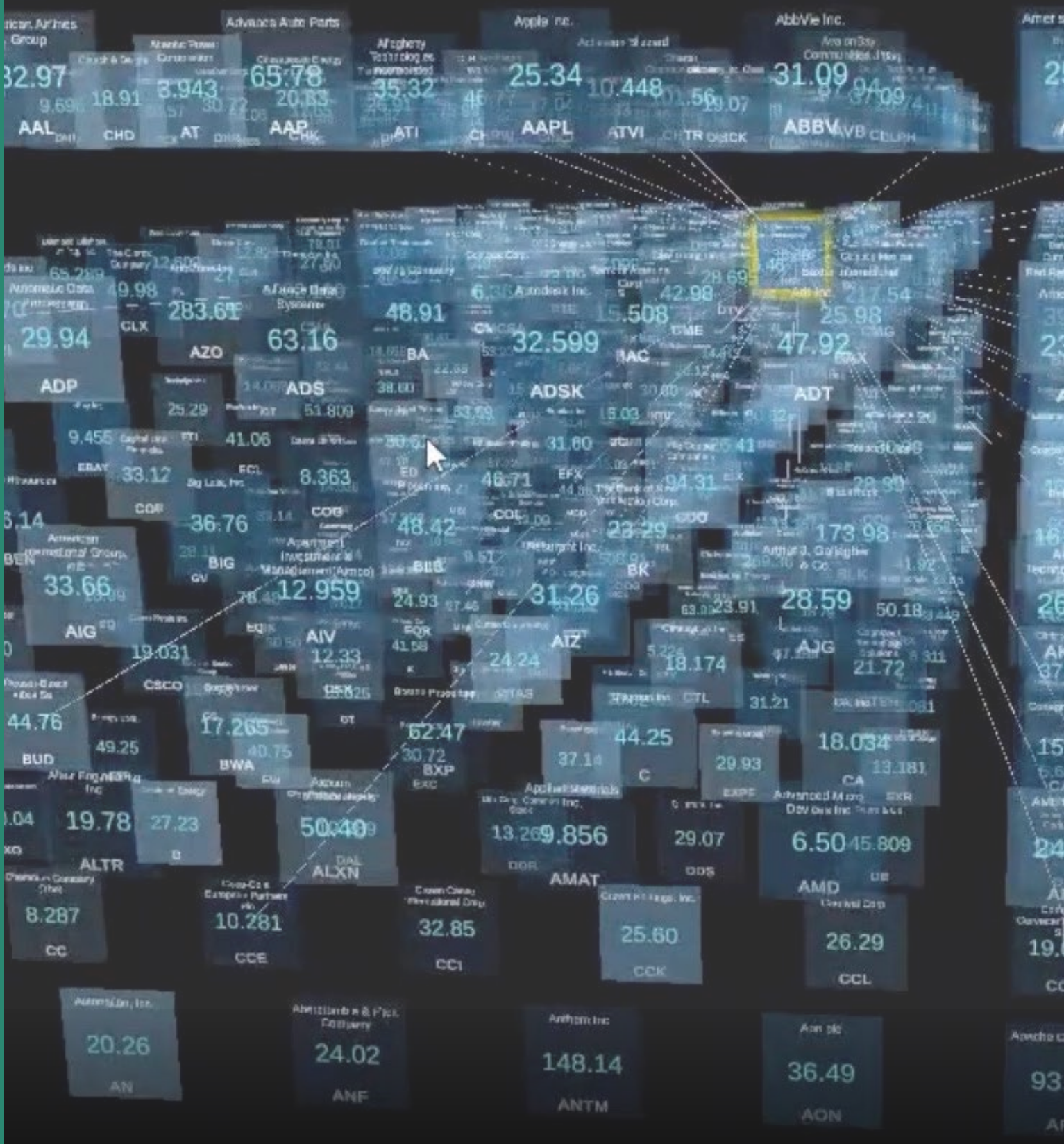
DIGITAL TWIN HUB



Hosted at Connected Places Catapult

CATAPULT Connected Places

Contact us: **dthub@cp.catapult.org.uk**

Credit: Axomem's Axoverse Digital Twin platform – currently in use at one of Singapore's largest hospitals for tracking COVID19, respiratory illnesses, and Multi Drug Resistant Organisms (MRDOs). See xomem.io

"Digital twins and connected digital twins will equip us against global systemic challenges including pandemics, climate change and resilience. They make investment sense for societies, industries and governments as we move towards the vision of a cyber physical future, and their impact on our economies will be huge. The need for connected digital twins to meet the challenges of this changing world has never been greater and the Digital Twin Hub is leading the way."

Dr Alison Vincent, Chair, Digital Twin Hub

ABOUT THE DIGITAL TWIN HUB

The Digital Twin (DT) Hub was created in March 2020 by the Centre for Digital Britain at the University of Cambridge. In 2022, it transitioned to a multi-sector Industry and Catapult Network partnership housed at the Connected Places Catapult. It also operates in collaboration with the new National Digital Twin Programme run by the Government's Department for Business, Energy and Industrial Strategy.

Digital twins and interoperable, connected digital twins, are significant tools for fighting the global systemic challenges currently facing the world – challenges like pandemics, climate change and resilience. They are key enablers for ensuring better outcomes for people and nature through aiding a collaborative and co-ordinated approach to problem-solving. The DT Hub supports this socio-technical mission.

The DT Hub is a network for finding partners and collaborators. It is a place for learning and sharing experiences; for driving innovation, developing expertise and advancing the state of the art for digital twins. It identifies good practice, develops guidance and shapes standards on data sharing as well as showcasing the benefits of collaborative, connected digital twin endeavours.

We focus on four core priorities:

- A vibrant industry-led community
- A purposeful, mission-driven voice for industry
- Engagement with a growing number of sectors
- Acceleration of open standards and interoperability.

