Celebrating 110 years 1913-2023

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State of the World

Digital Technology on a Path to Net Zero

Getting cleaner with technology

/A FIDIC report

Contents

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Foreword from the President and CEO

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In 2022 FIDIC released its first State of the World report in its Digitalisation series titled *Digital Disruption and the Evolution of the Infrastructure Sector*, which explored how technology continues to evolve at an unprecedented pace.

Whilst most believe this is a new phenomenon, the pace of technological change and the need for business to invest and maintain a relevant skills base have always been essential.

The report found that not only is the pace of change faster, but the companies and people we deal with today may not be the ones we are dealing with in ten years' time.

It discussed the role of technology as a potential disrupter to industries changing their business model as a result of shifts in technology, data and/or how a combination of how customers/clients and the sector can access and use such information. Importantly, it also explored the role of technology as an innovator and as something which drives real changes and improvements.

The previous report, however, whilst exploring the changing attitudes and environment in which the infrastructure sector is operating, did not go into the detail of current technological use, change and how it applies to agendas such as carbon reduction and net zero.

The recent Global Leadership Forum Summit that was organised by FIDIC re-emphasised the importance of this topic, demonstrating not only the interest in technological change and carbon reduction, but also the increasing need to understand how technologies will evolve, talk to each other, share data and inform decision-making going forward.

This report, using a combination of desk research and discussions, starts to focus in and take a deeper look into how this change is occurring within the infrastructure sector and how this change also links to the reduction of carbon emissions.

Interestingly, whilst technology is a driver, the implementation of real change and the use of technology is found to go hand in hand with how companies and stakeholders collaborate, design their systems to interact and their views on 'future proofing' and avoiding being "locked-in".

There are definitely lessons to be learnt in this space as net zero will require no less than:

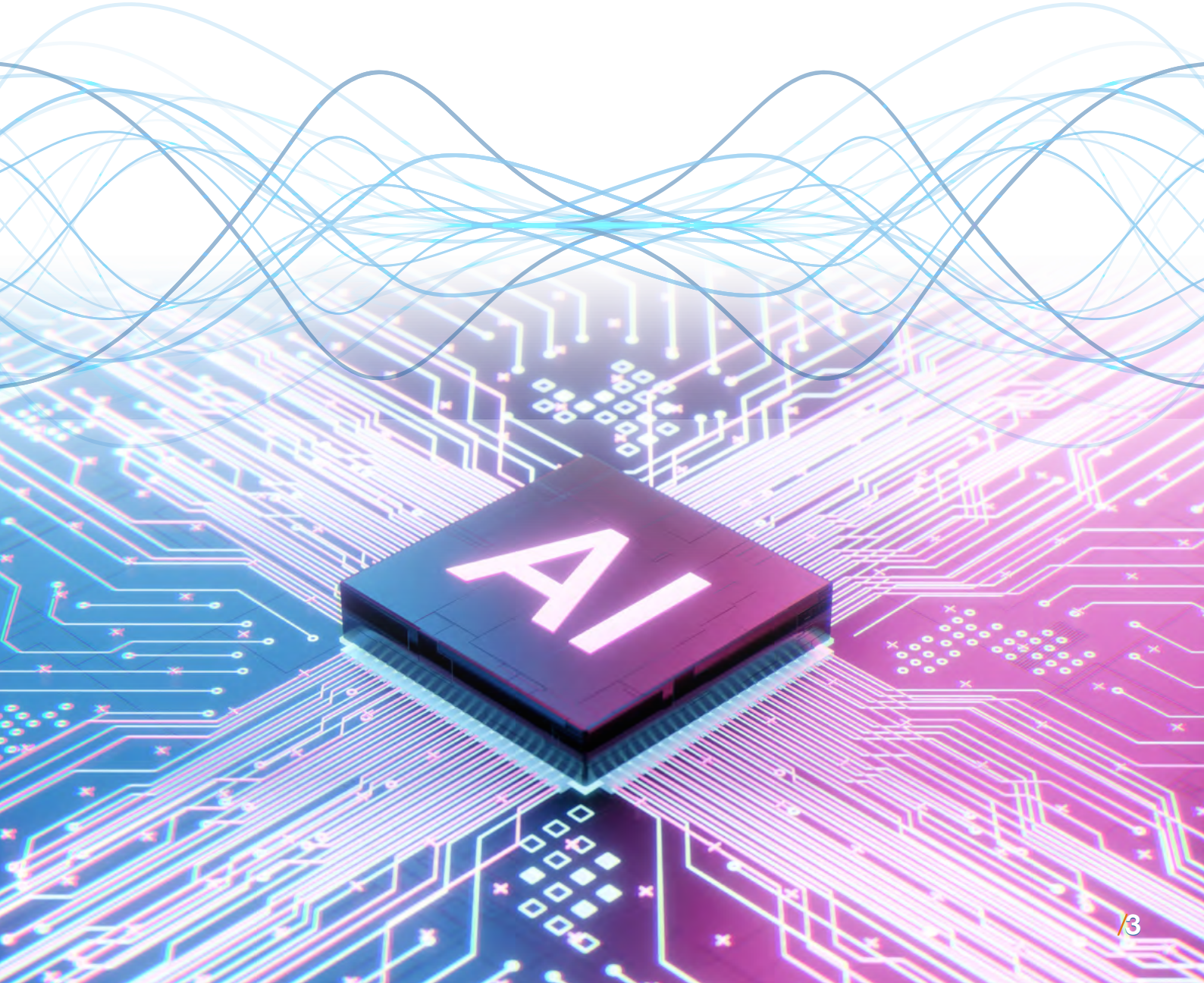
- Full collaboration
- Data sharing
- Analysis sharing
- Performance sharing
- Risk management
- Lifecycle infrastructure service management
- Full carbon / sustainability reporting

Foreword from the President and CEO

We also consider the lessons that can be learnt from the rapid pace of change that occurred during the Covid pandemic. Suddenly, companies found themselves in a situation where systems that would have taken six months if not years to implement, had to have them in operation within weeks if not months . . . and they did. This goes to show the scale of adaptability that can be achieved if the impetus is there.

The report also looks at the development of technology and how it is being used across various sectors, from energy and railways through to improving and retrofitting buildings. This provides insight into the fact that a number of the emerging technologies, such as AI, are already being used and are already having a significant effect on the way we procure, design, construct, operate and maintain infrastructure.

Finally, having considered all of the above, we ask the question that is in the back of everyone's mind with such radical change - and that is the question of cyber security. The report provides real examples where infrastructure has been a target for malicious activity, but it needs to be stressed that cyber security, whilst important, is a barrier that has to be addressed and embracing innovation may be the only way to do this as attacks continue to evolve and become increasingly complex.



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So, what does this mean?

The development of digital systems is necessary to achieve net zero emissions. The industry must choose the right technology for the job, incorporate technology into both new and existing infrastructure, collaborate effectively, challenge perceptions and take advantage of the opportunities presented by technology. The Covid-19 pandemic has highlighted the need for agility and resilience in adapting to rapid technology change. With the right approach, it is possible to achieve a sustainable infrastructure system.

Digitalisation in itself is a race into new frontiers. Given the two drivers of change that have emerged in the last few years, the race in the digital space has taken on a completely new face. The first of these is the pandemic, which has accentuated the value of automation, remote monitoring, data-driven forecasting and digital collaboration. The second is the growing urgency of climate action and the energy transition, for which new energy systems of increasing complexity, decentralisation, and diversification are being created ever faster around the world. Organisations that lead with data and new technologies gain profitability and market share while also advancing towards shared social and environmental goals.

Digital Technology on a Path to Net Zero delves into the profound and transformative impact of digitalisation on the infrastructure sector's mission to achieve carbon reduction goals. Building upon FIDIC's 2022 report on digital disruption, this paper uncovers the relentless pace of change and the pivotal role of technology as both a disruptor and an innovator across industries. By embracing the inevitability of this seismic shift, stakeholders can unleash the true potential of digital transformation to confront pressing challenges and pave the way towards a sustainable future.

Recommendation 1

Embrace the transformative power of digital systems to achieve ambitious net zero targets in the infrastructure sector. Capitalise on technology's potential to facilitate data-driven decision making, optimise resource utilisation and seamlessly integrate renewable energy sources, electrified transportation and other sustainable practices.

At the heart of our collective endeavour to achieve net zero targets, lies the indispensable role of technology within the infrastructure sector. This paper unveils the critical importance of digital systems in optimising resource utilisation, empowering decision-makers with data-driven insights and revolutionising how we approach sustainability. With technology as our ally, we can seamlessly integrate renewable energy sources, spearhead electrification in transportation and champion a myriad of sustainable practices necessary to chart a course towards carbon reduction. An essential concept explored in this report is technology agnosticism, a philosophy that champions adaptable digital solutions, untethered by the constraints of specific technologies. By embracing this mindset, infrastructure projects can safeguard their agility, sidestepping the peril of technological obsolescence. Moreover, the paramount significance of standardisation and interoperability reverberates throughout this study, ensuring the seamless integration of digital solutions and fortifying our ability to future-proof our endeavours. This paper also unveils the transformative potential of technology in procurement and contract management, propelling efficiency, transparency and accountability to unprecedented heights.

Recommendation 2

Prioritise adaptability and interoperability and the implementation of machine-based technologies in digital systems, liberating infrastructure from the shackles of specific technologies. Champion the need for standardised and interoperable digital solutions, ensuring future-proofing, scalability and the avoidance of technological dependencies.

As we embark on a journey of sustainable infrastructure development, this report traverses both the realm of pioneering projects and the realm of retrofitting existing infrastructure. With inspiring case studies as our guide, we witness how technology is reshaping the landscape of smart cities, engendering green buildings and rejuvenating sustainable transportation systems. Furthermore, it explores how digital solutions can be deployed to retrofit existing infrastructure, enhancing energy efficiency, reducing carbon emissions and prolonging lifespan.

Recommendation 3

Drive innovation through technology: Unleash the potential of technology in both new infrastructure projects and the retrofitting of existing infrastructure. Seamlessly integrate digital technologies to revolutionise the development of smart cities, green buildings and sustainable transportation. Maximise the efficiency, longevity and environmental impact of existing infrastructure through intelligent retrofitting.

The Covid-19 pandemic has served as a catalyst for the rapid adoption of digital technologies in the infrastructure sector. Lessons learned from this experience, including the pace of technology change, the rise of remote work and the importance of digital resilience, inform future strategies for leveraging technology in infrastructure development.

Recommendation 4

Seize the momentum of change: Capitalise on the lessons learned from the Covid-19 pandemic's profound impact on the infrastructure sector. Embrace the rapid pace of technological change, leverage the power of remote work and fortify digital resilience. Empower these valuable insights to shape future strategies, propelling infrastructure development toward new horizons of technological advancement.

Collaboration and technology emerge as inseparable components in sustainable infrastructure development. By embracing data sharing, interoperability and stakeholder engagement, we unlock the full potential of technology in driving sustainable infrastructure development. Through compelling examples, the report demonstrates the power of collaboration between governments, the private sector, academia and local communities in harnessing technology to drive sustainable infrastructure development.

Recommendation 5

Cultivate collaborative ecosystems: Foster dynamic collaborations that unite stakeholders across the infrastructure sector. Encourage open data sharing, interoperability and inclusive stakeholder engagement to drive the effective development and implementation of digital solutions. Highlight successful partnerships among governments, private enterprises, academia and local communities, unlocking the transformative power of technology for sustainable infrastructure development.

Yet, this transformative journey is not without its challenges. Challenging traditional perceptions is a critical aspect of the digital journey. This report addresses the barriers and challenges that hinder the adoption of digital technologies in the infrastructure sector, such as cybersecurity concerns, data privacy and upfront costs. It advocates for a shift in mindsets to embrace innovation and cultivate a culture of digital transformation. Insights and strategies for overcoming these challenges are presented, empowering stakeholders to embrace change and drive sustainable infrastructure development.

Recommendation 6

Overcome barriers and embrace innovation. Confront the barriers impeding the widespread adoption of digital technologies in the infrastructure sector. Address concerns regarding cybersecurity, data privacy and upfront costs head-on. Champion a cultural shift that challenges conventional mindsets, nurturing an environment that embraces innovation and digital transformation. Implement strategies and best practices that transcend barriers, fostering an ecosystem primed for technological advancement.

Digital Technology on a Path to Net Zero is a resounding call to action, resonating with unwavering conviction. It underscores the indomitable role of technology in realising our shared vision of sustainable infrastructure and carbon reduction. This report implores stakeholders to unite in a spirit of collaboration and harness the potential of digital disruption. By embracing the digital journey, we can transcend boundaries, reshape industries and forge a sustainable future where our infrastructure thrives in harmony with the environment.

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/The journey from disruption and innovation to net zero

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/The journey from disruption and innovation to net zero

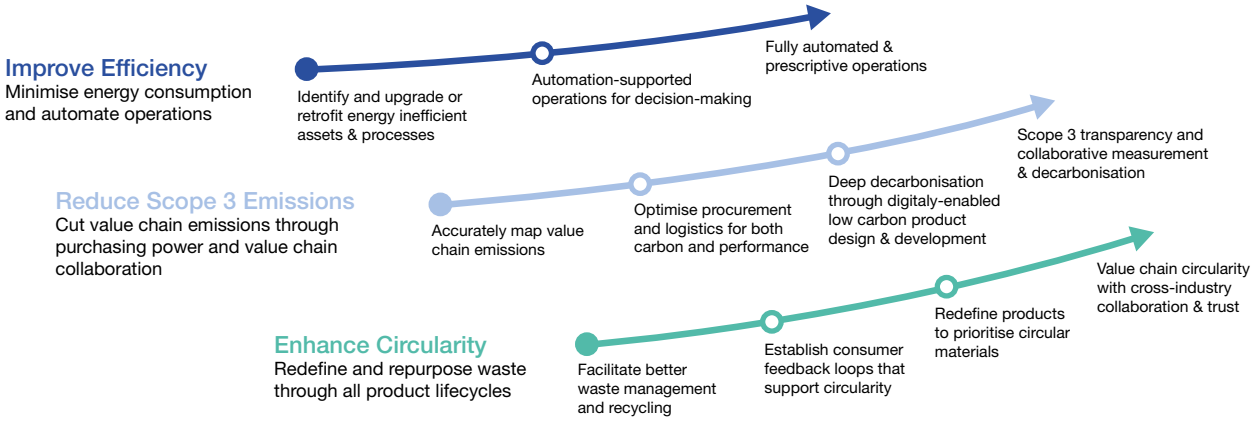
FIDIC's *Digital disruption and the evolution of the infrastructure sector* State of the World report, published in 2022, highlighted the role of technology in disrupting industries and changing business models due to shifts in technology and data usage. The report highlighted the importance of recognising the constant pace of change and the necessity to adapt to challenges such as net zero emissions. It explored the practical role of technology in the development of infrastructure and its impact on carbon reduction, retrofitting and increased cooperation.

