

Infrastructure

ISSUE 03: INNOVATION AND DIGITAL TRANSFORMATION

Reimagined



Knowledge is power

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Reimagining operations to reduce carbon emissions

Brazilian miner Vale's green briquettes will make the metals sector more sustainable.

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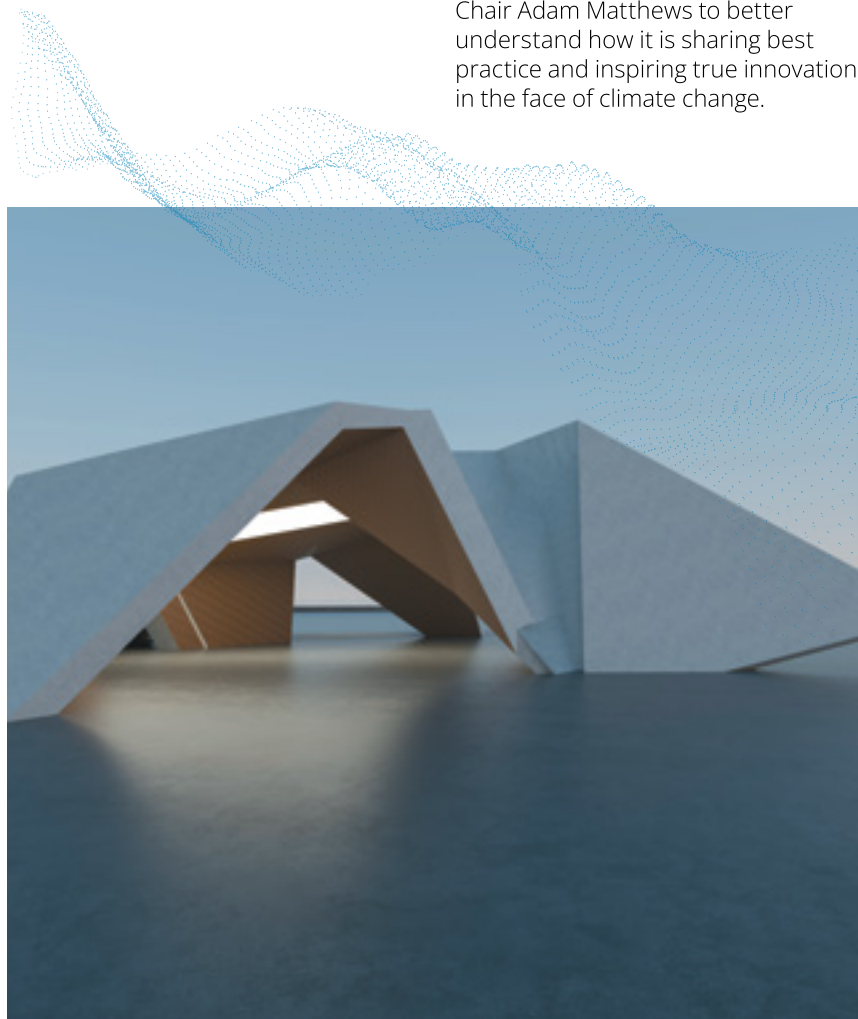


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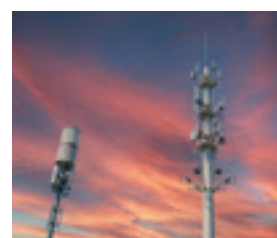
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Jakarta recently transitioned from 25 years of privatized water supply back to a publicly run water utility. The focus? Achieving 100% coverage with piped drinking water by 2030 to provide water sovereignty for all 11 million residents in Jakarta.



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EXPERIENCE + INSIGHTS = THOUGHT LEADERSHIP

Deloitte is committed to producing evidence-based reports that provoke new ideas, inspire action and contribute towards infrastructure for good. We summarize seven global reports.



Introduction from Luke Houghton



INFRASTRUCTURE ADVISORY LEADER, DELOITTE GLOBAL

IN THIS THIRD EDITION OF DELOITTE'S GLOBAL INFRASTRUCTURE MAGAZINE, WE FIND OUT HOW LEADERS ARE EMBRACING INNOVATION AND THE LATEST TECHNOLOGY TO TRANSFORM INFRASTRUCTURE FOR GOOD.

I am delighted to see the variety and depth of examples from across the globe – ranging from our inspirational insights shared in these first few pages, through to in-depth client interviews that unpack what it takes to truly transform entire sectors, industries, cities and states. There is no doubt we are seeing some common traits: bold ambitions, a desire to collaborate deeply and widely, an acute sense

of responsibility to the environment, societies and the economy and most of all, leaning in to challenges and finding new ways to convert these into exciting opportunities.

You will also find summaries of some of Deloitte's latest thought leadership and reports, as well as a fascinating interview with the Chair of Global Building Information Modeling Network and an excellent contribution

from Bridges to Prosperity, a leading non-profit organization dedicated to transforming rural communities. I hope you enjoy this latest edition – please don't hesitate to reach out to myself or any of the contacts peppered throughout this inspirational magazine.

Contact Luke Houghton
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Let's take a moment to celebrate pockets of excellence from around the world where infrastructure with impact is improving citizens' lives, communities, economies and the environment.

These great examples aren't just inspirational, they're interesting and show how we can set the next generation up for long-lasting success.

Incredible insights

UKRAINE – EUROPE'S FIRST 3D PRINTED SCHOOL

International partnerships are utilizing innovative technologies to help rebuild Ukraine amid its devastating war. With UNICEF estimating that more than 1,300 schools have been destroyed in Ukraine since the beginning of the conflict in 2022, humanitarian foundation **Team4UA** and Denmark's **3DCP Group** have set out to build the first-ever 3D printed school in Europe.

Using **COBOD's BOD2** printer on-site, the 1,214 square feet one-story school in Lviv, a city in western Ukraine, will be the world's largest educational facility to be built with this exciting technology. The school's build will use 90% locally sourced materials, support local jobs and lower construction costs. 3D printing has also expedited the school's construction, with half of the printing completed within the first four days of the BOD2 printer's operation. The school's opening is slated for early 2024.



Printing nozzle at work in Lviv, Ukraine. (Image: www.rferl.org © Yurly Dyachyshyn, AFP)



The 200MWh project on Jurong Island, Singapore. (Image: www.energy-storage.news © Sembcorp)

SINGAPORE – BUILDING GRID RELIABILITY IN RECORD TIME

Faced with land size limitations and significant energy demands, Singapore has rapidly responded to market demands by developing the largest battery energy storage system (BESS) in Southeast Asia. This project was launched by **Sembcorp** and Singapore's **Energy Market Authority**, who delivered it from conception to completion within six months; the fastest deployment of a

BESS of this scale. Consisting of 800 containerized units storing 285MWh, this project alone was enough to exceed Singapore's deployment target of 200MWh of energy storage capacity by 2025. Singapore is one of the most solar-dense cities on the planet, and this BESS will assist in combatting challenges of weather-hampered solar generation by storing enough electricity to power 24,000 four-room households per day, per discharge.



Europe's digitization is being fast-tracked. (Image: Getty Images)

EUROPE - A NEW DIGITAL DECADE

We've seen digital transformation embed itself as a priority for organizations for many years. Now, it's being pursued by perhaps the biggest entity yet – the **EU**.

Conceived in 2021 by the European Commission, the executive body of the EU, the European Digital Decade is a transformation initiative and comprehensive framework. Its vision is to propel people and businesses in Europe into the digital age by delivering a range of education and infrastructure capabilities by 2030.

To drive innovation and improve Europeans' quality of life, the initiative sets a range of targets for delivering key digital infrastructure.

Connectivity is key, with the end goal of achieving 100% 5G and Fibre to the Premises (FTTP) coverage for all populated areas of Europe.

Since the adoption of the program in January 2023, it has been announced that Europe has already achieved an impressive 81% 5G and 56% FTTP coverage. The European Commission also plans to produce 20% of the world's semiconductors (currently 10%) and three quantum computers by 2030 (currently none). Although distant, these ambitions remain important milestones to strengthen Europe's digital and technological sovereignty.

SOUTH AMERICA - INNOVATIVE INFRASTRUCTURE FINANCING THROUGH CONCESSIONS

In a challenging economic environment, Chile has continued to pursue innovative financing by revamping its concession program. In 2023, the Chilean government has offered 54 projects to eligible companies worth a collective US\$13 billion, with the tender process for 14 of these projects to be launched in 2024. Significant projects include new sections for the Route 5 highway (part of the Pan-American Highway), which

is the nation's longest at 3,364 kilometers (2090 miles).

Chile first offered a public infrastructure initiative under the concession model in 1993 – and has since awarded more than US\$27 billion in contracts for critical infrastructure such as railways, airports and hospitals. The concession program in Chile has been a significant source of foreign investment, with competition set to increase with the entry of Chinese state companies into the bidding process.



After 16 months, Chile launches the first infrastructure concession tender under President Gabriel Boric. (Image: bnamerica.com)

SAUDI ARABIA - NEXT STEPS FOR NEXT GEN CITY

Neom, the planned, revolutionary smart-city is under construction and moving forward quickly, developers say. With claims of 3,000 employees and 60,000 construction workers commissioned for the giga-project, developers have their eyes set firmly on the future – with visions of a range of critical infrastructure, including a new port, the world's largest hydrogen plant and a floating manufacturing complex. Most ambitious is 'The Line', a 170-kilometer (105 mile)

linear smart city with no cars and all daily essentials planned to be within a five-minute walk for residents.

Neom was conceived as an initiative to create a new economic engine in Saudi Arabia to shift the nation's reliance on fossil fuels. With an anticipated capacity of 450,000 people by 2026 and, eventually, 9 million by 2045, the world will watch to see if Saudi Arabia can transform its ambitions into a reality that redefines how we view cities and infrastructure.



The Line in Neom, Saudi Arabia. (Image: archipanic.com ©Neom)

INDIA – BUILDING THE FUTURE WITH CONSENSUS AT G20

The 2023 G20 New Delhi summit delivered a consensus on digital public infrastructure (DPI) that was hailed as "groundbreaking" by Microsoft co-founder **Bill Gates**. DPI technology is provided by governments to the public to assist with access to key information, resources and systems.

During the summit, the G20 Framework for Systems of Digital Public Infrastructure was agreed upon by ministers of G20 states and set guiding principles for the development, deployment and

governance of DPI. Under the initiative, projects should be built for the benefit of the public and should be trustworthy, secure, accountable and inclusive.

India has been seen as a global leader in DPI development, led by its biometric ID system **Aadhaar**, which is the world's largest and lauded as "the most sophisticated ID program in the world" by the World Bank Chief Economist, **Paul Romer**. It's hoped that this framework, alongside India's proposed Global Digital Public Infrastructure Repository, will provide for synergy in the development and deployment of DPI across the world.



'Bharat Mandapam', the main venue of the G20 Summit, in New Delhi, India, September 7, 2023. (Image: reuters.com © Altaf Hussain)

Knowledge is power

Fluvius, close to you

2022 KEY FIGURES

A DIGITAL TWIN-BASED ENERGY MODELING APPROACH FOR A CLIMATE-NEUTRAL FUTURE

AS THE WORLD RACES TO ACHIEVE A CLIMATE-NEUTRAL SOCIETY BY 2050, FLUVIUS, BELGIUM'S LEADING MULTI-UTILITY COMPANY, AND DELOITTE HAVE BROUGHT TO LIFE A GROUND-BREAKING RESULT: A SOPHISTICATED GRID DIGITAL TWIN SUITE CALLED 'NEXT GENERATION INFRASTRUCTURE' (NGIN), WHICH HAS INSPIRED A DELOITTE GLOBAL INITIATIVE: ELECTRIFIEDGRID.

NGIN not only assesses but also visualizes the impact of electrification at the distribution grid level. This helps Fluvius maximize value creation by optimizing asset management, identifying potential digital technologies, and future-proofing grid architecture.

Roy Gys, senior manager, Infrastructure and Energy Solutions, Deloitte Belgium, and Robert Saunders, senior manager, Strategy and Transformation, Deloitte Canada, share nine insights on how the Fluvius and Deloitte collaboration has ignited a broader journey towards a cleaner, greener and more sustainable future.

Before digging into these key insights about this innovative offering, Robert reflects on what working on this particular digital twin has meant to him.

"In working with clients mostly in North America, considering the unique forces impacting energy and policy, it became clear years ago that the digital capability to model the energy transition in high fidelity – all the way to the individual meter level – was going to be necessary and valuable. The question was just 'when' and 'where'. It was exciting to find geographies overseas where 'the future' was already being

experienced. In Belgium, with the government installing electrical fleet vehicles and progressive electrification policies, there is very high EV (electric vehicle) adoption.

"Due to past incentive schemes, price instability and future uncertainty, solar photovoltaic (PV) adoption is also high. Also, the adoption of heat pumps and air-conditioning is on the rise. This combination creates risks, such as grid congestion and related problems, within the planning horizon and greatly changes the assumptions of the design of the electrical system. Planners and designers, therefore, need better, more granular forecasting and analysis.

"In North American terms – it's a 'California type' adoption market. Almost every geography is on this path, just at different speeds, as the electrical system is asked to do something it wasn't designed for – to handle much more of our daily energy needs. The planners and policy makers will also need more advanced means for analyzing the ability of the grid to meet demand through implementation of new equipment and tools. For instance, capabilities that will be enabled by a confluence of new hardware and software, including Distributed Energy Resources, Distributed Energy Resource Management Systems (DERMs), Advanced Distribution Management Systems (ADMS) and Advanced Metering Infrastructure (AMI).