The next phase for the DT Hub is ambitious, as digital twin owners and builders look to support each other to develop increasingly advanced digital twins for diverse applications – joining up across sectors to follow the DT Hub motto: 'learning by doing, progressing through sharing.'

Join today

digitaltwinhub.co.uk/register

WHAT IS A DIGITAL TWIN?

The DT Hub defines a digital twin as:

- A dynamic data connection between the physical twin and the digital twin. How this data is updated between the physical and the digital will vary and one example would be sensors on a bridge to inform predictive maintenance. It should be at the ‘right’ time, focusing on the use case sought, and therefore does not necessarily need to be real time
- A computer model as a digital representation of a physical asset, for example a 3D model of a housing block
- A digital asset where the physical twin may exist or may not yet exist, for example a model of an unbuilt tunnel.

Source: Digital Twin Toolkit 2021, published on the DT Hub.

SECTORS ON THE DT HUB

The sectors we cover include:

- Aerospace
- Architecture
- Automotive
- City Infrastructure
- Defence
- Education
- Energy
- Government
- Maritime
- Manufacturing
- Rail
- Technology
- Telecommunications and more

OUR OBJECTIVES

Collaborate
Encourage collective learning and sharing of experiences on digital twins

Innovate
Encourage and enable the development of expertise and the advancement of digital twin usage

Guide
Steer the development of best practice and offer guidance on data sharing and digital twins

Champion
Highlight and promote the benefits of digital twins and present case studies

Connect
Provide a register of digital twins to facilitate knowledge and experience sharing

Support
Provide support and guidance

Enable
Use the connected data insight to empower smarter decision making for generations to come

OUR COMMUNITY
THE DT HUB

Since March 2020, the DT Hub has established a core group of members from industry, academia and policy. By putting the right building blocks in place, it has been able to deepen the engagement of its members, facilitating more opportunities for collaboration and enabling representation across an increasing number of sectors and industries.

By organisation and numbers, we are the largest online community dedicated to digital twins and we have increased the individual membership by over 900 since 1 April 2022.

“The Digital Twin Hub helps to accelerate the industry’s journey towards the vision of connected digital twins, that provide better information so better decisions can be made, leading to better outcomes for people and nature. By bringing people together from all different parts of different industries, we can learn from each other and speed up our progress in this area which is so critical for solving global systemic challenges like climate change and the move to a circular economy.”

MELISSA ZANOCCO OBE,
Head of Programmes for the Infrastructure Client Group and Co-Chair of the Community Council

THE COMMUNITY IN NUMBERS

The DT Hub is fostering international collaboration and benefits from having members from over 67 countries.

As well as developing our global reach, we have seen increasing interest from other national digital twin initiatives which we have welcomed to the DT Hub to share best practice and standards. Learning and sharing across borders enables us to set industry standards and be emulated across the world.

1746 ORGANISATIONS

3100 MEMBERS

167 ARTICLES

549 DISCUSSIONS

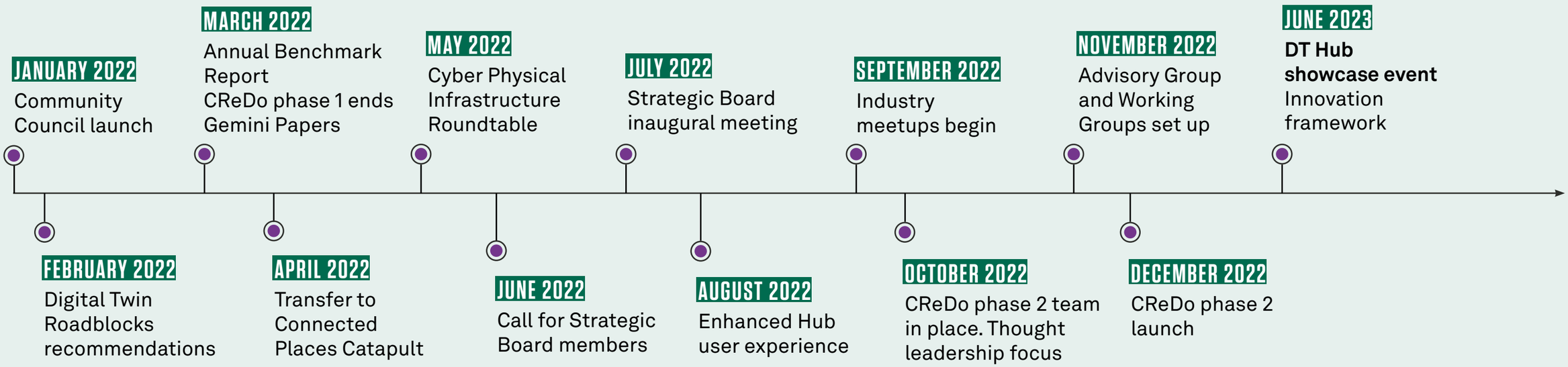
42 CASE STUDIES

31 DIGITAL TWINS

159 RESOURCES

OUR TIMELINE

Key events and developments January 2022 to July 2023



STRATEGIC BOARD

Our strategic board brings together individuals with diverse skills and experience, helping to steer the DT Hub and build its community.

The Digital Twin Hub is at the heart of the UK's digital twin community, shaping and promoting the development and use of this technology motivated by complex challenges that require a connected collaborative approach.

DR ALISON VINCENT,

Chair

Alison Vincent sits as a non-exec director and technical advisor to multiple private and public companies. She has previously held senior technical positions at organisations including Cisco, HSBC and IBM. Her roles have spanned cyber security, research and development, strategy execution, product management and business development. She has particular expertise in digital strategy, innovation and mergers and acquisitions.

She is an ambassador for women in science and engineering and is a passionate supporter of the STEM agenda in schools.