It highlighted the role of technology not only as a disruptor but also as an innovator and how it continues to evolve at an unprecedented pace. Whilst most believe this is a new phenomenon, the pace of technological change and the need for business to invest and maintain a relevant skills base have always been essential. Whilst technology provides multiple opportunities for more efficient working, communication monitoring etc, it also poses several challenges.

As we have seen in recent times with the introduction of GDPR requirements, users are increasingly becoming aware of the data that is being stored on their activity. Authorities are also improving the rights of individuals to access, monitor and if need be, delete such data held on them if so requested. This therefore requires new levels of compliance, governance and risk assessment for companies. Such data is also becoming increasingly more valuable and cybercrime is still a threat as a direct result of this. Companies are increasingly aware of attempts to try and harvest or illegally access their systems. Such systems therefore now need to be more resilient and secure than ever, whilst also increasingly being integrated and able to share data with other systems both internally and externally.

This challenge is not going to subside with the pace of technological change. The report explored the pace of this technological change and showed that not only is the pace of change significant, but that many of the technology companies we use today for day-to-day activities in the grand scheme of time are actually very young and company longevity is continuing to decline. This suggests that not only is the pace of change faster but the companies and people we deal with today may not be the ones we are dealing with in ten years' time.

Digital can support the road to net zero for hard-to-abate sectors across materials, energy, building, and mobility.



Source: (Adapted from) Accenture in collaboration with the World Economic Forum[1]

/The journey from disruption and innovation to net zero

Digitalisation has revolutionised the way industries operate, disrupting traditional business models and transforming various sectors including infrastructure. The pace of change in the digitalisation of infrastructure has been remarkable with technology serving as a significant disruptor in industries.

First and foremost, the speed at which digitalisation has advanced in the infrastructure sector is unparalleled. Technological advancements such as the Internet of Things (IoT), artificial intelligence (AI), Building Information Modelling (BIM), digital twins, cloud computing and big data analytics, have rapidly transformed how infrastructure is designed, constructed, operated and maintained. These advancements have enabled the development of smart infrastructure, where physical assets are embedded with sensors, connected to networks and powered by data-driven insights. This has facilitated real-time monitoring, predictive maintenance and optimisation of infrastructure performance, resulting in improved efficiency and resilience as well as sustainability.

Furthermore, the role of technology as a disruptor in industries cannot be overstated. Digitalisation has disrupted traditional business models and value chains, challenging established norms and creating new opportunities. For instance, in the construction industry, BIM and digital twins are revolutionising the design and construction processes, allowing for virtual modelling, simulation and coordination, which has improved collaboration, reduced errors and accelerated project timelines. While these technologies have brought about significant improvements, their full potential is yet to be realised as their integration and adoption are still an ongoing process.

In the transportation sector, ride-sharing and on-demand mobility services have disrupted the traditional model of car ownership and transformed urban mobility. In the energy sector, renewable energy technologies, such as solar and wind power, have disrupted the traditional fossil fuel-based energy generation, leading to a shift towards sustainable and decentralised energy systems.

Technology has also disrupted the workforce in industries undergoing digitalisation. Automation and robotics have transformed labour-intensive tasks, leading to workforce displacement and the need for reskilling and upskilling is essential to offset the impact of digitalisation on employment and social equity.

Hence the pace of change in the digitalisation of infrastructure has been rapid, and technology has played a disruptive role in various industries. It has transformed traditional business models, disrupted value chains and redefined the workforce. As industries continue to embrace digitalisation, understanding the rapid pace of change and the disruptive role of technology is crucial for navigating the opportunities and challenges in this digital era.

Change is continuing at pace and will need to continue to do so to meet net zero

Pressure is mounting on the race to zero emissions. Countries, regions, cities and companies have all made bold commitments to decarbonise within the coming decades. However, how can they turn those pledges into concrete actions that actually achieve their goals? Particularly in areas as complex as the built environment.

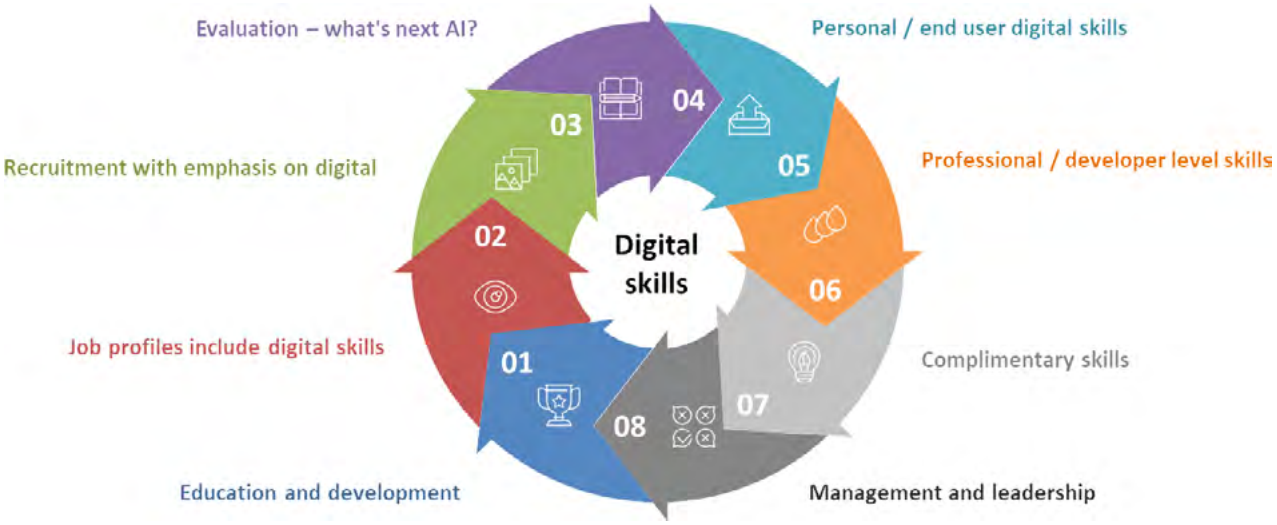
In today's rapidly evolving world, digitalisation has become a key enabler for transforming infrastructure to meet the challenges of the future, including the urgent need to achieve net zero emissions. The recognition that change is constant and inevitable and embracing this reality, is crucial to effectively addressing challenges such as achieving net zero.

The infrastructure sector is facing unprecedented challenges, such as increasing urbanisation, growing populations and the urgent need to mitigate climate change by reducing greenhouse gas emissions. Digitalisation provides opportunities to optimise infrastructure systems, enhance sustainability, and create more resilient and adaptive solutions. It is important, however, to recognise that digitalisation itself is a constantly evolving process that requires ongoing adaptation and innovation.

Emphasising the need to recognise that change is constant and inevitable is vital because it highlights the importance of being proactive and adaptive in the face of rapidly changing technological advancements and shifting societal and environmental needs. Infrastructure systems need to be designed, implemented and operated with the flexibility to adapt to changing circumstances and digitalisation can enable this by providing real-time data, analytics and insights that can inform decision-making and optimise operations.

Furthermore, the recognition of change as a constant factor in digitalisation also underscores the need for continuous learning, upskilling and reskilling of the workforce. As technologies evolve, the skills required to design, build, operate and maintain digitalised infrastructure systems will also evolve. Emphasising the importance of a skilled and adaptable workforce in the digitalisation of infrastructure can help address concerns related to workforce displacement and ensure that the workforce is prepared to meet the changing demands of the industry.

Investing in digital technologies positively correlates with employment of high-skilled workers, which highlights the need to enhance the skillset of the workforce to meet the demands of an evolving industry. Developing working partnerships with academics and sponsoring programmes that provide work experience opportunities in the private sector are crucial in nurturing talent and developing a more hands-on and interdisciplinary engineering curriculum. Offering on-the-job training opportunities and graduate schemes to those with little experience, as well as encouraging ongoing professional development, is also important. Developing professional certifications and standards and encouraging transnational collaboration to enhance safety standards in engineering-intensive industries, is crucial. The investment in machine-based digital technologies, such as robots, 3D printing and the 'internet of things', is driving the current industrial revolution and therefore it is essential to develop a skilled workforce that can meet the demands of the digital age.



Digital skills – supply, demand and development

Additionally, recognising change as inevitable also underscores the importance of fostering a culture of innovation and collaboration. Digitalisation often involves interdisciplinary collaboration, as well as partnerships between the public and private sectors, academia and communities. Emphasising the need for open collaboration, knowledge sharing and continuous improvement can foster innovation and drive positive change in the digitalisation of infrastructure.

In the context of achieving net zero emissions, recognising change as a constant factor is particularly important. The transition to a low-carbon economy requires innovative and sustainable solutions that can be adapted to changing technologies, policies and market conditions. Digitalisation can play a critical role in enabling the integration of renewable energy, electrification of transportation and optimisation of energy systems, but it requires a proactive approach that recognises change as inevitable and embraces the need for ongoing adaptation and innovation.

The need to recognise that change is constant and inevitable is crucial in the context of digitalisation in infrastructure. It highlights the importance of being proactive, adaptable and innovative in the face of evolving technologies, societal needs and environmental challenges, including the urgent need to achieve net zero. By recognising change as a constant factor, we can effectively harness the power of digitalisation to transform infrastructure and create a more sustainable, resilient and adaptive future.

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/The role of technology in meeting net zero goals

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/The role of technology in meeting net zero goals

The achievement of net zero targets in the infrastructure sector requires a holistic and integrated approach that leverages the power of digital systems. Digitalisation, as a key enabler, will play a pivotal role in facilitating the transformation needed to achieve net zero emissions. The use of digital systems in the infrastructure sector will be necessary to drive innovation, optimise operations, enable data-driven decision-making and enhance sustainability.

Digital systems enable the collection, analysis and management of vast amounts of data that can inform and optimise infrastructure operations. For instance, through the 'internet of things' (IoT), sensors and connected devices can collect real-time data on energy consumption, emissions and other critical parameters from various infrastructure assets, such as buildings, transportation systems and energy grids. This data can then be analysed using advanced analytics and artificial intelligence (AI) algorithms to identify patterns, trends and inefficiencies, leading to informed decision-making for optimising operations and reducing emissions.

Moreover, digital systems facilitate the integration of renewable energy sources and the optimisation of energy systems. Renewable energy, such as solar and wind power, plays a significant role in achieving net zero targets by reducing reliance on fossil fuels. As the use of these technologies expands, as does the use of electric vehicles, it will however, become increasing complex to balance energy systems as more generation is based on intermittent technologies, reducing the resilience of base load in the system.

Source: World Economic Forum. (2021)[2]

Digital systems can enable the effective integration of renewable energy into the grid, leveraging advanced grid management and energy storage technologies to ensure efficient utilisation and integration of intermittent renewable energy sources. Additionally, digital systems can enable the optimisation of energy systems through demand-side management, energy storage and smart grid technologies, leading to more efficient energy use and reduced emissions.

These systems can enable the design, construction, and operation of sustainable infrastructure. Building Information Modelling (BIM), for example, is a digital system that allows for virtual modelling, simulation and coordination of construction processes. This can result in optimised designs, reduced waste, improved construction efficiency and enhanced energy performance of buildings and other infrastructure assets, supporting the transition to net zero emissions and of constructing in a truly circular economy way

Furthermore, digital systems can support predictive maintenance and asset management, leading to optimised resource utilisation, reduced downtime and extended asset lifespan. By leveraging data analytics, machine learning and condition monitoring, digital systems can enable predictive maintenance of infrastructure assets, ensuring that assets are operating efficiently and effectively, minimising unnecessary maintenance activities and associated emissions.

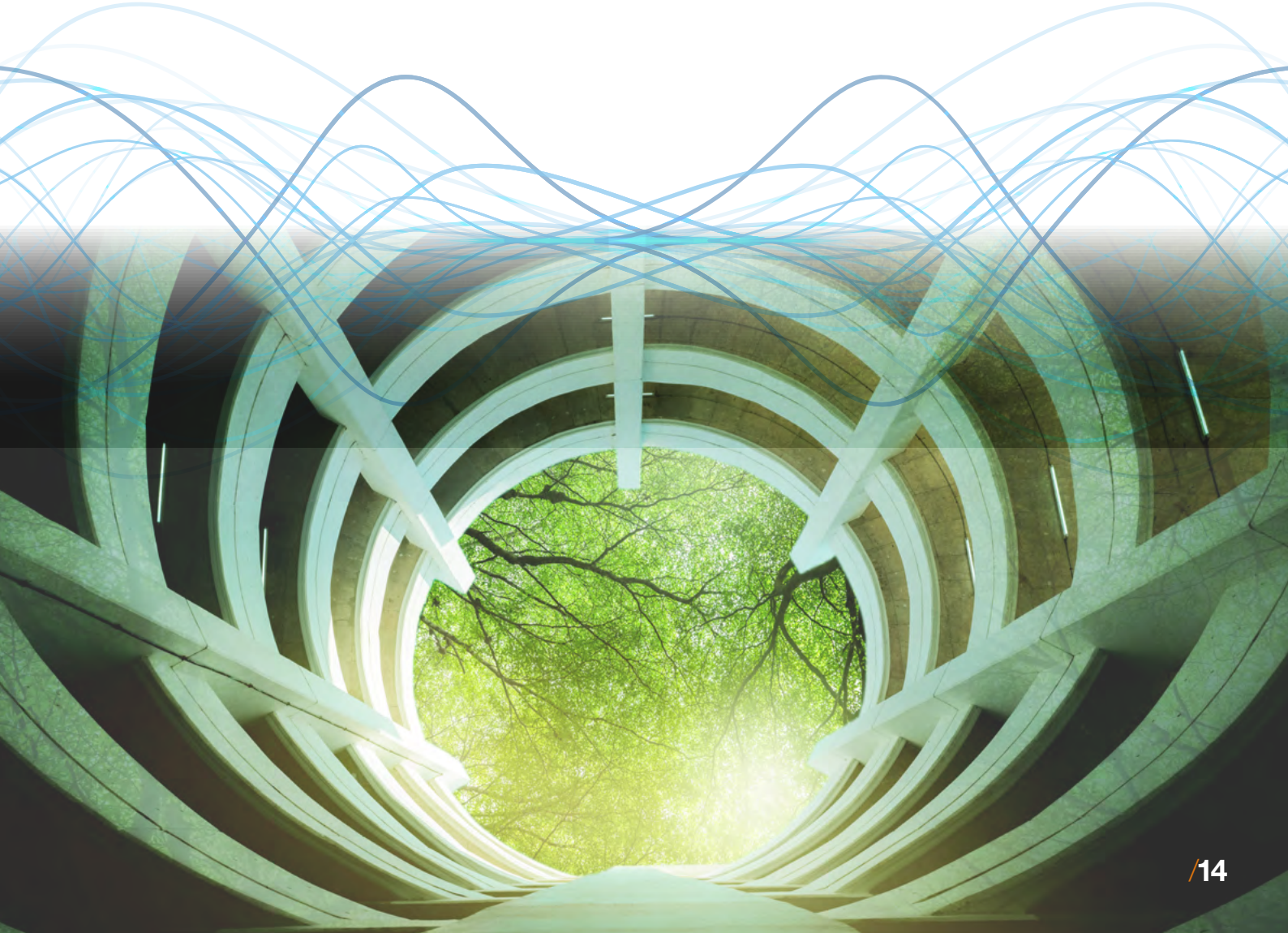
/The role of technology in meeting net zero goals

Thus, digital systems are essential for achieving net zero targets in the infrastructure sector. They enable data-driven decision-making, optimisation of operations, integration of renewable energy, design and construction of sustainable infrastructure and predictive maintenance of assets. The use of digital systems in the infrastructure sector is imperative for driving innovation and transformation towards a more sustainable resilient and net-zero-emissions future. The International Energy Agency states that digital technologies will be crucial in driving innovation and transformation towards a more sustainable, resilient and net-zero-emissions future. Moreover, a recent report from the Carbon Trust found that digitalisation of the infrastructure sector could help to reduce global carbon emissions by up to 20%.

