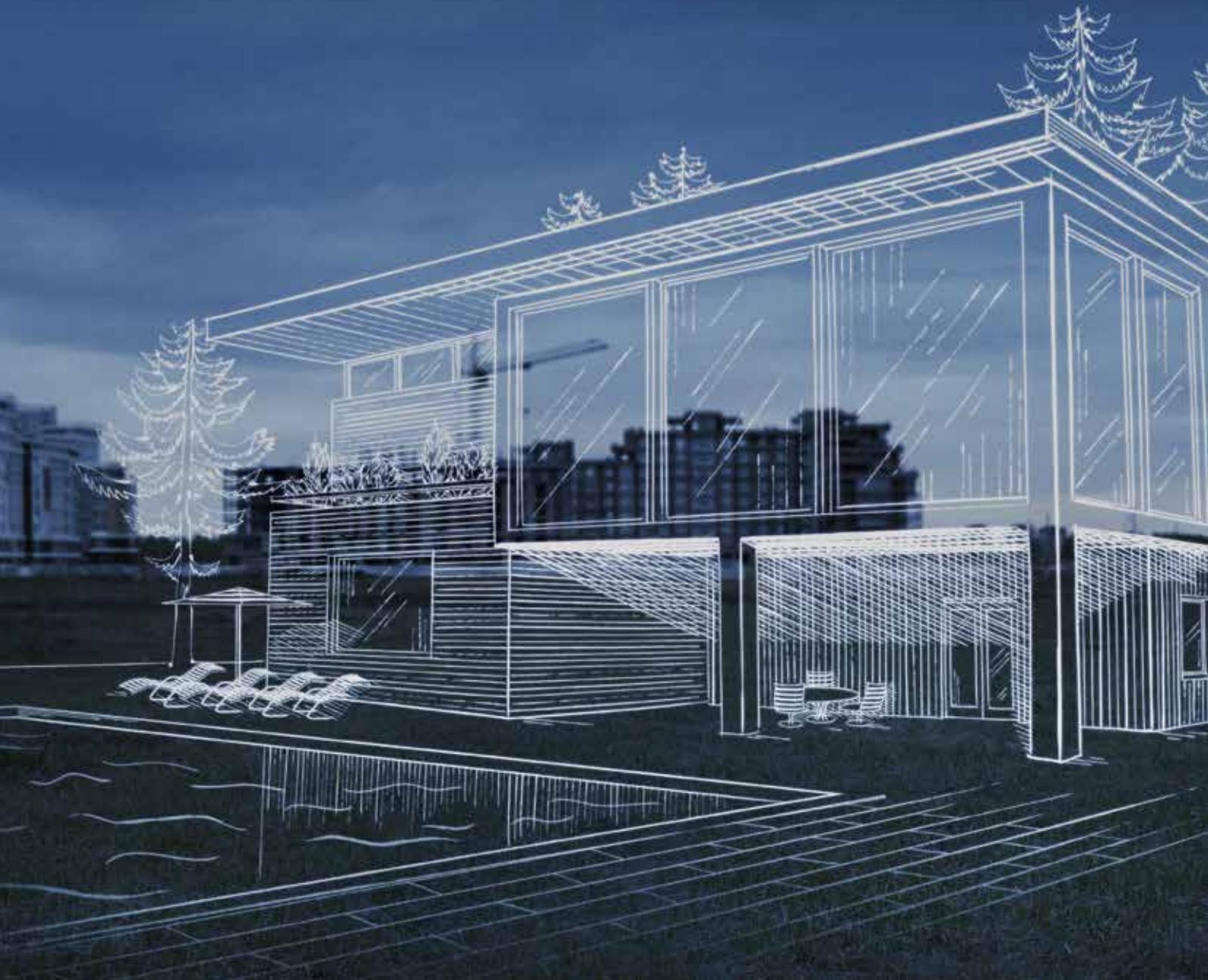


FRONTIER **S**
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SPATIALLY ENABLED
DIGITAL TWINS

**CAPABILITY
STATEMENT**



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ABOUT FRONTIERSI

FrontierSI brings together the best people to solve the most complex spatial problems.

We are the spatial organisation of choice to lead, formulate, broker and deliver collaborative innovative solutions with government, industry and universities. We are a not for profit organisation which provides independent innovation and research advice and brokering services to deliver the best solutions for our partners and clients. We represent a partnership of over 30 research agencies, government and private sector companies across Australia and New Zealand. FrontierSI draws on the expertise of its university and industry partners to provide the complex and varied skills required to solve problems in the development and implementation of digital twins.

