

Empowering Land and Geospatial Agencies-a New Era



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Digital Twin

*a Platform for Providing
Geospatial Information
Intelligence and Smart
Services*



Advancing Industries & Societies with *Location Intelligence* and *Digital Twins*

... a World-Class Interdisciplinary Research and Innovation Centre that:

- advances the science and knowledge base, and
- develops the digital technologies and platforms

in location intelligence, land administration systems, spatial data infrastructures to transform the geospatial enablement of industry and services to benefit wider society.

Key Drivers

- Population Growth & Increasing *Complexity*;
- **Emerging Markets, Global Trade, Safety and Supply Chain;**
- Ageing Infrastructures;
- Environmental Sustainability, Climate Change;
- Increasing Disasters-a *Worldwide Problem*; **Pandemic-COVID;**
- **Digital Economy** and Smart Societies;
- Land Administration System Modernisation agenda;
- The Role of location information in **Industry 4.0**, and Technological Trends
- **Connected, automated** and shared services;
- Future planning (**Digital Twin- leveraging BIM**);
- Needs and opportunities in the context of **Sustainable Future for All-SDGs**;
- IoT, AI, AR, making sense of smart data, smart utilities, 3D, 4D,.. ***nD data...***



Centre for Spatial Data Infrastructures and Land Administration (CSDILA)

Local Challenges to
Global Action
Global Market to
Local Opportunities

Bridging the Gap...from Local to Global

Est. 2001



CORE CAPABILITIES

Centre for Spatial Data Infrastructures and Land Administration offers an extensive range of scientific, strategic and innovative services in the following areas to meet the needs of industry, governments and research community:



Modern Land Administration systems

To advance towards e-land administration and demand for stronger property rights in land.



Building Information Modelling (BIM)

To streamline construction project delivery workflow and improve building performance.



Spatial Data Infrastructures (SDIs & NSDIs)

To enable seamless discovery, access, use and fusion of spatially enabled data for all users.



Community Resilience & Public Safety

To effectively respond and recover from the impacts of the increasingly frequent disaster events.



Digital Twin Technologies

Digital counterpart of physical environment to promote integration between virtual and physical models.



Advanced Hologram & AR/VR Visualisation

To enable interactive 3d visualisation for better analysis, engagement and informed decisions



Urban Analytics & City Science

To inform the planning process and to support data-driven insights, creative actions, and better governance



Sustainable Development Goals (SDGs)

Universal call to end poverty, protect the planet, and ensure a better and sustainable future for all



Future Smart and Connected Cities

Explore new ideas and new approaches for the acceleration and realisation of smart and connected cities

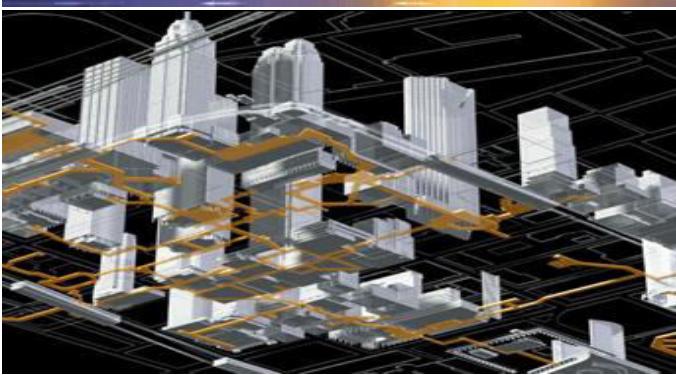


Capacity Building & Executive Training

Strengthen both public and private agencies and support better leadership and effective policy making



Infrastructure - Complex Intersection between Land, Hinterland, and Marine Environment



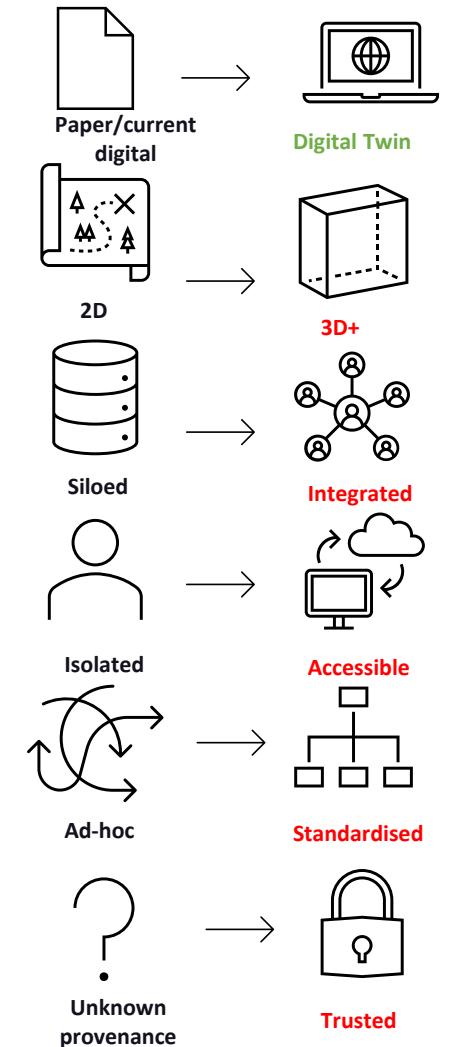
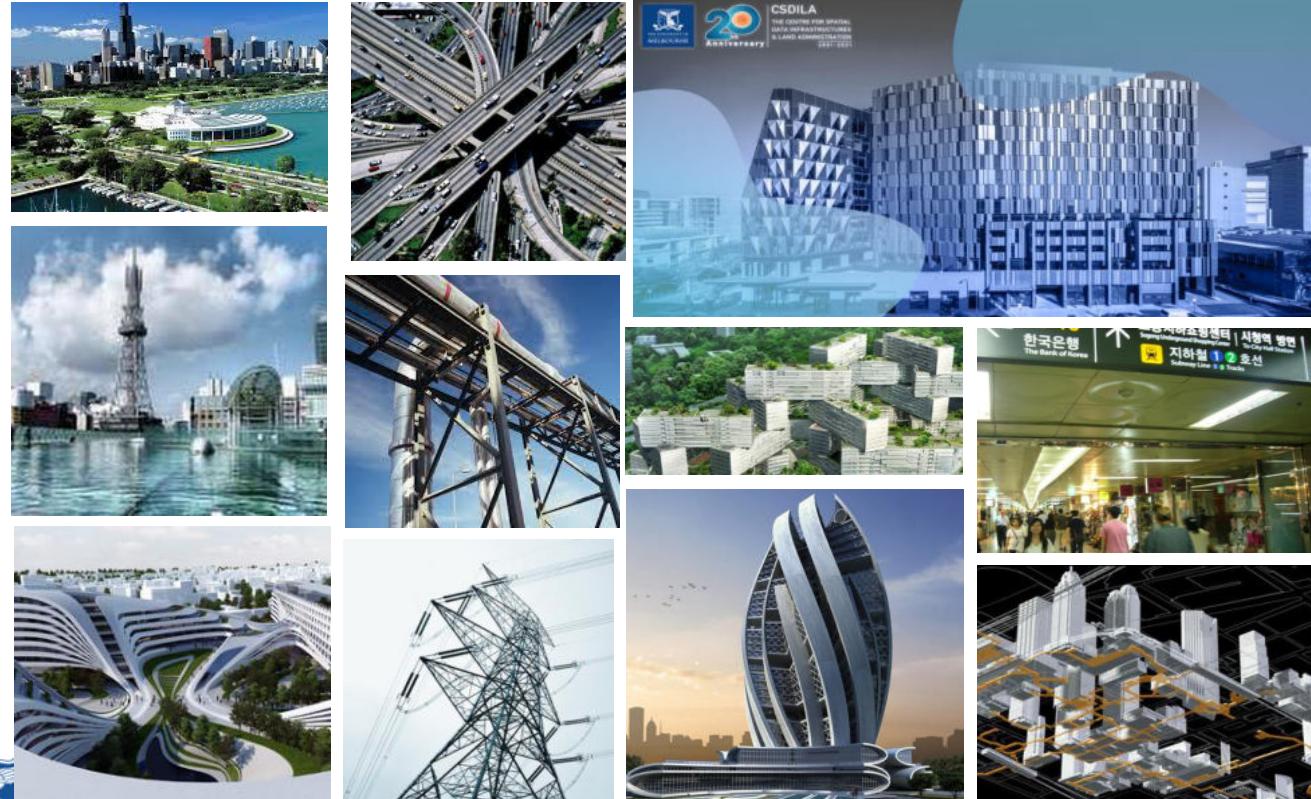


Critical surface and subsurface infrastructure and physical assets such as buildings, roads, bridges, rail lines, tunnels, utilities, processing plants, refineries as well as resource industries **form the backbone of Australia's productivity**. Yet, according to the Australian Infrastructure Audit (2015) **most infrastructure used in 2030 will be in a substandard state of repair**.