"It's a credit to the whole team in Belgium (Fluvius and Deloitte) for being strategic in how they solved the problem, in an integrated fashion that unites the functional areas of their organization – customer, asset management, operations, sustainability, strategy,

finance, etc. and repeatable to help the world with these same challenges," says Rob.

For his part, Roy agrees. "When we tap into the potential of data, we can build solutions that support our strategic and tactical decision-making about the future of infrastructure. Deloitte's unique collaboration with Fluvius has been a career highlight for me. Although we were relatively early in the market when it launched a few years ago, we can see how this type of digital twin-based modeling is picking up pace and really making a difference. Its data-driven analysis is informing the optimal way in which we can achieve the energy transition with its rapid electrification across Belgium. It has huge potential for the rest of the Europe, and the world, too."

Rob adds, "It's important to understand that this is not just about the distribution end of the system; going forward Deloitte is integrating modeling capabilities throughout the entire value chain – including the bulk (generation and transmission) system, with our macroeconomic modeling and indeed across energy systems and the shifting sources of demand (like transportation).

"The trillions of dollars per year being forecasted for the global energy transition, and the implied mega projects, aren't always modeled by contemplating the maximum potential of the distribution system to handle and shift peak demand. Instead, forecasts are made based on extrapolating the status quo of how demand has been predicted and managed in the past. But what happens when EVs charge back to the grid? It's a great question – and

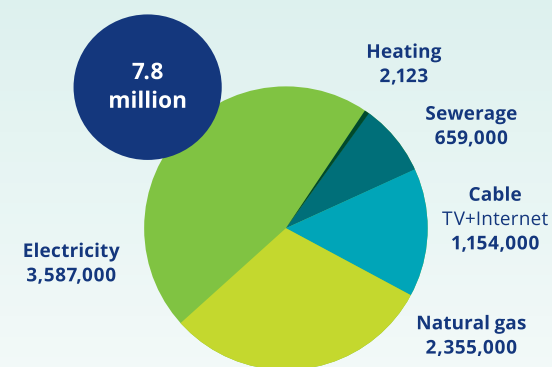
society will expect politicians and grid planners to have that answer if we're going to invest billions in each region and cause rates to increase – we better have that answer! There's really only one way to know with confidence – thanks to big data and advances in processing speeds we can do that inexpensively." Deloitte is uniquely positioned to

Southern California Edison's 'Countdown to 2045' whitepaper outlines near-term priority actions to achieve net zero. It starts with: "Reimagine System Planning: California must reimagine how it plans the electric system to efficiently interconnect clean energy resources and enable operational flexibility. The state needs a planning process that is integrated across domains (including generation, transmission, distribution and local resources) and objectives (including affordability, reliability, load growth and climate adaptation) to ease the process of interconnecting resources and enable a more resilient, cost-effective system."

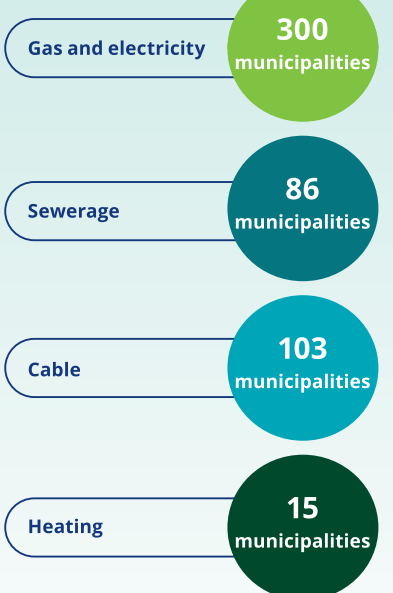
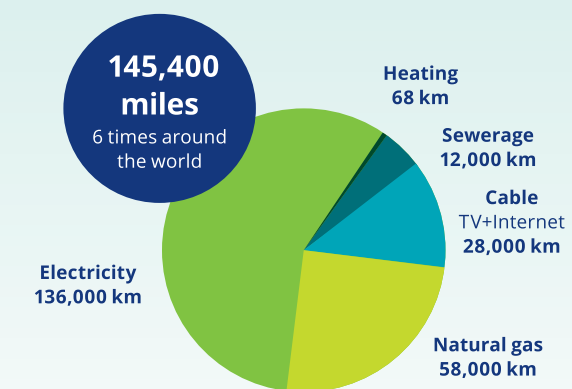
lead with our clients in this space because we have the modeling capabilities, proven assets, global teams and local specialists to ease the burden of implementation. Through our global work on the future of mobility projects, we're able to apply those insights into energy modeling. For instance, what happens to a regional energy demand profile if vehicles become autonomous by 2035?



NUMBER OF CONNECTION POINTS



LENGTH OF DISTRIBUTION GRIDS



Source: <https://jaarverslag.fluvius.be/2022/en/key-figures>

9 key facts...



1 GAINING CLARITY ON THE TERM 'DIGITAL TWIN'

"People get confused on the definition of 'digital twin'; it is really better to think of it as a concept, which is applied differently in many spaces. Generally speaking, 'digital twin' just means a digital representation of real-world physical elements. For the energy transition application, it is the representation of the equipment constituting 'the grid' for power flow analysis," says Robert. On top of the representation of the grid, we model factors impacting demand, from the rise of EVs to the growing adoption of heat pumps, and everything in between.

This is adjacent, although somewhat complementary, to other applications of digital twin technology used for 3D visualizations to do things like inspections (in which Deloitte also specializes). They are complementary because at the core both need to know where the assets are, what they are, etc., so there are elements of the data that could be shared which means big efficiency and cost savings for the utility, so long as they identify the opportunities.

2 VISIONARY LEADERS A FUTURE OF UTILITIES TRANSFORMATION

Fluvius' digital twin solution is entirely client-centric, following several years of foresight analysis with them regarding the future of energy. The effort has been centered on visionary leadership: the choices utilities must make, the ramifications for their existing capabilities, the disparities between the present and the envisioned future, the ability to address external influences, and the optimization of pathways to seize future opportunities in a world with high uncertainties. The utility has its sights set on the future of energy and aims to bridge the gap between today's capabilities and tomorrow's needs, ensuring they can adapt to external factors and optimize pathways to a sustainable future.

"We are currently developing and building the 'grids of tomorrow' in Flanders. That is our number one priority today," says **Raf Bellers**, Director Grid Management and Supply Chain at Fluvius. "To support an increasing number of heat pumps, solar installations, wind turbines and electric vehicles, our electricity grid needs to be progressively and proactively reinforced and digitized over the next 10 years. Our digital twin solution helps us analyze and simulate our grids to pinpoint and prioritize where specifically we need to invest. It's an important tool to work as efficiently as possible to help enable the energy transition."

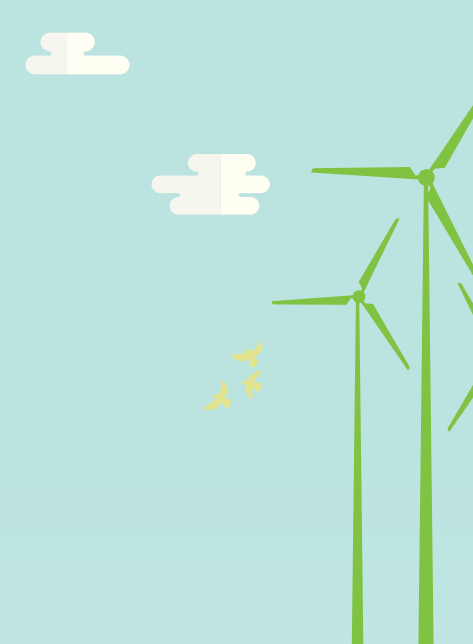
3 BRINGING THE BEST FROM AROUND THE GLOBE TOGETHER WITH PURPOSE

Inspired by the Fluvius work on the distribution end of the system, the Deloitte ElectrifiedGrid initiative has cast its net globally, starting with a core in Canada and Belgium and concentrically building a collective of leaders in multiple areas of modeling and grid expertise from places such as Japan, France and the US. The guiding principle is to not duplicate efforts, and instead find ways to share benefits and integrate towards a future vision.

A good example is the way that Deloitte is integrating already built (or being deployed in regions) macroeconomic and bulk energy system models in specific geographies (e.g., Deloitte's DARE – Deloitte Applied Research on Energy modeling capability) with the deep 'bottom up' modeling capability of a deployed instance of 'ElectrifiedGrid' in a region. The common rallying cry is the noble cause at hand – accelerating the energy transition so that we can meet the commitments of the UN Paris Agreement (COP21) while not sacrificing reliability or cost.

4 LEAVING NO ONE BEHIND

Deloitte supports Fluvius, and many other utilities globally, to provide safe, reliable, affordable and clean energy to everyone. Increasingly in focus, too, is ensuring that no one is left behind in the transition to a sustainable future, that we enable a 'just transition' for society. ElectrifiedGrid is an enabler of achieving this goal, as it equips the utilities with the capabilities needed to help identify affordability challenges at a neighborhood level, or even street level, and test digitally customer programs which can help alleviate these issues.



5 NAVIGATING UNCERTAINTY WITH CONFIDENCE TO MOVE WITH URGENCY

Using ElectrifiedGrid to assess the transition costs required to meet government-set climate targets, under a variety of scenarios, will help accelerate progress where the urgency of change has been most pressing. By simulating scenarios of electrification and assessing the infrastructure needed, the grid digital twin proves invaluable for supporting the selection of 'low' or 'no' regret investment choices and lighting a policy path forward. Key to the confidence is understanding not just costs but also risk in a more statistical manner.

The recent tide of news stories (e.g., failed rate increase requests) show the sometimes growing divide between government and utilities, and underscore technology and data-driven insights are increasingly indispensable in shaping the energy landscape of the future.

6 A COMPLEX LANDSCAPE

There's no one-size-fits-all solution to the global energy transition challenges; the transition is highly dynamic. It's no secret that each region has unique challenges, and the future of energy isn't evenly distributed. The ElectrifiedGrid team has looked at global scenarios and found that regions with the most pressing issues tend to be furthest along in adopting digital twins to help them better understand and tackle those issues. Another visible example is the area of grid resiliency analysis – because of the increase in severity and frequency of natural disasters, namely and most recently wildfires and floods; grid digital twins have been used to enhance disaster preparedness through the simulation of extreme weather events.

7 THE IMPORTANCE OF DATA

Effective modeling requires high-quality data. Fluvius and Deloitte recognized early that data quality is an ongoing journey, and they use their digital twin program to incentivize data improvements within the organization. Robert explains how ElectrifiedGrid will continue forward with this concept at its core: "Data is the lifeblood of the digital twin. It plays a vital role in achieving accurate diagnoses, modeling and simulations. The commitment to data-quality improvement sets a precedent for ongoing data-driven excellence. However, organizations can't wait for perfect data – so we are helping them by using AI to help set assumptions, fill data gaps and validate and improve those over time in a structured manner. The result is an acceleration to value being generated."

8 A CROSS-SECTOR TOOLBOX OF USE CASES

ElectrifiedGrid is not a single-use case solution; it's a dynamic tool that can be applied to a wide range of challenges. The value of the tool/platform will snowball, which is an important aspect of its overall investment thesis for utilities and others in the regional ecosystem. The adaptability of the digital twin technology makes it a valuable resource for informed decision-making and improved operations in adjacent sectors as well. It's cross-sector impact could extend – from answering questions and planning the electrical grid, to gas delivery systems, to transportation planning, water planning and waste management and more. The ability to leverage Application Program Interfaces (APIs) will lead to cross-sector cross organizational efficiencies – and is ultimately aligned with the vision for 'Smart Cities'.

9 PLANNING WITH THE REGULATOR AND OTHER ENERGY STAKEHOLDER GROUPS

The digital twin is a powerful tool for evolving relationships between utilities, regulators, government entities, and special interest groups (such as indigenous first nations), catalyzed by working together to plan the energy transition. ElectrifiedGrid will help align utility investments with the needs of regulators and the public – and highlights the significance of building a shared 'living vision' at the core of collaborative planning sessions. As a tangible example, Roy notes that "Fluvius secured an additional EUR 4 billion to invest in the energy transition because they could quantify the benefits and addressed risks better using the digital twin."

The journey that ElectrifiedGrid is pioneering is a sustainable energy future that serves the needs of today and tomorrow. The Fluvius digital twin program supported by Deloitte is not just another piece of technology; it's a shining light guiding the way to a climate-neutral society and an inspirational example of how data and digital underpin leaders' ability to make decisions that benefit everyone.

Roy concludes that while the capability had its beginning and foundation in Belgium, Deloitte is continuing the development globally, transcending borders: "Electrification is a worldwide problem, so we're looking at making a global portfolio of assets to support the energy transition – and that's ElectrifiedGrid."



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Australia's national housing challenge has been intensifying



THIS REPORT EXPLORES THE SCALE OF THIS COMPLEX CHALLENGE AND THE INTERESTS AT STAKE AND PROPOSES A BOLD PEOPLE-CENTRED, SYSTEMS-THINKING APPROACH.