She has a PhD in cryptography from London University and is a Fellow of the Royal Academy of Engineering, the British Computing Society and the Institution of Engineering and Technology. She is also a non-exec director on the board of Connected Places Catapult.

MARK ENZER,

Vice Chair

Mark is a keen champion of innovation through collaboration and is particularly interested in the transformation of the built environment and the infrastructure industry, including digital transformation, systems-thinking, connected digital twins, smart infrastructure, low-carbon sustainable solutions, product/platform-based delivery and the circular economy.

Mark was the Head of the National Digital Twin programme and contributed to the leadership of this ambitious programme to enable an ecosystem of connected digital twins across the built environment.

For five years, Mark was Mott MacDonald's Chief Technical Officer and was accountable to the Executive Board for technical excellence across the Group. As Strategic Advisor for Mott MacDonald Digital Ventures, he provides strategy-level advice to key clients on digital transformation, connected digital twins and broader industry transformation.

DAVIN CROWLEY-SWEET,

Chief Data Officer, National Highways

Davin is Chief Data Officer at National Highways, with specialisms in the transport and the built environment sectors. He is passionate about data and digital centric change that enable step changes to businesses, lives, the economy and the environment.

Davin's experience in leading complex transformation programmes has given him deep understanding of the technical and non-technical risks and opportunities to make things happen and make them last.

Davin is a recognised thought leader and public speaker with articles published in Forbes magazine. He was voted by industry peers as DataIQ's top 100 most influential people in data since 2019.

CRISTINA DATA,

Non-Exec Director

Cristina has 20 years' experience in telecommunications, from business intelligence and strategy to regulation.

She is a Non-Executive Director at Energy Systems Catapult and Director of Policy and Analysis at Ofcom in their Spectrum group

where she leads a team of policymakers and analysists looking at the future of wireless technologies for digital transformation. Prior to joining Ofcom, Cristina held various marketing and strategy roles at Telefonica O2, EE, and Red Bee Media. Cristina holds a master's degree in management engineering from the Politecnico di Torino university in Italy.

"I am very excited to be part of the DT Hub Strategic Board, sitting at the heart of the Catapult system; leveraging the work done by the Catapults within their own sectors, to build digital twin solutions that can tackle greater problems across a wider footprint. I am keen to bring my experience of working with Energy Systems Catapult, and my knowledge of the communication sector. Communications is a critical component in ensuring that we can build digital versions of the physical reality."

MATT EDWARDS,

Chief Data Officer,
Anglian Water Services

Matt has worked in the water industry for over 20 years across a wide spectrum of roles in engineering, asset management, operations and customer management, and programme and change management.

He is currently the Chief Data Officer for Anglian Water Services and serves as the Water Company Data and Digital Board member for the Government's retail Market Operator (MOSL) for England and Wales.

He has an undergraduate degree from Edinburgh University, a postgraduate degree from Cranfield University and is a Chartered Member of the Institute of Water and Environmental Management. For the last five years Matt has worked as part of the National Infrastructure Digital Transformation Task Group with a specific focus upon enterprise information management, advanced analytics, and digital twins.

SIMON EVANS,

Global Digital
Twin Leader, Arup

Simon is the Global Digital Energy Leader and the Global Digital Twin Leader at Arup, and chairs the Gemini Call for the Digital Twin Hub. He was also the delivery team lead for the National Digital Twin programme, and led the Arup team in authoring the Gemini Papers for CDBB.

Simon is a technology developer and a chartered mechanical engineer, with a background in renewables and offshore oil and gas.

He has a passion for the transformational applications of digital technology, where he speaks and publishes extensively on the topics of digital engineering and digital twins and has received numerous awards for his contributions to the engineering profession. He is a Fellow of the Institution of Mechanical Engineers, Liveryman of the Worshipful Company of Engineers, author of the digital twin maturity spectrum, and co-host of the digital twin fan club podcast.

MARK COATES,

International Director of Public Policy and Advocacy, Bentley

Mark Coates is Bentley's International Director of Public Policy and Advocacy, where he helps to inform and guide government, policymakers, business leaders, and decision-makers globally on the benefits of digital transformation. A former quantity surveyor with an extensive background in global project delivery,

Mark began his work in the construction sector 33 years ago. He has worked with Thames Water, United Utilities, ICI, Highways England, the Olympic Delivery Authority, and Crossrail.

For the past ten years, Mark has been driving digital transformation, seeing great advances made in sectors by adopting digital ways of working. He has worked on numerous infrastructure projects, consulting asset owners and their advisors on technology adoption to attain better project results while being conscious of time, cost, and quality. He is a member of the Chartered Institution of Highways and Transportation, chairman of the British Water Forum and a member of the advisory board of the Institute of Government and Public Policy.

JOHNNY FURLONG,

BIM Strategy Lead,
L&Q Housing

Johnny is passionate about transforming our industry for the better. He is currently BIM Strategy Lead at L&Q (one of the UK's leading housing associations) and has 15 years' experience in implemented BIM and digital strategies in a range of organisations.

His current focus is on using digital and information management techniques (including BIM) to solve the issues of building safety and quality in the construction industry.

Johnny is also vice-chair of the Golden Thread Initiative (GTI) which is chaired by the Department for Levelling Up, Housing and Communities and feeds into the BRAC golden thread working group which supports the developing golden thread policy.

MARK GIROLAMI,

Chief Scientist,
The Alan Turing Institute

Mark Girolami is the Chief Scientist of The Alan Turing Institute, taking up this role from October 2021.

Previously he led The Alan Turing Institute-Lloyds Register Foundation programme in data-centric engineering which launched a whole new discipline that has global reach and influence.

In 2019 he was elected to the Sir Kirby Laing Professorship of Civil Engineering at the University of Cambridge where he also holds the Royal Academy of Engineering Research Chair in Data Centric Engineering. Prior to joining the University of Cambridge, Professor Girolami held the Chair of Statistics in the Department of Mathematics at Imperial College London.