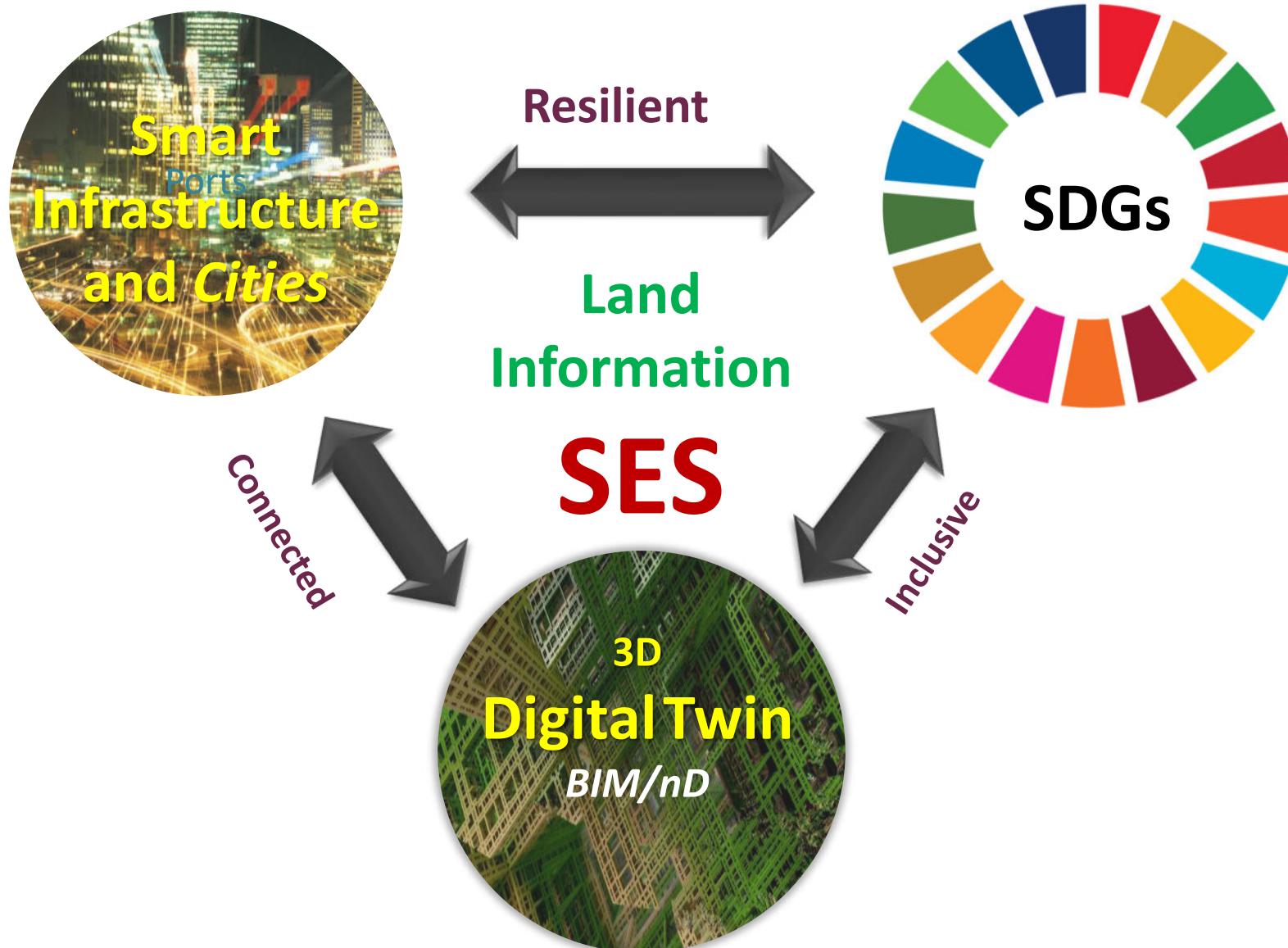


Complex Urban and Regional Environments

A primary reason for the limitations in addressing the interdisciplinary challenge of sustainability is the lack of **an ecosystem of open, harmonised and interoperable information models and datasets across land, built environment and natural environments.**

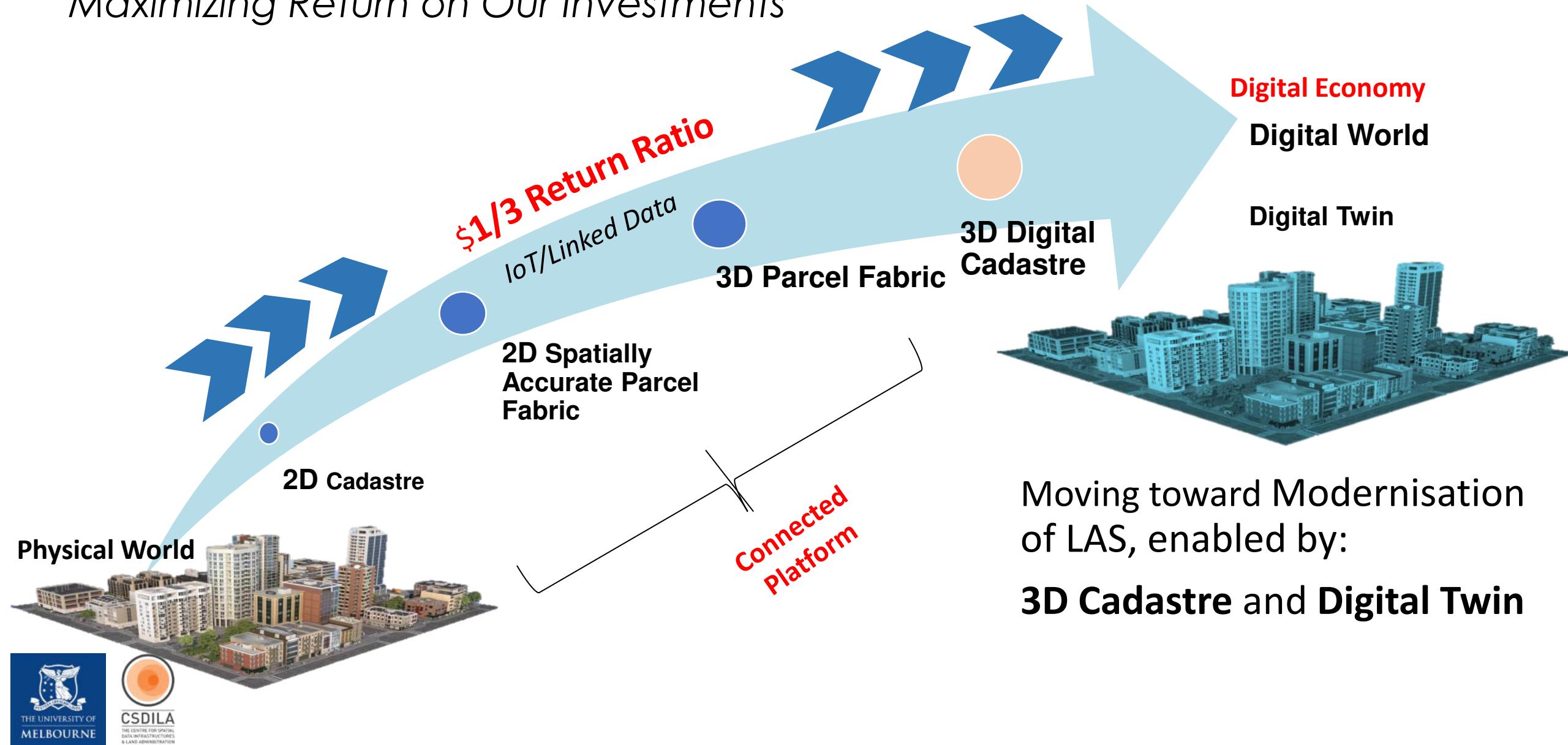


Interconnected FUTURE For ALL



From Physical World to Digital World-

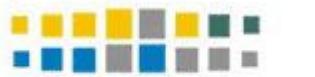
Maximizing Return on Our Investments



3D Suite Data Workflow



GEOJSON



CityGML



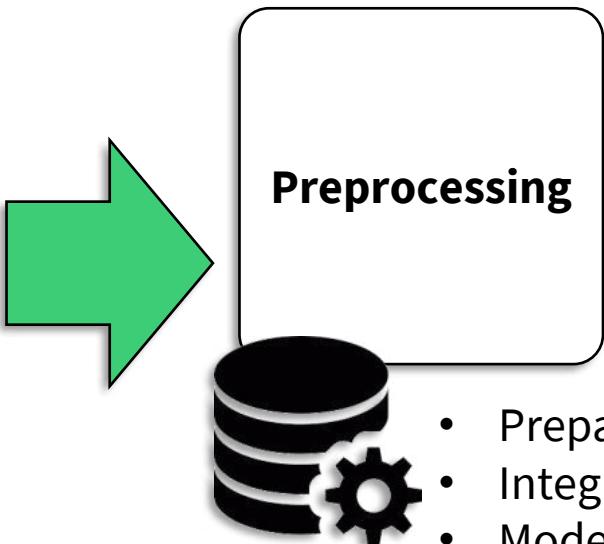
PostgreSQL



Point Clouds

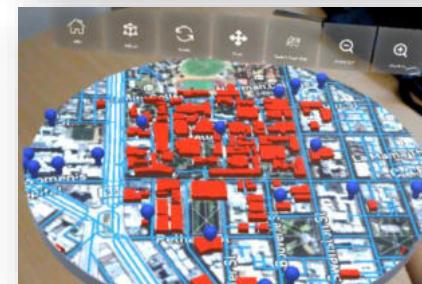
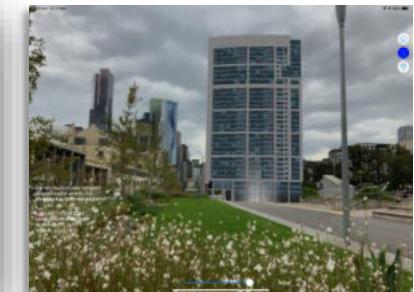
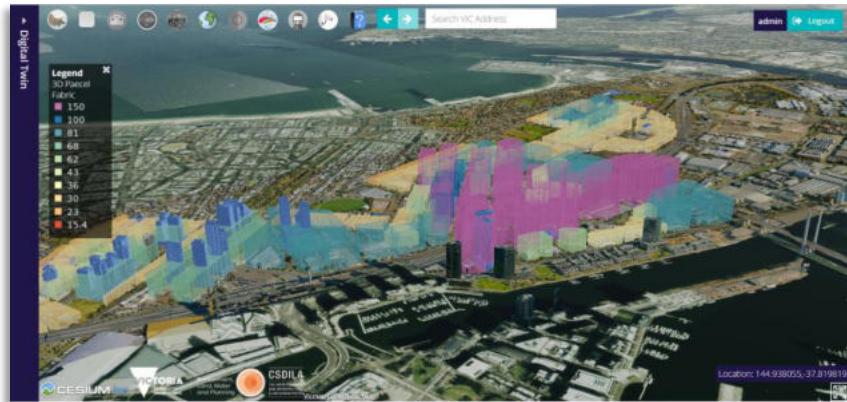