FIND OUT MORE AND READ OUR FIVE COMPLEMENTARY ACTIONS FOR BETTER HOUSING

Smart City Expo World Congress 2023

CREATING BETTER FUTURES



Smart City Expo World Congress, South entrance. (Source: www.businessyokohama.com)

TOGETHER WITH OUR CLIENTS, DELOITTE IS PASSIONATE ABOUT OFFERING CUTTING-EDGE SOLUTIONS ON HOW CITIES CAN USE ADVANCED TECHNOLOGIES TO ADDRESS CHALLENGES AND OPPORTUNITIES IN THE KEY AREAS OF SUSTAINABILITY, INFRASTRUCTURE AND BUILDINGS, TRANSPORT AND MOBILITY, AND DIGITAL MODERNIZATION—INCLUDING 5G, CYBER, DIGITAL TWINS AND AI. THE DESIRED RESULT? A TANGIBLE IMPACT ON URBAN LIVING.

Drawing on our global reach and cross-sector experience, Deloitte translates a holistic vision of smart cities and urban transformation into concrete action that can enable a

brighter urban future. At the recent Smart City Expo World Congress held in Barcelona, Spain, we proudly presented over 25 innovative solutions that explore these vital areas. The 2023 Congress attracted 25,300 attendees from 140 countries, setting a new standard for urban innovation and providing a great forum to evolve the debate on what it takes to enhance urban living, safeguard the level of amenities and the quality of the public space.

Miguel Eiras Antunes, partner, Smart Cities & Urban Transformation Leader, Deloitte Global, attended and spoke at the three-day event and said: "We're putting all our energy and focus on ensuring human-centricity is at the core of all our tech developments and innovations.

Deloitte is involved in supporting and expanding the most impactful projects worldwide, benefiting over 500 million people, successfully delivering cases in diverse regions such as Europe, the Middle East, Canada, the US, APAC and Africa. Through these interconnected initiatives, involving various partners and geographical locations, we play an active role in shaping a future where positive change and innovation thrive."

We believe in building human connections that bring together people at the heart of the organizations and businesses we work with. Together with our extensive network of global relationships such as with the World Economic Forum and several alliances

including AWS, Salesforce, NVIDIA and ServiceNow – we help transform cities into engines of wellbeing, economic growth and sustainability.

Michael Flynn, Partner, Global Infrastructure Public Sector Leader, Deloitte Global, said, "With most of the world's population set to reside in cities by 2050, cities are key to the future of our planet. Therefore, developing inclusive and sustainable infrastructure that harnesses the transformational potential of technology will be crucial - for both the environment and for communities."



Visit our **Smart Cities & Urban Transformation page** and contact our experts to discover how we are creating urban landscapes that are smarter, more sustainable and prosperous, leaving a lasting positive impact on people's lives.

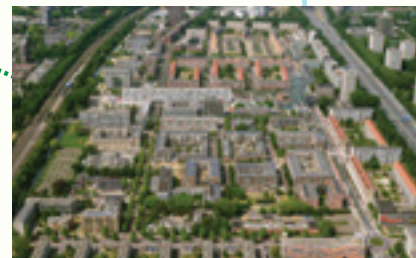


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Improving Amsterdam's New-West

URBAN RENEWAL IN OVERTOOMSE VELD FOR AN INCREASING POPULATION



Overtoomse Veld, Amsterdam. (Image: www.amsterdam.nl)

OVERTOOMSE VELD IS A BURGEONING NEIGHBORHOOD IN NEW-WEST, ONE OF AMSTERDAM'S EIGHT DISTRICTS. APPRECIATED FOR ITS GREEN AND SPACIOUS CHARACTER, IT IS CONVENIENTLY LOCATED NEAR THE CITY CENTRE AND LOCAL PUBLIC TRANSPORT.

The municipality of Amsterdam, the principal form of government for the city and a number of small towns, is working on urban renewal in the neighborhood. Its main aim is to improve on the built environment, which consists of both buildings and public spaces.

The urban renewal task includes densification of the area – namely increasing the neighborhood's

Amsterdam map. (Image: Getty Images)

population density by building additional housing within the existing area. An important challenge is to safeguard the level of amenities and the quality of the public space, so Overtoomse Veld continues to be a pleasant place to live for over 12,200 residents.

David Dortmans, consultant, Infrastructure & Capital Projects, Deloitte Netherlands, has been

providing his services to the City of Amsterdam's project management office and collaborating with the Amsterdam Engineering Office and the Space & Sustainability department, among others.

He says, "This project is challenging and involves lots of different tasks. I especially enjoy extensive consulting with different departments and external parties, such as housing



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cooperations and developers. Together, we make sure the improvement and densification task is met. As the junior project manager, I ensure that ongoing processes run smoothly and on schedule, and that communication stays efficient."

Public space is where Amsterdam's city life plays out and flourishes. Because the city's population is increasing by 11,000 people on average per year - and the City of Amsterdam aims to enable the construction of 52,500 new homes primarily within the city limits by 2025 - the pressure on public space is only set to increase. The growing number of jobs and tourists in the city also mean it's more important than ever to think carefully about the use of public space. (Source: amsterdam.nl)

Deloitte.

INFRASTRUCTURE FOR GOOD

Which nations are delivering quality infrastructure in a sustainable way?



FIND OUT HERE



Initiative by

ECONOMIST IMPACT

Research partner



The beacon for public sector digital transformation

FUELING INNOVATION WITH INFORMATION AND TECHNOLOGY

WITH A 25-YEAR BACKGROUND IN TECHNOLOGY AND CHANGE MANAGEMENT, ADAM MATTHEWS, CHAIR, GLOBAL BUILDING INFORMATION MODELLING (BIM) NETWORK, BRINGS TOGETHER DIGITAL INNOVATION WITH NATIONAL TRANSFORMATION EXPERIENCE.

COMBINED WITH WORKING IN THE INFRASTRUCTURE INDUSTRY FOR OVER A DECADE, ADAM'S DIGITAL TRANSITION EXPERTISE PUTS HIM IN GREAT STEAD TO CHAMPION CHANGE ACROSS THE PUBLIC SECTOR AND ITS INTRODUCTION OF BIM.

The Network he leads has a vision of a global digital built environment that delivers benefits for people and places.

Guri Neote, partner in Major Programmes with a focus on Digital & Capital Projects in Deloitte UK, spent some time with Adam to find out more about his vision for the future and the critical role digital transformation plays in unlocking innovation, efficiency and performance in the sector. Interestingly, Adam reveals that his perspective is one that is entirely focused on change, and making continued improvements by asking the right questions to

save time, money and effort on digital transformation journeys.

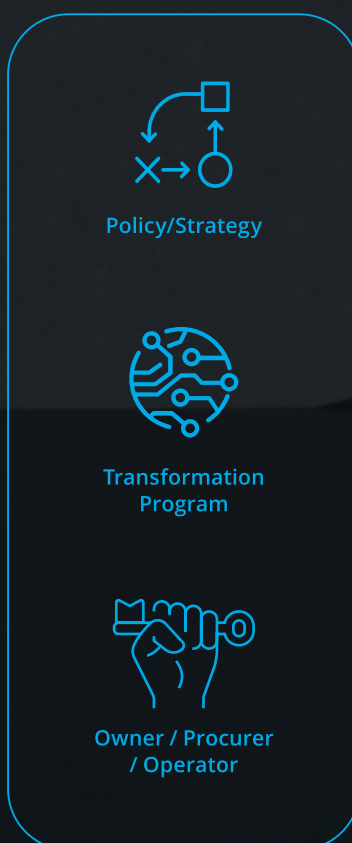
When describing his role for the UK Government's BIM program (2010-2017), Adam says, "I've been involved with BIM since the formation of the UK's BIM policy and it's an incredibly rewarding experience working with the UK's and other governments around the world to look at the challenges facing both government and industry in terms of adopting digital practices. I'm fascinated by our future and how we can shape today's built environment to make sure it is responsive and fit for purpose for decades to come."

GLOBAL BIM NETWORK, ITS VISION AND PRIORITIES

When asked to describe the Global BIM Network, Adam says it was established in March 2021 to connect international public sector representatives and

multi-lateral organizations with the aim of advancing the digitalisation of the global built environment and sharing the resulting benefits. BIM is a powerful digital innovation tool, which combines technical standards, technology, data, collaborative working and digital skills, to deliver better outcomes for projects, people and places.

"The network is the natural development of the increased level of international collaboration between governments and multi-lateral organisations on the digitalisation agenda in the construction industry and built environment. This includes policy makers (from public sector entities), program leads (of a national digital transformation program in a country or within an organization), and public procurers (those involved in the execution supervision of public infrastructure within their organizations or countries)," says Adam.



THE RISE OF PUBLIC SECTOR TAKING A LEADERSHIP ROLE TO PROMOTE BIM IN ITS PUBLIC CONSTRUCTION AND INFRASTRUCTURE PROJECTS.

"These three communities learn from each other, so fundamentally it's a learning, knowledge sharing, information gathering network – so the bigger our membership, the richer our knowledge and the more we can inspire innovation across the public sector. Essentially, the BIM Network acts as a beacon, a flag, and a direction finder for those who work in the public sector to drive digital transformation within the industry as a whole," explains Adam.

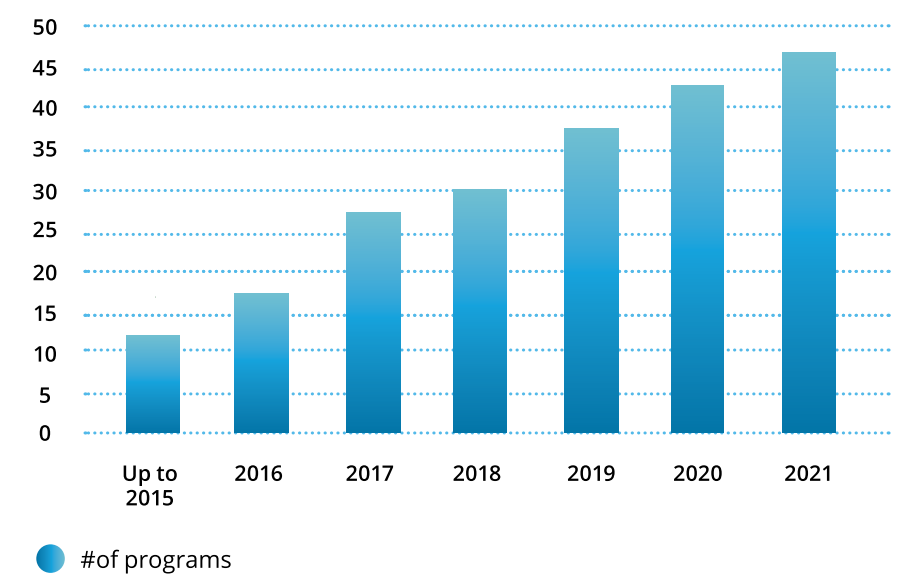
When sharing the network's priorities, Adam says there's a wealth of material that the network can use to support and address its challenges, including tackling risk aversion or low risk appetite for public procurement. "It's helpful to have information exchange between how somebody's managed to work through some of

these challenges, so one of the basic ideas is to bring all that information together into one central, structured place so civil servants can easily find and digest those insights.

"With this in mind, our priority for the next 12 months is to build on the 500 global articles we've already collected on digital transformation that could be useful for the public sector across all different levels of government, spanning national strategies.

"Articles cover topics from creating the business case for digital transformation, to developing a roadmap for digital transformation, right down to the execution level for introducing digital construction into project supervision or project procurement. We're creating a wealth of easily accessible knowledge, based on a wide span of documents, so this combined this becomes the 'digital transformation playbook' for public sector construction so everyone benefits; citizens, communities and ultimately economies," says Adam.

PUBLIC SECTOR BIM PROGRAMS



THE GLOBAL BIM INFORMATION COLLECTION

From this wealth of information we've developed a world first: a dedicated knowledge product for the public sector to guide the introduction of BIM from the early stages of developing a case for it through to scaling implementation. It is developed by the public sector for the needs of the public sector.



<https://www.globalbim.org/playbook>



<https://www.globalbim.org/information-collection>

CREATING A GLOBAL BIM VIEW

As well as completing the digital transformation playbook in the next few months, Adam is focused on making sure that those who use this resource will feel confident to act on the knowledge they have access to.

“We’re creating a global BIM view, a collective view, across about 60-70 countries, of what is happening, which we’ll do in two ways: A secondary

research study of the database with over 400 articles, including analysis and interpretation of what the articles mean; and producing and running a survey with our partner network, including government representatives from 27 European countries and close to 10 Latin countries. The survey will focus on accurately understanding the extent of people’s knowledge, what’s working well and less well in those countries.”

TAKING PEOPLE ON THE JOURNEY

When asked about digital adoption barriers, Adam shares a few different examples.

“Firstly, we need greater public sector involvement; especially in public procurement, which tends to be quite a risk averse area because of the need to reduce exposure.

“Secondly, it’s appreciating that the landscape we operate in is complex. So even though our focus is on digital transformation, it’s about people and engaging their desire for change – and it’s bringing people along the journey that I enjoy most. We need to change the way we think to be about social change to succeed,” says Adam.

INCREASING COVERAGE OF BIM KNOWLEDGE ACROSS THE GLOBE

400+
RESOURCES

60+
COUNTRIES



Source: Scope and scale of the global BIM network information collection resources

BUILDING A PICTURE OF THE FUTURE TO INSPIRE CHANGE

When thinking about the built environment, Adam likens its potential to science fiction. For example, imagine having the ability to completely, instantly understand an asset’s potential, like R2-D2’s probe droid in Star Wars (an apparent reference to the 1977 Episode IV!).

Adam explains, “The central idea of really understanding our built environment means understanding not only how it’s built, but how we can build better infrastructure to support our changing climate. There’s something to be said for understanding how we interact – as people – with our surroundings, and how our surroundings can interact with us ... and how we relate to each other. That’s impossible without technology and the broader

understanding of how to introduce this technology into the environment. Infrastructure is one of the least digitalized sectors on the planet. I believe process innovation is the key.”