We value collaboration, future focus, agility, integrity, and communication.

We are solutions-driven and achieve high quality outcomes through **collaboration**, being open-minded and embracing inclusion, working together as a team internally, and with our partners and clients;

We are **future-focused**, looking at what's next: from tapping into the most promising technologies through to new application areas, to ensure we deliver;

We respond to our partner needs with **agility**, being flexible and deploying teams and effort as needed to adapt to our rapidly changing environment;

We work with **integrity**, we do what we say, and we are professional and respectful of others;

We **communicate** and share information effectively, we listen first, seek to understand other perspectives and simplify complex concepts into understandable stories.

COMBINED CAPABILITY

FrontierSI's collaborative partner model provides unparalleled experience across a broad range of sectors and application areas.

Our combined expertise spans the entire digital twin development and deployment phases, including acquiring new 3D datasets (e.g. property, elevation), governance arrangements for data sharing, licensing and access, methods for data integration and fusion, off-the-shelf and custom built platforms to house, analyse and visualise the data, as well as sophisticated spatial modelling that derive insights and deliver value.

This expertise is critical to successful digital twin research, development and deployment assist a range of sectors for improved decision support and service delivery.



RESEARCH & INNOVATION

Despite the significant progress and extensive capability in delivering spatially enabled digital twins there are still some high-level challenges remaining. FrontierSI is well positioned to solve these challenges through our ability to form and manage collaborative teams comprising the very best research institutions, government agencies and companies to deliver major outcomes quickly and effectively.