CHARLES KENNELLY,

Chief Technology Officer,
Esri UK

Charles Kennelly is Chief Technology Officer at Esri UK, a company that has long been envisioning, encouraging and enabling the adoption of digital twins through the development of geographic information system (GIS) solutions.

For over thirty years, Charles has helped organisations across all industry sectors to harness the potential of GIS and create digital twins in fields ranging from habitat conservation and renewable energy to public safety, city planning, transportation and engineering.

He is passionate about promoting understanding of digital twins and showcasing how organisations can embed geospatial technology into their digital twin strategies to solve diverse business problems.

PAUL LAM,

Strategy and Policy Officer for Digital and Technology, AIIB

Paul Lam first joined the Asian Infrastructure Investment Bank (AIIB) in 2018 where he worked in the investment department; he is now Strategy and Policy Officer for Digital and Technology.

Paul has developed and is responsible for executing the digital infrastructure strategy and thematic priority of technology-enabled infrastructure, which guides AIIB's engagements and investments in technology and its applications in infrastructure sectors (infra-tech).

Paul is responsible for operationalising AIIB's infra-tech platform, which builds conducive ecosystems, creates insights, interconnects stakeholders and finances the development and applications of infra-tech.

HARKIRAT SINGH,

Technical Director, Public Sector, Palantir Technologies UK

In his role as Technical Director, Public Sector at Palantir Technologies UK, Harkirat focuses on developing lasting digital change programs with customers, setting the direction of internal product development efforts to meet new challenges, and overseeing the technical and financial health of Palantir's customer portfolio in the sector.

Harkirat has over ten years' experience of technical roles across multiple industries in the commercial space at Palantir - including automotive, financial services, and aerospace.

He has a bachelor's in computer science from Carnegie Mellon University.

LIZ ST LOUIS,

Assistant Director of Smart Cities, Sunderland City Council

Liz is a dynamic, highly motivated and experienced leader with over 30 years' experience. She is currently Assistant Director of Smart Cities at Sunderland City Council. Driving transformation programmes and digital and data initiatives throughout her career, she has a passion for person centred user design and ensuring digital and data enabled transformational change that makes a real and measurable difference.

Leading the delivery of the Smart City Programme for Sunderland, Liz is responsible for driving forward city-wide investment in next-generation digital infrastructure and use cases that will make a transformational difference across a city landscape.

The opportunities afforded by digital twins have an important role to play in guiding this work and unlocking new insights.

PETER VAN MANEN,

Principal Consultant, Frazer-Nash Consultancy

Peter is Principal Consultant at Frazer-Nash Consultancy, working on digital twins and autonomy in the defence, energy and transport sectors. Both promote well-timed and well-judged interventions in high impact industries. The digital twins support policy, manage assets and provide assurance of critical infrastructure. Assured autonomy enables widespread utilisation of uncrewed vehicles for inspection and delivery, reducing operator burden and exposure to potential harm.

Peter worked for over 20 years at McLaren, leading the electronics company supplying control and data systems to all competitors in Formula One, NASCAR and IndyCar.

The company also developed and deployed systems for the automotive and aerospace industries.

MELISSA ZANOCCO,

Head of Programmes, Infrastructure Client Group

Melissa is Head of Programmes for the Infrastructure Client Group, as well as one of the instigators of Our Vision for the Built Environment and is committed to transforming the built environment sector to produce better outcomes for people and nature.

She is Co-Chair of both the Project 13 Adopter Community and the Digital Twin Hub Community Council as well as a member of the United Nations Industrial Development Organisation's Deep Decarbonisation Initiative, World Economic Forum Digital Twin Cities Project Global Advisory Committee and Construction Leadership Council Task Force.

She was part of the UN Women UK delegation to the 66th session of the Commission on the Status of Women 2022.

BENJAMIN FORD,

Technology and Innovation Manager – Operations, Network Rail

Ben Ford is Technology and Innovation Manager – Operations for Network Rail. Originally a metallurgist, Ben turned to alchemy when he became an innovation consultant, helping small companies transform their opportunities. He built collaborative partnerships, bringing together capabilities, market demand and investment to create new customer added value. He came to the railway ten years ago to help promote innovation, championing SME engagement, pioneering new procurement mechanisms, and building closer relations with government bodies, and between rail industry organisations.

With increasing digitalisation of consumption, he recognised the need for digitalisation of supply, for optimised decisions and service delivery. Ben has increasingly focused on planning, operations, and improving customer insight.

Covid allowed him to secure investment in the largest change in understanding rail demand since the 1970s, making use of telecoms data, foundational knowledge for the digital twin systems we need.

HOW TO ENGAGE

Community engagement through networking, knowledge and showcasing

GOVERNANCE

	November	December	January	February	March	April	May	June
CPC Board			●				●	
CPC Corporate Leadership Team	●	●	●	●	●	●	●	●
Strategic Board	●				●			
Advisory Group	●				●			
Working Groups:								
Business case and demonstrating value			●			●		
Open standards and interoperability			●			●		
Digital skills and capacity building			●			●		
Governance models and trust			●			●		
Community Council				●				●
Gemini Calls	●●●●●	●●	●●●●	●●●●	●●●●	●●●●	●●●●●●●●●●	●●●●
Annual Showcase	→							●

3000+ PEOPLE WORKING TOGETHER

1,500+ COMPANIES

ADVISORY GROUP

The Advisory Group is chaired by the DT Hub's Strategic Board Chair – Dr Alison Vincent. Members of this newly established group represent government and policy interests, academic and industry stakeholders to drive growth and adoption of digital twin technologies.

Members of the group have a long-term, ongoing relationship with the DT Hub and bring their external expertise into all aspects of the DT Hub.