IoT



Preprocessing

- Preparation
- Integration
- Modelling
- Hosting
- Publishing



Design Philosophy: A Highly Customisable and Open Ecosystem



Data



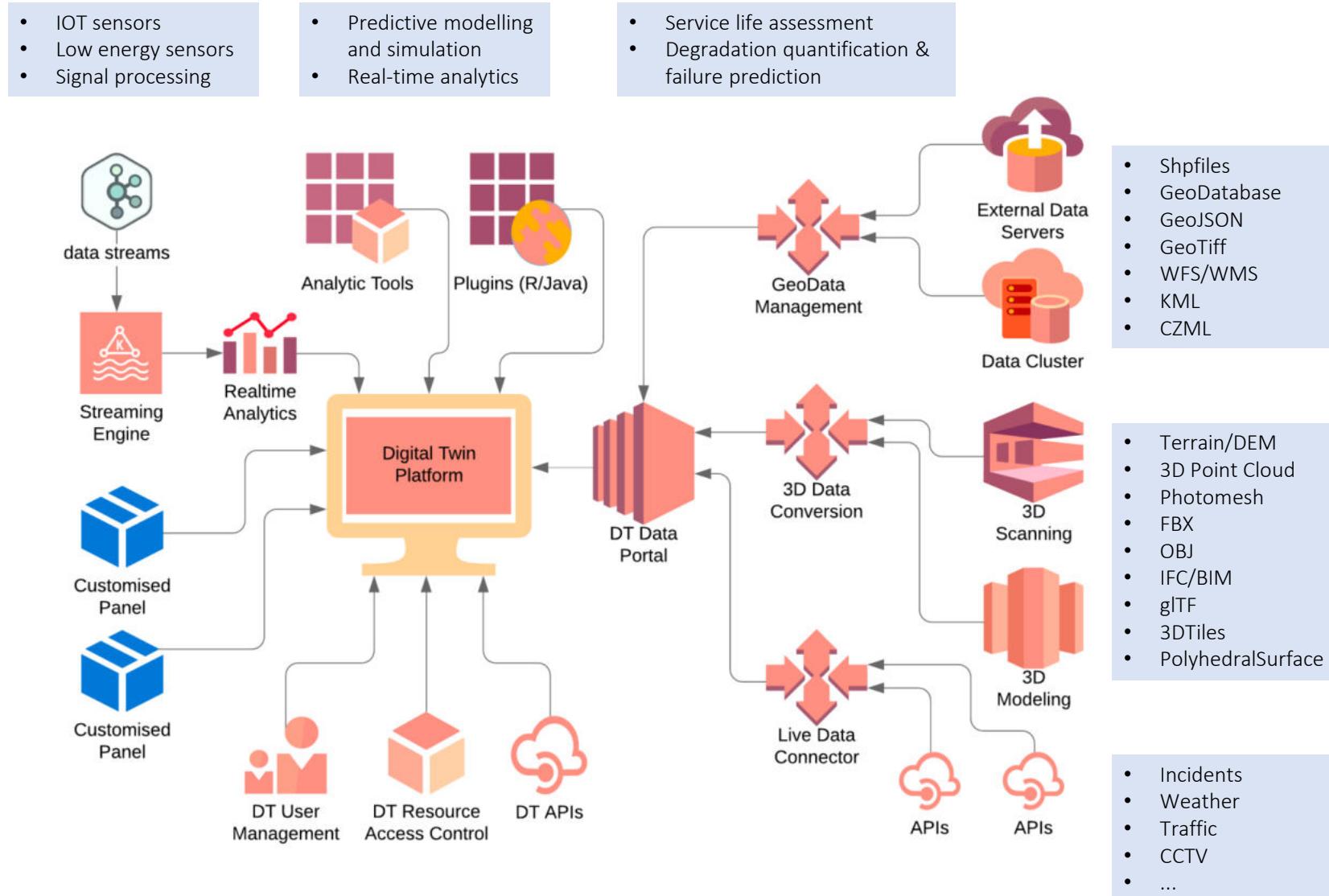
Model



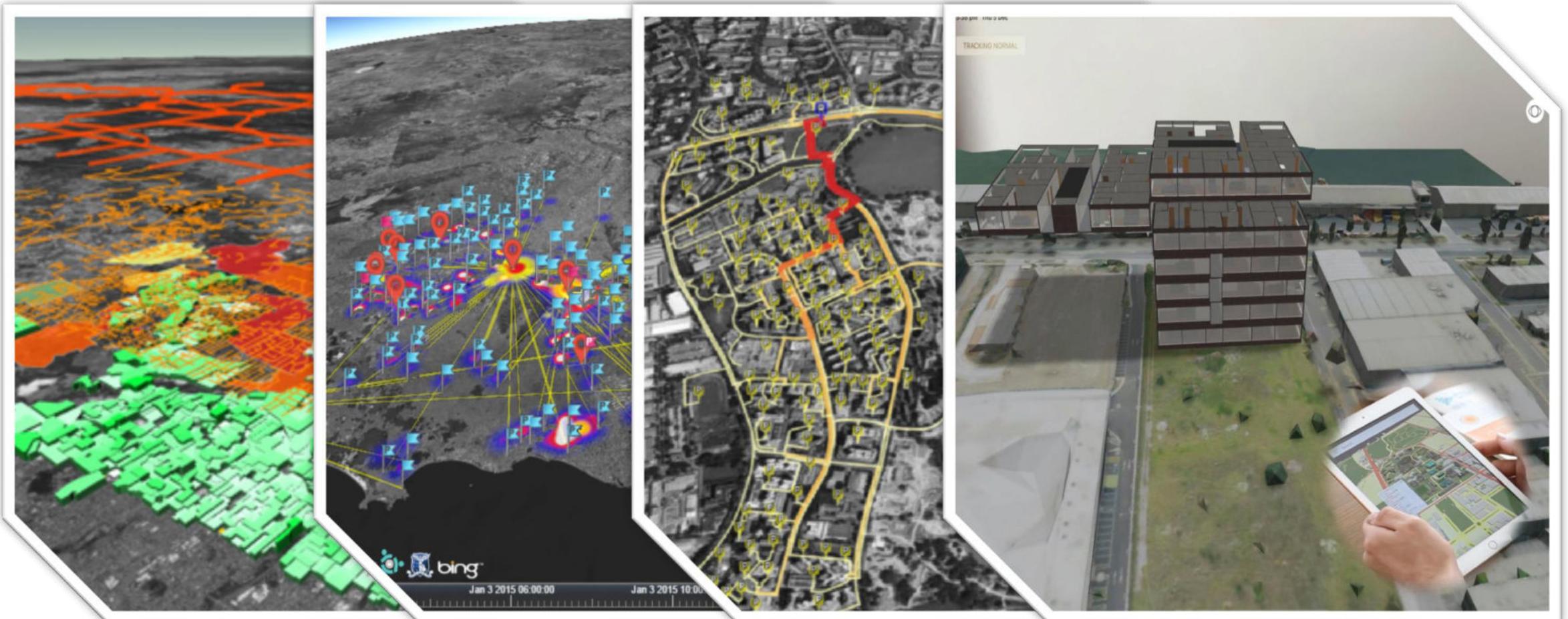
Script

High-level System Architecture

System Components



Core Capabilities



Multi-source Data
Integration

Modelling & Simulation

Advanced Urban
Analytics

Augmented and Virtual
Reality Capabilities

Application Areas

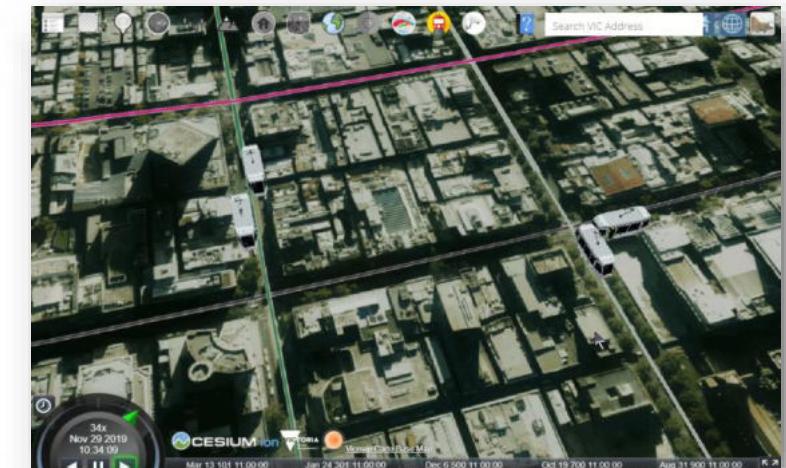
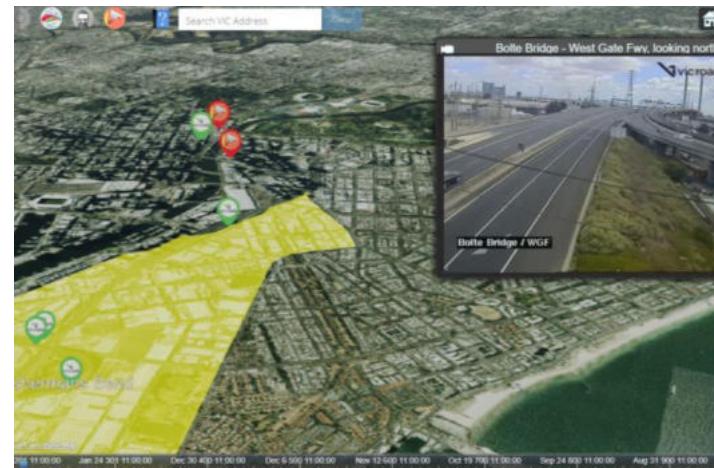
- Digital Twin
- 3D Cadastre Research
- Disaster Management
- Urban Planning Support
- IoT and Real-time Data Analytics
- Space Management
- Sustainability and Resilience