Data-driven decision-making is the future

Technology has immense potential to enable data-driven decision-making and optimise resource usage in the infrastructure sector. With the increasing availability of data from various sources, such as sensors, connected devices and other digital systems, coupled with advancements in data analytics and artificial intelligence , infrastructure stakeholders can leverage technology to make informed decisions and optimise the utilisation of resources.

Data-driven decision-making is the process of using data to inform and guide decision-making, rather than relying solely on intuition or experience. In the infrastructure sector, data-driven decision-making can be applied to various areas, such as energy management, water management, transportation planning and asset maintenance, among others. By collecting, analysing and interpreting relevant data, decision-makers can gain insights into the performance, efficiency and sustainability of infrastructure operations and make informed decisions to optimise resource usage.



/The role of technology in meeting net zero goals

Energy: In energy management, digital systems can collect real-time data on energy consumption, production and distribution from various infrastructure assets, such as buildings, transportation systems and energy grids. Advanced analytics and AI algorithms can then process this data to identify patterns, trends and inefficiencies and provide insights on how to optimise energy usage, reduce waste and improve overall energy efficiency. This can result in significant energy savings, reduced greenhouse gas emissions and cost savings.

Water: Similarly, in water management, digital systems can collect data on water usage, quality and distribution from various sources, such as sensors, weather stations and geographic information systems. Data analytics and AI can then analyse this data to optimise water usage, identify leaks or inefficiencies in distribution systems and optimise water treatment processes. This can lead to more sustainable water usage, reduced water waste and improved water resource management.

Transport: In transportation planning, digital systems can collect data on traffic patterns, vehicle movements and transportation infrastructure conditions. This data can be analysed using advanced analytics and AI to optimise transportation routes, reduce congestion and improve overall transportation efficiency. This can result in reduced fuel consumption, emissions and transportation costs, while improving the reliability and effectiveness of transportation systems.

Maintenance: In asset maintenance, digital systems can collect data on asset performance, condition and maintenance history. This data can be analysed to predict asset failures, optimise maintenance schedules and improve asset performance. Predictive maintenance can help prevent unexpected asset failures, reduce downtime and extend asset lifespan, resulting in more efficient resource usage and reduced maintenance costs.

Recommendation 1

Embrace the transformative power of digital systems to achieve ambitious net zero targets in the infrastructure sector. Capitalise on technology's potential to facilitate data-driven decision making, optimise resource utilisation and seamlessly integrate renewable energy sources, electrified transportation and other sustainable practices.

Renewable energy sources will drive electrification and data-driven grids and services, within which technology plays a crucial role in facilitating the integration of renewable energy sources, electrification of transportation and other sustainable practices. One significant way technology contributes to these initiatives is through advanced Renewable Energy Management Systems. These systems utilise sophisticated software solutions that optimise the management and integration of renewable energy sources, such as solar, wind and hydro power into the power grid. Through data analytics, machine learning and automation, these systems can forecast renewable energy generation as well as facilitate efficient utilisation and help with grid stability. This helps increased penetration of the renewable energy into the energy mix, reducing reliance on fossil fuels and promoting sustainability.

/The role of technology in meeting net zero goals

Energy storage solutions are another critical aspect of integrating renewable energy sources. Energy storage technologies, such as batteries, pumped hydro storage and thermal energy storage, store excess energy generated from renewable sources during periods of high production and release it during periods of low production or high demand. This helps address the intermittency of renewable energy sources and ensures a reliable energy supply. Advancements in energy storage technologies, including improved energy density, longer battery life and decreased costs, are making energy storage solutions more viable and scalable, thus facilitating the integration of renewable energy into the grid.

Green hydrogen, which is produced sustainably using renewable energy sources, is expected to replace gas in some countries like the UK and others. This process involves the electrolysis of water, which separates hydrogen from oxygen, using electricity generated by renewable energy sources. The hydrogen can then be stored and used to power fuel cells or burned in combustion engines, producing only water and heat as by-products.

Hydrogen is particularly promising in the transportation sector, where it can be used to power fuel cell electric vehicles (FCEVs), providing a zero-emissions alternative to gasoline-powered vehicles. FCEVs have a longer range and shorter refuelling time than battery electric vehicles (BEVs), making them a more viable option for long-distance travel. The use of green hydrogen in transportation can also help to reduce greenhouse gas emissions and improve air quality, making it a more sustainable option.

Examples of countries that are investing in green hydrogen include the UK, which aims to produce 5GW of low-carbon hydrogen by 2030 and Germany, which plans to produce 5GW of hydrogen by 2030 and 10GW by 2040. The EU is also investing in hydrogen as part of its Green Deal, which aims to make the EU carbon-neutral by 2050.

The role that technology plays in the electrification of transportation is pivotal. Electric vehicles (EVs) are a sustainable alternative to traditional fossil fuel-powered vehicles and technology is driving the development of EV charging infrastructure. Fast-charging networks, smart charging stations, and Vehicle-to-Grid (V2G) systems are being deployed to support EV adoption. Fast-charging networks enable quicker charging times for EVs, making them more convenient and accessible to users. Smart charging stations can optimise charging based on factors such as grid demand, renewable energy availability and user preferences, ensuring efficient utilisation of energy. V2G systems allow EVs to not only charge from the grid but also feed excess energy back into the grid, contributing to grid stability and supporting renewable energy integration.

‘Internet of things’ (IoT) and energy management systems are also instrumental in facilitating sustainable practices. IoT and energy management systems enable better monitoring, control and optimisation of energy consumption in buildings, industries and homes. Smart meters, sensors and automation systems can collect and analyse data on energy usage, enabling demand-side management and load balancing. This leads to improved energy efficiency, reduced energy waste and better integration of renewable energy sources into the grid. Additionally, IoT can enable remote monitoring and control of energy systems, allowing for real-time adjustments and optimisations, further supporting sustainability efforts.

The advent of smart meters, sensors and automation systems is revolutionising the way we consume and manage energy. These technologies are enabling user-driven change, empowering individuals and organisations to take an active role in reducing their carbon footprint and promoting sustainability. Smart meters, for example, provide real-time data on energy consumption, allowing users to monitor and adjust their usage patterns to reduce waste and save money on their bills.

By collecting and analysing data on energy usage, smart meters and other sensors can also enable demand-side management and load balancing, helping to reduce peak demand and improve the stability of the grid. This not only improves energy efficiency but also enables the better integration of renewable energy sources, such as wind and solar power, into the grid. With the ability to adjust energy usage in real-time, users can make the most of intermittent renewable energy sources and reduce their reliance on fossil fuels.

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/Technology agnosticism, standardisation and open data? What and where is the balance?

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/Technology agnosticism, standardisation and open data? What and where is the balance?

Technology agnosticism

Technology agnosticism is a concept that refers to the design and implementation of digital solutions in a way that is adaptable and not tied to specific technologies. It emphasises flexibility and interoperability, allowing digital solutions to evolve and adapt to changing technological landscapes, without being locked into proprietary technologies or becoming obsolete as technologies evolve.

One of the key principles of technology agnosticism is the focus on open standards and protocols. Open standards are technical standards that are openly available, non-proprietary and can be implemented by multiple vendors. They promote interoperability and allow different technologies and systems to communicate and work together seamlessly. By designing digital solutions based on open standards, organisations can ensure that their solutions are not tied to specific technologies or vendors and can be easily integrated with other technologies or systems, both now and in the future.

ChatGPT for example, as a language model trained on the GPT-3.5 architecture, has had a significant impact on the development and implementation of digital solutions in various industries. One of the key principles of technology agnosticism, which ChatGPT embodies, is the use of open standards and protocols in designing digital solutions.

The remarkable pace at which ChatGPT has permeated global spheres and garnered millions of users is unparalleled, underscoring a resounding testament to the world's unwavering embrace of technological advancements and digital transformation.

Source: Digital Information World. (2023, January). Chat GPT Achieved One Million Users in 2023[3]

In the infrastructure sector, ChatGPT has also become part of the construction industry, with its artificial intelligence now allowing contractors to talk to their plans and their plans talking to them back! The announcement was made by Togal.AI a construction technology business that produces estimating software. Togal.AI has launched OpenAI ChatGPT, a system intended to enhanced document management. With hundreds of pages in construction plans, ChatGPT helps users save time, improve accuracy and serve as a powerful tool to eliminate mundane tasks, so estimators can focus on higher-value jobs. The system allows construction professionals to use semantic search functionality to quickly access information across thousands of pages of, for example, plans, specification books, schedules and budgets.

/Technology agnosticism, standardisation and open data? What and where is the balance?

Interestingly, research by the KOF Swiss Economic Institute[4] has shown when looking into the role and implementation of technology and how it relates to the skills of companies and their performance found that:

- Specifically, we found that investment in **digital technologies is positively associated with employment of high-skilled workers** and **negatively associated with employment of low-skilled workers**, with an overall positive net effect on employment.
- These effects are **entirely driven by machine-based digital technologies** (robots, 3D printing, the 'internet of things') that are supposed to fuel the current industrial revolution.
- We find **no significant impact of investment in digitalisation** when only firms that adopt non-machine-based digital technologies, such as ERP, e-commerce or cooperation support systems, are considered.

Another aspect of technology agnosticism is the use of modular and flexible architectures. Modular architectures involve designing digital solutions as a collection of smaller, interchangeable components or modules that can be easily replaced or upgraded as needed. This allows for flexibility in incorporating new technologies or replacing outdated ones without disrupting the entire system. Flexible architectures also allow for scalability, enabling solutions to grow or adapt to changing needs over time.

Furthermore, technology agnosticism promotes a mindset of continuous learning and adaptation. It encourages organisations to stay updated with the latest technological developments, evaluate new technologies objectively and adopt those that align with their goals and requirements. It also encourages organisations to invest in building the skills and capabilities necessary to adapt to new technologies, rather than being solely reliant on specific technologies or vendors.

Technology agnosticism can have several benefits. It can help organisations future-proof their digital solutions by making them adaptable to changing technological landscapes. It can also foster innovation and competition by enabling organisations to choose the best technologies for their needs, rather than being locked into proprietary technologies. Moreover, technology agnosticism can support interoperability and data exchange among different systems or organisations, enabling seamless integration and collaboration.

However, there are also challenges associated with technology agnosticism. It may require additional effort and resources to design, implement, and maintain digital solutions that are adaptable to multiple technologies. There may also be trade-offs in terms of performance or features, as some proprietary technologies may offer unique capabilities that may not be available in open standards. Additionally, ensuring data security, privacy and compliance can be more complex when working with diverse technologies.

Recommendation 2

Prioritise adaptability and interoperability and the implementation of machine-based technologies in digital systems, liberating infrastructure from the shackles of specific technologies. Champion the need for standardised and interoperable digital solutions, ensuring future-proofing, scalability and the avoidance of technological dependencies.

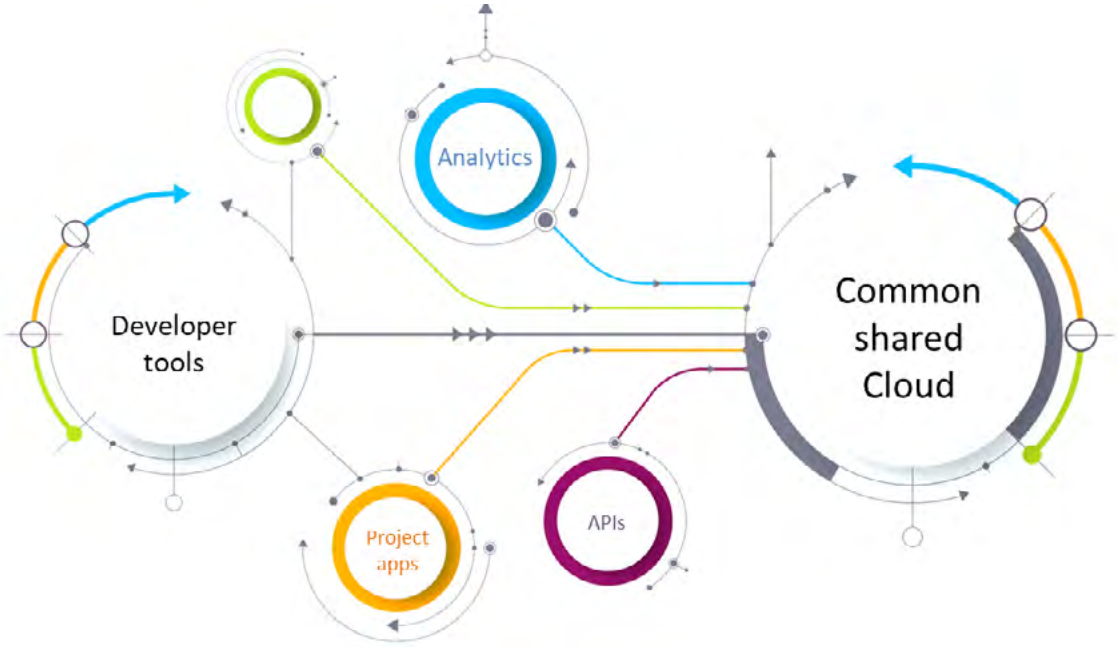
/Technology agnosticism, standardisation and open data? What and where is the balance?

Open source and data sharing - the flexibility we need to get to net zero?

Flexibility and interoperability are paramount in digital systems to ensure future-proofing and to avoid technology lock-ins. In today's fast-paced technological landscape, where advancements are rapid and dynamic, being able to adapt and integrate with diverse technologies is crucial for sustainable and effective operations.