Some of organisations represented on the Advisory Group are:

- TechUK
- KPMG
- BIM Academy
- Turner & Townsend
- Fujitsu
- STFC
- Cohesive
- Iotics
- High Value Manufacturing Catapult
- The Alan Turing Institute
- Coventry University
- Innovate UK
- Department for Culture Media and Sport

COMMUNITY COUNCIL

The Community Council was formed in January 2022 and is critical in ensuring that the voice of the community is captured and heard, internally and externally. It works to inspire and enable members to feel more confident to share and engage with the DT Hub, building on an increasing amount of community-led activity and knowledge. As the Hub develops and the knowledge grows, it makes sure that it is in line with member needs.

The Community Council is co-chaired by Melissa Zanocco OBE, Head of Programmes for the Infrastructure Client Group and Ali Nicholl, Head of Engagement at Iotics.

"The DT Hub is a unique community with a shared vision of using technology to deliver meaningful change. An active inclusive community of SMEs, asset owner/operators, service providers, industry stakeholders, academia, international and policy members share insights, events, best practices and debate. The level of commitment demonstrated by speakers, contributors, Gemini call attendees, networks, champions, councils, working groups, boards and advisors is testament to the appetite to enact change and make a difference."

ALI NICHOLL,
Head of Engagement at Iotics and Co-Chair of the Community Council

GEMINI CALL

The Gemini Call is the DT Hub's weekly half-hour virtual stand-up call with the community where we share case studies and research from our members.

Chaired by Arup's Global Digital Energy Leader Simon Evans, each call includes updates and features on digital twin projects from the community and is an open forum for comments, questions and news.

With over 100 guests on the call each week, we showcase digital twin applications across sectors as diverse as healthcare and fusion energy.

GEMINI PAPERS

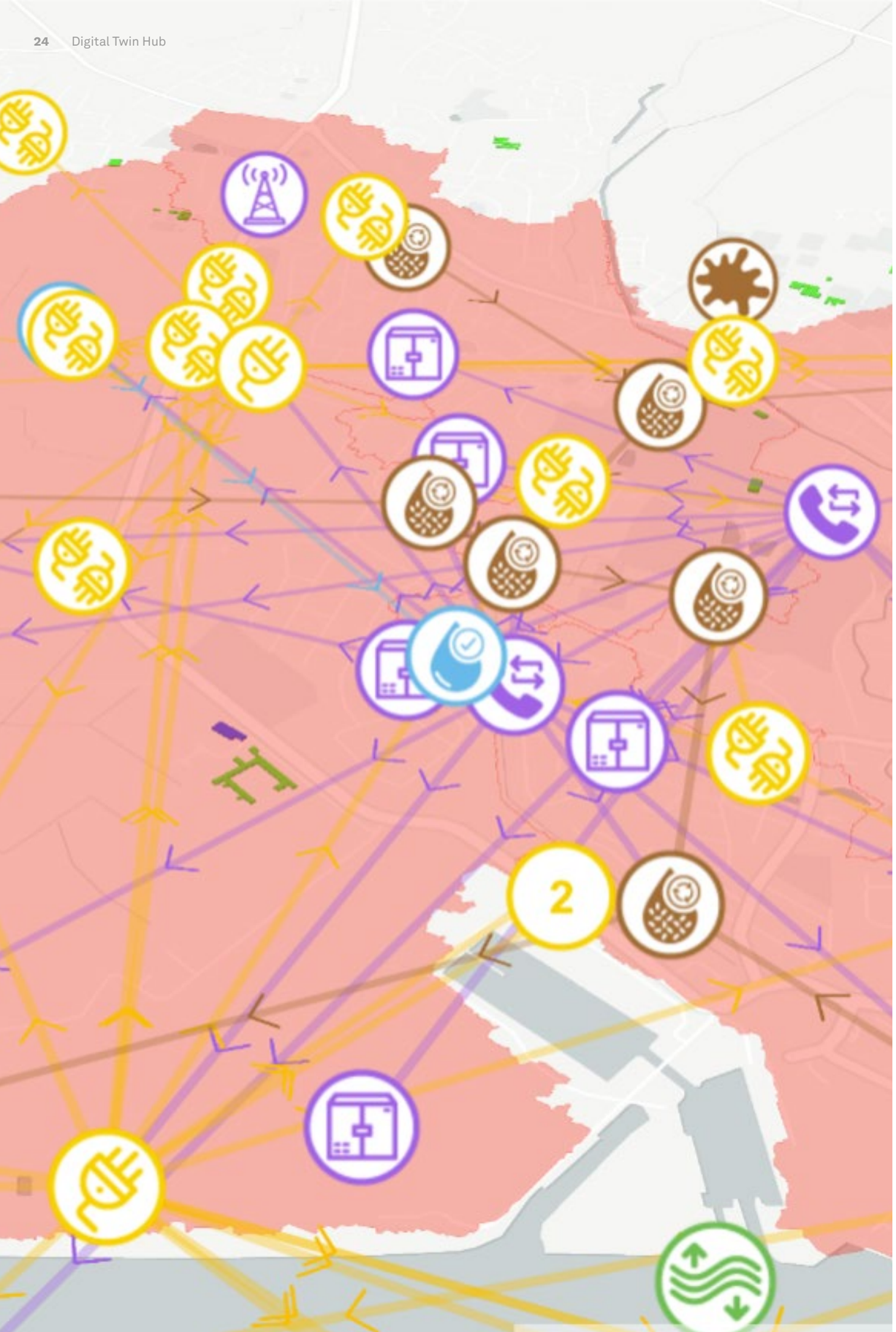
The Gemini Papers set the vision for the future, showing the vital role that connected digital twins play in improving social, economic, and environmental outcomes.