If we are to take the next leap to a real-time interaction with our built environment with a much promised ‘digital twin’ of the built environment – we first need to build the digital skills and capabilities of both the public sector infrastructure client community and the private sector.

UNPACKING THE FUTURE, QUESTION BY QUESTION

In closing, Adam reflects on how innovation is fuelled by asking the right questions to unlock transparency and an ability to act faster and better.

Over the years he has been involved in projects that revolved around understanding the nuts and bolts of government departments.

“I have asked tens of questions during workshops with representatives from government departments at the table. Questions about what their information needs as a department were, to asking them to talk us through what they did day-to-day, to describing their processes and what decisions were being made ... so that I could better understand how information, or better and more reliable information, could improve the quality of or speed up decision making. Not only did these questions help me, they helped the workshop participants too. They began to realize that their interpretation of what they did was different to what they actually did, or what others thought they did, creating moments of clarity for those

involved. So for me, innovation is a lot about driving a process change through asking better questions to gain clarity and alignment ... alignment towards goals, and clarity on how to work together and make better decisions. Ultimately, we need to become more intelligent clients with better questions for our suppliers. “Timing is also key: Sharing information early removes unnecessary work and rework and misunderstandings. It’s about driving transparency to maximize value, saving time and unlocking the intended benefits for the public sector, engineers, contractors – everyone involved in planning, operations and maintenance so citizens have a great experience of the assets in question. When you have visibility of the final destination, you can make sure you have the rights laws and policies in place to make them a reality,” concludes Adam.



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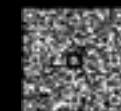
Editor note: Adam Matthews OBE is a Director of CIMO Consulting, a change management practice dedicated to the social change aspect of strategic transformation within the public infrastructure sector.

GreenSpace Tech

by Deloitte

In a rapidly evolving and complex tech landscape, swift decisions on the ideal climate technologies for your organization’s decarbonization goals can be challenging.

Help accelerate this process with GreenSpace Tech by Deloitte—a leading, AI-powered solution. Deloitte’s platform can match your business needs and climate objectives with the right existing and emerging technology solutions and insights. Working within an ecosystem of climate specialists, innovators, and intelligence from around the globe, we can help fast-track your sustainability goals.



CONNECT WITH US



Digital twins and the Metaverse in the construction industry

DIGITAL TWINS ARE UNLOCKING NEW POTENTIAL IN THE MIDDLE EAST WHEN OPERATING IN A METAVERSE ENVIRONMENT

THE METAVERSE SEEMS LIKE IT'S EVERYWHERE ALL AT ONCE, ESPECIALLY FOLLOWING FACEBOOK'S REBRANDING TO META.

Best described as a general term for how virtual worlds can be used for a variety of creative purposes, the metaverse is a very powerful concept. Essentially, it is a digital space where users can interact with each other and with virtual objects and environments in a way that simulates the physical world.

A DIGITAL TWIN, ON THE OTHER HAND, IS A DIGITAL REPLICA OF A PHYSICAL ASSET.

Such as a building or a complex infrastructure project. Digital twin technology allows developers, architects, and contractors to optimize the design, reduce errors and improve the performance of a building. Typically, digital twins are produced for the construction phase of development, to improve cross-disciplinary coordination and as a visualization tool for stakeholders. They are also widely used during building operations to monitor performance, run simulated scenarios, and optimize maintenance.

By no means are these concepts new, but as it relates to the property and construction industries, integrating digital twins into a metaverse environment is at the forefront.

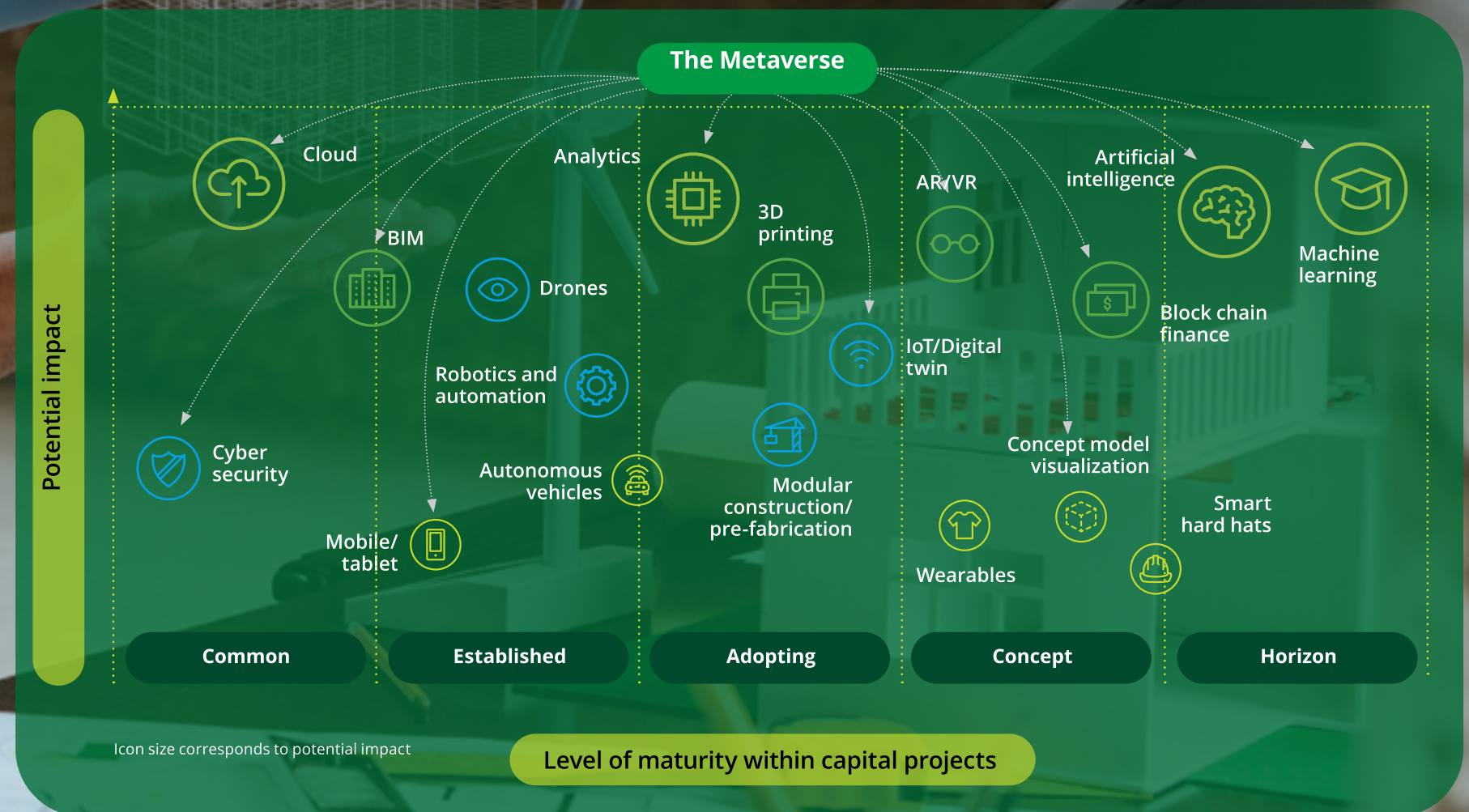
This integration can also produce significant efficiencies throughout the whole property development lifecycle by extending the useful life of digital twins. Uses range from concept design, for use in marketing and sales, through to operations, for maintenance and integration with connected devices, and even through to decommissioning. It opens significant opportunities

for the integration of additional technologies as outlined in Figure 1, which shows how the metaverse simultaneously draws on many technologies, with almost infinite potential for expansion. As adoption of the metaverse and digital twins increases, integration across technologies will also increase.

Additionally, advances in technology and increased investment in the space are leading to greater opportunities for partnership between firms at different stages in the capital project life cycle. This leads to improved collaboration, increased engagement of the market and potential customers, and ongoing operational and end user benefits. These all help justify the investment in the technologies, creating a positive feedback loop of accelerating adoption and implementation within the construction industry, which is historically resistant to change and notoriously slow at adopting new digital technology.



Figure 1. Technology maturity spectrum





Designing 3D architectural precast concrete building model with BIM technology in VR. (Image: Getty Images)

ENGAGING CUSTOMERS AND STAKEHOLDERS

Typically, architects, design firms and creative agencies are responsible for the production of conceptual renderings, visuals, and animations of a new project for marketing and sales purposes. These productions offer very little flexibility in terms of re-use despite the high cost.

A solution to this is the early development (concept design stage) of a project-wide digital twin. Coupled with recent improvements in photorealistic visualization technology (e.g., Unreal Engine 5) there are almost infinite possibilities for engaging with customers and stakeholders including marketing content creation, VR and AR tours, and immersive design experiences. Plus, as design progresses, the level of detail can also increase, bringing stakeholders and customers even closer to the end-product.

As potential customers and stakeholders spend time in the metaverse, similarly to social media, their focus and engagement with different elements of an asset can be monitored and measured. This could open new possibilities for user experience (UX) design, applying principles currently used in the software design world to architecture. During detailed design and construction, the digital twins can be used to facilitate collaboration between teams working on different aspects of the project, regardless of their physical location. Allowing for real-time communication and coordination, reducing delays and design clashes, and increasing efficiency.

Digital twins within the metaverse can be used to optimize design based on an end-user experiences. For example, VR walkthroughs of the building allow stakeholders to experience the building before it's built. This can be used to showcase the building to potential

clients and investors, as well as to train workers on how to navigate the construction site or building safely. This is particularly relevant for assets with very specific operational needs, such as hospitals, where being able to demonstrate designs to users in a near-realistic environment could greatly enhance the feedback and sign-off process.

A LIVING DIGITAL ASSET

Following completion and handover, this same digital twin can be used for continuous monitoring and analysis of the building's performance. This can enable the identification of issues in real-time, optimize the operations and maintenance of the building, and reduce operating costs. Digital twins can be used to simulate different scenarios, such as different layouts and materials, to optimize the operations and maintenance of the building. These examples are very common, especially for oil rigs and manufacturing facilities with

extremely high shutdown costs. Additionally, data captured during operations can be used to inform the design of future projects. For residential and hospitality assets, the use cases for digital twins and the metaverse extend into device connectivity, security and privacy, and other smart home applications. As these are tangible benefits to the end user, assets with these features can command a price premium that can be charged to customers, compared to those without.

Additionally, as these technologies become more common, consumers will begin to expect these features as standard, which will further drive investment in and adoption of these technologies.

CURRENT STATE OF PLAY IN THE MIDDLE EAST

Recently, a combination of technological limitations and a lack of tangible ROI has kept digital twins out of the metaverse. Middle Eastern giga-projects with enormous budgets and an eagerness to drive technological innovation have helped to bridge this gap.

Forward-thinking leaders are seeing the incredible opportunities that a metaverse embedded digital twin can offer, made evident by the recent acceleration of investments in metaverse related ventures.

A notable example is the kingdom of Saudi Arabia's Public Investment Fund (PIF) recent US\$ 1 billion commitment to Tonomous

(a subsidiary of NEOM) for AI and Joseph Bradley, Tonomous Chief Executive, has spoken at length on the ambitions for digital twins at NEOM including their role in improving the experience of future residents. In the UAE, the government recently announced its plans for a ministry in the metaverse, and Dubai's newly developed metaverse strategy has digital twins as one of its key pillars.

By embedding digital twins into the metaverse, asset owners can greatly extend their useful life and unlock integration with a range of other technologies, further enhancing the value of the digital twin and even the asset itself. To take full advantage of this opportunity, it is crucial for leadership to stay up to date with the latest developments in this technology and to dedicate resources to the potential opportunities and risks.



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Catalyzing the clean hydrogen economy using business model innovation

WHILE WE KNOW HOW TO PRODUCE CLEAN HYDROGEN TO HELP ENABLE A NET ZERO FUTURE, IT REMAINS PROHIBITIVELY EXPENSIVE RELATIVE TO ALTERNATIVES FOR MANY BUSINESSES. WE IDENTIFY FIVE KEY UNCERTAINTIES AND OUTLINE 13 BUSINESS MODEL SOLUTIONS THAT COULD HELP ADDRESS THESE THROUGH RISK REDUCTION MECHANISMS.



READ THE REPORT

Transforming connectivity worldwide

5G IS TAKING THE WORLD BY STORM

CONNECTIVITY IS THE CORNERSTONE OF OUR MODERN LIVES, TOUCHING EVERYTHING FROM ENTERTAINMENT TO HEALTHCARE. BUT WHAT'S THE DRIVING FORCE BEHIND OUR SEAMLESS ONLINE PRESENCE? AND WHAT MAKES 5G STAND OUT?

Deloitte US colleagues **Brad Hunt**, based in Kansas, and **Aritz Aldecoa**, based in Washington, collaborated to find out 5G's five key strengths and set out to describe some of the expert capabilities required to make the most of this thriving technology.

First, there's **Millimeter Wave** technology, which taps into higher frequency bands, essentially supercharging data speeds. This translates to lightning-fast downloads and uploads, redefining our expectations of speed.

Second, the deployment of **Small Cells** is key to the 5G experience due to the unique characteristics of these higher frequencies. These smaller, low-power transceivers are spread far and wide to ensure that connectivity blankets even the most remote corners, leaving no one in the digital dark.