First and foremost, flexibility in digital systems enables organisations to respond to changing business requirements and market dynamics. As business needs evolve, the ability to modify and adjust digital systems to accommodate new processes, data sources, or user interfaces is critical. Flexible systems can easily scale up or down, add or remove functionalities and integrate with new technologies, allowing organisations to stay agile and responsive to changing demands. This agility is essential for remaining competitive in a rapidly evolving digital landscape.

Interoperability is equally vital for future-proofing digital systems. Interoperable systems are designed to seamlessly communicate and exchange data with other systems, regardless of their underlying technologies or platforms. This ensures that digital systems can integrate with new technologies and adapt to evolving standards without being tied to a specific vendor or proprietary technology. Interoperability fosters an ecosystem of interconnected systems, enabling organisations to choose the best-in-class solutions and avoid being locked into a particular technology or vendor, which can limit their flexibility and hinder innovation.



As can be seen from the architecture diagram above, it is increasingly important to be able to integrate specific and shared components. This means, mixing and integrating shared cloud systems that utilise shared developer tool kits that can then output or provide project specific components, but share data analytics via various methods including for example the use of APIs.

Avoiding technology lock-ins is crucial for organisations to avoid being trapped in obsolete or costly technologies that may become redundant in the future. Technology lock-ins can limit an organisation's ability to innovate, adapt, or switch to more advanced solutions, resulting in increased costs, reduced competitiveness and potential disruptions to operations. By prioritising flexibility and interoperability, organisations can future-proof their digital systems, ensuring they can evolve and integrate with new technologies as needed, without being constrained by outdated or proprietary technologies.

In addition, flexibility and interoperability foster collaboration and partnerships among different organisations. Interoperable systems enable seamless data exchange and interoperable processes, allowing organisations to collaborate and share information more effectively. This promotes innovation, efficiency and synergies among different stakeholders, driving digital transformation across industries and creating new business opportunities.

/Technology agnosticism, standardisation and open data? What and where is the balance?

Standardisation or at least harmonisation will be key

The need for standardisation and interoperability in the development and implementation of digital solutions in infrastructure projects cannot be overstated. Standardisation refers to the establishment of common frameworks, protocols and guidelines, while interoperability refers to the ability of different systems or technologies to seamlessly exchange data and work together. Together, they form the foundation for effective digitalisation in infrastructure projects, bringing numerous benefits, some of which are outlined below.

Seamless data exchange: Infrastructure projects involve multiple stakeholders, such as government agencies, contractors, subcontractors and consultants, who use different systems and technologies. Standardisation and interoperability ensure that these diverse systems can exchange data seamlessly, facilitating efficient communication, collaboration and decision-making. This enables stakeholders to work together effectively, reduces data errors and redundancies and streamlines project processes.

Enhanced project efficiency: Standardisation and interoperability enable the integration of different digital solutions, such as Building Information Modelling (BIM), Geographic Information Systems (GIS), and Project Management Information Systems (PMIS), into a cohesive ecosystem. This allows for automated data exchange, real-time updates and streamlined workflows, resulting in enhanced project efficiency, reduced delays and improved project outcomes. Standardised and interoperable digital solutions enable better project planning, monitoring, and control, leading to more effective resource allocation and improved project performance.

Futureproofing and scalability: Standardisation and interoperability ensure that digital solutions in infrastructure projects are built on open, standardised frameworks and technologies, rather than proprietary or closed systems. This allows for greater flexibility, adaptability and scalability, as projects can evolve and integrate with new technologies in the future without being tied to specific vendors or technologies. Future-proofing digital solutions in infrastructure projects mitigates the risk of technology obsolescence, reduces switching costs and enables long-term sustainability.

Cost-effective solutions: Standardisation and interoperability facilitate competition and innovation among technology providers, leading to a wider range of options and cost-effective solutions for infrastructure projects. When different systems can seamlessly exchange data and work together, it promotes a competitive market where organisations can choose the best-in-class solutions that meet their specific needs and budget. This drives down costs, increases affordability and promotes a healthy ecosystem of digital solution providers, fostering innovation and driving digital transformation in the infrastructure industry.

Improved data management and governance: Standardisation and interoperability provide a robust framework for data management and governance in infrastructure projects. Common data standards, protocols and guidelines ensure that data is captured, stored and exchanged consistently and securely, enabling data integrity, accuracy and traceability. This facilitates effective data management, analysis and reporting, supporting evidence-based decision-making and ensuring compliance with regulatory requirements.

/Technology agnosticism, standardisation and open data? What and where is the balance?

Inevitably standardisation and interoperability are critical in the development and implementation of digital solutions in infrastructure projects. They enable seamless data exchange, enhance project efficiency, future-proof digital solutions as well as promote cost-effective options and improve data management and governance. Emphasising standardisation and interoperability in digitalisation efforts in infrastructure projects is essential for achieving successful outcomes, maximising the benefits of digital solutions and driving sustainable innovation in the infrastructure industry.

FIDIC has recognised the critical role of standardisation and interoperability in the development and implementation of digital solutions in infrastructure projects. FIDIC contracts incorporate provisions that emphasise the importance of standardisation and interoperability, ensuring that digital solutions are designed to be future-proof and can work together seamlessly. By promoting standardisation and interoperability in digitalisation efforts, FIDIC contracts help to improve project efficiency, data management and governance. This, in turn, enhances the cost-effectiveness of digital solutions, maximises their benefits and drives sustainable innovation in the infrastructure industry. By adopting FIDIC contracts, infrastructure projects worldwide can ensure that they are built sustainably and are capable of contributing to the global efforts of achieving net zero emissions.

Procurement and greater data sharing

Technology plays a crucial role in procurement and contract management in the infrastructure sector. Today, technology has become an essential tool that helps businesses achieve operational efficiency and drive success. In procurement and contract management, technology can significantly enhance the overall efficiency of the process and minimise the risk of errors and delays.

One of the most significant benefits of technology in procurement and contract management is automation. With the help of technology, businesses can automate various processes, such as supplier selection, requests for proposals and contract negotiations. Automation streamlines these processes, reduces the time taken, and minimises the risk of human error.

Automating digital contracts and contract management software is also a major part of digitalising infrastructure. Technology has made it possible to create digital contracts that can be signed electronically making the process faster and more convenient. This eliminates the need for paper contracts which can be time-consuming to sign and file. Contract management software also helps organisations manage contracts by automating the process. This software can help with everything from creating contracts to tracking changes and renewals, making the process more efficient and reducing the risk of errors.

As the world becomes increasingly digital, FIDIC recognises the need to adapt and embrace digital solutions in the infrastructure industry. The FIDIC Contracts Committee is actively focusing on the digitalisation of FIDIC contracts, acknowledging that it will be crucial in the future. By recognising the need for digitalisation and proactively addressing it through the development of standardised digital contracts, FIDIC is taking a proactive step towards ensuring that the infrastructure sector is well-equipped to address the challenges of the future. Another significant advantage of technology is its ability to improve transparency and visibility. With the use of technology, businesses can monitor and track the procurement process, contract compliance and supplier performance in real-time. This helps businesses identify potential risks and take corrective actions proactively, thereby reducing the likelihood of contract disputes.

Furthermore, technology can facilitate collaboration and communication among stakeholders involved in the procurement and contract management process. With cloud-based solutions, multiple stakeholders can access relevant documents and data in real-time, making it easier to share information and collaborate on projects.

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/Technology and infrastructure projects both new and existing

/SOW2023

Technology and infrastructure projects both new and existing

Technology in new infrastructure

Technology plays a critical role in the development of new infrastructure projects, such as smart cities, green buildings and sustainable transportation. It enables the design, construction and operation of infrastructure that is more efficient, sustainable and resilient, contributing to a better quality of life for people and the environment.

In the context of smart cities, technology is used to create connected and integrated systems that optimise the use of resources, improve service delivery and enhance the overall urban experience. For example, 'internet of things' sensors can be deployed to collect data on various aspects of urban life, such as traffic flow, air quality and energy consumption. This data can be analysed in real-time to inform decision-making, optimise resource allocation and improve urban planning. Additionally, technologies such as artificial intelligence, big data analytics and blockchain can be used to manage and analyse the vast amounts of data generated by smart city systems, enabling more efficient and effective management of resources.

Green buildings, which are designed to be environmentally responsible and resource-efficient, rely heavily on technology to achieve their sustainability goals. Information management software allows for virtual modelling of buildings, helping architects and engineers optimise designs for energy efficiency, water conservation and waste reduction. Energy management systems, such as smart thermostats and automated lighting, enable real-time monitoring and control of building energy consumption. Renewable energy technologies, such as solar panels and wind turbines, can be integrated into the design of green buildings to generate clean energy on site. Furthermore, smart building technologies, such as occupancy sensors and advanced building management systems, enable efficient use of resources and reduce operational costs over the building's lifecycle.

A Structured Methodology for Planning Commercial Real Estate Portfolio Decarbonisation

Case study provided by: Schneider Electric

Beyond compliance with reporting and regulations, building owners and operators are also facing new market pressures. Tenants, employees, and hiring prospects now demand work and living spaces that are more sustainable, healthy and resilient. It is within this scope of greener assets – ones that avoid a 'brown discount' in the perception of the wider real estate market – that investors are increasingly focusing on maximising returns and reducing risk.

The valuation of building stocks and investment strategies is increasingly tied to sustainability. Commercial real estate firms must set a path to decarbonise existing building assets or risk impacting future profitability. While it is incumbent on asset owners and managers to enable modernisation work on behalf of ownership during financial control of an asset, they are faced with a confluence of needs when managing large portfolios or funds encompassing an array of building types. This presents a multi-dimensional challenge, from setting objectives, engaging stakeholders and acquiring data, to prioritising opportunities and interventions, minimising disruptions and funding projects.

The race to net zero carbon is challenging the global commercial real estate (CRE) market. Banks, the broader investment community, tenants and all CRE stakeholders now demand sustainable building practices. The valuation of building stocks and investment strategies is increasingly tied to sustainability, wellness and resilience. To reduce risk and avoid compromising future profitability, a path must be set to decarbonise existing building assets. Schneider Electric offers a recommended six-initiative methodology that CRE teams can use to analyse and prioritise brownfield modernisation projects across large asset portfolios to achieve maximum payback with minimal disruption to occupants.

These recommendations are based on the successful collaboration between Brookfield Asset Management, WSP and Schneider Electric on a modernisation plan for portfolio decarbonisation that encompasses a variety of property types within a European asset fund.

The methodology has delivered three early wins:

1. Greater data coverage across the portfolio
2. An increase in Brookfield's GRESB (ESG performance) score
3. A springboard for the next level of asset modelling

Source: https://go.schneider-electric.com/WW_202306_A-Structured-Methodology-for-Planning-Commercial-Real-Estate-Portfolio-Decarbonization_WSP-Brookfield-WP_FIDIC_MFLP.html

/Technology and infrastructure projects both new and existing

Sustainable transportation is another area where technology is driving innovation in infrastructure development. Electric vehicles (EVs) are becoming more prevalent and charging infrastructure, such as EV charging stations, is being deployed to support their adoption. Intelligent transportation systems (ITS), which use advanced technologies such as GPS, communication networks and data analytics, are being implemented to optimise traffic flow, reduce congestion and improve road safety. Connected and autonomous vehicles are also being developed, which have the potential to significantly improve transportation efficiency and reduce greenhouse gas emissions. Additionally, shared mobility services, such as ride-sharing and bike-sharing, are leveraging technology platforms to provide convenient and sustainable transportation options to users.

Retrofitting transportation infrastructure, such as highways and bridges, can involve the use of advanced materials, sensors and monitoring systems to enhance structural integrity, improve safety and reduce maintenance costs.

Technology is increasingly playing a crucial role in upgrading and optimising the performance of ageing infrastructure to meet modern sustainability requirements. For example, energy retrofits in existing buildings can involve the installation of smart building technologies, such as energy management systems, LED lighting and upgraded insulation, to reduce energy consumption and lower carbon emissions.

Recommendation 3

Drive innovation through technology: Unleash the potential of technology in both new infrastructure projects and the retrofitting of existing infrastructure. Seamlessly integrate digital technologies to revolutionise the development of smart cities, green buildings and sustainable transportation. Maximise the efficiency, longevity and environmental impact of existing infrastructure through intelligent retrofitting.

/SOW2023

Stacy Van Dolah-Evans
Global Segment Director – Design Firms
Digital Energy Division
Schneider Electric

Traditional procurement and collaboration methods are no longer enough

Traditional procurement and collaboration methods have become outdated and inherently inefficient in today's world and to survive, our industries have no option but to embrace change. As we shift into an environment where infrastructure, technology and entire supply chains need to work together, share data and drive change to achieve carbon reductions to meet net zero, we can no longer simply believe that today's model is sufficient.

This State of the World report is important as whilst the topic is broad it does highlight the increasing need for action. Below are some of the key factors that demonstrate why traditional procurement is no longer fit for purpose and that the way we all work has to change.

Lack of flexibility: Traditional procurement methods are characterised by rigid and sequential processes, which can be slow and inflexible. They follow a linear path from project initiation to contract award, often resulting in lengthy procurement cycles. In today's fast-paced business environment, organisations require more agile and responsive procurement approaches.

Limited supplier engagement: Traditional procurement tends to be a one-way process where the buyer sets requirements and seeks bids from suppliers. This approach restricts supplier involvement and collaboration during the early stages of project planning, limiting opportunities for innovation and value creation. Modern procurement recognises the value of early supplier involvement and emphasises strategic partnerships, but these models still do not fully engage manufacturers, software developers, engineers etc early enough in the process to ensure that every effort to reduce carbon and optimise is undertaken.

Focus on lowest cost: Traditional procurement methods often prioritise selecting suppliers either solely or primarily based on the lowest price. While cost is an important consideration, it should not be the sole determining factor. This focus is going to become increasingly stark as carbon reductions are required and low-carbon solutions may not always be the cheapest option. Emphasising the lowest cost can also lead to quality issues, delivery delays, as well as increased risk. Modern procurement recognises the importance of considering total cost of ownership, quality, sustainability and other factors.

Limited transparency and accountability: Traditional procurement processes may lack transparency, making it difficult to track and evaluate processes and outcomes. This can lead to a lack of accountability and potential corruption. Modern procurement practices prioritise transparency, fairness and accountability to ensure ethical and efficient procurement processes.

Inefficient use of technology: Traditional procurement methods often rely on user-based, manual, or even paper-based processes, which can be time-consuming, error-prone and resource-intensive. Artificial intelligence can and will play a role in changing this going forward. With advancements in technology, organisations can leverage digital tools and platforms for streamlined procurement processes, automated data analysis and improved decision-making.

Changing business landscape: The business landscape has evolved significantly in recent years, with globalisation still important, but also with a rise in protectionism, technological advancements and changing customer expectations will not always align to such shifts. Traditional procurement methods may struggle to adapt to these changes and may not effectively address emerging risks and challenges, such as supply chain disruptions, cybersecurity threats and sustainability requirements.

