies that could work to reduce costs and financial burdens. This rather speculative approach explains why some are determined to hold out until fiscal years 2028 or 2029 to allocate costs to site improvements.

In the meantime, offsets are currently permitted, with deductions from emissions associated with annual electricity consumption granted when facilities use Renewable Energy Credits (RECS), carbon offsets or clean distributed energy resources. This means the less proactive can still achieve compliance by taking advantage of an ever-greener grid.

Embracing the opportunity to improve asset value

While some asset owners and managers are resistant to what they see as over-zealous state interference, aside from the



avoidance of fines, there is clear scope for return on investment (ROI) on the outlay they are obliged to make. This is not limited to lower utility costs, higher occupancy rates, increased net revenue per occupant and improved asset transaction value from investment in the energy and cost efficiencies necessary to achieve compliance. Certainly, early adherence to LL97 enhances price per square foot asset value and leaves building owners and managers well positioned when it comes to lease negotiations and site selection.

New builds offer up significant advantages over existing assets in that their blank canvas state allows for optimum material selection to realise maximum efficiencies and lowest possible carbon intensity. Equally, those with the largest portfolios will be able to swallow the financial costs associated with compliance more easily than developers with smaller inventories, who may need to rely on tax breaks and other assistance to implement the changes effectively.

Seeing low carbon as a force for good

It is hard to argue against the force for good of New York City's new low-carbon transition requirements, and anyone imagining these to be passing phenomena, or that normal service will resume, is mistaken.

> "The takeaway here is to engage with the process in good time. This means setting aside adequate capital and adopting short-, medium-and long-term strategies that go beyond mere conformity with the regulations to actively capitalise on the opportunities presented."

Act now to avoid financial implications later

Post-pandemic, it is perhaps understandable commercial real estate attention has been trained on immediate and pressing concerns like soaring inflation and rising interest rather than on LL97. It is also likely that without the unscripted arrival of COVID-19, more buildings would have been futureproofed by now. However, there seems little appetite from lawmakers to shift timelines to accommodate the unexpected, meaning the window of opportunity to implement the requisite changes in a financially cost-effective way, and as part of a coordinated strategic plan, is closing.

New York City's plan of action to make its built environment climate-fit-for-purpose was always going to have to be profound and far-reaching, given the extremes in weather it is increasingly subjected to and the age of its infrastructure. Belying its conservative East Coast reputation, LL97 would appear to fit the bill: a decidedly progressive piece of legislation that has become something of a blueprint for other US cities drafting similar laws.

Client interview

Digital Realty and harnessing the power of fibre to change lives

Interview with

Ilker Esener

Vice President, Design, Engineering & Construction - EMEA, Digital Realty

The entire African continent is experiencing a communications boom as mobile phone ownership accelerates across the 1.4bn population and internet connectivity becomes a vital part of urban and rural life. The power of digital technology is literally changing lives every day – from communication to education, entertainment, commerce, banking and more.

At the heart of this transformation is rapid investment in fibre-optic cable networks. These link a growing number of data centres to provide the backbone to fixed and mobile services being rolled out across this vast and complex land mass. According to Ilker Esener, Vice President, Design, Engineering and Construction – EMEA at Digital Realty, the importance of this fibre infrastructure investment cannot be overstated:

> "If you think about a data centre, it needs power to keep servers and its infrastructure running, and it needs cooling to make sure that the heat is well managed. But at the top of the priority tree is connectivity – without fibre you have a facility that doesn't join up with anything. It is the veins and the arteries of a data centre network."

The entire communication network coverage across a continent the size of Africa has been made possible by the increasing use of satellites and high-power mobile phone signals. But, Esener points out, this technology relies on fibre networks |to take the signal from the mast or satellite transmitter, down into the ground and, at the speed of light, move data via a server connected to the internet.

"Data has to sit somewhere – it can't sit in the ether," explains Esener. "Whether it is photographs, videos, emails or files, it all has to be to be stored somewhere and then accessed on demand. Fibre makes that possible."