Our Digital Twin Case Areas

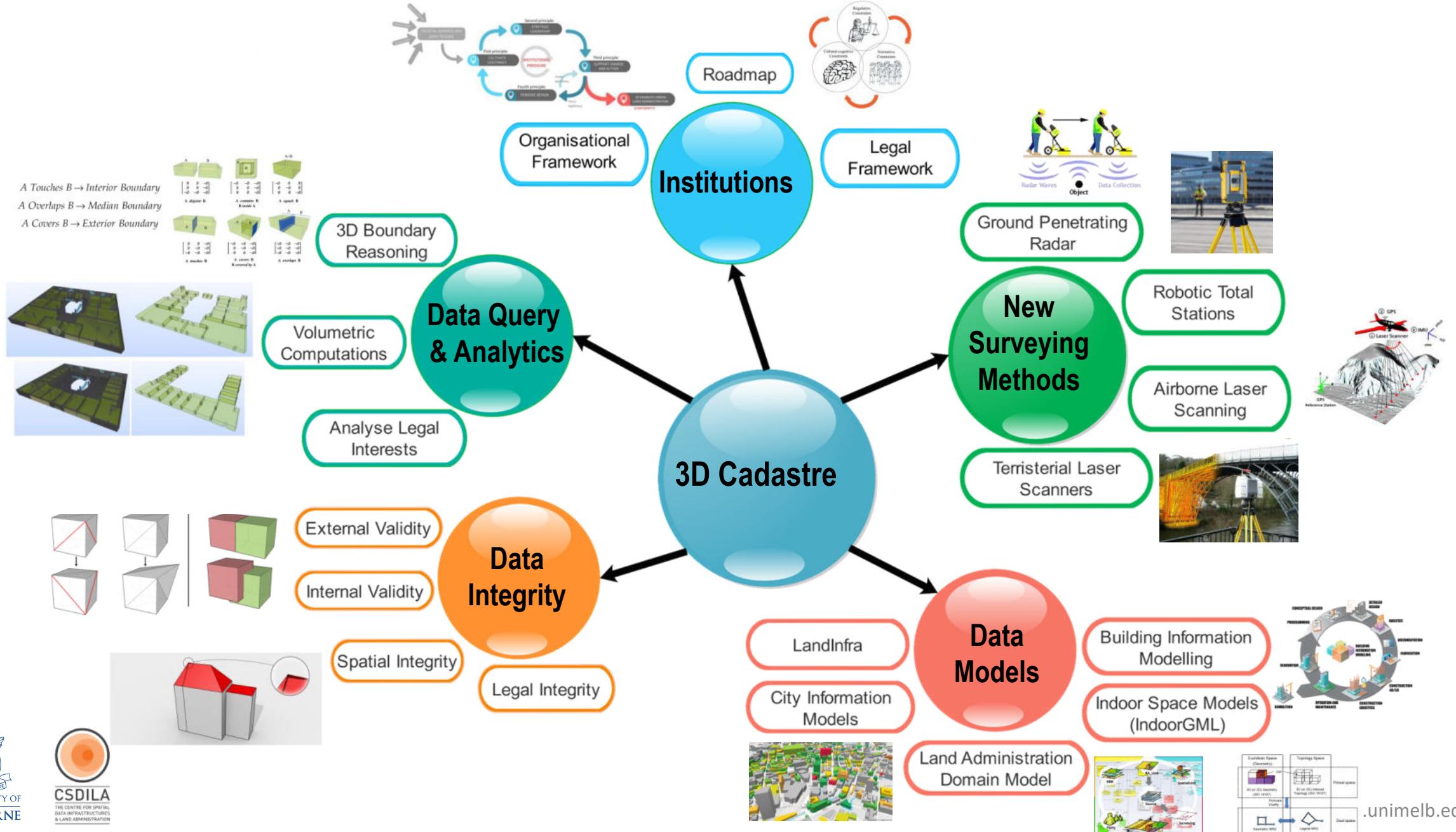


Digital Twin - Fishermans Bend, Australia

- An enterprise solution for web-based visualisation of massive 3D datasets
- A collaborative environment for 2D and 3D data sharing with sophisticated access control
- Visualising different 3D data formats (e.g., BIM, CityGML, Obj, FBX, 3DTiles, DEM, point cloud)
- In-house 2D/3D data format conversion and hosting capabilities
- Visualising high resolution photomesh
- Sensor network data integration, visualisation and analysis (e.g., building occupancy, building energy index)
- Real-time data visualisation (e.g., Public transport mobility visualisation)
- BIM based 3D Cadastre query and visualisation
- Planning analysis tools (e.g., quantitative shadow analysis, sky view factor)
- Providing plug-in capability for adding analytical tools