There is a major upshift in the requirement for intelligent electrical devices and BMS for the optimisation of buildings. This further exacerbates the need for clients to engage early with technology vendors to manage supply and demand risk. For example, demand for intelligent electrical distribution and the rise in electric heating and electric vehicle infrastructure is growing as the urgent need to decarbonise accelerates electrification and digitisation of buildings and infrastructure. Due to this growing demand, technology providers are increasingly prioritising certain customer types that are focused on intelligent solutions.

Emphasis on value creation: Modern procurement practices recognise the importance of value creation beyond cost savings. Organisations now aim to achieve strategic objectives, such as innovation, sustainability, social responsibility and risk mitigation, through their procurement activities. Traditional procurement methods are still widely used across the globe and going forward will not be sufficient to adequately address these broader objectives.

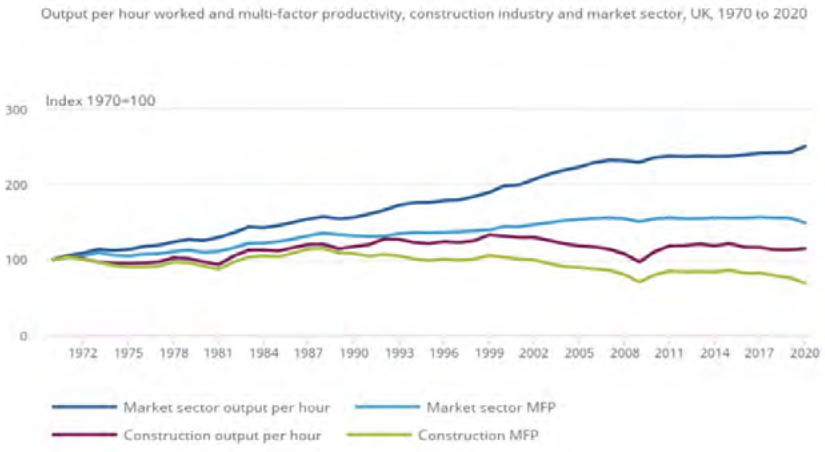
In response to these limitations, many organisations are adopting modern procurement approaches, such as strategic sourcing, collaborative procurement, e-procurement and supplier relationship management. These approaches aim to overcome the shortcomings of traditional procurement methods and align with the evolving needs and challenges of the business environment.

Schneider Electric stands at the forefront of digitalisation within the procurement domain, leading the transition from traditional to modern procurement practices worldwide.

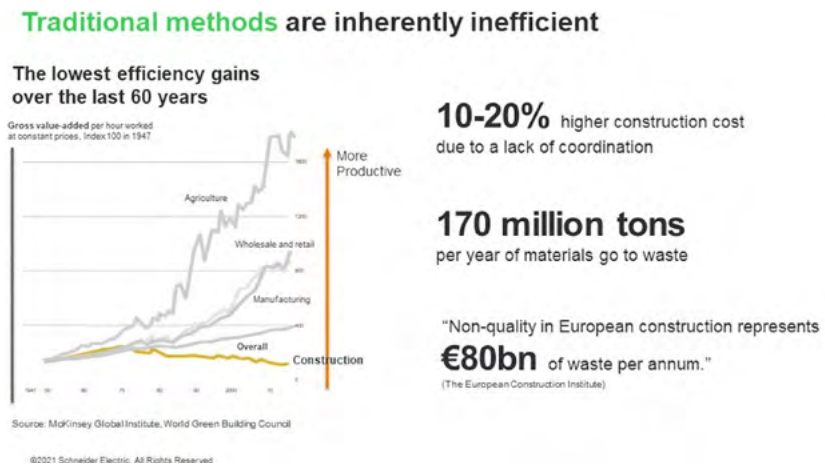
This journey might be a bumpy one for the construction sector being considered the least efficient sector in world industries (figure above) and if we were to embark on the journey to achieving net zero, drastic change is inevitable.

Schneider Electric endeavoured on a mission to relocate employees scattered across 17 disparate sites in Grenoble and unite them in three state-of-the-art sustainable buildings.

Firstly, Technopole is a major retrofit project that reduced 14 sites to a four-building campus.



Source: Office of national statistics – Labour productivity and multi-factor productivity[5]



Source: Schnider Electric (graphic) Mckinsey Global Institute, Green World Building Council (Data)

The Challenge:

- With no sustainability credentials, the challenge was to update existing office buildings to meet sustainability targets and accreditations
- Difficult to add new technology and no data visibility
- Reduce the number of sites and incorporate smart technologies to foster collaboration, improve the workplace and attract talent

The Solution:

- Digitise: Data-driven design and build via BIM modelling and energy simulation
- Decarbonise: Reduce energy consumption withs pace and meeting room management. Uses geothermal heat pumps,100% green energy electric supply and is smart-grid ready.

The Outcome:

- 46-48kWh sqm per year (Target 45kWh)
- Platinum LEED in Operations certified (91 points)
- Platinum LEED Design Build +Construction (83 points)
- Smart grid and solar ready
- Space and meeting room management to increase safety and efficiency

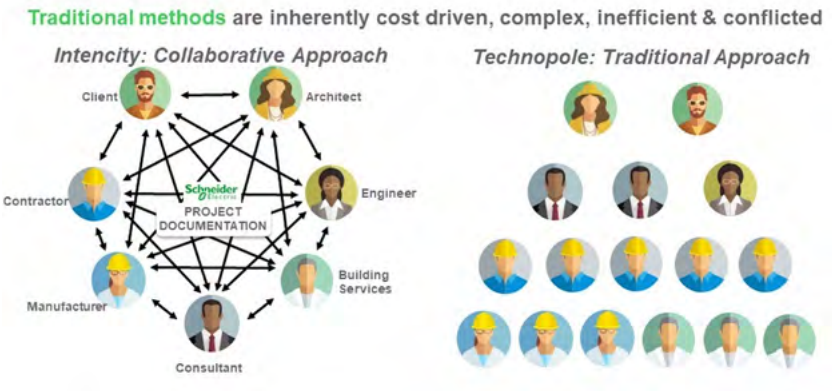
This project began in 2014 and adopted traditional procurement methods. Schneider Electric learned that retrofitting to this scale was not going to be possible via said traditional methods, as a result, they needed to upskill various supply chain players to deliver the desired outcomes. This of course added cost to the project.

Secondly, Intencity, Schneider Electric's net-zero new build project, also in Grenoble. This project showcases the transformative power of software industrialisation and modern procurement, where BIM 4 models and collaborative software played a pivotal role.

What is unique about IntenCity?

- It is an all-electric building with all heating, cooling, and cooking equipment powered by electricity only.
- The building is designed to consume only 37kWh per sqm per year, which is approximately 10% of the average consumption of a comparable building.
- IntenCity generates 970MWh from onsite renewable energy sources. This is enough to power 200 homes and is provided by wind turbines and 40,000 sqft of photovoltaic panel - enough to cover 15 tennis courts.
- Nestled between two rivers, it uses energy from groundwater in the aquifer to power the heating and cooling for most of the year.
- It is part of a microgrid and is able to share energy with a local university and other neighbouring buildings.
- It uses integrated lighting and climate control technologies that allow sub-segments of spaces to be deactivated when unoccupied, driving down energy usage and the resulting carbon footprint.
- It is a fully flexible design: the interior can be fully rezoned in software, I.e., all the building controls can be re-assigned without rewiring.
- Sun-tracking technology allows the building to balance daylight harvesting and shading perfectly to ensure the lowest possible energy consumption.
- It is designed to report its LEED certification data to the Arc Skoru platform automatically.
- The building is undergoing a two-year commissioning cycle to maximise decarbonisation efforts. The building operation is closely monitored to identify additional opportunities to avoid waste.
- This project is the culmination of a zero-carbon buildings research project which was initiated in 2008.

Schneider Electric enforced the lessons learned from Technopole for the IntenCity project, taking a different route toward the procurement market. Schneider selected appropriate parties who could deliver outcomes to BIM Level 4. This project showcases the transformative power of software industrialisation and modern procurement, where BIM 4 models and collaborative software played a pivotal role. By employing a streamlined machine process, the project was completed within the allocated budget and on time.



Source: Designing for Facility Management 2.0: Changing how digital systems are specified to achieve smart building outcomes

This success story highlights that the need for change extends beyond software alone; it underscores the significance of transforming the entire process, fostering a collaborative environment where all parties work together harmoniously.

Throughout the projects (starting in 2014), Schneider Electric conducted a study of all available software packages the industry uses, from design to completion; architect to cost consultants and project managers to technical engineers. What we discovered is that the software packages were not designed to work together; they were all legacy systems.

Through this study, Schneider and its partners have determined that with traditional procurement and delivery methods, it will be extremely difficult to achieve net zero carbon goals. The way forward must be modern procurement, data sharing and collaborative agnostic software. As highlighted by this report the journey to net zero is not just a carbon journey it is going to be a data and intelligence-driven one.

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/What did Covid teach us about technology change?

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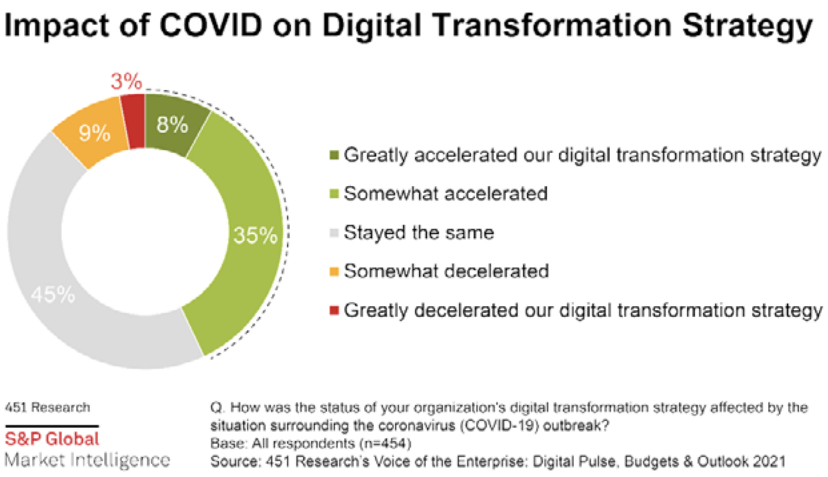
What did Covid teach us about technology change?

The Covid-19 pandemic brought unprecedented challenges to the global infrastructure sector, requiring swift and innovative responses to ensure business continuity and project resilience. In the face of these challenges, the adoption of digital technologies has emerged as a pivotal solution, propelling the industry into a new era of accelerated digital transformation. Since the pandemic, phrases like 'new normal', 'next new normal', and 'post-Covid world' have become part of everyday speech. And, although a fundamental restructuring of our economies and societies was apparent long before Covid-19, the pandemic has imbued it with unprecedented momentum. While former challenges such as digitalisation, the war of talents, disruption, globalisation and how to act in a world beset by volatility, uncertainty, complexity and ambiguity persist, they have now been enriched and supplemented by new concerns.



Source: 451 Research's Voice of the Enterprise: Digital Pulse, Budgets and Outlook[6]

The pandemic has reshaped the landscape of infrastructure development, driving a rapid shift towards remote work and virtual collaboration. From architects and engineers to contractors and owners, project teams have harnessed the power of digital tools such as MIBMI, cloud-based project management platforms and virtual communication tools to seamlessly collaborate and ensure project progress despite physical limitations. Through virtual design and construction processes, project stakeholders have transcended the boundaries of location and time, enabling them to conduct virtual design reviews, coordinate construction activities and monitor project progress with unparalleled efficiency. This digital revolution in remote work and virtual collaboration has not only ensured the continuity of projects during challenging times but has also fostered unprecedented levels of productivity, accuracy and innovation in the infrastructure sector.

Furthermore, the pandemic has spurred a paradigm shift in construction site management and safety through the adoption of cutting-edge digital technologies. With the need to minimise physical contact and mitigate risks, construction companies have turned to digital solutions such as IoT devices, wearables and real-time data analytics to monitor worker health and safety, optimise equipment usage and streamline construction schedules. Remote video monitoring, drones and robotics have been deployed to reduce on-site personnel, enhance safety protocols and optimise construction processes. These digital technologies have not only mitigated risks associated with crowded workspaces but have also elevated safety standards, increased productivity and enhanced project efficiency, fostering a safer and more resilient construction environment.

Moreover, the pandemic has catalysed the adoption of digital technologies in project documentation and communication, redefining how information is exchanged and managed in the infrastructure sector. Cloud-based document management systems, digital signature platforms and virtual meeting tools have become integral to project communication and collaboration, enabling seamless exchange of project information, tracking of changes and obtaining of approvals. These digital tools have streamlined project workflows and minimised delays as well as improved transparency among project stakeholders, fostering a culture of efficient and effective communication in the industry. Additionally, remote inspections, audits and certifications have been made possible through digital technologies, enabling projects to progress despite limitations on physical interactions.

What did Covid teach us about technology change?

We have also seen the adoption of digital technologies for remote training and upskilling in the construction and infrastructure sector. As traditional training methods faced disruptions, construction companies have turned to digital learning platforms, virtual simulations and augmented reality (AR) applications to deliver training and upskilling programmes to their workforce. These digital technologies have empowered workers to acquire new skills, enhance their capabilities and adapt to changing project requirements, even in times of limited physical interaction. This has not only ensured the continued professional development of the workforce but has also contributed to increased efficiency, quality and innovation in construction projects.

The Covid-19 pandemic has been a catalyst for the accelerated adoption of digital technologies in the infrastructure sector, revolutionising how projects are planned, designed, executed and managed. The widespread adoption of remote work, virtual collaboration, site management technologies, digital documentation and remote training has enabled the industry to overcome unprecedented challenges and embrace a new era of digital transformation. These digital technologies have not only ensured business continuity during these tumultuous times, but have also elevated productivity and resilience as well as safety in the infrastructure sector. As the industry continues to adapt and evolve, the adoption of digital technologies is poised to remain a driving force for innovation, sustainability and success in the infrastructure sector.

The Covid-19 pandemic has been a wake-up call for the infrastructure sector, underscoring the critical importance of rapid technology change, remote work and digital resilience. The lessons learned from this unprecedented crisis have been profound and have reshaped the way the industry operates, paving the way for a new era of digital transformation.

First and foremost, the pandemic has highlighted the imperative of embracing rapid technology change in the infrastructure sector. Organisations that were quick to adopt and leverage digital technologies such as BIM, virtual collaboration tools, IoT devices, and cloud-based project management platforms were able to navigate the challenges posed by the pandemic with agility and resilience.

The ability to quickly pivot and harness the power of digital solutions has proven to be a game-changer, enabling organisations to ensure business continuity and optimise project workflows as well as maintain productivity levels. The lesson here is clear - the need to embrace rapid technology change and stay abreast of the latest digital innovations has become non-negotiable for the infrastructure sector to thrive in the face of unforeseen challenges.