Expanding to meet growing demand for data

Digital Realty is driving the continent's digital transformation by building, operating and maintaining the data centres that form these vital communication hubs – the nodes that bring life into the fibre network. We have been working with Digital Realty to help plan and deliver the infrastructure capable of driving and capitalising on this boom.

Having started life as a real estate business, Digital Realty is now one of the world's largest data centre companies. It provides a range of services from single server racks for smaller clients through to entire data centre buildings, even campuses for its larger and 'hyperscale' customers.

Africa is the world's fastest-growing continent in terms of GDP and population growth and is experiencing rapid digital transformation. However, it is estimated that some one billion Africans still do not have proper access to the benefits of the internet.

Digital Realty is currently expanding its activities across the continent in the knowledge that, over the next decade, there will be a huge opportunity for global businesses to tap into Africa's expanding internet economy and to meet growing customer demand for connectivity.

Digital Realty's aim is to deliver the largest and most densely interconnected data centre platform in Africa through its proprietary global data centre platform PlatformDIGITAL®. This will enable multinational and local businesses to accelerate digital transformation by having a leading global data centre provider at the heart of the region's growing connected data community.

"What drives that growth is obviously the population in Africa," says Esener, highlighting that Nigeria's population of around 230m is now almost entirely economically active and reliant on some form of digital connectivity.

"The African continent is at the foothills of what the infrastructure can do for it. The ingredients are there for e-commerce and then the entrepreneurial nature will very quickly piggyback on that," he adds. "I would expect to see an explosion in digital services. Mobile phones are ubiquitous, and e-commerce follows. That's the potential; that's the future."

Renewable power on tap: invest in the opportunity

Data centres consume a vast amount of power, particularly in Africa due to the added cooling requirements of the climate. However, Africa's expanding renewable energy market is creating new opportunities as, according to the International Renewable Energy Agency, between 2010 and 2017 the average cost of producing solar energy fell by 73 percent and by 22 percent for onshore wind power.

Africa is therefore evolving into a major interconnection hub for data-driven businesses seeking a cost-effective, future-proofing platform for data services. With robust and reliable fibre networks and low-cost energy, it then becomes possible to draw on data from anywhere in the world via new sub sea fibre links.

Digital Realty's African footprint across South Africa, Nigeria and Kenya, together with its Mediterranean interconnection hubs in Marseille and Athens, means it can serve local as well as multinational enterprises and service providers.

"Africa is a brand-new market where legacy technology doesn't exist," explains Esener. "It's an opportunity for the African continent to benefit by leapfrogging legacy technology and deploying more state-of-the-art equipment which is more efficient. Pound for pound, dollar for dollar, naira for naira, it is cheaper."

Setting new global standards

With the acquisition of various companies across South Africa, Nigeria and Kenya, Digital Realty is continuing its expansion fast through major investment in the continent's internet infrastructure. This direct investment not only brings a massive financial stimulus to the region, but also drives the uptake of global standards and operational excellence.

"Our pride is our availability - making sure we don't go dark and don't go down," says Esener. "We operate 'five-nines availability', which means we operate with 0.001 percent downtime in terms of our data centre facilities. So, in reality, in terms of critical environment, we keep the lights on all the time."

Maintaining this standard and protecting the company's reputation for delivery means Digital Realty must navigate the unpredictable reliability and resilience in power supply systems in South Africa and in Nigeria. Historic underinvestment in critical infrastructure and increasing demand means the whole society is used to juggling between mains power and back-up generators.

No field of dreams - but a huge opportunity

The reality of the African market is that, like all rapidly emerging markets, global businesses such as Digital Realty must go in with their eyes open, having carried out thorough due diligence on the potential risks to manage.

Esener explains that it requires a mindset towards innovation and fast learning, plus a pioneering spirit to succeed in Africa. Many businesses, he adds, prefer instead to have a clearer and more established regulatory framework without such inherent complexity.