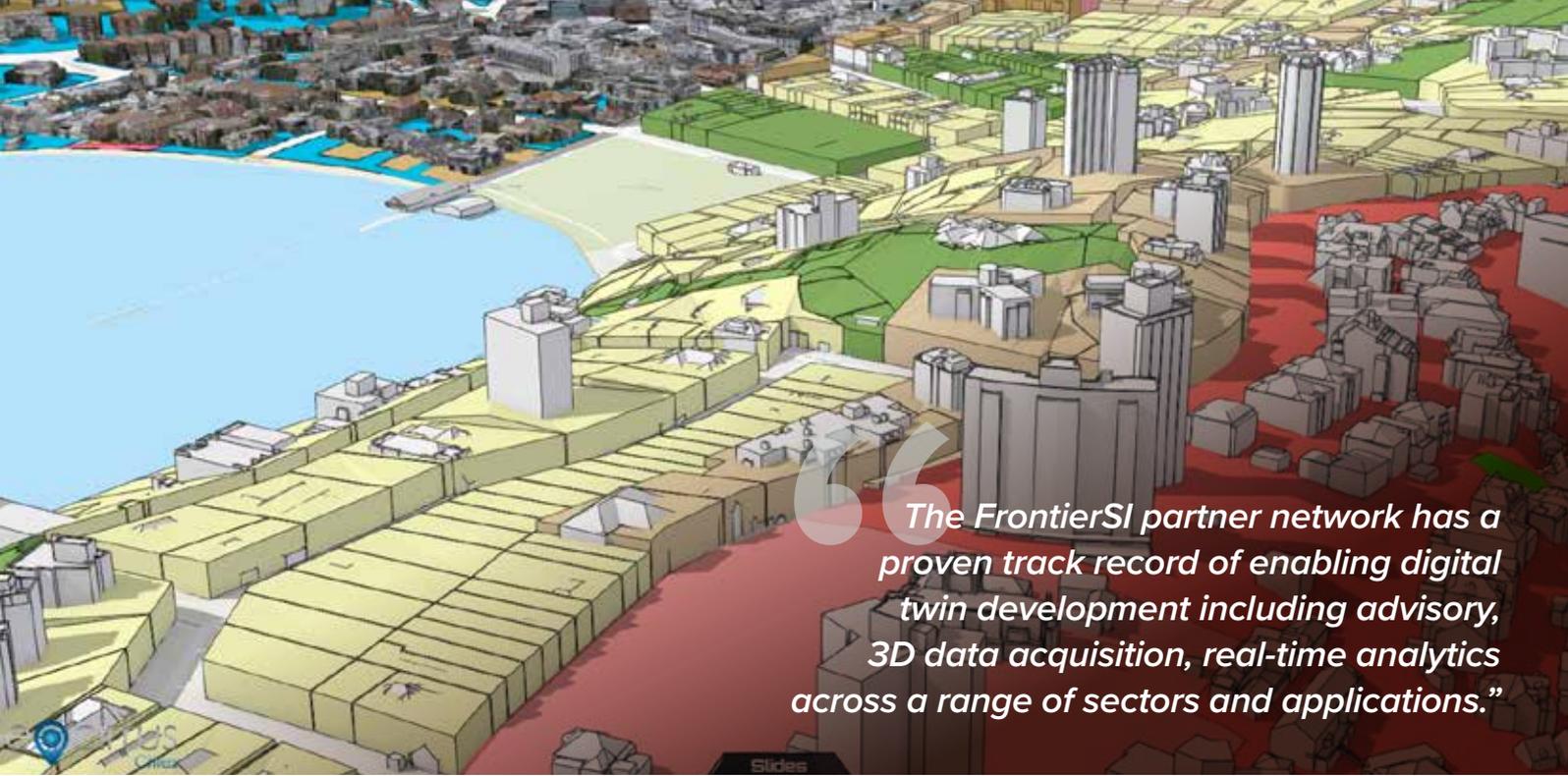
COLLABORATION

Benefits from the next generation spatially enabled digital twins will be maximised if we can collaborate, share our data and make digital twins accessible within a common ecosystem for the broadest possible range of users across the economy. As a not for profit, we are determined to build the spatial capabilities across government, industry and universities to deliver an ecosystem of integrated digital twins.



CORE COMPETENCIES

Improved Governance Frameworks	FrontierSI	Our Partner Network
Frameworks – expertise in leading the establishment of governance arrangements for digital twins that focusses on both end-user and data custodians.	✓	
Data procurement – expertise in the development of new business models for government to procure data (e.g. LiDAR and 3D imagery) to populate digital twins.	✓	✓
Data licensing – capability in designing enterprise licensing for digital twin data access and use.	✓	✓
Data	FrontierSI	Our Partner Network
Data acquisition – Provision of an extensive range of data capture technologies including IoT, LiDAR, UAV imagery, BIM and satellite-based datasets and features.		✓
Synthetic household data – Australia-wide synthetic household data based on national census and local household travel survey data.		✓
Data standards and models – Industry & research partnerships to establish the requirements for digital twin deployment across the plan, build and operate phases.	✓	✓
Quality assurance – Automated QA to ensure the integrity of digital twins are maintained.	✓	✓
Data Integration and Visualisation Platforms	FrontierSI	Our Partner Network
Methods for data integration – Semantic and linked data approaches to combine diverse data types and simplify data supply chains.	✓	✓
Value Testing and Validation – Proof of concept & minimum viable product implementations.	✓	✓
Range of viewing platforms – Consolidated desktop, mobile and web viewing platforms utilising off-the-shelf packages or custom-built technologies.		✓
Virtual and augmented reality – Fully immersive experiences for user engagement and communication.		✓
Analytics for Decision Support & Planning	FrontierSI	Our Partner Network
Agent-based models – Simulation of real-world entities, such as individuals or groups. This enables the forecasting of actions and interactions of people within complex systems to generate new insights.		✓
AI and machine learning – Automated machine learning feature extraction (e.g. trees, rivers, solar panels, pools, powerlines).	✓	✓
Algorithm suites – These include vehicle movement simulations, sea level rise predictions, property valuations and urban scenario planning.	✓	✓
Cross Jurisdiction Collaboration and Stakeholder Engagement	FrontierSI	Our Partner Network
National collaboration – Actively lead and/or contribute to relevant inter-jurisdictional forums to support national collaboration.	✓	
Stakeholder engagement – To improve industry engagement and communication across jurisdictions and sectors through forums, newsletters and workshops.	✓	✓



The FrontierSI partner network has a proven track record of enabling digital twin development including advisory, 3D data acquisition, real-time analytics across a range of sectors and applications.”

TRACK RECORD

The FrontierSI network has delivered digital twin services including research, 3D data acquisition and analytics, advisory and consulting and implementation across a range of sectors and applications. Below is an overview of the sectors we work with, application experience, and a selection of case study examples.