Third, 5G leverages Massive **Multiple Inputs / Multiple Outputs** (mMIMO) technology. This innovation allows for precise sectorization of antenna banks, effectively guaranteeing reliable and dedicated transmission paths. It's like having an express lane for data, ensuring a smooth and congestion-free journey.

Fourth, **beamforming** harnesses the power of advanced artificial intelligence to create intricate radio frequency patterns. This wizardry reduces interference by optimizing the direction of the radio frequency path, ensuring a clearer and more efficient communication highway.

Fifth, another game-changing feature is **Full Duplex**, which enables data to flow simultaneously in both directions on a single logical circuit. This breakthrough greatly enhances network efficiency, allowing for seamless communication that was once thought to be the stuff of science fiction.

Together, these features mean we can take a technological leap and redefine our digital experiences. It's a new dawn of capacity, latency and reliability in the applications that are integral to our daily lives.

A DIGITAL LEAP BY SECTOR

5G is enhancing network infrastructure (the hardware and software that enable network connectivity and communication between users, devices, apps, and the internet) dramatically. All organizations rely on some form of this to run daily.

DRAWING ON EXPERT CAPABILITIES

5G is the glue that will enable a wider suite of new technologies (such as AI, AR and VR) to realize their full potential and perform as intended. It provides the necessary capabilities for these technologies to thrive.

"5G connectivity opens the door to new applications, sources of business, and cost reductions – with significant benefits for industries including logistics, transportation, health and education. As the fifth-generation mobile network, 5G is designed to bring everyone and everything closer together by processing high volumes of data with minimal delay, enabling millions of devices to connect and interact."

- Global Infrastructure Hub, July 2023

Figure 1

While improved telecommunications are the backbone of every industry, there are other improvements to be seen across sectors as outlined in this table:

Manufacturing	Precision manufacturing benefits from low-latency, highly reliable connectivity for advanced robotics.
Healthcare	Remote healthcare – crucial during the Covid-19 pandemic – relies on 5G for seamless, low-latency connections, especially in remote areas.
Education	With lower latency and greater bandwidth, 5G enhances educational experiences, improving video conferencing quality and enabling virtual reality applications.
Defense	Real time, 5G powered communication is critical to geographically dispersed military.
Power/Utilities	Smart grid applications, like reclosers and cap banks, depend on low-latency communication to function effectively.
Automotive	Autonomous (self-driving) vehicles use 5G's low-latency communication for sensor-driven command and control.

Figure 2

Deloitte Infrastructure & Capital Projects can provide value to clients for future 5G opportunities globally including, but not limited to:

Owner's representation	Provide engineering oversight using existing knowledge of the requirements associated with these complex builds.
Construction management	Manage the construction process to ensure compliance with applicable design specifications.
Financial modeling	Develop business case justification for projects, including cash flow and total cost of ownership (TCO) models.
Strategic planning	Establish project plans for 5G buildouts that align with strategic requirements.
Government grants and loan assistance	Assist in the development of grant and loan processes to align operations with strategic goals of the client.



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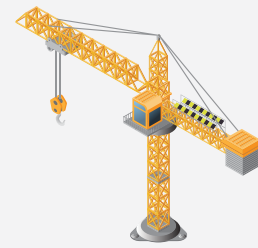
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ARE YOU ONE OF THE 464.7 MILLION PODCAST LISTENERS IN THE WORLD?¹ WE'VE GOT A RECOMMENDATION FOR YOU! FUTUREPROOFED IS A NEW REAL ESTATE AND CAPITAL PROJECTS PODCAST SERIES DEVELOPED BY DELOITTE UK REAL ASSETS ADVISORY TO EXPLORE HOW TECHNOLOGY AND INNOVATION IS IMPACTING MAJOR PROGRAMS ACROSS THE REAL ASSETS AND INFRASTRUCTURE SECTORS.

Launched in April 2023, the podcast series is dedicated to interviewing leading industry subject-matter experts to explore the challenges, opportunities, benefits and insights emerging in the infrastructure and real estate sector with some of our Deloitte specialists.

PODCAST 3: UNLOCKING THE POWER OF DATA

In the third podcast, host **Eoin Ó Murchú**, director, Financial Advisory,

Deloitte UK, was joined by **Georgia Stillwell**, Director Client Solutions EMEA at ALICE Technologies, and **Mike White**, director, Financial Advisory, Deloitte UK. During the podcast, listeners can find out more about how to unlock the power of data to optimize the delivery of their major capital programs through complex scenario analysis, based on a range of inputs and constraints.

ALICE Technologies is a construction optioneering platform that empowers the world's leading contractors to plan, bid, win and build more profitable projects.

Eoin says he was fascinated to learn more about how ALICE gives AI rules – e.g., volumes of certain elements, equipment and essential logic – so it can find the best routes from the start to the end of a project.

Eoin highlighted, “Georgia also shared the four key benefits that ALICE likes to find when using AI in major capital programs. These include assurance, true optimization, operational savings and digital transformation.”

CASE STUDY: UNLOCKING THE POWER OF DATA

The ALICE Technologies platform was recently used to support a tier one contractor on a bridge project. Initially, the platform provided assurance on the project baseline, identifying resources that had not been budgeted for in the bid.

The platform was then able to find and assess feasibilities in the baseline to bring the project on track with the available resources. This included identifying opportunities for reducing the overall project duration, resulting in reduced overhead costs.

KEY LESSONS FROM EPISODE 3:

- **Looking into the unknown:** by understanding risks early, you can plan early.
- **Time management:** by arriving at a decision far more rapidly, you save time to effect change and add more value to the client. “It helps validate our hypothesis more quickly,” says Mike.
- **Getting in front:** by adopting tools like ALICE sooner rather than later, you can move from a risk-focused mindset to an opportunity-driven mindset and maximize competitive advantage.
- **Embracing change:** One of the major benefits of using tools like ALICE is the ability to quickly re-plan or when things change during project delivery, or to optimize for a different outcome if priorities change, e.g. the need to hit a deadline becomes more important than the original budget constraint.

PODCAST 4: EXPLORING THE POWER OF AI

Futureproofed's fourth podcast explores the power of AI, and its ability to disrupt capital projects.

In this episode Eoin hosted a conversation with nPlan co-founder and CEO, **Dev Amratia**, and **Hugh Dullage**, partner, Financial Advisory, Deloitte UK to take a closer look at this emerging tech and its huge potential.

nPlan specializes in AI that forecasts project outcomes, creates scenarios of the future and helps mitigate risk across single projects and portfolios.

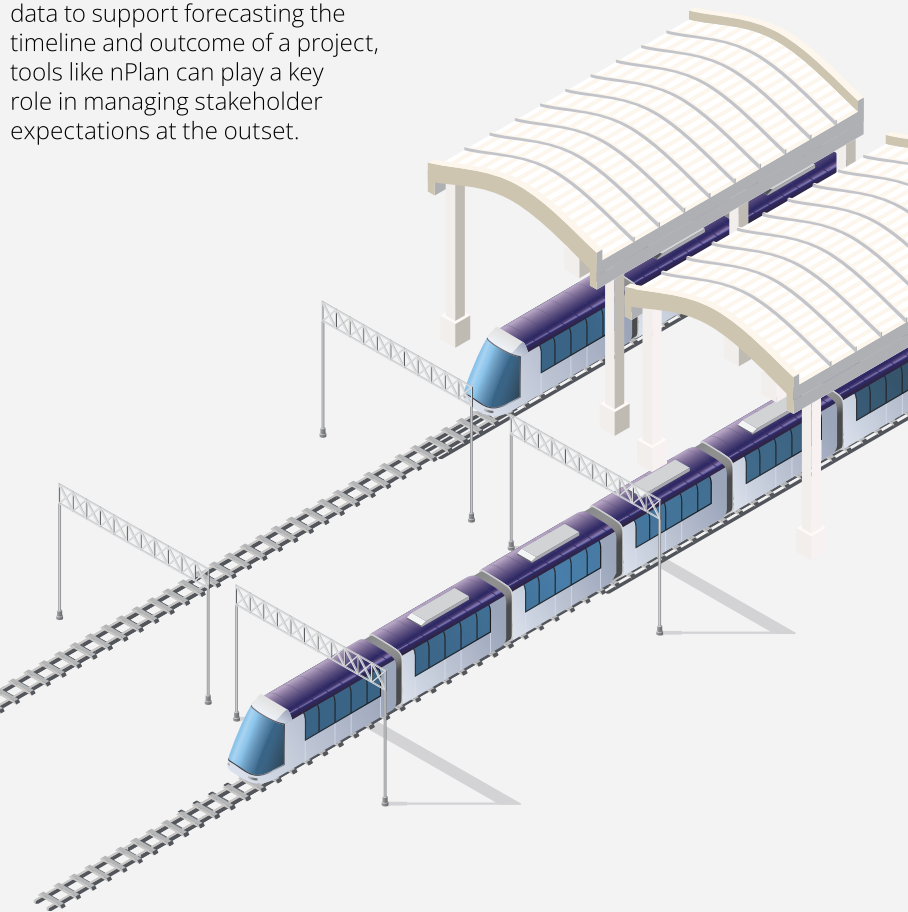
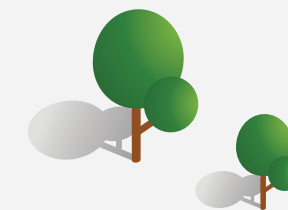
When reflecting on this podcast, Eoin said he enjoyed learning more about how nPlan utilizes Machine Learning (ML) to help clients predict their project completion dates and identify the risks which may impact them. nPlan forecasting outcomes can say how long a project is likely to take and what could go wrong using data from historical projects. He says, “ML can look at a new project and

compare it to over 750,000 previous projects to help spot potential future risks. In the past, senior engineers held this knowledge, but now ML can constantly learn and evolve because it draws on multiple sources.”

The podcast shares how AI and ML can optimize the delivery of capital projects – and how nPlan's ML technology forecasts the duration of construction projects and significantly supports the de-risking of major projects. This performance and its potential to significantly improve project delivery confidence has earned nPlan recognition as a finalist in the prestigious MacRobert Award for engineering innovation from the Royal Academy of Engineering.

CASE STUDY: MACHINE LEARNING IN ACTION

A large UK rail project uses nPlan's platform to help them understand risk and uncertainty. The platform supports the client with two key problems: firstly, assuring the direction of travel



of the project by forecasting parts or the entire project to give an independent assessment. This provides stakeholders with confidence in the project schedule. Secondly, helping to drive performance on the project through identification of future risks that the project should consider. This enables the project teams to proactively manage and mitigate these.

KEY LESSONS FROM EPISODE 4:

- **Business case justification:** by using AI and historical project data to support forecasting the timeline and outcome of a project, tools like nPlan can play a key role in managing stakeholder expectations at the outset.

- **Mixed data:** by combining diverse data sets from different organizations that are not used to working together, the algorithm means all available data is used to underpin and drive the project forward.
- **Mindset challenge:** by highlighting scenarios using the evidence beneath the outcomes, tools like nPlan's can help to convince stakeholders that tech, which they may not fully understand, can give reliable answers.



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Reimagining operations to reduce carbon emissions

VALE IS INTRODUCING GREEN BRIQUETTES TO MAKE THE METALS SECTOR MORE SUSTAINABLE

HEADQUARTERED IN RIO DE JANEIRO, BRAZIL, VALE IS ONE OF THE WORLD'S LARGEST INTEGRATED MINING COMPANIES AND EMPLOYS APPROXIMATELY 125,000 PEOPLE IN MORE THAN 30 COUNTRIES. VALE IS A LEADING GLOBAL PRODUCER OF IRON ORE AND NICKEL, WITH A VISION TO IMPROVE LIVES AND TRANSFORM THE FUTURE.

VALE'S BRAZIL OPERATIONS FEED DIRECTLY INTO THE VERY BEGINNING OF BRAZILIAN AND GLOBAL SUPPLY CHAINS FOR STEEL – SO ANY CHANGE IN THE WAY IT EXTRACTS IRON ORE HAS A LONG TAIL OF CONSEQUENCES. THIS IS TRUE IN TERMS OF HOW ITS PRODUCTS ARE TRANSPORTED ACROSS RAIL AND VIA PORTS, AND FOR UPSTREAM CUSTOMERS WHO NEED IRON ORE TO PRODUCE VEHICLES, RAILWAYS, BRIDGES, PYLONS AND MUCH MORE.

In 2022, Vale announced to its investors and the market that it would become a sustainable mining company, switching its focus from being a 400 metric tons per year (mtpy) standard miner to a 350 mtpy quality and sustainable iron ore solution provider. This commitment was underpinned by its desire to focus on quality, rather than quantity, aiming for a +50 mtpy increase in iron ore agglomerates such as pellet feed, and the newly introduced to the market green briquette. We take a closer look at how this is being achieved.

GREEN BRIQUETTES: A NEW BEGINNING

Marcello Spinelli, Executive Vice-President for Iron Solutions at Vale, says the company has been working towards green briquettes for almost 20 years, knowing these will reduce greenhouse gas emissions by up to 10% for its steelmaking clients. Fast-forward to November 2023, and Vale announced the startup of the first iron ore briquette plant at its Tubarão Unit, in Vitória, Brazil. "We already have an estimated backlog that should take 18 months to fulfill," says Marcello.

Rogério Nogueira, Vale's Director of Product and Business Development, says, "With the development of this new type of briquette, Vale is taking another important step in its contribution to reducing emissions from the steelmaking chain through innovation, always in close collaboration with its clients and development partners."

Fernanda Tauffenbach, partner, Infrastructure & Capital Projects, Deloitte Brazil, is delighted to be working on this leading-edge, exciting program of work.