But market entry needs to be very clearly thought through and understood, first and foremost to protect reputation, but also to ensure the business is fundamentally successful and able to make a financial return before it commits to investing in new data centre assets. That means looking at all input costs, running costs and borrowing costs to assess the risks.

> “One of the most interesting parts of working in Africa is its complexity,”

says Esener, pointing out that the size of Africa means that what works in one country or even region may not work in another.

“This market is not a field of dreams,” he adds. “It has to be very prudently and cautiously managed in terms of environment, financial, brand and reputation and has to be done very professionally with the highest ethical standards. It’s a step change, absolutely, a total step change.”

Facts about Digital Realty

- Digital Realty has a vision to establish open, secure, and dynamically connected data communities in major hubs around the world which includes growing its African footprint and reach for PlatformDIGITAL® over the next decade. The company has committed more than US$2bn to invest in Africa’s technology infrastructure over the next decade and has already progressed acquisitions and expansions to accelerate its pan-African expansion strategy.
- Digital Realty, in a joint venture with the Pembani Remgro Infrastructure Fund, has accelerated its expansion into Africa with the acquisition of Medallion Data Centres, Nigeria’s leading colocation and interconnection provider.
- iColo, Digital Realty’s business interest in Kenya, has announced several expansion plans in 2022 including:
  - Entering Mozambique through the development of its first data centre in the country, located in Maputo.
  - Connecting iColo’s Mombasa data centre to new subsea cable systems bringing 1.6MW of power and 12,900 sq ft of space for customers.

How bespoke management systems drive efficiency and enable regulatory compliance

Investment in digitally innovative solutions is critical for the modern construction industry. While the US construction market has no shortage of off-the-shelf project management information systems (PMIS) designed to unlock digital benefits, bespoke, customisable systems are necessary to ensure compliance to legislation shaping project and programme delivery at a local level and better decision-making.

Kelly Wheeler
Senior Project and Programme Manager
Turner & Townsend

In the rapidly evolving industry of construction, it's not just about bricks and beams – it's about the tools and technologies that drive success. As a result of COVID-19, thanks to industry innovation, teams were pushed to find new ways to deliver public- and privately funded projects. Now the industry is primed for an equally innovative solution to information systems, driven by their project management teams.

Bespoke project management information systems: public versus private

A PMIS built for public versus privately-funded projects has significantly different performance measures and regulatory compliance needs. While project management scopes are often the same, client core deliverables vary greatly, and project success is often contingent on having a PMIS that works for a specific organisation.

For public clients in the US, customising a PMIS to comply with local legislation is often required.

Our Oregon team has developed a PMIS to mitigate Oregon-specific public procurement requirements, record retention and accessibility regulations (ORS 279C.525 and OAR 137-047-0560), which are two of the most common infractions in Oregon legislation. A customised PMIS allows clients to monitor contract values, ensuring they align with procurement law thresholds and that documentation also complies with public record retention and accessibility requirements.

The success criteria for a custom PMIS for a private client is different. Teams often span multiple states and time zones, and with stakeholders frequently in different locations, systems need to be designed for mobile collaboration and governance.

> "This means providing a concise, efficient and informed decision-making tool, while ensuring a user-friendly solution for collaboration across multiple companies."

Our team designed a PMIS that provides high-level dashboards and live information on all critical issues and allows owners to action any items. The approval process provides all required information for owner sign-off in one automated form that relays information back to the team immediately.

Building an integrated system for project success

Although there are clear differences between building a bespoke PMIS for both public and private clients, five key components are common across both sectors.

1. Compliance at the core

In today's construction arena, compliance is non-negotiable. A PMIS needs to integrate mitigation methods, such as procurement rule thresholds, and meet Generally Accepted Government Auditing Standards (GAGAS). Unwaveringly committing to legal integrity helps set projects up for success and build a client's trust for future projects.

As historic volatility in commodities pricing demonstrates, it is no easy task to get these models correct, leading either to an oversupply that depresses prices or an undersupply that slows the innovation the minerals bring.