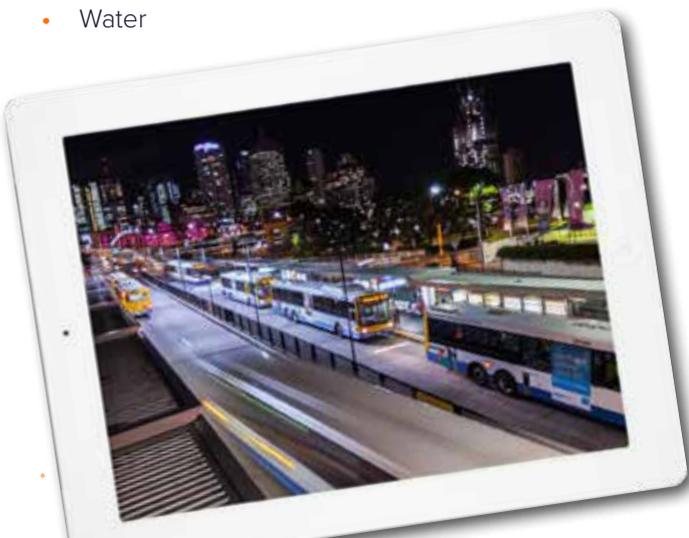
Sectors

- Smart cities, precinct and urban development
- Transport and urban networks
- Power, rail and other major Infrastructures
- Mining
- Energy
- Emergency management
- Water



Applications Across Sectors

- e-Planning and e-Construction within the property development pipeline
- Asset integrity monitoring and surveillance
- National automated land valuations and value uplift modelling
- Urban scenario planning for precinct management and development
- Business intelligence for efficient property and infrastructure maintenance programs
- Virtual reality (VR) training and safety simulation for property and asset identification



PARTNER CASE STUDIES

Partner: AAM



CLIENT >

City of Melbourne – Melbourne City Baths

PROJECT DESCRIPTION >

First opened in 1860, the iconic Melbourne City Baths provides health and fitness facilities and maintains the largest swimming pool in the Melbourne CBD. Although it is a beautiful building, the Melbourne Baths are showing signs of ageing. In response to the need to pro-actively manage the site, the City of Melbourne demonstrated leadership in heritage building management by commissioning a “digital twin” of the building.

The challenge:

- The structure is spread over a triangular site with three levels and a complex undercroft beneath the pools.
- The site contains two pools, gyms, sports facilities, offices and commercial spaces, so conducting onsite surveying was a challenge. The site is extremely complex in terms of its façade detail and myriad of small rooms and tight stairways.

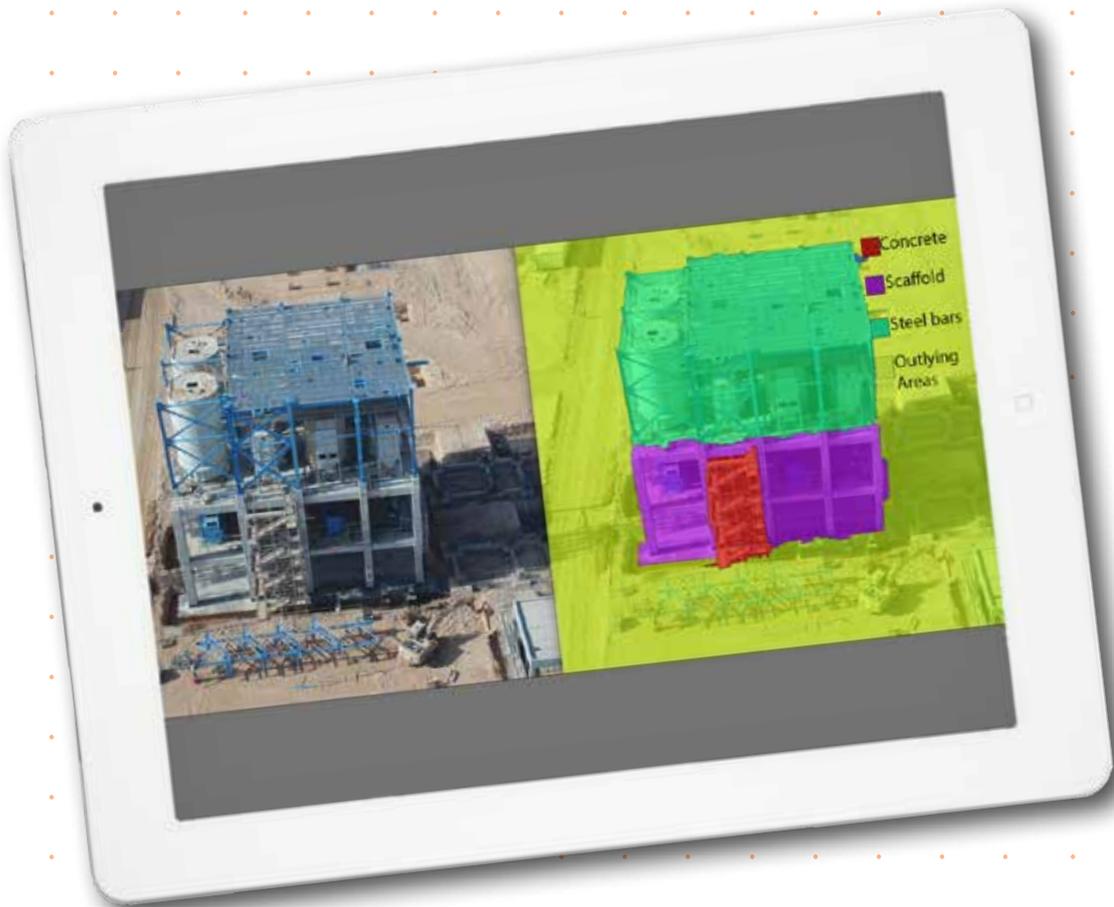
The solution:

AAM were commissioned to carry out laser scanning around and throughout the building. This included office spaces, back of house, the undercroft and areas closed to the public. AAM used advanced laser scanning technology to capture dense point cloud data across the site, mostly at night. The significant data set of point cloud information was then packaged into smaller portions to enable AAM’s team of modellers to work both independently and collaboratively.

BENEFITS >

The 3D parametric REVIT model, with fully individual and editable elements, will enable all stakeholders working on the current and future management of the site to collaborate within this valuable digital asset. The AAM 3D model forms the framework of the Melbourne City Baths Digital Twin. This spatially accurate, single source of truth will provide ongoing benefits for the owners and users of the baths.





Partner: Orbica

CLIENT >

Thyssenkrupp Industrial Solutions, Germany

PROJECT DESCRIPTION >

This project was a proof-of-concept to automate traditional/manual build progress reporting on a large, industrial building site by using Orbica's deep learning feature extraction and classification algorithm.

Orbica was supplied with drone-collected imagery of an industrial building site in Saudi Arabia in order to build a 3D point-cloud model as a digital twin to the existing CAD model. The point-cloud model was then processed through an artificial intelligence feature extraction and classification algorithm and automated geoprocessing to determine built features such as scaffold, concrete, steel pipe and structural steel. This produced a "point-in-time" snapshot of built features that could function as a model to compare future models to for the purpose of determining build progress.

BENEFITS >

- Automation of build progress reporting represents improvement in accuracy and speed compared to manual reporting.
- As an automated build progress reporting algorithm is improved in testing and training over time, it has the potential to offer significant savings on large-scale projects.
- Orbica won the Thyssenkrupp Industrial Solutions Drone Analytics Challenge and People's Choice award at Beyond Conventions, Germany, with this concept.
- The concept was successfully proved.

Partners: Omnilink and UNSW



CLIENT >

Valuer General, Local Council, Big 4 Bank

PROJECT DESCRIPTION >

Value Australia supports Australia's largest market, the \$6.8 trillion property market, by creating valuation products that provide better information sooner to homebuyers, investors, businesses and governments whilst reducing costs and risks. Combining research, extensive data assets and using state-of-the-art analytics and artificial intelligence this project will deliver secure digital valuation models and tools that cover a broad range of land and property types across Australia and overseas. Value Australia builds on two years of pilot work across Metropolitan Sydney and Brisbane through the RAISE project and will create a national suite of data and software products over the coming three years.

The Value Australia team is an ideal collaborative mix, bringing together research, industry, State Government (Valuer General's Office NSW) and Local Government (Liverpool Council).

The product suite will include:

- **Cyber secure land and property valuation models** including machine learning driven mass appraisal valuations for urban, peri-urban and regional Australia
- **Predictive Infrastructure sequencing** and integrated city growth models
- **Value creation models** for critical infrastructure projects with a focus on proximity benefits attributed to transformational public infrastructure and land rezoning
- **Infrastructure value capture financial models** including incremental financing, betterment taxes and land taxes
- **Economic feasibility models** to calculate the likely returns on property development.





Partner: GHD

CLIENT >

The Level Crossing Authority

PROJECT DESCRIPTION >

The Level Crossing Removal Project (LXRP), established by the Victorian Government, oversees the largest rail infrastructure project in the state's history. The project aims to remove 75 level crossings across metropolitan Melbourne by 2025, in addition to upgrading or constructing more than 27 train stations and the associated rail improvements.