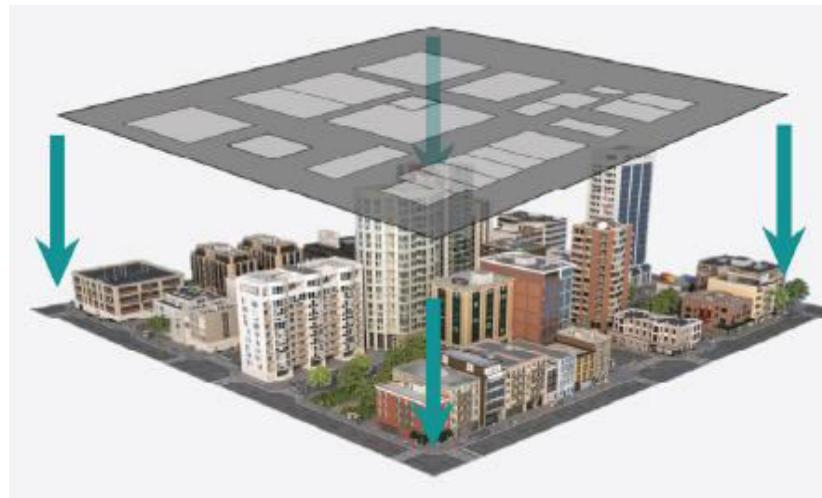


3D Cadastres – Modelling & Development



Cadastre Maturity Levels

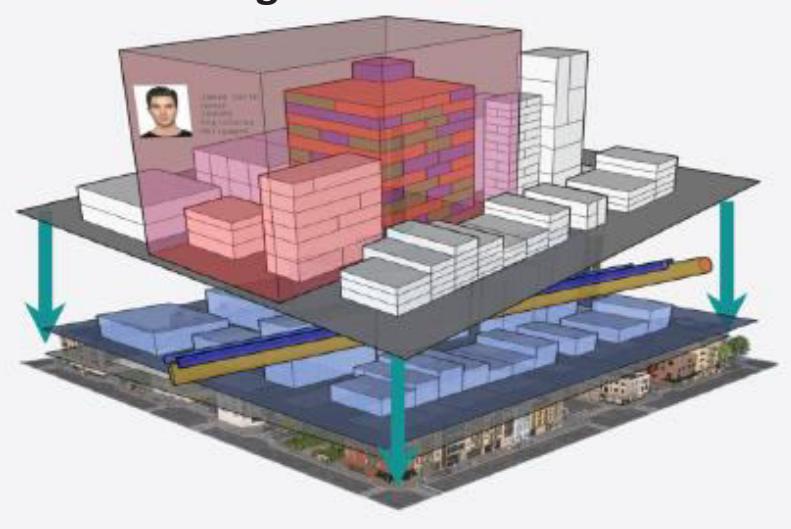
Level 1 – 2D Digital Cadastre



Level 2 – 3D Parcel Fabric



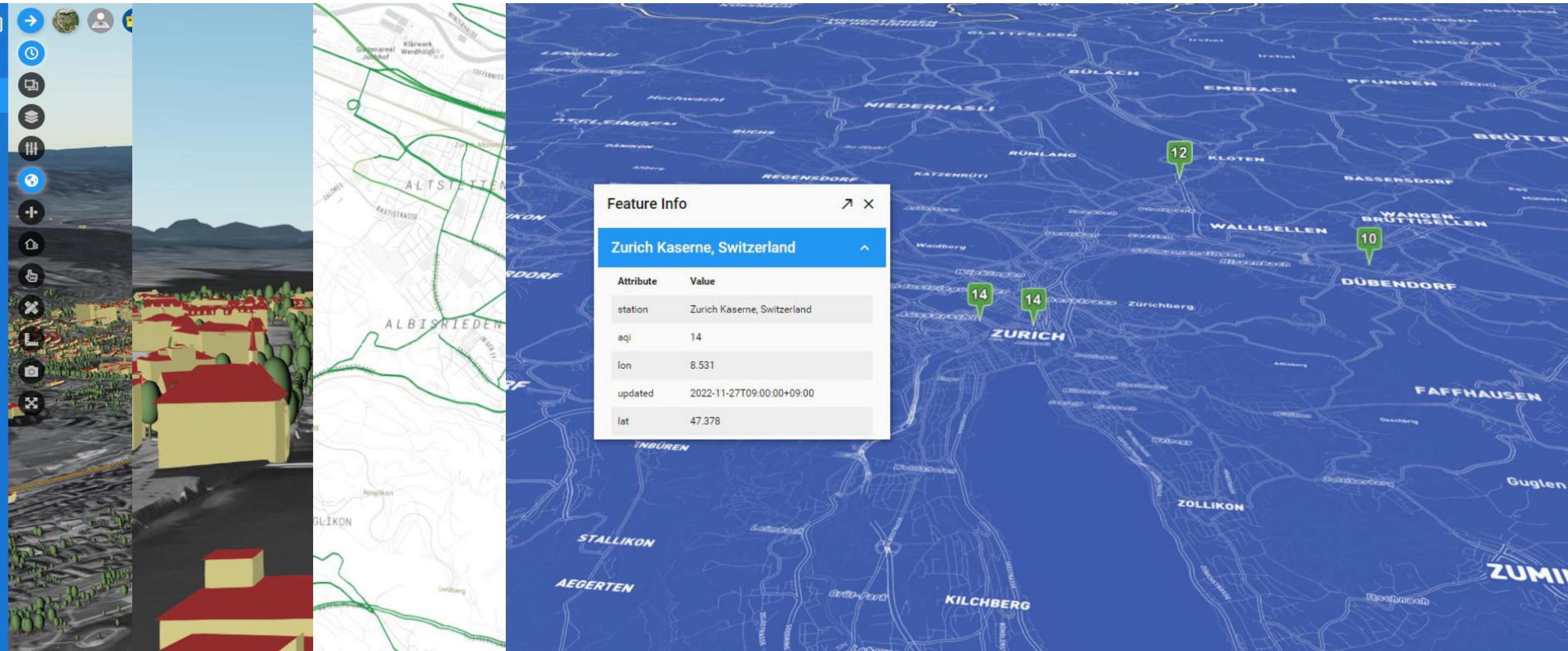
Level 3 – 3D Digital Cadastre



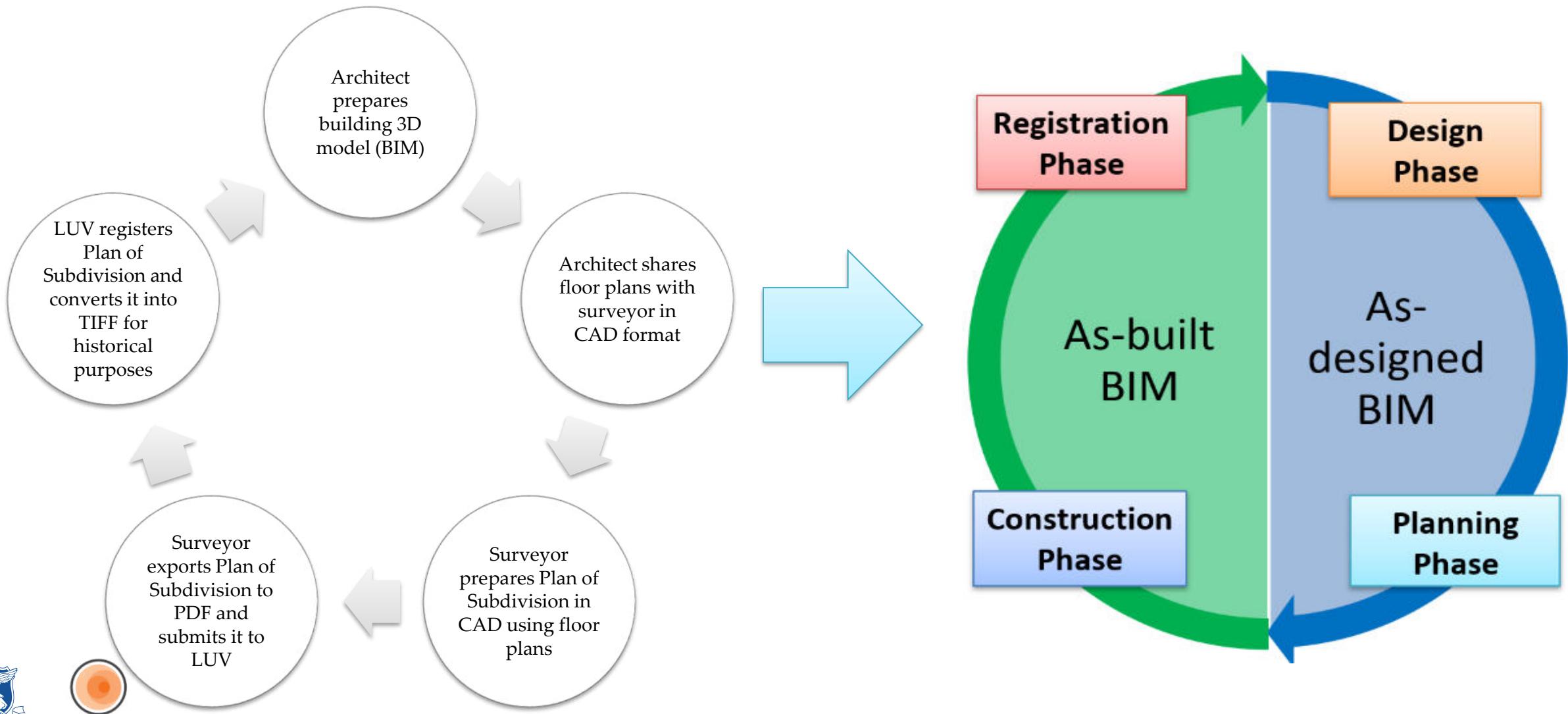
Level 4 – Full Digital Cadastre in DT



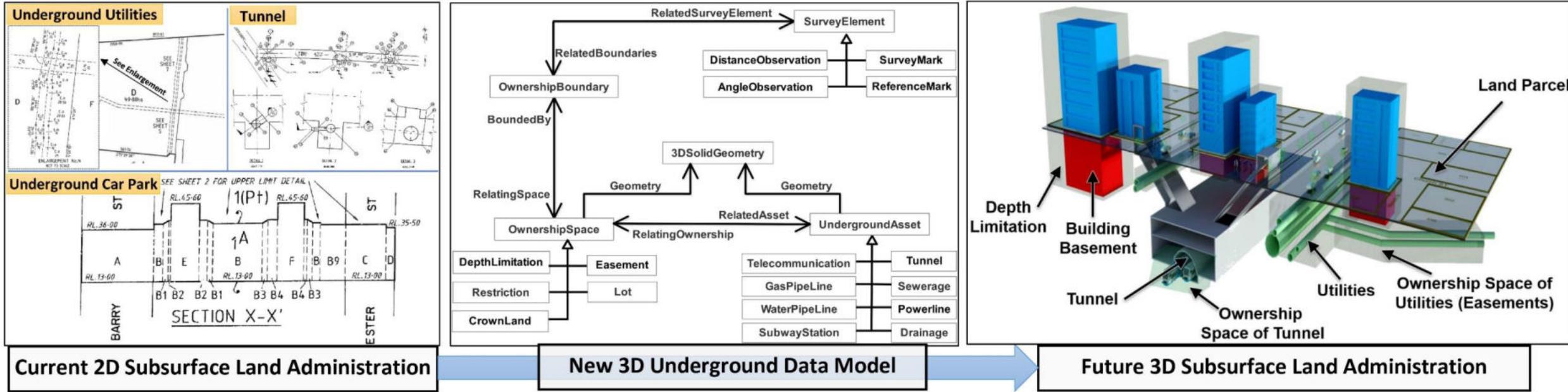
Digital Twin - Zurich, Switzerland



Moving from 2D Paper/PDF to BIM-Driven Workflows



Data Model for Underground 3D Cadastre

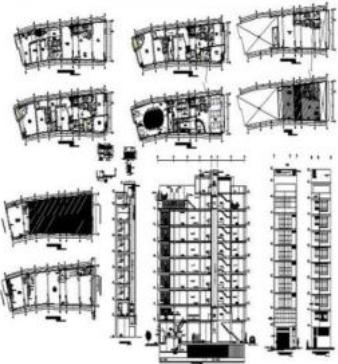


We are developing a **new 3D data modelling approach** to managing **subterranean ownership RRRs** by referencing these RRRs to the **physical reality** of the **underground** environment

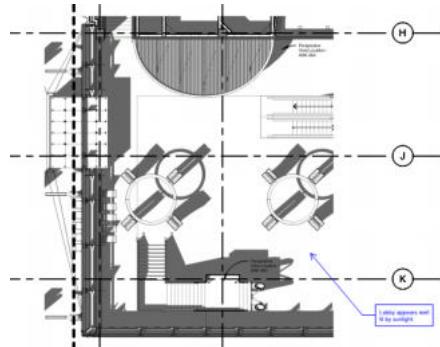
Spatial Planning – Digital Assessment

Current

- PDF-based
- 2D-based
- Complex
- Fragmented Business



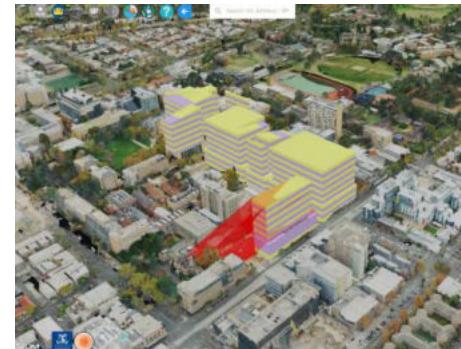
<https://www.pinterest.com.au/pin/689543392926806950/>



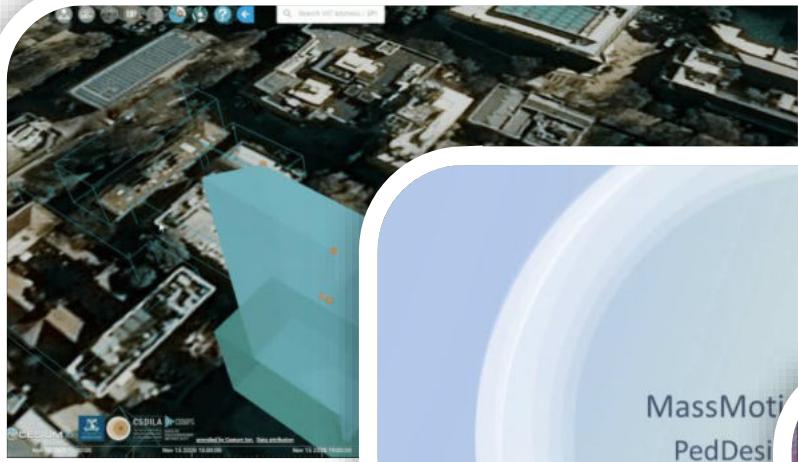
<http://bim4scottc.blogspot.com/2013/04/solar-study-floor-plan-doesnt-show.html>