2. Meeting the net-zero challenge

Carbon reduction is a central driver for clients across the construction sector. Having a PMIS that includes a fully digital document control system and approval process provides a sustainable approach for more long-term solutions, including tracking supply chain performance against key net-zero targets.

Good data is imperative in driving decarbonisation initiatives. Equally important, but often overlooked, is the need for alignment between corporate commitments, net-zero strategy and measurement of ground-level activities. The implementation of a PMIS presents a clear opportunity to standardise and create a tangible link between strategy and action.

3. Accessibility from anywhere

Providing accessible systems from anywhere is essential for business continuity. A PMIS should be accessible from anywhere while providing regular backups to prevent data loss.

The PMIS must be based on a collaborative approach and device-agnostic access that enables project managers to work seamlessly, including from the field. It needs to easily share things like photos, updates and notifications, and allow for document markups to ensure that everyone stays on the same page.

4. Fiscally driven

The precise tracking of funds is pivotal in construction projects. A PMIS needs to provide clear and easily traceable accounting, document access, approval pathways and project reporting throughout the project's lifecycle. It also needs to be at a sustainable price point without requiring the need for costly external licences for each user.

5. Simplicity amidst complexity

Many current systems hinder our project management best practices. Your PMIS should be designed with a user-centric perspective and should continually provide added value to organisations and projects.

Investing in innovation

A PMIS, along with other digital tools and technologies, provides opportunities for innovation across the industry, as well as the chance to:

Improve efficiency → *Provide better decision-making* → *Drive net-zero targets* → *Build private and public client's trust*

Those companies that take the leap to invest in bespoke systems to support complex programme delivery in both public and private sectors will reap the rewards.

Q&A

How our future leaders think

AI is shaping the construction industry

Artificial intelligence (AI) is one of today's most frequently debated tools. While AI has potential to revolutionise multiple industries, the transformative opportunities it presents are simultaneously loaded with challenges around accuracy, ethics and the impact automation may have on jobs. The construction industry needs to understand the potential implications of AI and how it is likely to influence the sector, whether embraced or ignored.

We spoke to four rising stars from across our global offices, **Siti Norman, Guilherme Lombardo, Michaela Fiserova and Habel Mwashigadi** to consider the use of AI in their respective countries and how they believe AI will impact the construction sector, and wider society.

Siti Norman
Director

Guilherme Lombardo
Senior Digital Manager

Michaela Fiserova
Associate Director

Habel Mwashigadi
Project Manager

Q How much is AI being used or investigated in construction schemes in your region of the world?

Siti: There has been a lot of buzz around ChatGPT, however AI tools have been used in the construction market for the past five years. This includes a particular interest in generative AI for design optioneering, automated ruled-based 3D model checking and site safety for compliance. We have also seen universities setting up labs for innovation and incubating ideas.

Guilherme: In Brazil, AI is being used mainly in image and document analysis to improve processes such as budgeting, construction monitoring and contract management. Some start-ups are also investigating the use of robots and drones with AI for inspections and monitoring. This is on a small scale, and mostly in the testing phase but it is a great opportunity to introduce AI to consulting.

Michaela: AI tools have been used in the UK construction market for a while even though the construction industry is one of the least digitalised industries. I've seen some interesting use cases recently in Health & Safety where AI robots are tracking sites to prevent accidents and injuries. We've also been trialling using machine learning for quantity take-offs and pricing.

Habel: AI has been deployed in Africa across various markets, however the uptake within the construction space still is in its early stages. The use of AI powered analytics through products such as OpenSpace has been used on fit-out and brownfield projects, as well as for reality capture on site. Matterport is also being used for virtual reality capture of spaces and design during execution on site.

Q What do you think are the advantages and disadvantages to applying AI in construction?

Siti: The advantages of applying AI in construction will be having access to data that makes a difference. It will change the attitude we have towards collecting data and make it purposeful.

It also gives us the opportunity to level the playing field. AI can create space for diversity and inclusion, as it has the potential to allow more people to contribute to the workplace.