Secondly, the pandemic has underscored the value and viability of remote work in the infrastructure sector. With the adoption of remote work practices, project teams have been able to transcend the limitations of physical presence, enabling seamless collaboration, decision-making, and project progress.

The ability to work remotely has not only ensured the continuity of projects during times of crisis but has also unlocked new opportunities for talent acquisition and project execution. The lesson here is that remote work is not just a temporary solution but a viable and valuable practice that can enhance the flexibility, resilience and productivity of the infrastructure sector, and should be integrated into the industry's working model moving forward.

What did Covid teach us about technology change?

Lastly, the pandemic has highlighted the significance of digital resilience in the infrastructure sector. Organisations that had robust digital infrastructure, data management and communication systems in place were better equipped to navigate the disruptions caused by the pandemic. The ability to quickly adapt and respond to changing circumstances through digital means has been crucial in maintaining operations and project progress. The lesson here is that digital resilience, encompassing robust data management, cybersecurity measures and digital communication protocols, is an essential aspect of modern infrastructure operations. Organisations need to invest in building and maintaining digital resilience to ensure business continuity and project success in the face of unforeseen challenges.

Undoubtedly the Covid-19 pandemic has raised valuable lessons for the infrastructure sector in terms of rapid technology change, remote work and digital resilience. Embracing digital technologies, leveraging remote work practices and building digital resilience have proven to be critical for ensuring business continuity, productivity and resilience in the face of unprecedented disruptions. The pandemic has accelerated the adoption of digital technologies and transformed the way the infrastructure sector operates, providing valuable insights for the industry to embrace a more digitally driven and resilient future.

Recommendation 4

Seize the momentum of change: Capitalise on the lessons learned from the Covid-19 pandemic's profound impact on the infrastructure sector. Embrace the rapid pace of technological change, leverage the power of remote work and fortify digital resilience. Empower these valuable insights to shape future strategies, propelling infrastructure development toward new horizons of technological advancement.

/SOW2023

Prof Jianping Wu
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Tsinghua University,
World Federation of Engineering Organizations (WFEO)

WFEO contribution to Global Climate Change Mitigation

The atmosphere is a global shared resource. Greenhouse gas emissions contribute to the global problem of climate change. The negative impact of climate change on forests, species, water supply and human health is immeasurable, and frequent extreme weather events have added many uncertainties to the life of human society.

As a common interest of human society, global climate change issues not only require the effective control of each country, but also the effective cooperation of international communities. It requires not only awareness raising and policy control, but also scientific research and innovative engineering practices.

This report highlights the challenge we face as an industry but also how technology is going to play an increasing role in how we deliver projects. This influence will not only affect clients, contractors and consulting engineering business but also individual engineers whose digital skill set will need to adapt to meet the challenges going forward.

Industry viewpoint

The World Federation of Engineering Organizations (WFEO) is an international non-governmental organisation representing global engineering experts, with more than 100 national or international members and about 30 million engineers from all over the world. WFEO and its member institutions are committed to engineered solutions for global climate change mitigation and adaptation, resilience and sustainability which is why we are pleased to contribute to this important piece of research by FIDIC.

Like FIDIC, WFEO is also having to adapt and undertake research to ensure we can meet the climate challenges of the future. Under the guidance of the goal and mission to global climate change mitigation, the WFEO Climate Change Mitigation Best Practice Project was set up as part of the WFEO Committee on Engineering and Environment (CEE).

The aim of the project is to seek and promote the best engineering solutions to address climate change mitigation. The project includes the following tasks:

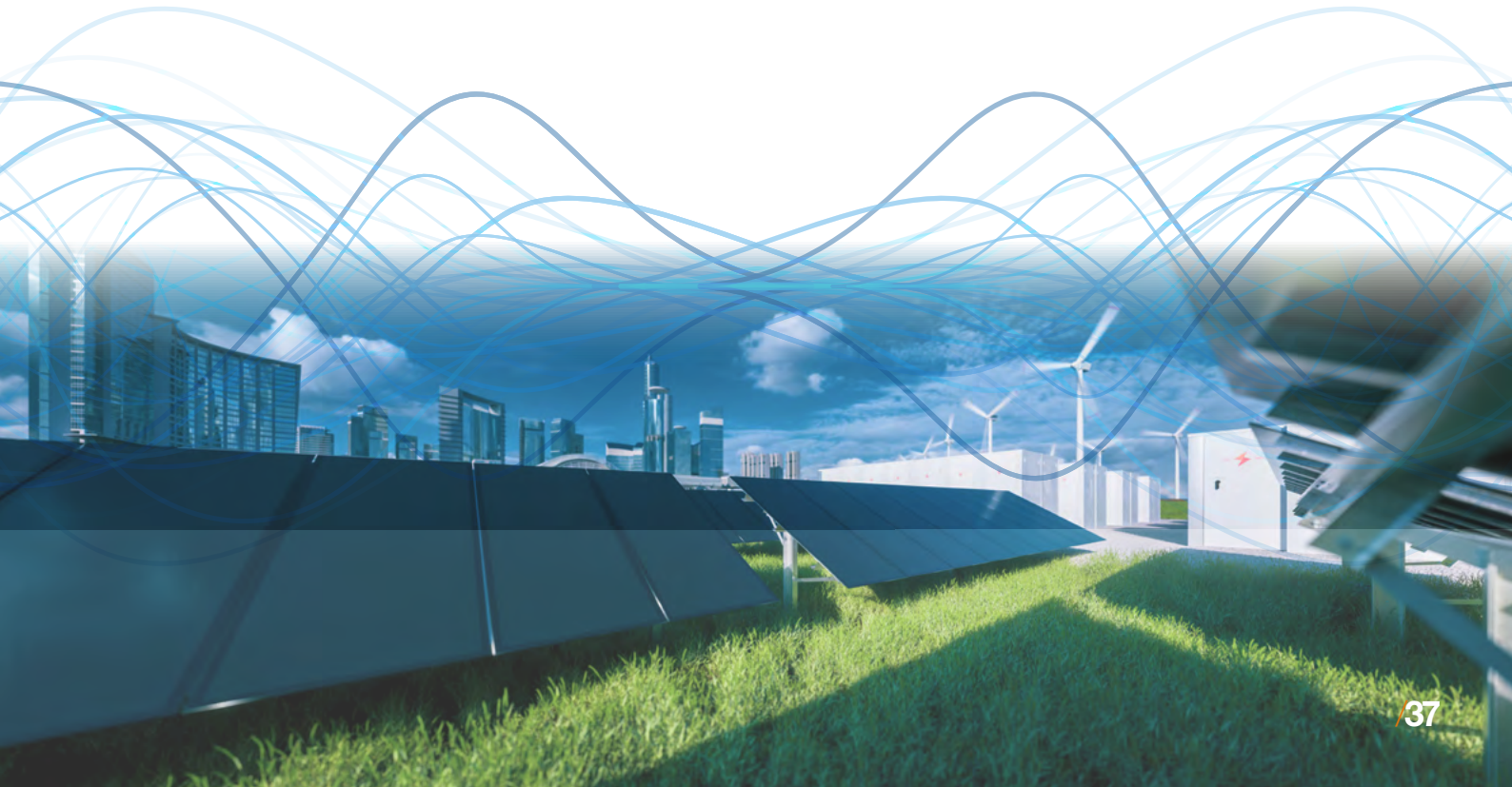
1. The project will solicit successful engineering projects, plans and ideas from all WFEO member countries, and build a “WFEO Climate Change Mitigation Best Engineering Practices Database”. The database will open to all members, partnering institutions,, relevant UN organisations and agencies, allowing the sharing of different countries’ climate change mitigation technologies, methodologies and engineering experiences.

2. The database will be regularly updated based on the best practice engineering project data and a report of practices will be published regularly. The intention is to share the successful engineering applications and best projects to mitigate global climate change and help to drive some of the change required and highlighted in this State of the World research.

3. Technical guidelines for climate change mitigation on the basis of systematic analysis of successful experiences, advanced technologies, methods and projects of various countries will be produced in line with regional culture, economic conditions and scientific and technological levels, and make the engineering and technical guidelines suitable for different countries to cope with global climate change.

4. International conferences and workshops will be held to promote exchange of the best strategies, experiences, technologies, methodologies and engineering projects for global climate change mitigation.

5. Provide relevant training courses on climate change mitigation and innovative practices to Member States and their cooperators, by accredited international experts.



The buildings and construction sector are key actors in the fight against climate change as they contribute 36% of global final energy use, and 39% of energy and process related emissions (2017 figures). The WFEO Climate Change Mitigation Best Engineering Practices project will focus in particular on civil engineering and construction sectors. As this report highlights, bringing together data is only part of the story and how we use technology to harness that data going forward to enable cultural change and a shift in skill sets to deliver practical results on the ground will be important.

Considering data collection from WFEO member countries we intend to cover the following 7 aspects: Design, Building materials, Construction, Operation, Reconstruction, Wastes, and Macro Indicators. This we believe will provide the project with a good base and encourage the information and data exchange that will be needed to meet the challenges highlighted in this report.

Preliminary data analysis results based on the 3 member countries' (China, Peru and Malaysia) data reveals that different countries focus on different aspects of climate change mitigation engineering activities based on their regional culture, life habits, economic conditions and scientific and technological levels. Many of these technologies and successful engineering practices will provide very precious experiences to be shared with other countries.

The WFEO CEE project team had great support from China Association of Science and Technology (CAST) and Tsinghua University during the early stage of this project. As we stated at the beginning of this contribution and as is made clear by this research, climate change is a global issue and change is inevitable and is increasing in speed.

WFEO by contributing to this state of the world report and by highlighting the synergies in how the industry could better work together would encourage stakeholders from across the infrastructure space to engage in both FIDIC's and WFEO's ambitious projects, which success will make great contributions to climate change mitigation.

In today's fast-paced business environment, organisations require more agile and responsive procurement approaches, climate adaptation, innovation and technology

Celebrating 110 years FIDIC 1913-2023

/Collaboration and technology go hand in hand

/SOW2023

/Collaboration and technology go hand in hand

Collaboration and technology are the dynamic duo that is driving the decarbonisation of the infrastructure sector towards a greener future. In today's fast-paced world, digitalisation has become a game-changer, revolutionising how infrastructure projects are planned, designed, constructed and operated. It is, however, the power of collaboration combined with cutting-edge technology that is truly unlocking the potential for sustainable development.

Collaboration, fostered by technology, is breaking down silos and bringing stakeholders together to collectively address the challenges of decarbonisation. For instance, in the transportation sector, governments, urban planners, architects, engineers, construction companies and technology providers are working hand in hand to create intelligent transportation systems that optimise traffic flow, reduce congestion, and minimise carbon emissions. Through collaborative efforts they are integrating electric vehicles, intelligent traffic management systems and smart public transportation solutions to create a seamless sustainable and low-emission mobility ecosystem.

One remarkable example of collaboration and technology at work is the Hyperloop project which aims to revolutionise transportation by developing high-speed low-emission transportation systems. The Hyperloop concept, spearheaded by visionary entrepreneur Elon Musk, brings together experts from various fields including engineering, aerospace and transportation, to collaborate on designing a futuristic mode of transportation that is both environmentally friendly and efficient. This ambitious project showcases how collaboration among diverse stakeholders, powered by cutting-edge technology, can drive innovation towards sustainable infrastructure solutions.

Moreover, technology is playing a pivotal role in optimising the use of resources in the infrastructure sector. Advanced data analytics, machine learning, and artificial intelligence are being leveraged to analyse vast amounts of data related to energy consumption, material utilisation and waste management, leading to more informed decision-making and improved sustainability performance. For instance, BIM allows architects, engineers and construction teams to work together in a virtual environment, optimising designs, identifying energy-efficient solutions and reducing construction waste. This collaborative use of technology is helping to create more sustainable buildings and infrastructure projects with reduced carbon footprints.

Furthermore, technology is enabling remote monitoring and control of infrastructure assets, leading to increased operational efficiency and reduced carbon emissions. For instance, smart grid systems are leveraging real-time data analytics and automation to optimise energy generation, distribution and consumption and thereby reducing greenhouse gas emissions. Additionally, remote sensing and IOT devices are enabling real-time monitoring of water, waste and energy systems, allowing for proactive maintenance, improved resource utilisation and reduced environmental impact.

In conclusion, the combination of collaboration and technology is a powerful catalyst for driving the decarbonisation of the infrastructure sector. By bringing together diverse stakeholders, fostering innovation, optimising resource utilisation and enabling remote monitoring and control, collaboration and technology are propelling the development of sustainable infrastructure solutions. The Hyperloop project, BIM, smart grid systems and remote sensing are just a few examples of how collaboration and technology are driving measurable progress towards a greener and more sustainable future in the infrastructure sector. Together, they are shaping the infrastructure landscape and paving the way for a more sustainable and resilient world.

/Collaboration and technology go hand in hand

What does digital collaboration mean and how is it linked to open data?

Data sharing, interoperability and stakeholder engagement are crucial elements in the development and implementation of digital solutions for decarbonisation in the infrastructure industry. Some key highlights are listed below.

Data sharing: Data is the foundation of digital solutions and sharing data among stakeholders is critical for effective decision-making. Data on energy usage, performance, weather conditions and other relevant factors can help identify opportunities for improvement, optimise strategies and measure the impact of retrofitting measures. Data sharing enables stakeholders to access and analyse relevant data, leading to better insights and informed decision-making.

Interoperability: Interoperability refers to the ability of different digital solutions and systems to work together seamlessly. In the context of decarbonisation, interoperability allows different stakeholders to integrate their systems, data and processes, creating a holistic approach. For example, interoperability between energy monitoring systems, building automation systems and predictive maintenance systems can enable efficient data exchange and coordination, leading to synergistic effects and optimised outcomes.

Stakeholder engagement: Stakeholder engagement involves actively involving all relevant parties, including infrastructure owners, operators, managers, policymakers and end-users, in the development and implementation of digital solutions. Engaging stakeholders ensures that their perspectives, needs, and expertise are considered in the decision-making process. Stakeholder engagement fosters collaboration, ownership and accountability, leading to increased acceptance, adoption and success of digital solutions.

Standardisation: Standardisation of data formats, protocols and interfaces is crucial for data sharing and interoperability. Common standards enable seamless integration and exchange of data across different systems and platforms. Standardisation also ensures consistency, accuracy and reliability of data, which are essential for making informed decisions and implementing effective digital solutions.

Privacy and security: Data privacy and security are critical considerations in the development and implementation of digital solutions. Protecting sensitive data, complying with relevant regulations and implementing robust security measures are essential to gain the trust and confidence of stakeholders. Privacy and security measures should be incorporated into the design and implementation of digital solutions to safeguard data integrity, confidentiality and availability.

Capacity building: Building the capacity of stakeholders to effectively use digital solutions is important for their successful adoption and implementation. Training, education and skills development programmes can help stakeholders understand the benefits, functionalities and limitations of digital solutions. Building capacity also includes providing support, resources and technical assistance to stakeholders to effectively use digital solutions in their day-to-day operations.