"This significant investment and new way of working is part of Vale's strategy to reduce Scope 3 emissions by 15% by 2035. We are working closely with the Vale team to turn this innovative idea into a reality on time, on budget, safely and securely," she says.

So, what are green briquettes, exactly, and how will they make the steel supply chain more sustainable? The easiest answer is that a 'green briquette' is made of iron ore and an agglomerant technological solution that resists blast furnace temperatures without disintegrating, which reduces steelmakers' dependency on sintering, which requires the use of coal heated to about 2,372° Fahrenheit (1,300° Celsius). The green briquette does not require burning as part of its production: instead, a drying process between 392 and 482° Fahrenheit (200 and 250° Celsius) is used, requiring significantly less energy. All of this helps Vale and its customers contribute towards achieving decarbonization goals by reducing 10% of the carbon dioxide emissions that are emitted during the steel production process.

THE ART OF CONTROLLING CARBON EMISSIONS

Eduardo Raffaini, partner, Infrastructure & Capital Projects, Deloitte Brazil, has been closely involved in this transformation project.

"The focus of the briquette project is delivering a high-value, more sustainable product to Vale's clients across the country or overseas. The idea now isn't to mine the largest amount possible of iron ore, it's to mine and deliver only what's required, and to process those raw materials in accordance with high-quality standards to benefit the environment, as well as the rest of the supply chain," he explains.

Encouragingly, the innovation has sparked more creative thinking to control its carbon exposures, with Vale also carefully researching and testing how it can review the way it uses its furnaces to reduce their heat from 1,112 to 392° Fahrenheit (600 to 200° Celsius). This would mean that the main combustion can use natural gas, which causes less pollution than other energy sources.



Iron ore briquettes stockpile and close up. New product will be produced in plants in Espírito Santo, with a total capacity of 6 million mtpy. (Image: Vale)

REPURPOSING A BROWNFIELD SITE FOR THE BETTER

The two new briquette plants will be made possible by a combination of a brownfield site – two pelletizing plants that were going to be decommissioned that now have been converted – and a greenfield site using land that has not been developed on before next to the existing plants, where Vale built part of the new processes required for briquette production. The first one

commenced operations in November 2023 and the second is planned to start operating in mid 2024. Their combined production capacity will be approximately 6 million mtpy. Long-term estimates are that Vale will have the capacity to produce more than 50 million tons of green briquettes per year, resulting in a potential reduction in emissions of 6 million metric tons of carbon dioxide equivalent per year through the use of this technology.



Plants #1 and #2 at Tubarão Unit, in Vitória, Brazil. (Image: Rafael Coelho, Vale)

REALIZING THE NEW SOLUTION

Vale and Deloitte have been collaborating on strategy development, tactics and operations.

Eduardo Lavocat, senior manager, Infrastructure & Capital Projects, Deloitte Brazil, says "We have been helping Vale since the start of plants #1 and #2, developing and implementing a new integrated solution for project management and planning, through Lean Construction methods, Advanced Work Packaging (AWP), Building Information Modeling (BIM) and project controls. These solutions are helping to overcome the complexity and the usual roadblocks you would expect in the redesign of old plants."

Fernanda continues, "By working closely with Deloitte and our project management expertise, Vale is anticipating and controlling any risks, since the early stages of the projects, applying the Front-End Loading (FEL) method, and making sure its CAPEX investments deliver the desired outcomes in the short, medium and long-term."

"Considering the extensive project portfolio and the challenging delivery timeline, best-practice project management is recognized as essential to ensure that the best possible briquette plants are developed so that Vale can deliver the 50 million mtpy of the new green briquette product in the long-term."

CRITICAL SUCCESS FACTORS

When reflecting on what it takes to drive this industry-wide transformation, the team agrees it comes down to four main factors:

- **A unifying vision:** This is underpinned by a real purpose and commitment to innovate the mining industry and shift its reputation from one that harms to one that improves the environment.
- **Courageous leadership:** Being open minded, open to innovation, and open to making a difference.

- **Expert team:** Having a strong, robust engineering team that can tackle all the challenges that appear during the project – everything is new, so experienced professionals are needed to deliver in different and faster ways.
- **Partnership:** It takes an ecosystem to enact long-lasting change including designers, consultants, suppliers, construction companies, communities and all other stakeholders who are equally committed to delivering on the vision.

CHANGING THE GLOBAL MINING GAME, ONE STEP AT A TIME

There is no doubt that investment is required to reimagine the metal supply chain. So far Vale has self-funded approximately US\$250 million needed to implement the first green briquette plants and expects to invest billions in the program in the next ten years, but the spending doesn't stop there.

Steel companies, hot-briquetted iron (HBI) producers, and every other participant in the global metal supply chain will need to adjust or invest in new operations to use the green briquette effectively – and judging by existing customer interest levels, this is exactly what is already taking place.



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Construction and project collaboration at its best

10 SUCCESS FACTORS

THE GLOBAL BUILDING AND CONSTRUCTION INDUSTRY IS EVOLVING QUICKLY IN RESPONSE TO AN EVER-CHANGING ENVIRONMENT, DEMANDING NEW WAYS OF WORKING TO ENSURE THAT RISKS ARE CAREFULLY MANAGED, GOALS ARE ACHIEVED AND VALUE FOR MONEY IS SUCCESSFULLY DELIVERED WITH EACH PROJECT.

AT A RECENT INDUSTRY EVENT IN BRAZIL, RAFAEL MONTEIRO, INFRASTRUCTURE & CAPITAL PROJECTS PARTNER AT DELOITTE BRAZIL, GATHERED SOME RICH INSIGHTS FROM HIS INTERVIEW WITH PROFESSOR DR. WOLFGANG BREYER, AN INTERNATIONAL CONSTRUCTION LAW EXPERT BASED IN GERMANY. TOGETHER, THEY EXPLORED THE INS AND OUTS OF CONSTRUCTION AND PROJECT COLLABORATION, THEIR BENEFITS, CHALLENGES AND MORE. WE SUMMARIZE 10 COLLABORATION INSIGHTS FROM THEIR INTERVIEW THAT UNDERPIN SUCCESSFUL COLLABORATION AND CAN UNLOCK EXCITING INNOVATION ON A GRAND SCALE.

1 COLLABORATION NEEDS TO BE TAILORED, EVERY TIME

It's crucial to recognize that 'collaboration' is not a 'one-size-fits-all'. Its application hinges on the project's complexity. For straightforward projects, the tried-and-tested 'design-bid-build' approach may still be good. However, when it comes to intricate, large-scale undertakings, collaborative frameworks have the potential to truly excel – especially when they are founded on cooperation and multi-party contracts. Multi-party, in its turn, doesn't equate to a free-for-all; in the ideal scenario, at least three key players come together: the owner, the general designer and the general contractor.

2 MULTI-PARTY COLLABORATION REQUIRES A COMMITMENT TO QUALITY AND A COMMON GOAL

The primary objective of multi-party contracts should be to enhance quality from the outset. By integrating the specialized knowledge of construction personnel early in the design development phase, you proactively address potential discrepancies and prevent downstream issues that can compromise quality and lead to claims. This arrangement fosters shared goals and unified decision-making, replacing the adversarial atmosphere of traditional models. However, randomly adding parties to the mix can be counterproductive. Bypassing the general contractor and directly engaging subcontractors can also be detrimental.

3 COLLABORATIVE FRAMEWORKS ARE CHANGING THE GAME

Collaborative frameworks offer a pathway to mitigate conflict, foster innovation and unlock greater value from complex projects. Yet, like any powerful tool, wielding them effectively requires careful consideration, project-specific tailoring, and commitment to collaboration. It's not about throwing everyone into the room and hoping for magic; it's about orchestrating a symphony of expertise, where each note, each role, contributes to a harmonious and successful project.

4 EFFECTIVE COLLABORATION REQUIRES THE RIGHT TECHNICAL EXPERTISE

Collaboration is all about getting the right expertise on board for the specific project. Let's get them on board from the get-go and avoid those claims, right? This approach not only guarantees the presence of the most qualified individuals but also fosters collaboration from day one, improving the overall project development process. Every single one should be the best in their field. It's all about hand-picking the best team. Collaboration has the potential to promote these diverse experts and ensures that they work together efficiently. The same goes for dispute avoidance.

5 A PROJECT'S CHARACTERISTICS AND COMPLEXITY SHOULD GUIDE COLLABORATION

The true determinant of collaboration suitability lies in the project's characteristics, not the industry it sits within. Consider a standard housing development. With straightforward design and construction processes, the need for a bespoke multi-party contract, beyond simple framework alliances like FAC-1, becomes questionable. Such projects lack the intricacies demanding the specialized expertise these collaborative models can provide. The project complexity should be the primary driver for considering collaborative models. As intricate challenges and technical demands escalate, the potential benefits of these methods increase proportionally, making them more attractive as an alternative to traditional models.

6 FOSTERING COLLABORATION AMONG SUBCONTRACTORS IS ESSENTIAL

Subcontractors bring valuable expertise to the project, and the key to effective collaboration lies in redefining the purpose and structure of the contract. First, the traditional standard form of construction contracts primarily focuses on defining rights, obligations and consequences in case of non-compliance. However, in a multi-party contract, the purpose needs to shift towards project management, ranging from procurement to design and construction. Transparency and openness are vital throughout the project and vital to aligning interests. Collaboration is encouraged by rewarding common project goals rather than individual success. To address this, we establish a unique remuneration system. No party is rewarded for individual success; instead, we set common project targets.

7 BALANCING GENERAL CONTRACTOR WITH OWNER INTERESTS WILL FUEL SUCCESS

This balance highlights the fundamental challenge of aligning general contractors' economic objectives, who naturally prioritize profit maximization, with the capital optimization goals of project owners. This historical tension often impedes project success. When pursuing a shared objective of project excellence, this can be overcome. Contractors and owners should share the risks and rewards of project execution, as well as any potential cost savings. This gain-sharing model incentivizes both parties to actively seek innovative solutions and optimize resource allocation, as any cost reductions are directly translated into shared financial benefits. Ensuring these reductions align with the project's true quality and functionality objectives is important. A collaborative, pre-project phase can help owners clearly define their desired outcomes and quality standards and ensure that cost optimization efforts remain firmly aligned with the asset's overall vision.

8 REAL-TIME PERFORMANCE MONITORING SYSTEMS ARE THE CORNERSTONE OF COLLABORATION

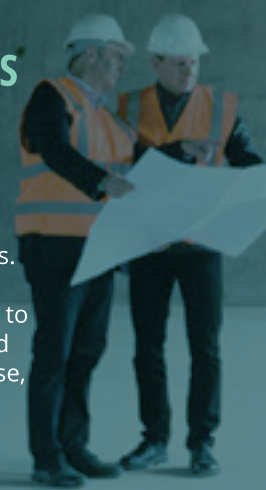
In construction projects, continuous and transparent progress evaluation can be achieved through real-time performance monitoring systems. Timely course correction, collaborative problem-solving and proactive adjustments become routine, optimizing outcomes on an ongoing basis. The result? Projects are delivered not only on time and within budget, but also exceed expectations across all facets of quality, functionality and sustainability. This is the transformative power of a shared multi-party model, where contractors and owners shed the outdated adversarial paradigm and embrace a collaborative approach, united in their pursuit of project excellence.

9 TRADITIONAL CONTRACTS NEED TO EVOLVE TO FUEL COLLABORATION AND INNOVATION

The engineering and construction industry is historically known for its adherence to traditional procurement methods. However, achieving sustainability and integrating technologies like Building Information Modeling (BIM) mean contracts need to evolve. To effectively adapt to multi-party agreements, owners must prioritize several key considerations. Firstly, building the right team for each project's and owner's needs is paramount; not just legal and construction professionals, but also specialists in technology, sustainability and innovative procurement methods. Secondly, overcoming conservatism and embracing innovation to tackle global challenges like sustainability. Finally, remembering that cost is not the sole success metric. The ultimate goal must be optimal value for money and this requires collaborative partnerships, where owners and contractors work together to unlock the potential of innovative technologies and deliver projects that are not only cost-effective but also sustainable, efficient and future-proof.

10 CELEBRATE INDUSTRY SUCCESS AND LEARN FROM IT

There is no doubt that managing risks continues to be important to project success; but it's also about unlocking innovation, value creation and shared success in the building and construction industry. Major players, like Siemens with its Siemensstadt project, are adopting integrated approaches with great success. The Siemensstadt project utilized IPA (integrierten projektentwicklung) based contracts – and are already collecting the rewards. The results speak for themselves: happy and engaged teams, seamless collaboration, and a project prepared for transformative success. This is the future of construction, and those who embrace it will stand at the forefront of a brighter, more sustainable project delivery.



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From private to public water supply: A just transition

CHANGING THE WAY WATER IS SUPPLIED TO SERVE JAKARTA'S PEOPLE

JAKARTA DATES BACK TO THE 14TH CENTURY AND IS ONE OF THE WORLD'S BUSIEST AND MOST CROWDED CITIES. HOME TO 11 MILLION RESIDENTS, THIS REPRESENTS ABOUT 4% OF INDONESIA'S VAST POPULATION OF OVER 275 MILLION PEOPLE. FOR DECADES, MANY JAKARTA'S HAVE BEEN STRUGGLING WITH READY ACCESS TO CLEAN DRINKING WATER. THIS IS SET TO CHANGE.