The Gemini Papers: Summary Paper contains insight from Dame Wendy Hall, Professor Andy Neely, Alexandra Bolton and Mark Enzer and tells you everything you need to know and what must happen next, in three parts:

- What are connected digital twins?
- Why connected digital twins?
- How to enable an ecosystem of connected digital twins?

The Summary Paper highlights the team responsible for the Gemini Papers and lists the key documents that helped in informing their creation.

Read the Gemini Papers and watch the videos.



CLIMATE RESILIENCE DEMONSTRATOR (CReDo)

The climate emergency is here now, and collaboration through connected digital twins is key to tackling climate change.

The recently published JCNSS report points to work underway on digital twins to model climate-related infrastructure interdependencies. As an example, it gives the government funded Climate Resilience Demonstrator (CReDo) project which is looking at the impact of flooding on energy, water and telecoms networks.

CReDo is combining datasets from Anglian Water, BT and UK Power Networks into one "system model" to develop a "cross-sector picture of impact of extreme weather events on the infrastructure system". Using data and insights across sectoral and organisational boundaries, we can collaborate on a national network of connected digital twins to create a resilient infrastructure.

"Storm Arwen showed how quickly the effects of a power shutdown can impact on other sectors. People were left without any access to their landline phones after the storms, and unable even to call emergency services in areas with a poor mobile signal. These cascading crises are a major danger to the functioning of the UK economy, and to society – that is why this is a serious risk to national security."

DAME MARGARET BECKETT MP,
Chair of the Joint Committee

The UK's critical national infrastructure (CNI) is vulnerable to extreme weather and other effects of climate change, such as sea level rises. Major power outages, landslides onto roads, buckling train lines and flooding of infrastructure sites: these are all realistic scenarios, and can lead to 'cascading' risks affecting other CNI sectors. Different infrastructure sectors are highly interdependent, so the shutdown of one CNI operator may cause knock-on effects on multiple other sectors.

We need to ready ourselves and adapt to the climate emergency, and although we can't stop it as we would want to, we can use technology and specifically connected digital twins to mitigate the impact of such natural disasters.

The first phase of CReDo was funded by a collaboration between UKRI, Connected Places Catapult and the Centre for Digital Built Britain. Connected Places Catapult has taken over as lead organisation for this next stage of development.

Find out more

DIGITAL TWINS ARE FINDING THEIR PLACE

Digital twins are moving beyond highly controlled engineering environments and emerging in everyday places: transport hubs, shopping malls, sports stadiums.

SARAH WRAY
AUTHOR

Sarah Wray is Editor of *Cities Today* and a specialist in the impact of technology in cities, particularly data, digitalisation and transport innovation.

Meet some of the real-world digital twins living inside the metaverse.

Digital twins are realistic virtual representations of physical assets, processes, and even people, generating insights and interventions which ultimately result in financial savings, improved performance and services, and greater resilience.
A report by global tech market advisory firm ABI Research finds that digital twins could save cities $280 billion by 2030 through more efficient urban planning.

"Digital twins will become the ultimate tool for city governments to design, plan and manage their connected infrastructure and assets in an efficient and cost-effective way,"

DOMINIQUE BONTE
Vice President, End Markets at ABI Research.

The analyst company also notes a growing role for technology such as digital twins in 'microcities', including the areas in and around large airports, ports, international rail stations, venues, office parks, shopping centres, and corporate and university campuses, which are focal points of economic and social activity.

There are several trends driving the growth in place-based digital twins in particular, such as an increased focus on collaborative efforts to tackle challenges like the climate crisis, traffic congestion and energy management. Alongside this, there has been a huge increase in the amount of data harnessed within organisations and a shift to data-driven decision-making. And advances in technologies such as the Internet of Things, artificial intelligence and edge computing are making digital twins more accessible, scalable, and affordable.

A digital twin is a digital replica or virtual copy of a real physical object or system, like a machine or a building or a process. It's basically a highly complex digital model which is the exact counterpart (or twin) of a physical thing. But what's particularly interesting about a digital twin is that it's updated using real-time data.

What makes this possible are connected sensors on the physical asset which collect data that can be mapped onto the virtual model. This means that if you're looking at the digital twin you can see how the physical thing is performing in the real world in real-time.

So the value of a digital twin is its ability to use simulation and machine learning to help with scenario planning and decision making.

This makes digital twins an invaluable tool for engineers and operators to understand not only how machines and products are performing now, but how they will perform in the future.

But where this gets really interesting is how digital twins can help us not so much understand machines like a jet engine, but rather large-scale infrastructure like buildings, transport systems, energy grids, even entire cities.

What insights into passenger behaviour would we glean from a digital twin of a major railway station? What kind of scenario planning could we do with a digital twin of a large office block or a stadium? And how might urban planners, transport operators and place leaders use this intelligence to shape the places of tomorrow?

These are just some of the questions that place-based digital twin technology is helping us to answer.

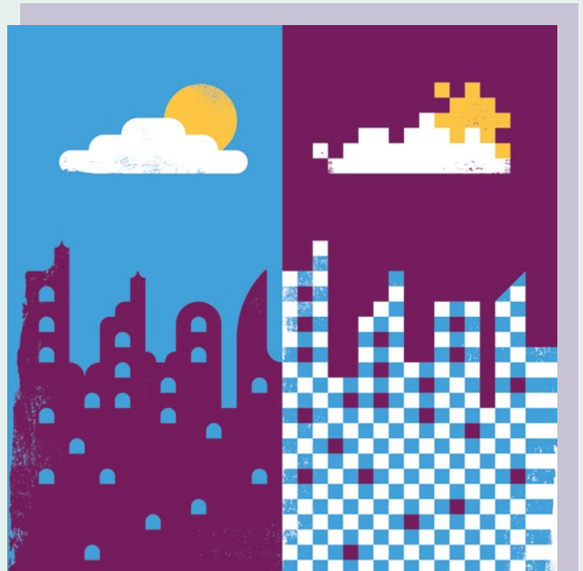
Building Information Modelling (BIM) is improving planning

Anatomy of a digital twin

Digital twins vary based on their providers and the use case but, fundamentally, they have the ability to ingest real-world operational and environmental data and aggregate and combine it with other relevant data. The data is modelled and analysed through algorithmic simulations and visualisation to produce insights. Actions from the digital twin to the physical infrastructure or process can be through actuators or via human intervention.