/Collaboration and technology go hand in hand

Data sharing, interoperability and stakeholder engagement are critical for the development and implementation of digital solutions in decarbonising the infrastructure industry. By fostering collaboration, standardisation, privacy, security and capacity building, digital solutions can be effectively utilised to achieve energy efficiency, carbon emissions reduction and lifespan extension goals.

Recommendation 5

Cultivate collaborative ecosystems: Foster dynamic collaborations that unite stakeholders across the infrastructure sector. Encourage open data sharing, interoperability and inclusive stakeholder engagement to drive the effective development and implementation of digital solutions. Highlight successful partnerships among governments, private enterprises, academia and local communities, unlocking the transformative power of technology for sustainable infrastructure development.

Shifting the mindset and creating the second new normal

The infrastructure sector, with its vast and complex systems of roads, bridges, airports, power grids and water networks, plays a crucial role in the global economy and has a significant impact on the environment, particularly in terms of carbon emissions. As the world grapples with the urgent need to decarbonise and combat climate change, digitalisation emerges as a powerful tool that can revolutionise the infrastructure sector and drive sustainable transformation.

To fully realise the potential of digitalisation in decarbonising the infrastructure sector, it is essential to challenge traditional perceptions and mindsets towards technology adoption. The status quo of relying on outdated methods and conventional practices must be disrupted and a bold new approach must be embraced.

First and foremost, it is crucial to recognise that technology is not a threat but rather an opportunity. The notion that technology will replace human workers, or diminish the importance of human expertise in the infrastructure sector, is a fallacy. In fact, technology has the potential to augment human capabilities and empower engineers, architects and other stakeholders with advanced tools and insights. From cutting-edge sensors that enable real-time monitoring of infrastructure performance to sophisticated data analytics that optimise energy consumption, technology can enhance decision-making, improve efficiency and reduce carbon footprints.

Moreover, the time for incremental change is over. A paradigm shift is needed. The traditional mindset of risk aversion and resistance to change must be replaced with a forward-thinking approach that embraces innovation and experimentation. This means challenging the status quo, being open to unconventional ideas and embracing a culture of continuous learning and improvement. It means breaking free from the shackles of legacy systems and embracing the potential of emerging technologies such as artificial intelligence, ‘internet of things’ and blockchain to drive sustainability in the infrastructure sector.

Additionally, inclusivity and collaboration are critical in the digitalisation journey. The transition to a more sustainable and decarbonised infrastructure sector requires a collective effort involving diverse stakeholders, including governments, private sector entities, academia, communities and civil society. Collaboration, cooperation and knowledge sharing are imperative to drive innovation, identify best practices and overcome challenges. It also means ensuring that the benefits of digitalisation are accessible to all regardless of size, location or level of technological maturity, to avoid exacerbating existing inequalities.

Furthermore, sustainability must be integrated into the very fabric of the digitalisation process. Digitalisation should not be viewed as a separate or add-on aspect of infrastructure development but rather as an enabler of sustainability. This means designing digital solutions with a strong sustainability mindset, considering their environmental, social and economic impacts throughout their lifecycle. It means leveraging digital technologies to optimise resource use, reduce waste, enhance resilience to climate change and foster inclusive and equitable outcomes.

/Collaboration and technology go hand in hand

The urgent need to decarbonise the infrastructure sector requires a fresh approach towards technology adoption. Challenging traditional perceptions and mindsets is imperative to fully harness the potential of digitalisation in driving sustainability. Embracing technology as an opportunity, fostering a forward-thinking mindset, promoting inclusivity and collaboration and integrating sustainability into the digitalisation process are key imperatives for a more sustainable and resilient infrastructure sector that can contribute to a better future for our planet and future generations. It's time to embrace the power of technology to catalyse positive change and revolutionise the infrastructure sector towards a more sustainable and decarbonised future.

How to foster a new culture of innovation

To overcome these challenges and foster a culture of innovation and digital transformation, the following strategies and best practices can be explored.

Leadership and vision: Strong leadership and a clear vision from industry leaders, policymakers and decision-makers are crucial in driving the adoption of digitalisation for sustainability in the infrastructure sector. Leaders need to communicate the benefits of digitalisation, set ambitious goals and create a roadmap for implementation.

Education and training: Building a skilled workforce that is equipped with the necessary digital skills is essential. Investing in education and training programmes to upskill the existing workforce and prepare the next generation of professionals with expertise in emerging technologies such as artificial intelligence, IOT and blockchain is vital.

Innovation and experimentation: Embracing a culture of innovation and experimentation is necessary to challenge the status quo and identify new and unconventional ideas. Encouraging experimentation, piloting innovative projects and learning from failures can foster a culture of continuous improvement and drive sustainable transformation.

Collaboration and partnerships: Collaborating with diverse stakeholders such as governments, private sector entities, academia, communities and civil society is critical. Partnerships can facilitate knowledge sharing, bring together diverse perspectives and foster innovation through collaborative efforts.

Inclusivity and accessibility: Ensuring that the benefits of digitalisation are accessible to all, regardless of size, location, or level of technological maturity, is crucial to avoid exacerbating existing inequalities. Ensuring inclusivity in the design and implementation of digital solutions can contribute to equitable outcomes and promote social and environmental sustainability.

Sustainability by design: Integrating sustainability into the design and development of digital solutions is imperative. Considering the environmental, social and economic impacts of digital technologies throughout their lifecycle can optimise resource use, reduce waste and enhance resilience to climate change.

/Collaboration and technology go hand in hand

Scalability and interoperability: Ensuring that digital solutions are scalable and interoperable is important to drive widespread adoption. Scalability allows for the replication of successful initiatives, while interoperability ensures seamless integration of digital technologies into existing systems and processes.

Regulatory and policy support: Creating an enabling regulatory and policy environment that supports the adoption of digitalisation for sustainability in the infrastructure sector is crucial. Policies that incentivise innovation, provide regulatory clarity and promote sustainable practices can accelerate the digital transformation of the sector.

Public awareness and engagement: Raising public awareness about the benefits of digitalisation in driving sustainability in the infrastructure sector and engaging the public in decision-making processes can build support and momentum for the adoption of digital technologies.

Monitoring and evaluation: Establishing robust monitoring and evaluation mechanisms to track the progress and impact of digitalisation initiatives is essential. Data-driven insights can inform evidence-based decision-making, identify best practices and drive continuous improvement.

By embracing these strategies and best practices, the infrastructure sector can harness the power of digitalisation to drive sustainable transformation and contribute to a more sustainable and decarbonised future. It requires a bold approach that challenges traditional mindsets and embraces the potential of technology as an opportunity for positive change.

/Industry viewpoint

/SOW2023

Sheena Sood and Sophia Harlow
Partner and Senior Associate
Beale & Co

Digital protection on the path to net zero

Digitalisation will have a widespread impact on construction companies. From the way they collate, store and share information to the way they collaborate with their client and other project team members, as well as the consequent responsibilities and rights of all concerned.

The ongoing important consideration of these issues and the contractual consequences, often do not get the attention they deserve on the path to net zero. For example, if a party is sharing data and information using a newly developed format or platform, is it complying with all its regulatory obligations in relation to the transfer of data both domestically and internationally? If an employer has certain requirements relating to the use or output of the technologies or digital processes being used, is it clear who is responsible for an unintended amendment, mistake or any loss of the data and information? Is it clear to the parties who owns the different elements of the data and other outputs being produced from the processes?

International legal systems are necessarily reactive. It is important for laws and regulations to be accurate and reflect the best practices for the area concerned. However, this is only possible once there has been sufficient use of the digital technology to learn from real-life experiences and views. There still remain very few laws and regulations aimed at specific digital technologies, for example, smart contracts and Building Information Modelling (BIM).

From a legal perspective, the contract negotiation stage is the key time to deal with the parties' legal risks. When moving into unchartered waters, clear contract terms on parties' rights and responsibilities will provide a safety net. The FIDIC suite of contracts promotes standardisation and interoperability in digitalisation efforts and aim to improve project efficiency, data management and governance.

Cyber security on the path to net zero

The UK's GCHQ National Cyber Security Centre (NCSC) noted, when issuing guidance aimed at the construction industry, that *"Due to the particular cyber risks facing the construction sector, the NCSC has advised businesses that cyber security measures are as vital as wearing a hard hat on site"*.

There have been an ever-increasing number of cyber-attacks in the construction industry with many businesses within the industry being viewed as easy targets that hold a huge amount of sensitive data. Additionally, due to the extensive use of subcontractors and suppliers involving large numbers of high value payments, construction businesses are an attractive target for cyber-attacks such as spear phishing, when attackers send a targeted email pretending to be from a legitimate organisation, in an attempt to trick the construction business into paying money into a criminal's account.

This FIDIC State of the World report has highlighted some of the exciting new ways in which the collaborative use of technology in virtual environments is helping to create more sustainable buildings and reduce carbon footprints. However, access to data, systems and services needs to be protected.

Understanding who or what needs access to data and under what conditions, is just as important as knowing who needs to be kept out. Construction companies must choose appropriate methods to establish and prove the identity of users, devices, or systems, with enough confidence to make access control decisions.

Shifting the mindset – a collaborative journey

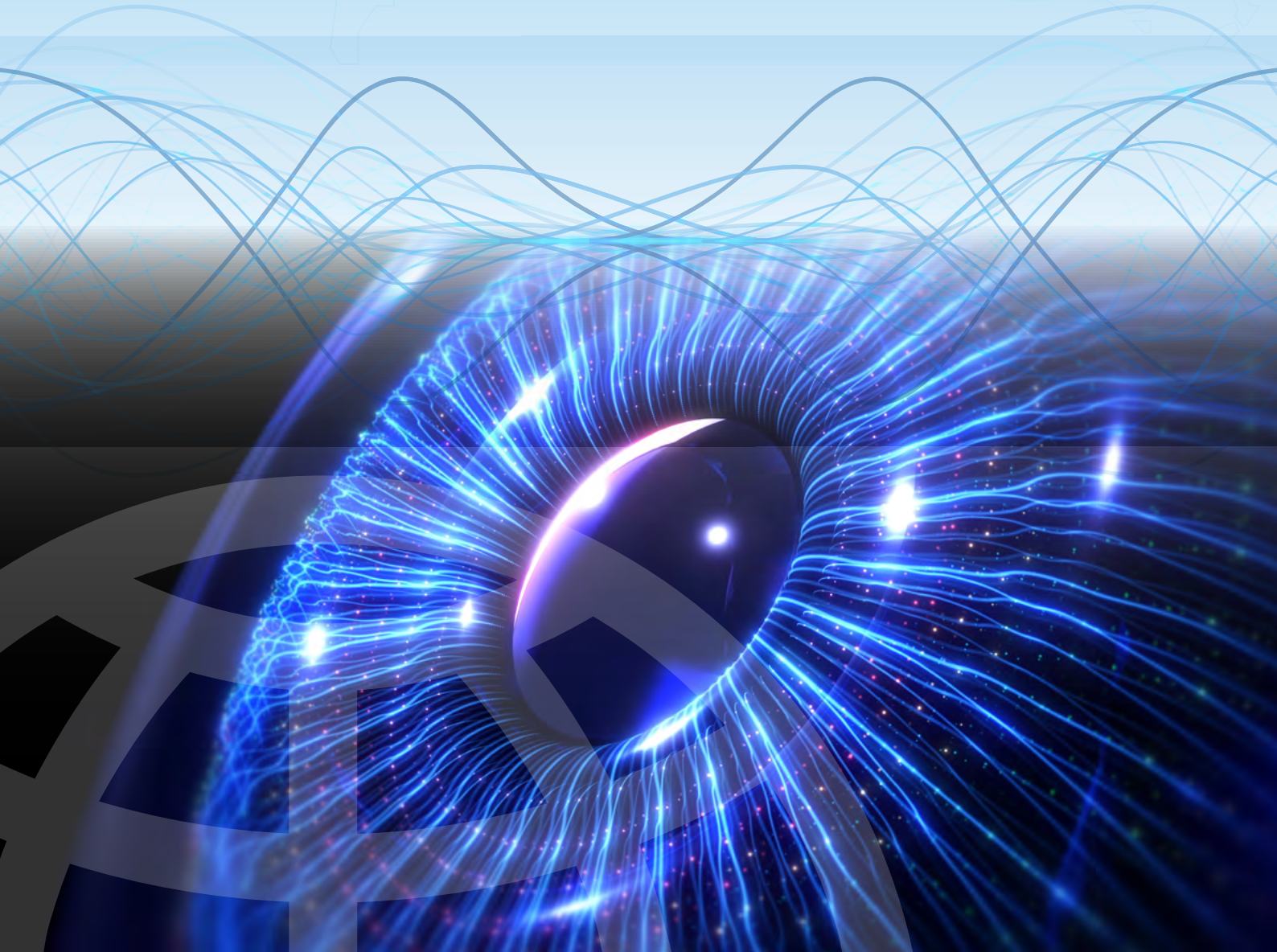
There was a photograph of an advertisement on a giant billboard around an under-construction building that went viral recently. The ad by a Belgian employment agency for construction professionals read as follows: "Hey ChatGPT, finish this building…Your skills are irreplaceable". It is a humorous advertisement campaign that highlights one of the key points being made in this State of the World report, that there is a need to "shift the mindset" in the construction industry and recognise that technological advancements and digitalisation are not threats, but rather opportunities. In that instance, the key takeaway may be that artificial intelligence and skilled labour do not need to be mutually exclusive and should complement and collaborate with each other in certain situations.

To facilitate the necessary progress on the path to net zero, the construction industry needs to make informed advancements. Our advice to the industry in embracing this era of digitalisation and new technologies is to work collaboratively from the outset of a project with in-house legal teams and external legal advisors. A lawyer's role is to help businesses safely achieve their commercial objectives. In order to realise sustainable and long-lasting progress, it will be essential to ensure that the teams driving that progress have a wide variety of skillsets, including legal expertise, to anticipate and plan for the challenges that lie ahead and create a safe and robust framework for the responsible and sustainable use of digital technologies in the construction sector.