Future

- Digital Twin
- 3D-based
- Standards and coherence
- Integrated and streamlined



Urban Planning Support



Planning Support
System Rule-based
Building Envelop
Control

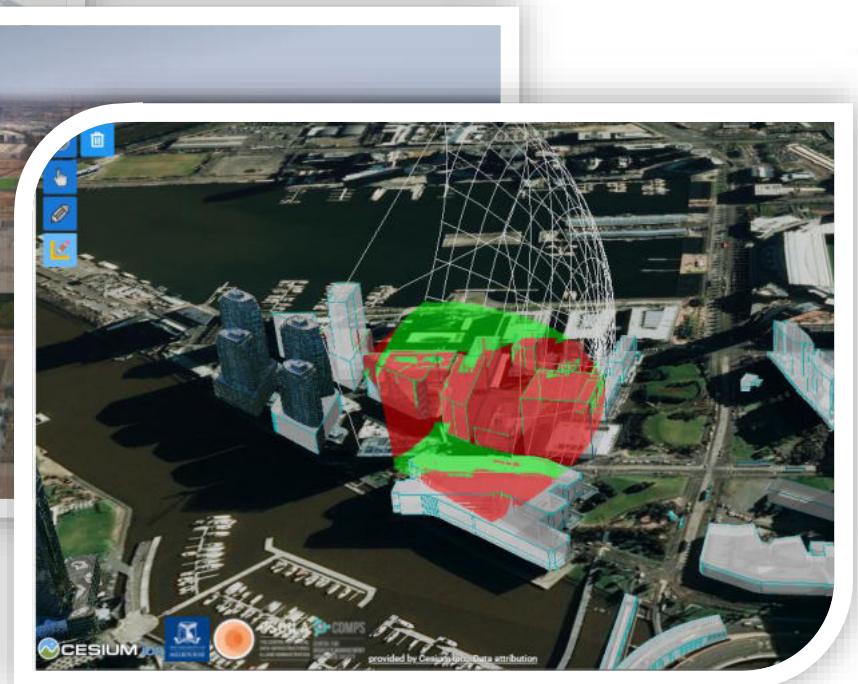
Integrating with
Public Health
Analysis



Urban Skyline
Current - Future



360 Visualisation

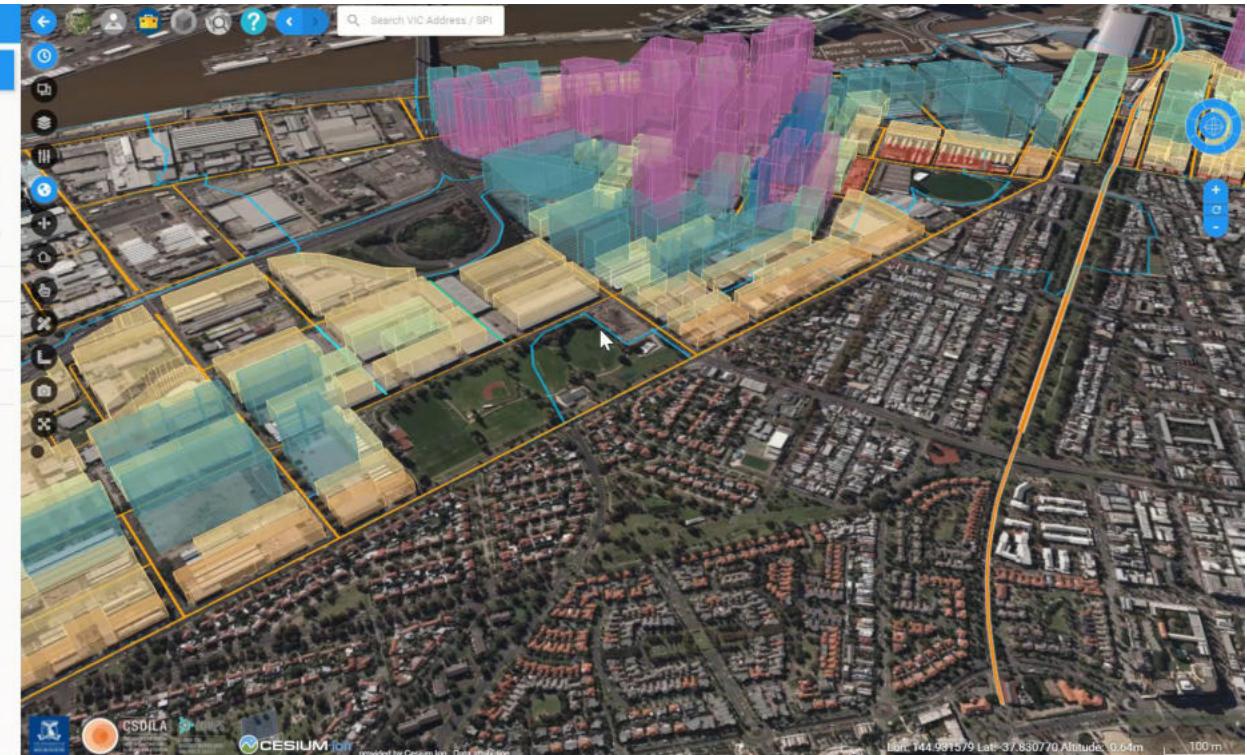
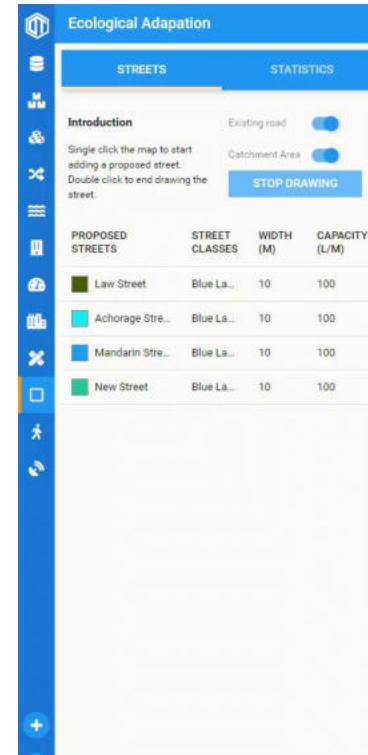
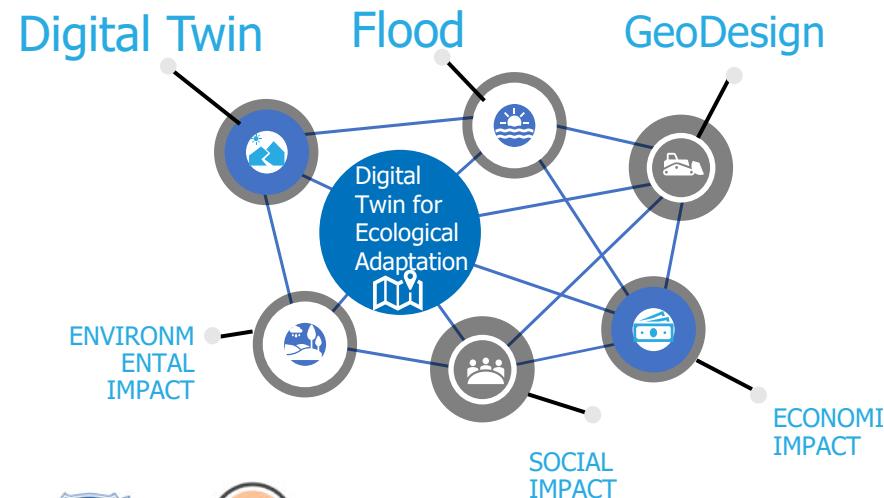


Viewshed Analysis

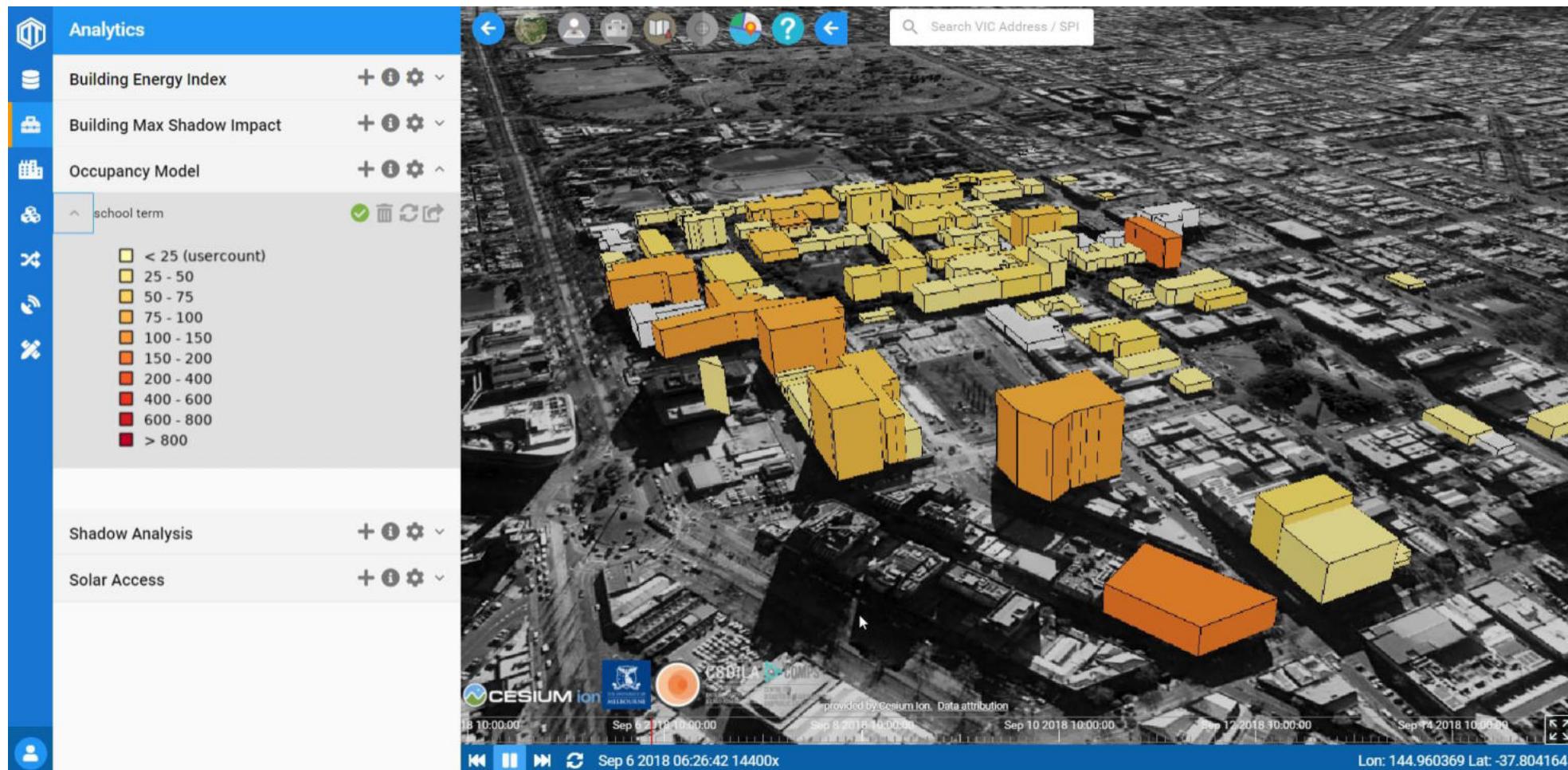
csdila.unimelb.edu.au

Urban Ecological Adaptation – Water Sensitive Urban Design

- A collaboration between transport planners, landscape designers, geospatial scientists, and urban planners