One of the potential disadvantages of applying AI in the workplace is the risk of exploitative business practices. AI presents large corporations with the option to develop service offerings for clients with the potential to eliminate whole teams. What AI cannot replace, however, is the human interventions that make our lived experiences unique. AI is a great enabler, but it is not the only solution.

Habel: AI gives the construction industry vast opportunities to combat a legacy of productivity issues. Design processes have been made faster with the generative capabilities of AI through predictive design processes that introduce more feasible variations. This allows both designers and enabled designs to be optimised and executed to avoid repetitive mistakes.

Through AI-enabled analytics, the decision-making process within the construction process has also been shortened, allowing for faster and more accurate decisions to be made.

Micheala: The disadvantages of AI are more likely to be caused by an incorrect implementation rather than AI itself. This could include insufficient regulation leading to misuse, inability to remove bias from the dataset or insufficient investment in change management. It's also important to consider the leaps in productivity and automation and the impact this will have on those who work in the industry.

Q What do you envisage for an AI-powered construction industry in the future? Where and how do you see it being applied, and what benefits will AI deliver?

Guilherme: I imagine that in the future AI will assist at all stages of construction, from planning and design to the maintenance of buildings. Projects designed by engineers with the best support from AI will be faster and of higher quality. Robots, 3D printers, and engineers wearing AR (augmented reality) glasses will speed up construction, while intelligent sensing systems will monitor structures. This will allow for more sustainable and safer projects.

Siti: Although AI is not a time machine, it will provide us with the ability to look through archives and find examples of best practice. AI will help with continuous learning and will also free up workers by removing redundant tasks, allowing more time to solve problems and provide better tailored solutions that focus on the needs of the client.

Habel: The possibilities are endless, but I envisage a productive industry. An industry where the design process is inclusive and interactive, and that is rich in data. It will also enable minimal waste generation as the concept of retrofitting and repurposing of assets is encompassed at the onset of the design.

Q What do you think the longer-term impacts of AI use could be on the world of work, and society more widely?

Siti: The potential impact of AI technologies such as automation and voice activation, and the shift this will have on inclusivity is profound. Imagine the doors that would open for individuals who currently face barriers to using traditional technology. This innovation doesn't just make life easier for the average user, it revolutionises the landscape for those who have been marginalised or left out of the workforce. A world of opportunity emerges for differently abled individuals to contribute their talents in ways that were previously inaccessible to them, ushering a new era of empowerment, where technology becomes the bridge to inclusion and a catalyst for a more diverse workforce.

Guilherme: I believe that AI will bring more productivity and greater quality of life, but it will also require careful policies and continued training to manage human redundancies. It will be necessary to rethink income distribution to include both creative and technological jobs that can't be replaced by machines.

Michaela: It's important we are comfortable not being able to foresee all potential impacts of AI. Technology has rapidly evolved over recent decades, and nobody was able to predict where developments would lead us. The key is the ability to adapt fast. I see AI as a positive enabler to transform working patterns that can generate time for us to solve the big challenges of today such as sustainability, inclusion and change of lifestyle habits. AI is an enabler of transformation, not the driver. It's up to us how we embrace it to see whether the impact will be positive or negative.

Habel: It is imperative that we understand that AI, in whatever shape and form, is here to stay. If the advantages of AI come into fruition, the long-term impact will be extrapolated efficiencies across multiple markets. If deployed within ethical confines, AI has the potential to enrich human lifestyle and augment standards of living.

About Turner & Townsend

Turner & Townsend is a global professional services company with over 10,700 people in 48 countries.

Collaborating with our clients across real estate, infrastructure and natural resources sectors, we specialise in major programmes, programme management, cost and commercial management, net zero and digital solutions.

We are majority-owned by CBRE Group, Inc., the world's largest commercial real estate services and investment firm, with our partners holding a significant minority interest. Turner & Townsend and CBRE work together to provide clients with the premier programme, project and cost management offering in markets around the world.

We are passionate about making the difference, transforming performance for a green, inclusive and productive world.

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