GHD and its joint venture partner Aecom, are the Technical Advisors for LXRP delivering technical investigations, consultation, planning and design for level crossing sites across the city.

Against a backdrop of escalating cost pressures, increased resource demands and complex coordination of work, the Level Crossing Removal Project was looking to challenge the construction industry using digital technologies and a human centric approach to project delivery. There was however, no clear vision for the utilisation of digital tools nor the organisational design needed to harness the teams and the data.

A key challenge the project faces is capturing the right information, formatted in an insightful and actionable way, and presenting it to the right people at the right time. This is compounded by multiple, remote sites, which can only be occupied by the project teams temporarily, for the duration of works, in an environment where connectivity for sending and receiving data is often challenging.

Members from the GHD Digital team are helping the client respond to these challenges, by supporting the LXRP project with "The Hive" and "The Connected Site". This a program of works to deploy and test digital technologies that improve the transparency and awareness of real time information at project construction sites and visualise this through a digital twin representation of all sites.

To do this effectively, team members from GHD Digital supported an integrated digital solution:

- 1. Digital Strategy and Transformation:** developed LXRP's digital transformation plan with a clear vision of delivering the connected, digitally enabled site of the future.
- 2. Smart Technology Solutions:** crafted a technical solution, combining several existing and emerging technologies, by incorporating global technology alliances.

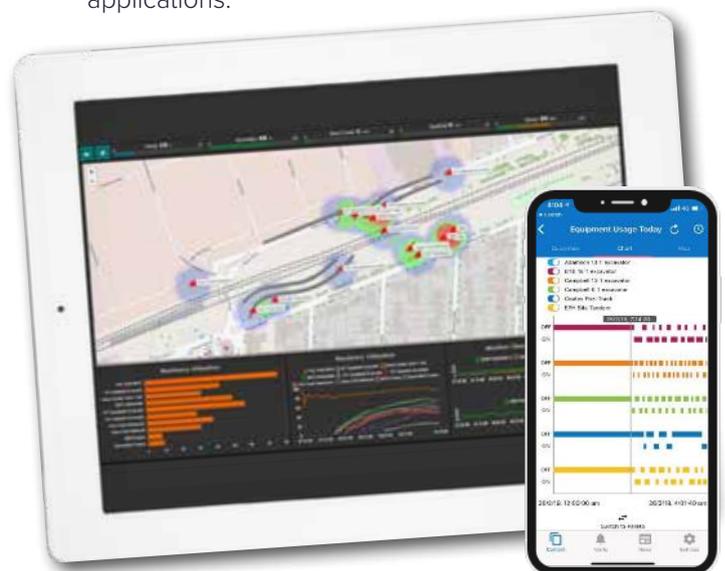
- 3. Data and Analytics:** created a series of dashboards and data analytics based on requirements which focused on real time value.
- 4. Cybersecurity and Digital Risk Management:** assisted in the creation of a risk management framework to manage the dialogue between site workers and government.
- 5. Digital Innovation:** built the digital incubator to constantly challenge, re-evaluate and reimagine the connected site platform.

To address the plethora of data, our GHD Digital team members created five 'Instant Intelligent Insights' that alter workflows in safety, environmental monitoring, site asset management, site logistics and program benchmarking.

BENEFITS >

A variety of benefits are being explored and exhibited through the Hive, these include:

- Site construction efficiencies targeting substantial savings in equipment usage
- Developing a learning organisation through a data driven and enterprise wide innovation program
- Providing a common data set across the project for all participants to use on both fixed and mobile devices
- Delivering data analytics to inform leading practice activities and share information and insights across the project sites
- Tailored project information accessible to project participants on mobile devices.
- Partnerships and associations with tier 1 technology vendors to pilot opportunities for step out applications.



Collaboration: FrontierSI and RMIT University

CLIENT >

Department of Environment, Land, Water and Planning (VIC), and Department of Customer Service (NSW)

PROJECT DESCRIPTION >

FrontierSI collaborated with state government partners and RMIT university to develop machine learning approaches to automatically extract features from airborne and space-based data sources for inclusion in the state digital twin demonstrators. Initially this work has focused on individual tree and building extraction utilising government data assets in order to integrate machine learning into their data production pipeline. This automated approach has substantially improved the data quality and reduced the level of effort to create features from months of person time to days of computer time.