IOT - Space Occupancy



IOT - Real-time Positioning

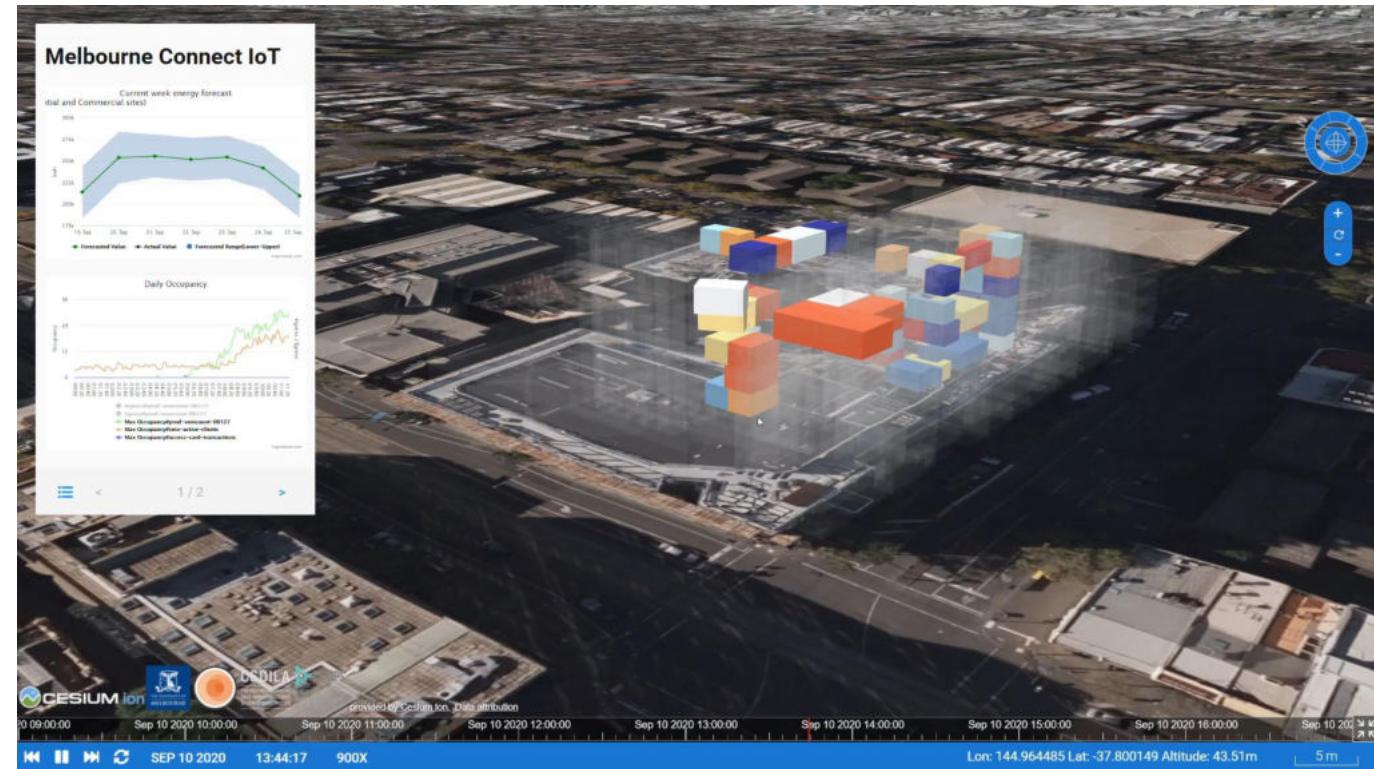
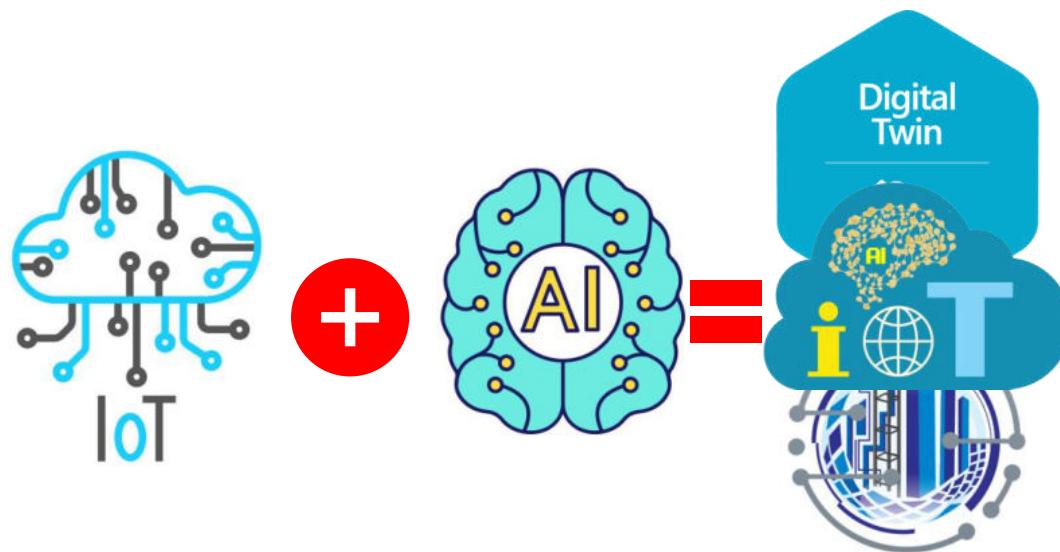


THE UNIVERSITY OF
MELBOURNE

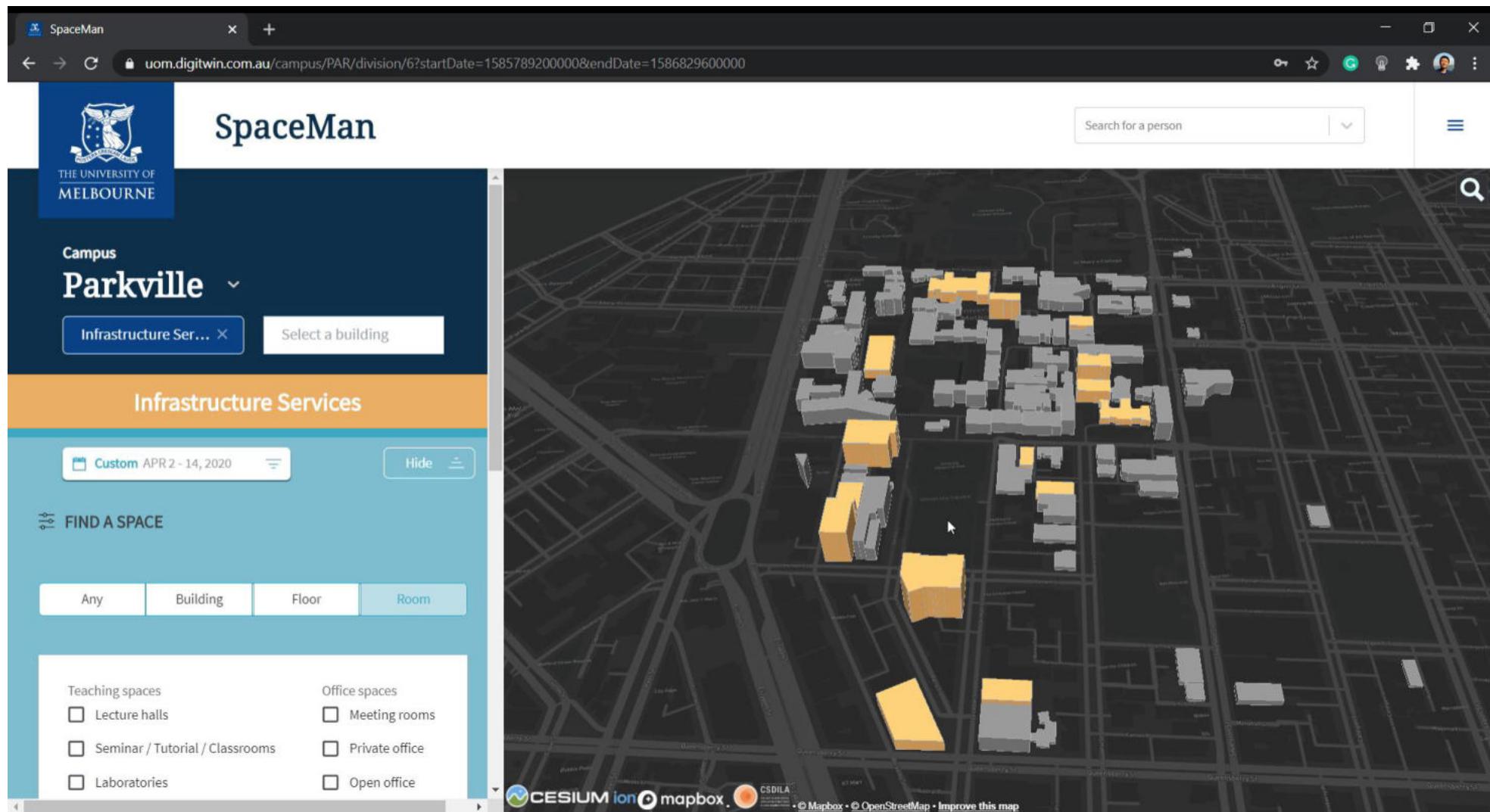
CSDILA
THE CENTRE FOR SPATIAL
DATA INFRASTRUCTURES
& LAND ADMINISTRATION

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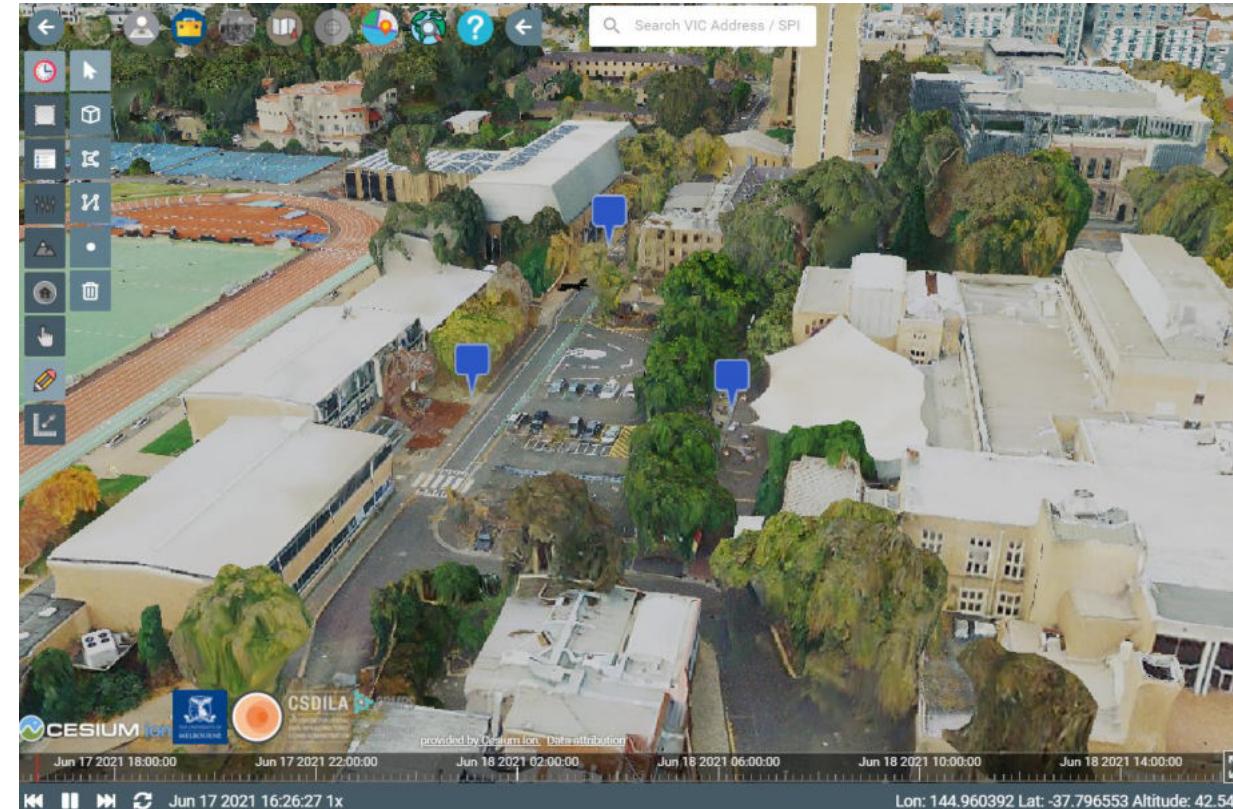
Artificial Intelligence of Things (AIoT) in Digital Twin