Digital twins offer a wide range of applications for place-based organisations, including strategic planning, operational planning, and active operations management. While most organisations will begin their digital twin journey with a specific project or goal, it's important to choose technology that is future ready to support a wide range of use cases, from real-time vehicle management to improving the design of future air mobility vehicles and dynamic grid load balancing.

Core capabilities to consider include the ability to ingest and fuse data from different sources, including real-time data, and the scope to scale the digital twin to more use cases and add extra functionality over time. Another key consideration is the ability to run and optimise multiple scenarios.



Through digital twins, organisations can do more with their data by gleaning actionable insights from it. A key benefit is operational efficiency.

Informed decisions, living twins

Cities outside the UK are already extolling the benefits of digital twins. Virtual Singapore, a dynamic 3D city model and collaborative platform, brings together data from various public agencies and other sources and includes static, dynamic, and real-time data and information such as demographics, movement and climate.

According to Singapore's National Research Foundation: "By leveraging the big data environment and aggregating information from the public and private sector, the potential uses of Virtual Singapore in tackling liveability issues are limitless."

For example, urban planners can visualise the effects of constructing new buildings or installing green roofs and understand the impact on the temperature and light intensity in the area. They can also overlay heat and noise maps for simulation and modelling of the most comfortable and cool living environments.

Virtual Singapore also helps to prioritise buildings for solar panel installation, based on interlinked data such as the height of buildings, surface of the rooftops and amount of sunlight. Further analysis can allow planners to estimate how much solar energy can be generated on a typical day, as well as the energy and cost savings. By cross-referencing with the historical data collected from neighbouring buildings, this analysis can be validated and seasonally adjusted to reflect an even more accurate and granular projection.
Another pioneering example, due to its scale, is the City of Seoul's S-Map digital twin which includes street topography, underground infrastructure, subway routes, real-time information on road traffic, and even street views of small marketplaces and alleys.

"It's the first of its kind in that although there have been 3D maps in Sejong, Busan and Jeonju, they didn't cover the whole area of the city," Seoul city government said in a statement last year. "This digital twin of the city will allow us to make simulations online to predict the impact of disasters and accidents, such as wildfires, and predict how new buildings and structures built in the city could interfere with the wind patterns of the area and possibly worsen fine dust pollution."

Operational efficiency

Through digital twins, organisations can do more with their data by gleaning actionable insights from it. A key benefit is operational efficiency.
Linda Wade, Co-founder and CEO of digital twin start-up Spinview, says: "As human beings we're visual and we are built to understand information spatially. Visual recreation is a way of translating all the data from a space into something that is usable and manageable by every employee.

"Quite often, data sits in silos from the top teams and the engineering teams and if you make it available in a format that everyone can use, you can drive efficiencies that previously weren't possible at scale."

People at the centre

With this in mind, people are becoming central to place-based digital twins, in an evolution from their predominantly asset-based roots. This approach will help to ensure that people have great experiences in complex places, and will also inform better infrastructure investment decisions.

With a decades-long background in using digital replicas in the automotive industry and then crowd simulation tools in rail infrastructure projects, Nicolas Le Glatin went on to bring these together through his start-up OpenSpace. The company is using its passenger flow digital twin technology to bring the customer experience into large-scale architecture, engineering and construction (AEC) projects.

“Cities are a series of experiences that fundamentally deliver the fabric of life or society, but engineers still tend to think about pouring concrete and moving cars and trains,” says Le Glatin.

“OpenSpace is trying to deliver the AEC industry some new tools to express the performance of the design and the operations from a people-centric perspective.”

This approach is important given the ‘passenger first’ mandate of organisations such as Great British Railways, the new public body that will oversee rail transport in Britain from 2023, as well as the wider push to encourage people back to public transport and to choose mass transit over the private car.

Following the development of a people-flow-management digital twin for St Pancras International station in 2020, which was later adapted to help manage social distancing, OpenSpace has been contracted to expand its digital twin infrastructure to all four HS1 stations: Stratford International, Ebbsfleet International, and Ashford International, alongside St Pancras. It has also been selected as part of the HS2 innovation programme and is delivering a ‘living lab’ at Euston station where HS2 is looking at how to design stations around the movement of people with real-time data.

The OpenSpace platform analyses historic, real-time and predictive data on people movement, fusing new and existing data sources such as 3D lidar asset scans and passenger flow from computer vision, with train timetable feeds and Wi-Fi analytics as well as other information related to managing the customer experience. At St Pancras, this includes data from escalator company Schindler and contract cleaning firm Churchill.

“Companies like HS1 are really in the business of monetising the movement of people by train but also leveraging the quite remarkable retail opportunities,” says Le Glatin. “A digital twin is a means of enabling them to continuously optimise against a set of objectives.”

This includes the configuration of buildings, the design and scheduling of services, and other real-time decisions which help to maximise revenue while minimising operating costs. The tool can, for example, guide when an escalator could be switched off to save energy and enable predictive maintenance based on footfall, or inform the facilities cleaning schedule on a weekly or daily basis.

“People are the common denominator between all the contributors of the built environment so a digital twin for managing people flow does more than making great decisions; it brings people together,” adds Le Glatin.

“It is astonishing how people are engaged or willing to be part of it and want to share data when you say we are going to optimise the end-to-end journey of their customers by collaborating with other rail operators.”