BENEFITS >

These features have been included in state-based digital twin demonstrators to complete the virtual environment. Below is an example of 3D trees in the Victorian Government Fishermen's Bend Digital Twin launch.





Partner: Fugro

CLIENT >

Ergon Energy (Utilities – Disaster Response)

PROJECT DESCRIPTION >

Since 2014, Ergon Energy has used the Fugro Roames Distribution Network Digital Twin and vegetation management service which includes the means for rapid deployment to quickly assess damage from cyclones (hurricanes), plan our response, and efficiently reduce power restoration times and costs. In early 2015, Fugro Roames Disaster Response services were deployed in the wake of Severe Tropical Cyclone Marcia, a Category 5 super-storm that battered Central Queensland. With wind speeds of over 200 km/h (125 mph), its widespread damage cost \$750M.

In its wake, Ergon Energy, supplying electricity across one million spans of network to more than 700,000 customers in Queensland, received reports of tens of thousands of power outages.

Within a day, Roames was mobilised, surveying the impacted network. 12 hours later, Roames' highly-automated cloud processing routines delivered a precise 3D virtual environment detailing the damaged network, enabling Ergon to allocate resources efficiently to minimise customer inconvenience and risk.

Using the Roames disaster response service, Ergon Energy's asset managers directed in-field crews, providing location specifics and recommending tools/materials to restore power.

In a record-breaking 10 days, Ergon's full network was returned, the quickest, most efficient restoration of power ever recorded in Australia.

BENEFITS >

- 63,700 power outages recognised across their network.
- Immediately surveyed over 5,000 km² of impacted network and surrounding environment.
- Rolling 24 hour turnaround of centimetre-accurate 3D virtual modelling of the damaged network.
- Fugro Roames' assessment identified and modelled over 654 instances of critical damage.
- Five days after Marcia, crews had restored power to 27,300 customers.
- Ergon's full network was restored in record time: 10 days, post-disaster.





symbolix

Partner: Symbolix

CLIENT >

United Energy (Energy Utility)

PROJECT DESCRIPTION >

This project involved a digital twin simulating engine to map Victoria's smart meter network. An electricity network of 640,000 smart meters through 14,000 distribution substations is difficult to physically manage. Due to rapid and agile network management, the physical phase a customer may be connected to is unknown.

The cost of physical inspections are high. To address this problem this project developed a digital twin of the electricity network to enable the distributor to view connections, and proactively test and manage issues. This task required agile development and prototyping of analytics options in a very big data environment.

BENEFITS >

This demonstrator project proved the digital twin as an effective platform for processing, visualising and managing a complex system in a highly dynamic, big data environment. As the platform is integrated into the business it opens up cost savings, by targeting field resources to resolve problems and increase network performance (rather than time in physical phase identification). It also provides a platform and process for integrating digital twin for broader scenario modelling. For example, with a digital twin electricity network plus household and travel demographics, we can start to predict load requirements as electric vehicles are more widely rolled out.



Partner: Spatial Vision



CLIENT >

City of Port Phillip

PROJECT DESCRIPTION >

Whilst the concept of a Digital Twin (DT) may be based on dynamic models of assets, in urban areas, the complexity and breadth of these models is often overwhelming. Spatial Vision has been working across a range of projects that are not only based on these digital asset models, but also, importantly, take into account the other very important characteristic of DTs – the need for real-time data flows from sensors, and control via feedback systems.