Space Management - 3D Floor Plan



Space Management - Virtual Campus



Challenges and Future Research

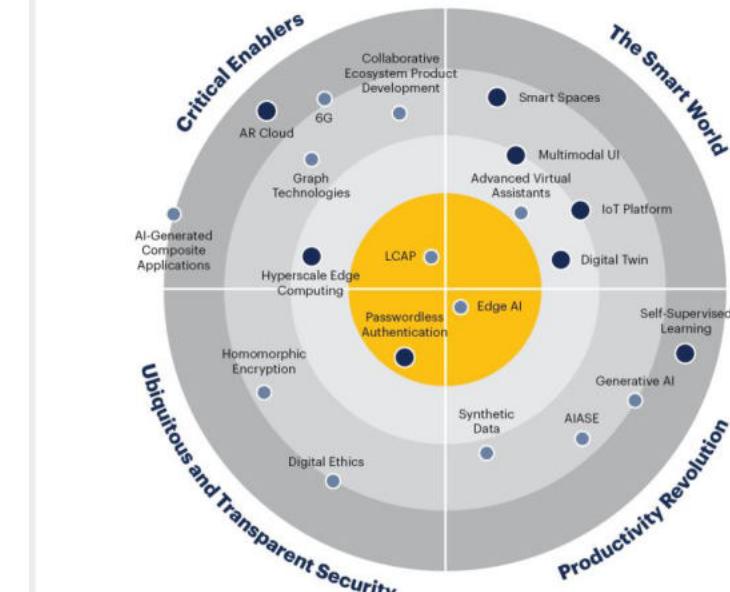
Data

- Automating the workflow of IFC to 3DTile conversion to create a Fit-for-Purpose LoD;
- Creating an ontological approach for standardisation and harmonisation of different 2D/3D data formats;

Technology

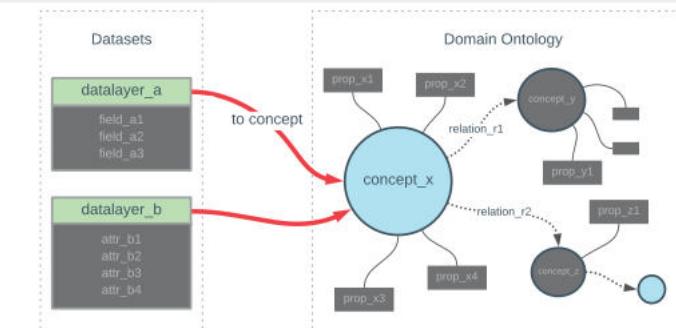
- Developing a **Digital Thread** capability through a two-way communications with external models, simulators, applications, libraries via web APIs and CLI (Command Line Interface), complying with open data exchange standards and protocols.

Impact Radar for 2022



gartner.com
Source: Gartner
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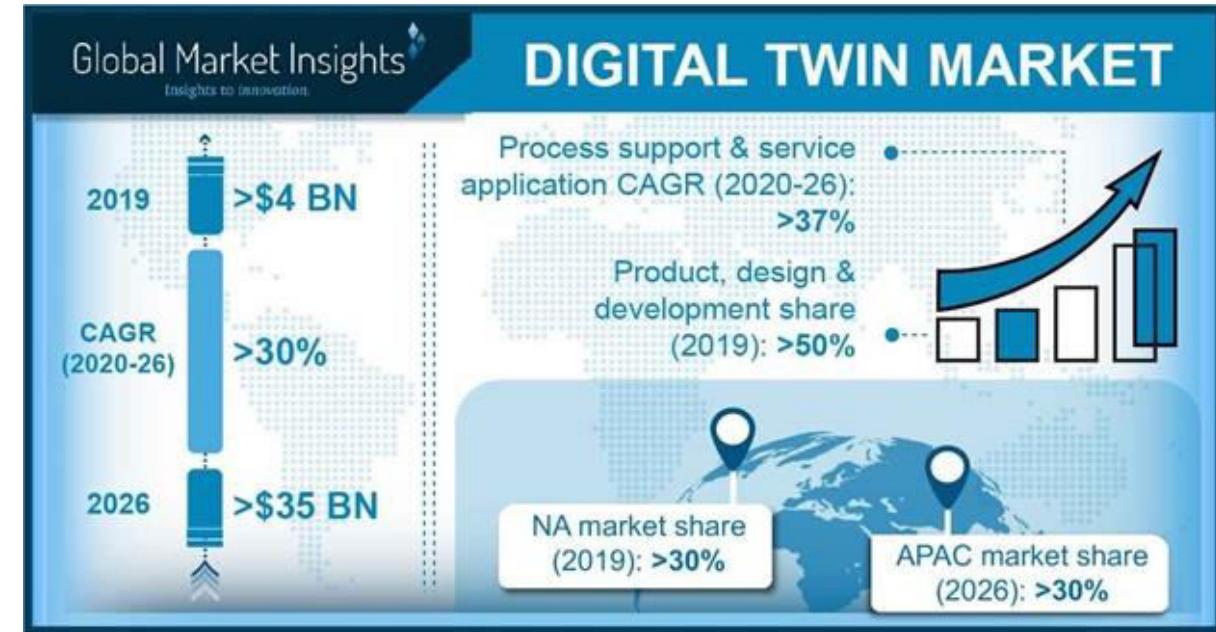
Challenges and Future Research (Con.)

Governance

- The value proposition of Digital Twin is not fully understood by different stakeholders;
- Defining the security and privacy principles

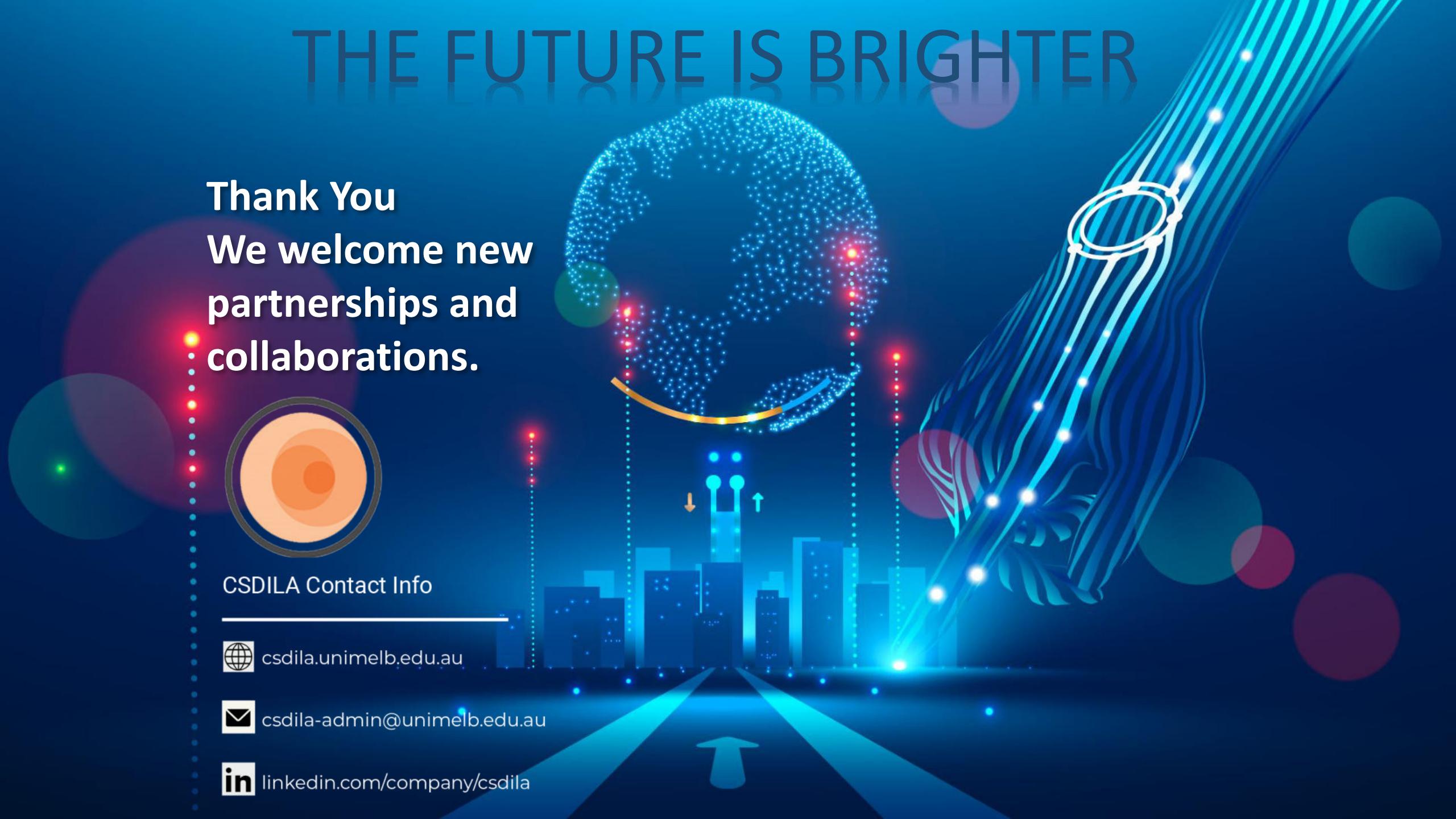
Capacity building, Advocacy, and Awareness

- The Digital Twin lifecycle should be defined and agreed upon by all stakeholders (learning from other standards; e.g. OGC);
- Upskilling and refreshing the professional community with potential use cases

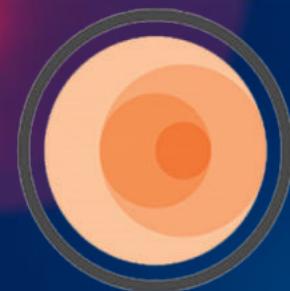


<https://www.gminsights.com/industry-analysis/digital-twin-market>

THE FUTURE IS BRIGHTER



**Thank You
We welcome new
partnerships and
collaborations.**



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