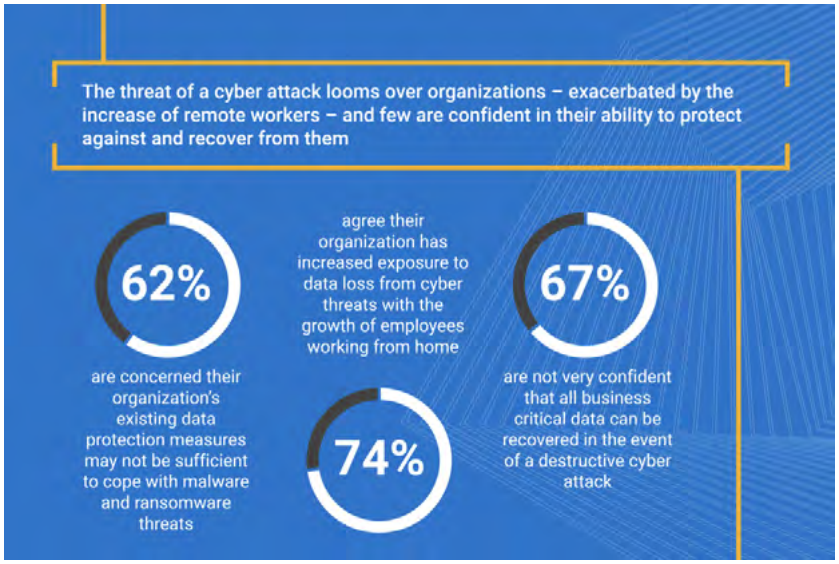
Celebrating 110 years FIDIC 1913-2023

/Challenging perceptions in the digital journey, cybersecurity, data privacy and upfront costs

/SOW2023



/Challenging perceptions in the digital journey, cybersecurity, data privacy and upfront costs



Source: World Economic Forum (2022)[7]

As the infrastructure sector embraces digitalisation to accelerate decarbonisation efforts there are several challenges and barriers that need to be addressed. These challenges include concerns related to cybersecurity, data privacy and upfront costs which can hinder the widespread adoption of digital technologies despite their potential benefits.

One of the major concerns is cybersecurity which has become increasingly important as infrastructure systems become more interconnected and data-driven. Hackers can potentially gain access to critical infrastructure systems which could lead to significant disruptions, safety risks and even loss of life.

There have been several major examples of cybersecurity challenges that have resulted from the increasing digitalisation of the infrastructure sector. Here are some recent and notable examples:

Colonial Pipeline Cyberattack (2021): In May 2021 one of the largest fuel pipelines in the United States, the Colonial Pipeline, was targeted by a ransomware attack. The attack resulted in a shutdown of the pipeline for several days causing fuel shortages and price spikes in several states. The attackers gained access to the company's IT systems through a compromised password and demanded a ransom to restore access. This incident highlighted the vulnerability of critical infrastructure systems to cyberattacks and the potential for significant disruptions to the energy supply chain.

SolarWinds Cyberattack (2020): In December 2020, it was discovered that a sophisticated cyberattack had been carried out against SolarWinds, a software company that provides IT management tools to numerous organisations, including many in the infrastructure sector. The attackers inserted malicious code into SolarWinds' software updates which were then distributed to their customers, including government agencies and critical infrastructure providers. The attack resulted in unauthorised access to sensitive information from numerous organisations, including classified government data. This incident highlighted the supply chain risks associated with third-party software providers and the need for robust cybersecurity measures throughout the entire ecosystem.

Ukrainian Power Grid Cyberattacks (2015 and 2016): In December 2015 and December 2016, Ukraine's power grid was targeted by cyberattacks that resulted in widespread power outages. The attackers gained access to the power distribution systems and used malware to disable critical infrastructure components causing extensive disruptions to electricity supply. These incidents were among the first known cases of cyberattacks causing physical damage to a country's power grid, demonstrating the potential for cyber threats to impact critical infrastructure systems and disrupt essential services.

/Challenging perceptions in the digital journey, cybersecurity, data privacy and upfront costs

These examples illustrate the significant cybersecurity challenges that can result from digitalisation in the infrastructure sector. They highlight the need for robust cybersecurity measures, including strong access controls, regular patching and updating of software, network monitoring and employee training to protect critical infrastructure systems from cyber threats. As digital technologies continue to be adopted in the infrastructure sector, cybersecurity must be a top priority to ensure the safe and secure operation of critical infrastructure systems.

Another significant challenge to the adoption of digital technologies in the infrastructure sector is data privacy. The collection, storage and processing of large amounts of data from infrastructure systems pose privacy risks particularly if personal information is involved. Unauthorised access to sensitive data can lead to identity theft, financial fraud and other forms of cybercrime. Additionally, data breaches can result in reputational damage and legal liability for infrastructure providers.

One major example of data privacy challenges in the infrastructure sector is the 2017 data breach of the US Securities and Exchange Commission. The breach compromised the personal information of individuals, including names, dates of birth and social security numbers, which were stored in the agency's electronic filing system. This breach highlighted the vulnerability of sensitive data in the infrastructure sector and the need for robust cybersecurity measures to protect against cyber threats.

Another recent example is the 2018 data breach of the construction giant Turner Construction Company, where hackers gained unauthorised access to the company's IT systems and stole sensitive data, including employee information and project details. This breach exposed the risks associated with the digitalisation of project data and the importance of securing information throughout the entire project lifecycle.

In addition to external threats, data privacy challenges also arise from the collection and use of data from smart infrastructure systems. For instance, the use of smart meters to collect energy consumption data raises concerns about the privacy of individuals' energy usage patterns and potential misuse of such information. Similarly, the use of sensors in transportation infrastructure, such as traffic cameras and toll collection systems, may raise privacy concerns about the collection and use of individuals' travel data.

Furthermore, data privacy challenges also arise from the sharing of data among different stakeholders in the infrastructure sector. For instance, collaborations between public and private entities, such as public-private partnerships, may involve the exchange of sensitive information, including financial data, contractual details and project plans. Ensuring proper data privacy measures are in place to protect this information becomes critical to prevent data breaches or misuse.

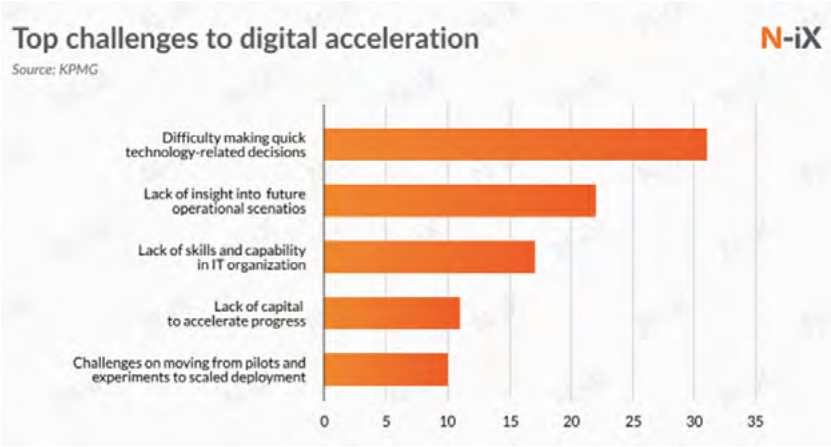
In response to these challenges, regulatory frameworks, such as the European Union's General Data Protection Regulation (GDPR), have been implemented to safeguard data privacy rights and impose stringent requirements on data collection, storage and use. However, compliance with these regulations can pose upfront costs and administrative burdens for infrastructure stakeholders.

In the past five years, Canada has implemented the Personal Information Protection and Electronic Documents Act (PIPEDA), which is a federal privacy law that regulates the collection, use, and disclosure of personal information in the private sector. PIPEDA requires organisations to obtain informed consent from individuals before collecting their personal information and to limit the collection, use and disclosure of that information to purposes that are reasonable and necessary. It also requires organisations to implement appropriate security measures to protect personal information against unauthorised access, disclosure and use.

The United States does not have an equivalent to the GDPR at the federal level. However, individual states have passed their own data protection laws, such as the California Consumer Privacy Act and the Virginia Consumer Data Protection Act. Additionally, there are federal laws that regulate specific industries, such as the Health Insurance Portability and Accountability Act for healthcare data and the Gramm-Leach-Bliley Act for financial data.

/Challenging perceptions in the digital journey, cybersecurity, data privacy and upfront costs

Upfront costs are also a barrier to the adoption of digital technologies in the infrastructure sector. The deployment of digital infrastructure technologies requires significant investment in hardware, software and other IT infrastructure. This can be a challenge for infrastructure providers, especially those with limited budgets. The costs associated with upgrading existing infrastructure systems can also be high. For example, the deployment of smart meters to monitor electricity usage in households requires a significant investment in hardware and software.



Source: N-iX. (n.d.). Digital Acceleration [Digital image][8]

In conclusion, the adoption of digital technologies in the infrastructure sector is critical to achieving decarbonisation goals, but there are challenges and barriers to overcome, including cybersecurity, data privacy and upfront costs. Successful examples such as the Port of Rotterdam and the use of BIM in the construction industry show that the benefits of digital technologies can and are increasingly outweighing the challenges. With proper planning and implementation, digital technologies can improve efficiency, reduce emissions and transform the infrastructure sector for the better. Striking a balance between the benefits of digitalisation and protecting data privacy is crucial to ensure the responsible and sustainable use of digital technologies in the infrastructure sector.

Recommendation 6

Overcome barriers and embrace innovation. Confront the barriers impeding the widespread adoption of digital technologies in the infrastructure sector. Address concerns regarding cybersecurity, data privacy and upfront costs head-on. Champion a cultural shift that challenges conventional mindsets, nurturing an environment that embraces innovation and digital transformation. Implement strategies and best practices that transcend barriers, fostering an ecosystem primed for technological advancement.

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The FIDIC board

As with all documents and research produced by FIDIC, the board plays a vital role in ensuring that quality, integrity and direction of such publications and as such we thank the board members for their contribution to this publication.

The secretariat

FIDIC is only possible because of the hard work of its staff team and this report would like to recognise the efforts of the individuals within the FIDIC secretariat that made this report possible. The FIDIC board will continue to support and endorse the actions of the secretariat to deliver for its members and the wider infrastructure sector.

Reviewers

FIDIC's research is important and covers a global stage so that research is peer reviewed by several independent individuals and a selected board member to help ensure its quality. FIDIC would therefore like to take this opportunity to thank:

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Contributors

FIDIC's reports do not only focus on FIDIC's objectives but by their nature are a culmination of industries' expertise and professionalism as such there are always contributors to FIDICs reports and in this one, we wish to recognise the following:

- **Stacy Van Dolah-Evans**, Global Segment Director – Design Firms, Digital Energy Division Schneider Electric.
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Thanking our member association partners

Finally, but by no means least, FIDIC is a product of its member associations without which FIDIC would not exist. Whilst all member associations can be found on the FIDIC website, in this and future *State of the World* reports we have engaged with FIDIC member associations on the detail of our work and we would like to thank the following member associations for their support for our research.

/About FIDIC

FIDIC, the International Federation of Consulting Engineers, is the global representative body for national associations of consulting engineers and represents over one million engineering professionals and 40,000 firms in more than 100 countries worldwide.

Founded in 1913, FIDIC is charged with promoting and implementing the consulting engineering industry's strategic goals on behalf of its member associations and to disseminate information and resources of interest to its members. Today, FIDIC membership covers over 100 countries of the world.

FIDIC, in the furtherance of its goals, publishes international standard forms of contracts for works and for clients, consultants, sub-consultants, joint ventures and representatives, together with related materials such as standard pre-qualification forms.

FIDIC also publishes business practice documents such as policy statements, position papers, guidelines, training manuals and training resource kits in the areas of management systems (quality management, risk management, business integrity management, environment management, sustainability) and business processes (consultant selection, quality-based selection, tendering, procurement, insurance, liability, technology transfer, capacity building).

FIDIC organises the annual FIDIC International Infrastructure Conference and an extensive Programmeme of seminars, capacity building workshops and training courses.

FIDIC 2020-2024 priorities

Lead the consulting and engineering industry visibly and effectively:

- Being the industry's credible global voice
- Providing the nexus for all stakeholders
- Facilitating improvement and growth in business
- Addressing global challenges

All of the above is for the benefit of society, FIDIC members and their member firms.

/Recent FIDIC policy documents

State of the World Series - Corruption, its effects and the need to take action

As evidenced by international public law and the domestic laws made according to the public policy of nation states, corruption is not and should not be acceptable. This report outlines figures on its effects, consider new relationships between economic, industry and FDI flows and the perceptions of corruption. The report looks at data collected over the last decade across as many countries as possible and asks the question, how has the fight against corruption gone? Are we really combatting it?

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State of the World Series - Digital disruption and the evolution of the infrastructure sector

This report explores the pace of this technological change and shows that not only is the pace of change significant, but that many of the technology companies we use today for day-to-day activities in the grand scheme of time are actually very young and company longevity is continuing to decline. This suggests that not only is the pace of change faster, but the companies and people we deal with today may not be the ones we are dealing with in ten years' time. We also discuss the role of technology as a potential disrupter to industries changing their business model as a result of shifts in technology, data and/or how a combination of how customers/clients and the sector can access and use such information. It is then also important to look at the role of technology as an innovator and as something which drives real changes and improvements. What does it mean in terms of big data, artificial intelligence, customer lead data and more devolvement of smart devices?

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State of the World Series - Net Zero - What Next?

Net Zero. It could be argued that we have only just begun, but such ambitions were set decades ago. Yes, to hit a target you first have to create one and to reach that target you have to gain acceptance, political support, industry support and then delivery through all related activity. FIDIC, as the global voice of engineering and infrastructure, asks not only what is next but we also provide the next global target. This target not only helps to achieve our current trajectory but also sets the kind of ambitions the engineering sector and humanity should be proud to achieve. We go beyond Net Zero and ask "what next?" Find out more about what comes next after Net Zero by attending the launch of "Net Zero... so, what next?", the fifth report in the FIDIC State of the World series.

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State of the World Series - Building sustainable communities in a post-Covid world

The world is gradually learning what it means to be sustainable as we march towards achieving the 2030 UN Sustainable Development Goals and approach net zero, but should we simply be adapting our current way of living or thinking about a new way of life? The Covid pandemic has demonstrated that remote working is not just the digital dream of IT professionals and visionaries, but is and can be real life. Do we need cities? Is urbanisation going to continue? Alternatively, should we be looking at the airline industry and the 'hub and spoke' model as the future for communities where most activity can happen locally in a more sustainable way via serviced offices, with only occasional visits to major hubs? The world is changing and this State of the World report asks: "are we changing quick enough to match the way communities want to live not only tomorrow, but today?"

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Tackling the global water crisis - State of the World 2020-2021

Water, it falls from the sky, runs in our rivers, fills our lakes, waters our crops and flows through our infrastructure, yet it is more than a monetary product. Yes, having explored the value of water in our second State of the World report, we explore the flip side of this equation. The environment we live in, the pollution that has historically occurred and minimising such pollution in the future, is becoming more important day by day. The SDGs make this clear, but how can industry stand up and lead the way.

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Establishing the value of water - State of the World 2020-2021

Water is vital to so many aspects of life, but investment into the infrastructure, environmental mitigations and resilience aspects of this sector for the wellbeing of humans, the environment, food production, energy etc are not sufficient.

This State of the world report therefore asks a very important question what the value of water is, is it valued incorrectly, how this will change and will this finally drive the investment required to meet the SDGs.

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Endnotes

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