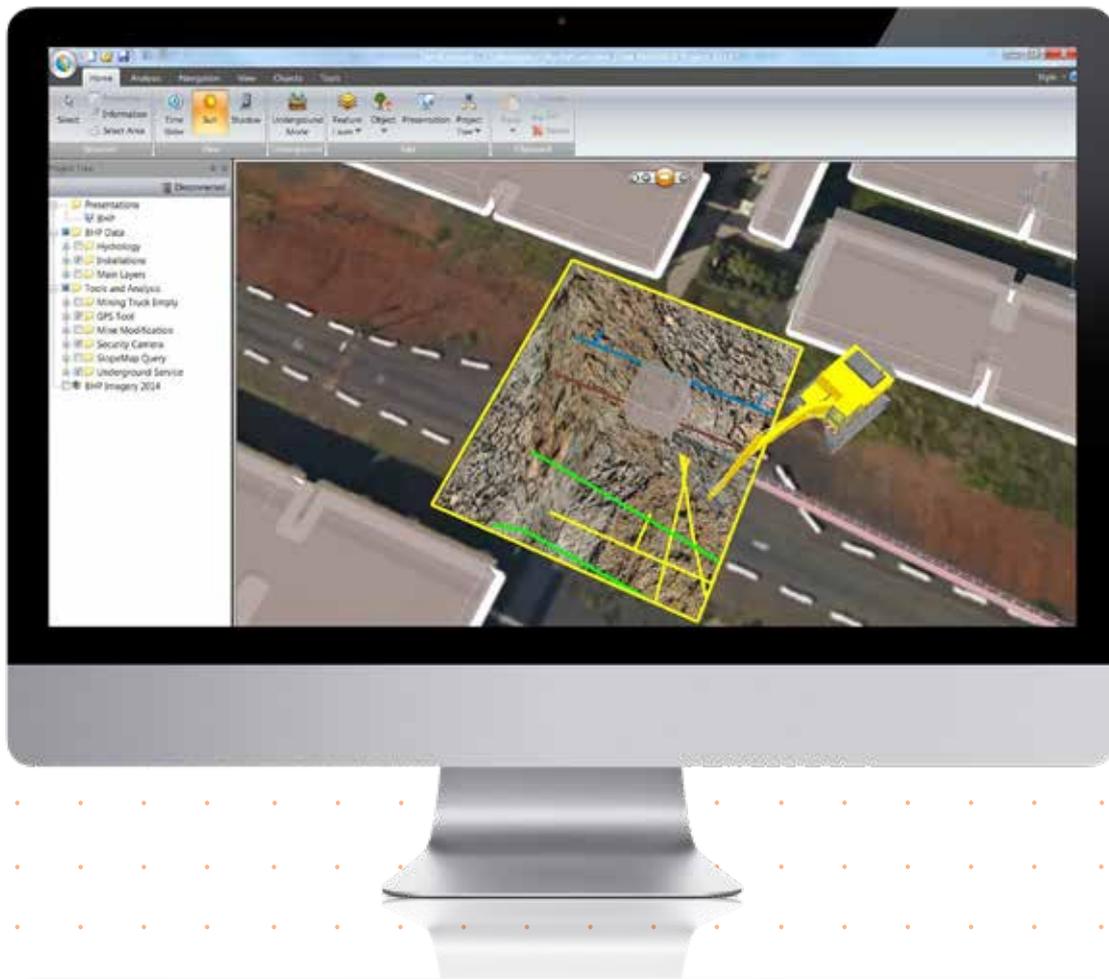
Using the latest climate modelling available from the CSIRO, suitably down-scaled for this application, Spatial Vision conducted a first-pass Asset Vulnerability Assessment for the City of Port Phillip (CoPP) to better understand the likely impacts of anticipated climate change for council assets. The assessment identified which of the council's built infrastructure and natural assets, such as roads and parks, will be impacted by future sea level rise, storm surges and flood events, and the costs associated with these scenarios if they were to occur.

As part of this analysis, Spatial Vision applied the latest inundation modelling sourced from the Victorian Coastal Inundation Dataset to determine the exposure of each individual asset to eight inundation scenarios. This enabled the CoPP to identify exactly which assets will be impacted and better prepare for harsh future events. Spatial Vision is working on the capacity to monitor these impacts semi-autonomously for the future.

BENEFITS >

For the City of Port Phillip, our modelling allows individual assets to be visualised in context, along with the nature and scale of future impacts. This assists Council with future planning and preparation for climate change, enabling better informed and proactive decision-making.





Partner: NGIS



CLIENT >

Resources Sector

PROJECT DESCRIPTION >

This project provided the initial design and implementation of a high-performing digital twin for the client to realise their vision of a digital mine and the value that location driven technology and data can deliver. The resulting Digital Twin is a self-service visualisation and intelligence platform that provides an overview of operations and activities in near real-time. The digital twin provides an immersive spatial experience with plug and play virtual reality capabilities of the full mine site operations.

BENEFITS >

The digital twin has delivered a range of benefits to the client and has established an approach that will continue to deliver value to its mining operations. These include:

- Over 2000 active users leveraging the digital twin to make more informed decisions and improve overall productivity and efficiency.
- The digital twin is now available to all company employees as part of the company's standard operating environment.
- There has been a 75 per cent reduction in static map requests with the use of a self-service visualisation platform enabling the Data and Geospatial teams to focus on value added activities within the business.





We know where.

For more information about Digital Twins
and how FrontierSI can help contact:

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