Having celebrated its 101st birthday on 23 December 2023, the water utility company PAM JAYA has historically been responsible for distributing clean water to Jakarta's residents and operates over 900,000 connections. 25 years ago, under then-president Suharto's leadership in 1998, PAM JAYA signed a policy of cooperation with the private sector. It consisted of concessions with two private sector water companies who were made responsible for ensuring the raw water supply, cleaning the raw water and improving the pipe network and customer service. During this 25-year arrangement PAM JAYA acted as a supervisory body and paid a 'water charge' to the private operators to supply water to the residents, while customers paid 'water tariffs'.

THE END OF THE PRIVATIZATION CHAPTER

Jakarta's water supply story has been changing since the Supreme Court ruled that the terms of the privatization of Jakarta's water violated the "common right to water" for its residents. When the private contract came to its 25-year end in February 2023, as a result, all assets and activities of the two private sector water companies formally integrated into PAM JAYA, marking the beginning of a new water supply chapter.

Raj Kannan, partner, Energy, Resources & Industrials Leader, Deloitte Southeast Asia says that President Joko Widodo has clearly

emphasized several important agendas that must be prioritized, including water conservation efforts; availability of clean water and sanitation; food and energy security; as well as mitigation of natural disasters such as floods and droughts. All of this will be made possible by continually improving water infrastructure in order to provide better for residents.

"We worked closely with PAM JAYA for some time to ensure that operations would run seamlessly from the first day of the integration (Day 1) and beyond. The initial objective was to minimize any service turbulence, followed by making service improvements in future," Raj says.

DAY ONE SUCCESS: THE STORY BEHIND A SUCCESSFUL HANDOVER

Ivo Jaap van de Griend, director, Energy, Resources & Industrials for Deloitte Consulting Southeast Asia, who has been integrally involved in this project, explains that 65% of Jakarta's residents are serviced by piped drinking water, with the remaining households using groundwater, surface water or buying from local vendors. "The government wants to achieve 100% coverage with piped drinking water by 2030 in an effort to provide water sovereignty for all Jakarta residents, without exception. To deliver on its big 100% coverage ambition, PAM JAYA needs to supply an additional 11,150 liters (2,945 gallons) of water

per second, requiring another 4,000 kilometers (2,485 miles) of pipes. This promises to have a significant positive knock-on effect on the environment by preventing flooding, as well as on public health," says Ivo.

As well as improving and increasing the supply of safe water in the coming seven years, PAM JAYA will also be focused on providing customer service to hundreds of thousands of people, including all aspects of sales, service, complaints and distribution.

This is a notable change and has required a change in mindset. Starting work in late September 2022, the combined team of Deloitte and PAM JAYA had less than four months to tackle the challenge of a successful transition.

Ivo says, "We were honored and proud to be integrally involved in helping PAM JAYA get ready for Day 1. It was a once-in-a lifetime project for the entire team, involving developing comprehensive integration workplans for water distribution, finance systems, operations, employee and HR systems, processes and contracts, technology platforms and supplier relationships."

And all the preparation paid off: the Day one transition was well managed and gave the new PAM JAYA team the foundations it required to set itself up for day-to-day success.

BEYOND DAY ONE: A KEEN FOCUS ON CUSTOMER SERVICE

Arief Nasrudin, President Director of PAM JAYA, shared his perspectives of the historic transition from private to public sector water supply.

It has been a mammoth, complex and rewarding task for everyone involved. Day one went better than expected, in part thanks to very thorough preparations including a ten-day, full operational dress rehearsal at 120 locations,

along with site inspections with stakeholders prior to PAM JAYA taking over.

INSIGHTS INTO A SMOOTH TRANSITION

Ivo's advice to anyone planning a similar private to public transition, and navigating the varied complexities associated with this, has been narrowed down to three main pieces of advice.

"Our focus was on identifying and mitigating any risks across the whole gamut of operations – in this case, this included thoroughly reviewing the original partnership agreement and identifying any sticking points; carefully identifying and managing stakeholder and customer expectations before, during and after the transition; and taking a 'one team' mindset across the entire combined team responsible for ultimate success," he says.

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BEYOND DAY ONE: A KEEN FOCUS ON CUSTOMER SERVICE

Arief Nasrudin, President Director of PAM JAYA, shared his perspectives of the historic transition from private to public sector water supply.

"This has been a really challenging time for the city, its residents and our teams. It has been important to manage all our stakeholder expectations, not just in the build up to day one, but well beyond. For day one, I was closely focused on 5M readiness: readiness of human resources (man), readiness of materials and work tools (materials), readiness of systems and applications (machine), readiness for operations and services (method), and readiness of the budget (money).

"Since then, PAM JAYA has been focused on tackling three challenges: firstly, the day-to-day art of managing our own operations and processes. Secondly, as a state-owned company, we have needed to simplify our finance operations to ensure we can work smoothly with all our suppliers. Lastly, we have been given the technical responsibilities of maintaining our own equipment – including treatment plants, pipes and valves – for the first time in 25 years. All of us have had to learn very quickly!" says Pak Arief.



Pak Arief giving a speech. (Image: ANTARA/HO-PAM JAYA)

Minimizing turbulence has been Pak Arief's daily mantra, and this is much easier said than done. "In the last few months, we've been operating relatively well. I am proud of our team, who have all stepped up and are really pleased to be developing their skills and careers at PAM JAYA. Together, we're working really hard on maintaining our customer service, especially for those customers who are dealing with leaking pipes. To ensure we continue to modernize our pipes, we recently integrated our East and West operations into one system to further unite our team and operations," says Pak Arief.

SHORT-TERM PILOTS TO INFORM LONG-TERM TRANSFORMATION

There is no doubt that Jakarta's water supply system faces high leakage rates. Accurate diagnoses have been vital to identifying where improvements need to be made most urgently.

Pak Arief explains. "We have been able to identify all the ages of our pipes, which range from zero to 100 years in age. This is a reality we face. The question is, how do you best fix the pipes that need to be replaced and fixed? And before we can do that successfully, we need to obtain permissions to do so and follow a process with provincial and federal governments. All of this takes time, and during this time, the leaks continue to flow. With 46% leakage, this costs us 2.5 trillion rupiah per year."

"Although I can buy water allocations from neighbouring villages while we fix our pipes, those residents will then have less allocations, creating a new problem. Instead, we're focused on 'quick wins' – we have identified six small areas in Jakarta that require over 300 kilometers (186 miles) of new water pipes. This involves identifying the land, jacking, disrupting traffic flows in and around Jakarta, and allowing our teams to get in to each area to do the repair and replacement work. While the work is going on, local communities live in a chaotic state. But by taking this pilot approach we can learn, identify our handicaps and obstacles, figure out the best way to engage with the local communities so they understand what's happening and when ... and 'copy and paste' our approach to the remaining 200 local areas and ensure all future investments align with providing the most value to Jakarta's residents," says Pak Arief.

Already, Pak Arief has seen that local face-to-face community engagement is key to success. PAM JAYA leaders and teams have been hosting briefings, staging socializations to explain intentions and improvements, answering questions about water supply and explaining what work is required to replace and modernize the pipes.

ONE DAY AT A TIME

Pak Arief says it is hard to describe the detail of what has been required

to change the culture, and the organization model, from private to government. One thing is for sure, Pak Arief concludes: "The insights we're gaining from the six areas we just fixed will help us tackle over 12,000 kilometers (7,456 miles) of Jakarta's water pipes, 40% of which are 50 years or older. We have a clear plan to continually improve our water supply for Jakarta's residents and I am confident that we will continue to go from strength to strength, one day at a time."



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Indonesian family. (Image: Getty Images)

Rural infrastructure innovation supports sustainable development

A BRIDGES TO PROSPERITY PERSPECTIVE

IN THE EVER-EVOLVING LANDSCAPE OF GLOBAL DEVELOPMENT, THE SYNERGY BETWEEN INFRASTRUCTURE AND CLIMATE RESILIENCE IS INCREASINGLY RECOGNIZED AS A CORNERSTONE FOR SUSTAINABLE GROWTH, PARTICULARLY IN RURAL SETTINGS. THIS SYMBIOSIS IS CRUCIAL – NOT JUST FOR THE PHYSICAL CONNECTIVITY IT BRINGS, BUT FOR THE PROFOUND IMPACT IT HAS ON THE OVERALL WELLBEING AND RESILIENCE OF COMMUNITIES. BRIDGES TO PROSPERITY (B2P), A PIONEER IN RURAL DEVELOPMENT INFRASTRUCTURE, IS A NON-PROFIT THAT STANDS AT THE FOREFRONT OF THIS TRANSFORMATIVE APPROACH.

Bridges to Prosperity (B2P) works with governments and isolated communities to create access to essential healthcare, education and economic opportunities by building trail bridges over impassable waterways and geographies. In this story, B2P sheds light on how pioneering approaches in rural infrastructure construction are bolstering community resilience and wellbeing in an uncertain world.

BEYOND BRIDGES: FROM INFRASTRUCTURE TO THRIVING COMMUNITIES

Approximately 80% of those living in extreme poverty are in rural areas, where access to basic services like healthcare, education, and markets is often hampered by inadequate infrastructure. To maximize its impact, B2P's philosophy is rooted in understanding that infrastructure development transcends mere physical connectivity; it realizes that bridge infrastructure can create foundational connections to what matters most. To this end, B2P projects extend beyond bridge-building, catalyzing holistic community development, which encompasses health, education and economic opportunities.

A single trail bridge has the power to transform entire communities:

Where B2P trail bridges are constructed, communities realize a 75% increase in farm profits, a 36% increase in labor market income and a 60% increase in women entering the labor market. Communities with new trail bridges also report a 49% annual return on investment. Moreover, B2P bridges save approximately 2,100 tons of CO2 emissions annually.

TECHNOLOGY AND INNOVATION: EMPOWERING RURAL DEVELOPMENT WITH FIKA MAP

Since 2023, B2P has been using the AI-driven Fika Map to integrate innovative technology into rural infrastructure. This advanced location intelligence tool, built with Mapbox GL JS, features 3D terrain and detailed satellite imagery and functions as a critical decision-support system, providing data-driven insights for infrastructure projects in rural, low-income areas.

Nivi Sharma, Chief Executive Office of Bridges to Prosperity, explains, "Utilizing a tool suite that combines remote sensing and machine learning, Fika Map forecasts rural transportation needs and scalable impacts. Its impact modeling capabilities offer travel time estimations to help decision makers visualize life-changing differences



Nyarusange bridge is one of the longest in Rwanda. (Image: Envision Rwanda)

pre- and post-bridge construction. This machine learning model processes imagery and field data, predicting terrain challenges and merging this with local population impacts."

Fika Map empowers governments and partners with guided investments, aligning resources with both community aspirations and national policy targets. B2P, through Fika Map, demonstrates a commitment to sustainable development, using precision-based solutions to meet the unique challenges faced by rural communities. The tool will be rolled out to more countries in 2024 and beyond.

B2P's Fika map tool aligns closely with Deloitte's impactful infrastructure vision and the Economist Impact's Infrastructure for Good Program, revolutionizing remote connectivity with advanced machine learning.

BUILDING RESILIENCE: SUSTAINABLE INFRASTRUCTURE IN THE FACE OF CLIMATE CHANGE

In an era where climate change increasingly challenges global communities, B2P is leading from the front by constructing not just bridges, but pathways to climate resilience. Its commitment to sustainability is evident in its construction methodologies, which prioritize long-term viability and minimal maintenance. This focus isn't only about preserving natural resources, but about equipping communities with reliable, year-round access amidst escalating flooding events and other climate-related challenges.

Its bridges, conservatively estimated to last 30 years, represent a link to markets, education, healthcare and emergency services, even in the face of environmental adversities.

Local communities are integral to the maintenance process, handling routine tasks like clearing vegetation with guidance and support from B2P. Major repairs and upkeep fall under the jurisdiction of local governments, the technical owners of these bridges. This responsibility includes replacing key structural elements and managing significant erosion control measures. Even beyond physical construction, B2P's work embodies the principles of climate justice.



Gasharu Bridge, Rwanda. (Image: Robb Hohmann)

This is climate justice in action: a deliberate effort to ensure that those least responsible for climate change, who often face its harshest impacts, are not left behind.

PUBLIC-PRIVATE PARTNERSHIPS: SYNERGIZING FOR GREATER IMPACT

At the heart of B2P's success is its community-centric model. Projects

are collaboratively designed and implemented, ensuring local ownership and sustainability. Special emphasis is placed on gender equity and inclusion, recognizing the pivotal role women play in community development. This empowerment is crucial for the long-term success and sustainability of the projects.

For example, its work in partnership with the National Governments and private sector in Rwanda, Uganda and Ethiopia exemplifies the potential of collaborations between the public, private and NGO sectors to ensure environmental, social and economic indicators are considered. These alliances have extended reach and amplified impact, providing safe access to essential services for thousands. Future plans include constructing additional bridges, potentially benefiting tens of thousands more.

SCALING THE MODEL: REPLICATING SUCCESS GLOBALLY

The success of B2P's integrated approach offers a scalable model for rural regions worldwide. Replicating this strategy can bridge the gap in access to critical services, paving the way for more resilient and prosperous communities.

Nivi concludes: "By integrating the health, education and other essential services rural communities need to thrive – while focusing on holistic community development – organizations like B2P redefine the role of infrastructure in empowering some of the world's most vulnerable populations. This integrated approach underscores the transformative power of infrastructure when intertwined with community needs. As we navigate global development challenges, embracing these innovative methodologies promises not just connectivity but a pathway to resilience and prosperity for rural communities worldwide."