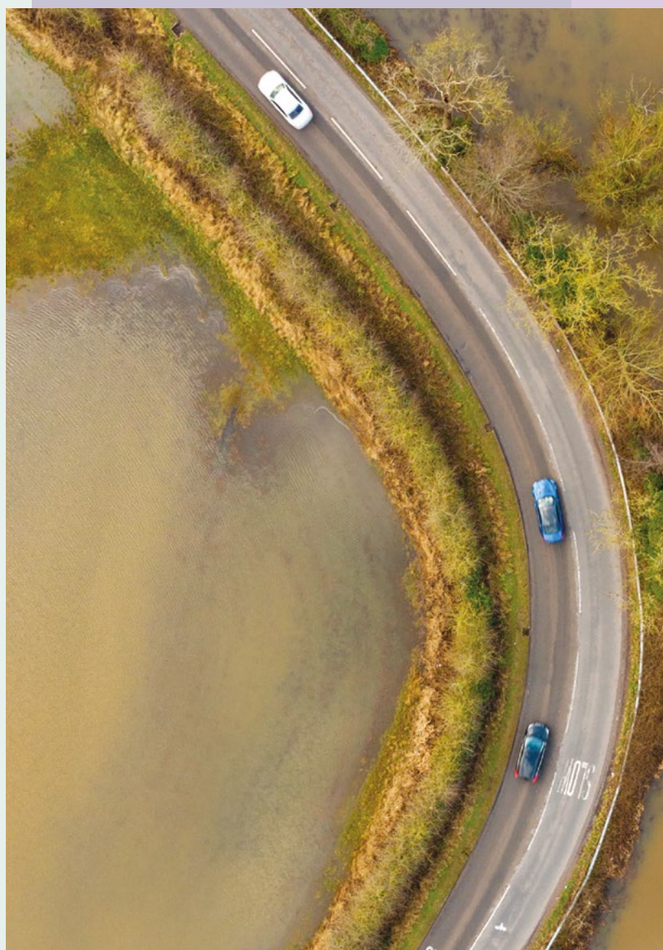
Future focus

These collaborative examples point towards an emerging trend – the need for individual digital twins to be interoperable and ‘talk’ to each other to meet the integrated needs of places.

This is something that will continue to be a focus for the Digital Twin Hub which from 1 April will transition from its current home at the Centre for Digital Built Britain to Connected Places Catapult, offering new opportunities for place-based organisations and supporting companies to launch projects focused on digital twins. Tamar Loach, Technology Initiative Director at Connected Places Catapult, points to a pioneering digital twin example in the Climate Resilience Demonstrator (CReDo), which is a particularly important project in the light of a spate of extreme weather events around the world and warnings from the Intergovernmental Panel on Climate Change that these will get worse.

The initial one-year phase of CReDo focused on proof of concept and showing how data from energy, water and telecoms networks can be connected up in one secure digital twin. It demonstrated the use of synthetic data, legal and data-sharing agreements, and the development of initial multi-level ontologies and an information management framework to enable data to interoperate.

“It’s bringing together different sectors that haven’t historically worked together,” says Loach. “They’re actually working together, sharing data, and therefore they’re able to look at their own systems and the investment needed to reinforce those systems so that they’re robust and resilient. And they’re able to look at that in the context of the systems that are affected and affecting each other.”



Getting digital-twin ready

While there is a lot of excitement around digital twins, the featured projects also highlight the practical groundwork still to do to unleash their true power in cities and spaces.

Digital twins can't be bought off the shelf ready to go; they are dependent on and powered by data, so this starts with developing a data culture and treating data as an asset.

Research commissioned by Connected Places Catapult outlined key competencies that place-based organisations need to develop to overcome barriers to adopting digital twins, such as lack of buy-in from the top, skills gaps, and limited data availability and quality.

The report advocates a range of practical steps including identifying and sharing successful digital twin case studies, facilitating partnership building, and growing digital operations competencies. Loach says: "Finance and advertising, for example, are much more advanced in how they make use of data in a joined-up way. And the opportunity for places to take advantage of data and interoperable digital tools is huge, but there's quite a long way to go and we can't underestimate the digital maturity aspect."

To gain confidence and demonstrate the value of a digital twin, experts urge place-based organisations to avoid the data-lake approach and instead pick a use case, gather specific data, evaluate results and scale from there. The right technology partners, large and small, will also bring technical best practices and skills to help projects succeed.

Axomem's Axoverse Digital Twin platform – currently in use at one of Singapore's largest hospitals for tracking COVID19, respiratory illnesses, and Multi Drug Resistant Organisms (MDROs). See axomem.io

Data economy

In their initial phases, digital twins are a good way to enable connected places to increase the return on investment for their existing data, and break down silos within the organisation.

To really get the most from the technology, though, they require data from an ecosystem of providers – increasingly this is a mix of internal departments, public sector organisations, the private sector and, with adequate permissions and privacy in place, citizens themselves. This is seeing organisations at the early stages of exploring various aspects of the 'data economy', starting with driving awareness of the value of sharing data.

"With Schindler and Churchill at the moment, we're exchanging data for the benefit of both parties and also the benefit of HS1, our client," says OpenSpace's Le Glatin.

"Where we all are as an industry is understanding how to monetise datasets, and how each dataset contributes to unlocking value [for others]. That, I think, is going to take some time for everybody." Projects such as CReDo also highlight the growing need for a 'shared language'.

To be able to create models of complex scenarios that involve multiple systems, Loach says we can learn from best practices in information management, such as using shared ontologies and striving for semantic precision, as well as principles from software engineering relating to modularity, interoperability and automated testing. Methods from data science around statistical validation and reproducibility of results will also help. "Combining a multidisciplinary approach to technical development plus putting subject matter experts at the centre of use case creation, and user-centred design at the heart of the front end for digital twins will make them a success," Loach comments.

The good news is that work to create these building blocks is underway.

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