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CALL TO ACTION: JOIN THE MOVEMENT TOWARDS SUSTAINABLE RURAL DEVELOPMENT

B2P invites you to join in its mission to transform rural infrastructure into a conduit for sustainable development. Your support can help bridge the gap for millions living in rural isolation, creating pathways to resilience, prosperity, and climate justice. Learn more, contribute, and become part of this vital global endeavor.



FIND OUT MORE ABOUT B2P

Locals rely on the Gahira trail bridge in Rwanda. (Image: Robb Hohmann)

Analysis toolkit

Moving beyond cost-benefit analysis

ENHANCING THE ACCURACY OF GOVERNMENT PROJECT APPRAISALS

AS WE CONTINUE TO RECOVER FROM THE LINGERING EFFECTS OF COVID-19, INFRASTRUCTURE SPENDING IS VIEWED AS A SOLUTION FOR STIMULATING ECONOMIES ACROSS THE GLOBE. IN FACT, IT'S CONSIDERED ESSENTIAL FOR A HEALTHY ECONOMY AND CAN BE USED TO ACCELERATE PROGRESS IN ADDRESSING ISSUES LIKE EVOLVING SOCIAL NEEDS AND MANAGING CLIMATE CHANGE.

STIMULUS INVESTMENTS HAVE NEVER BEEN MORE IMPORTANT

Public debt levels have increased due to the pandemic, making it crucial for governments to maximize the impact of these funding avenues. However, traditional cost-benefit analysis (CBA) may not properly reflect the outcomes of these investments, leading to inaccuracies and biases.

Deloitte and Oxford Global Projects – the world's leading experts on mega-project management – have written a two-part series focusing on the limitations of CBA and suggesting new strategies and supplementary approaches that provide a viable alternative.

In the first report of this series, *Why governments must look beyond cost-benefit analysis*, we took a deep dive into infrastructure spending and the challenges associated with prioritizing infrastructure projects.

We made recommendations for effective infrastructure prioritization, emphasizing the importance of community engagement, more accurate cost-benefit estimates and the integration of social impacts throughout the project lifecycle.

THE CBA FALLACY – OVERCOMING MISTAKEN BELIEFS

One of the report's recommendations centers on some common mistaken beliefs around CBA.

Luke Houghton, partner, Infrastructure & Capital Projects Leader, Deloitte Global, confirms, "Traditional CBA, historically used for project appraisal and prioritization, has limitations. It only provides a limited view of potential investment outcomes and, in some cases, it can be misleading."

The inaccuracies in CBA, known as the 'cost-benefit fallacy,' lead people to believe that cost-benefit estimates are largely accurate and unbiased when, in fact, they can

be highly inaccurate and biased. Other criticisms of CBA include its tendency to focus on easily measurable costs and benefits while ignoring broader social impacts, and some argue that CBA fails to account for variability and systematic biases in project outcomes, leading to inaccurate estimates.

To make CBA more reliable for prioritisation, cost-benefit estimates must be de-biased using historical data and reference class forecasting. Accurate estimates reduce financial risks and improve economic welfare.

EARLY COMMUNITY CONSULTATION IS A MUST

Another key report recommendation takes a closer look at the importance of engaging the broader community at an early stage in infrastructure projects – resulting in better project outcomes and public acceptance. Social considerations, such as promoting equality and access for disadvantaged communities, should be well integrated into the CBA process, rather than treated as add-ons. This involves including community representatives and

leaders who genuinely act in the interest of the broader community. Feedback from a diverse range of stakeholders is essential.

In *How governments can prioritize infrastructure stimulus investments: Moving beyond cost-benefit analysis*, the latest report in the series, we explore a variety of supplementary approaches that provide viable alternatives to CBA, along with best practices governments can use to strengthen the outcomes of their infrastructure investments.

For example, **Karlene Agard**, senior consultant at Oxford Global Projects, says, "In this increasingly complex world, CBA alone is inadequate for governments to address the wide-ranging needs of stakeholders. Supplementing with other complementary or alternative approaches combats some of CBA's weaknesses. For instance, computable general equilibrium models, which assess the economic impact of government initiatives, make them suitable for larger portfolios and infrastructure ecosystems."

A NUMBER OF OTHER ANALYSIS APPROACHES CAN OFFER SOUND ALTERNATIVES TO CBA:



COST-EFFECTIVENESS ANALYSIS

which measures project outcomes in natural units (e.g., lives saved, emissions reduced) rather than monetizing costs and benefits. This helps decision-makers select projects that achieve objectives at the lowest cost.



MULTI-CRITERIA ANALYSIS

which assesses project performance across various factors and is particularly useful in the early project evaluation stages. It assigns weights to criteria and scores project options accordingly.



LOCAL EFFECTS ANALYSIS (LEA)

which is an overlay to traditional CBA, focuses on how project benefits impact the local community. It analyzes factors like employment and income, giving insights into the change a project brings to a community.



STOCHASTIC COST-BENEFIT ANALYSIS

which incorporates uncertainty and risk into infrastructure project assessment by generating a range of possible outcomes and their likelihoods. It can assess the robustness of project performance indicators under different scenarios, but it requires more data and computational resources.

The latest report also looks at emerging methodologies such as artificial intelligence, and shares some real-world case studies that exemplify how the advanced technology can be used.

Andreas Leed, Head of Data Science at Oxford Global Projects, says, "It's exciting to work with governments that are embracing AI to get insights on project performance and prioritize their resources more

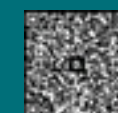
effectively. This is a trend that is on the rise and I look forward to seeing further improvements." By expanding the project appraisal toolkit beyond CBA and choosing the appropriate method based on

project size, complexity, and impact, governments can better prioritize infrastructure investments and save significant resources in the long run.

YOU CAN READ THE FULL REPORTS HERE



WHY GOVERNMENTS MUST LOOK BEYOND COST-BENEFIT ANALYSIS



HOW GOVERNMENTS CAN PRIORITIZE INFRASTRUCTURE STIMULUS INVESTMENTS: MOVING BEYOND COST-BENEFIT ANALYSIS



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EXPERIENCE + INSIGHTS = THOUGHT LEADERSHIP

ALL AROUND THE WORLD, DELOITTE IS COMMITTED TO PRODUCING REPORTS THAT PROVOKE NEW IDEAS, INSPIRE ACTION AND CONTRIBUTE TOWARDS INFRASTRUCTURE FOR GOOD

1

THE IMPORTANCE OF 'INFRASTRUCTURE FOR GOOD' FOR REBUILDING UKRAINE



Connecting 'Rebuild Ukraine' to the best international practices for infrastructure development and financing, and reshaping the way the government can evaluate infrastructure projects, will be critical to ensuring invested funds reach maximum impact and achieve social good. In fact, to recover from the war and rebuild Ukraine, the Ukraine Government will need to invest an estimated US\$411 billion to US\$1 trillion+ investment during the next ten years. This report looks at how the Infrastructure for Good Barometer can help governments like Ukraine's identify and apply

global infrastructure standards and patterns. For example, rebuilding Ukraine not only involves adopting best practices, but treating infrastructure as an interconnected ecosystem – this requires input from communities, especially those displaced by the conflict. Collaboration with various stakeholders, including citizens, government officials, private sector participants, investors and developers will be vital to achieve positive social, economic and environmental outcomes.



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WHERE PHYSICAL AND DIGITAL MEET: DIGITAL TWIN FOR RESILIENT INFRASTRUCTURE



Digital twins are a potent tool for addressing climate risks and ensuring critical infrastructure resilience. The technology can offer a way forward: enabling governments to turn complex data into insights that can guide decision-making to create a more resilient future. The speed of climate change means there's no time for trial and error in the physical world, and no time for physical pilot projects that take years to test a hypothesis about infrastructure and its resilience. As it represents the real world in a digital environment, an advanced digital twin could allow planners to



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DELIVERING INFRASTRUCTURE PROGRAM SUCCESS IN INFLATIONARY TIMES



Around the world, persistently high inflation poses a significant threat to government infrastructure programs which are known to deliver long-term economic, environmental and societal benefits. This report examines how, rather than canceling or postponing programs based on cost rises, governments can follow several important steps to ensure that the intended gains for communities are realized in the time frames needed. We have seen substantially renewed interest in the potential benefits offered by building infrastructure from roads to airports, schools to hospitals, and greener energy sources to digital

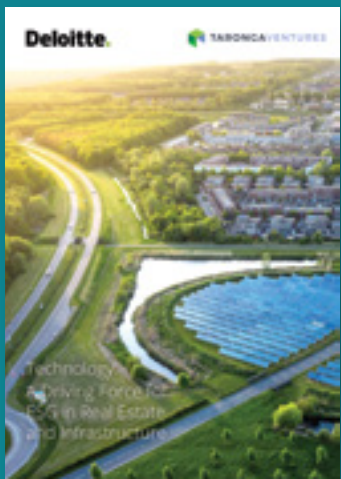


Ira Kalish
Managing director, Chief Economist,
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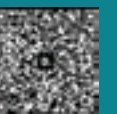
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TECHNOLOGY: A DRIVING FORCE FOR ESG IN REAL ESTATE AND INFRASTRUCTURE



In a world where tenants, residents, investors and regulators are demanding green, affordable and equitable solutions, the real estate and infrastructure sectors are facing increasing pressure to address environment, social and governance (ESG) risks and opportunities. Deloitte and Taronga Ventures collaborated to develop this joint perspective on how technology can drive improved ESG outcomes across these critically important sectors. The framework outlines potential risks and blockers, and it emphasizes the importance of having a clear value proposition, internal champions and transparent communication with stakeholders. It also highlights the significance of selecting the right technology based on practicality, interoperability, scalability, security



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A GENERATIONAL SHIFT IN URBAN MOBILITY: INSIGHTS FROM THE DELOITTE-THOUGHTLAB GLOBAL CITY SURVEY



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Traffic congestion, inadequate infrastructure and public transportation continue to stifle transportation in cities. Deloitte partnered with ThoughtLab to survey 200 city leaders and 2,000 citizens globally to better understand future expectations on mobility and transportation in urban areas and discuss how cities are becoming future-ready. The survey results suggest that city leaders and citizens foresee considerable shifts in urban mobility and transportation in future.



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In this Deloitte Insights article, we reveal a shared understanding that:

- Implementing strategies to manage traffic and enhancing the transportation experience for individuals is critical.
- Adopting more sustainable modes of transport is a priority to reduce carbon emissions and combat climate change.
- Expanding open spaces and infrastructure for walking and biking can move citizens from cars to other sustainable modes of transport and promote a healthier community overall.
- Citizens also want local governments to do more to help them shift to electric modes of transportation by developing and supporting electric vehicle infrastructure.

6

DID YOU SAY SUPPLY CHAIN DIGITAL TWIN? DEMYSTIFYING DIGITAL TWINS AND THEIR POTENTIAL IN SUPPLY CHAINS



As global dynamics are becoming more turbulent, technology innovation more disruptive and environmental sustainability ever more imperative, supply chain leaders are facing unprecedented challenges. But is Digital Twin the silver bullet? This report looks at supply chain organizations, which for a long time have been on a journey to advanced analytics capabilities that support the shift from linear supply chain to digital network. We show how digital twin technology will enable the ultimate step in this evolution. The key challenge in supply chain management is balancing customer service maximization with cost minimization, a task that has become more complex due to globalization, increased consumer demands, energy transition imperatives and geopolitical turbulence. Digital twins, powered by AI and machine learning intelligence engines, provide operational, tactical and strategic opportunities for improving supply chains and addressing sustainability concerns. The technology enables more informed decision-making at different horizons, from operational improvements to strategic scenario modeling, and can factor in sustainability parameters in optimization equations.



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INNOVATION OPPORTUNITIES FOR CIRCULAR CITIES



As of 2023, only 7.2% of the global economy is considered circular, with resource and material usage expected to double by 2050 compared with 2015 levels. Cities, in particular, present a challenge and an opportunity to address climate change and circularity. This outlook provides an overview of the state of the circular transition in urban environments, focusing on material cycles, mobility, resources and the water cycle. Cities are high-density conglomerates of consumers, buildings, and infrastructure and, therefore, are critical due to their escalating growth and profound influence on energy, resources and heightened susceptibility to climate issues. Transitioning to a circular economy requires product, business model and ecosystem innovation. Product innovation focuses on materials and processes that use fewer, recycled and renewable resources. Business model innovation aims to find new market opportunities to generate value while reducing resource usage and waste.



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Discover how the future of infrastructure is being revitalized, rebuilt and reimagined.



EXPLORE PREVIOUS EDITIONS OF DELOITTE'S GLOBAL INFRASTRUCTURE MAGAZINE

Villagers using Nyarusange bridge,
one of the two longest bridges built by
Bridges to Prosperity in Rwanda to date.
(Image: Robb Hohmann)

**BRIDGES TO PROSPERITY HAS BUILT
MORE THAN 500 TRAIL BRIDGES IN 21
COUNTRIES, CONNECTING 1.8 MILLION
FORMERLY ISOLATED PEOPLE TO THE
RESOURCES THEY NEED. IT HOPES TO
COMPLETE EIGHT BRIDGES IN UGANDA
AND 25 IN RWANDA THIS YEAR, WITH
150 BRIDGES PLANNED IN ETHIOPIA.**

**A SPECIAL THANKS TO THE GLOBAL TEAM OF EXPERTS
WHO MADE THIS MAGAZINE POSSIBLE**

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We would also like to thank everyone who
contributed to and featured in this magazine.
We greatly appreciate your time, insights and interest.

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