Faculty of Arts, Design and Architecture
School of Built Environment

Digital Twins - - -

Prof. Dr. Sisi Zlatanova

Head GRID Lab, UNSW Sydney, Australia

zlatanova@unsw.edu.au; http://grid.unsw.edu.au

President ISPRS TC IV Spatial Information Science

isprs-pr-c4@isprs.org; https://www2.isprs.org/commissions/comm4/

ISO/IEC JTC 1/WG 11 "Smart cities"

ISO/TC 211

Definitions of Digital Twin

ISO/TC184 (1)

A Digital Twin is a **digital model** of a particular **physical element** or a process with data connections that enable **convergence between the physical and virtual states** at an appropriate rate of synchronisation.

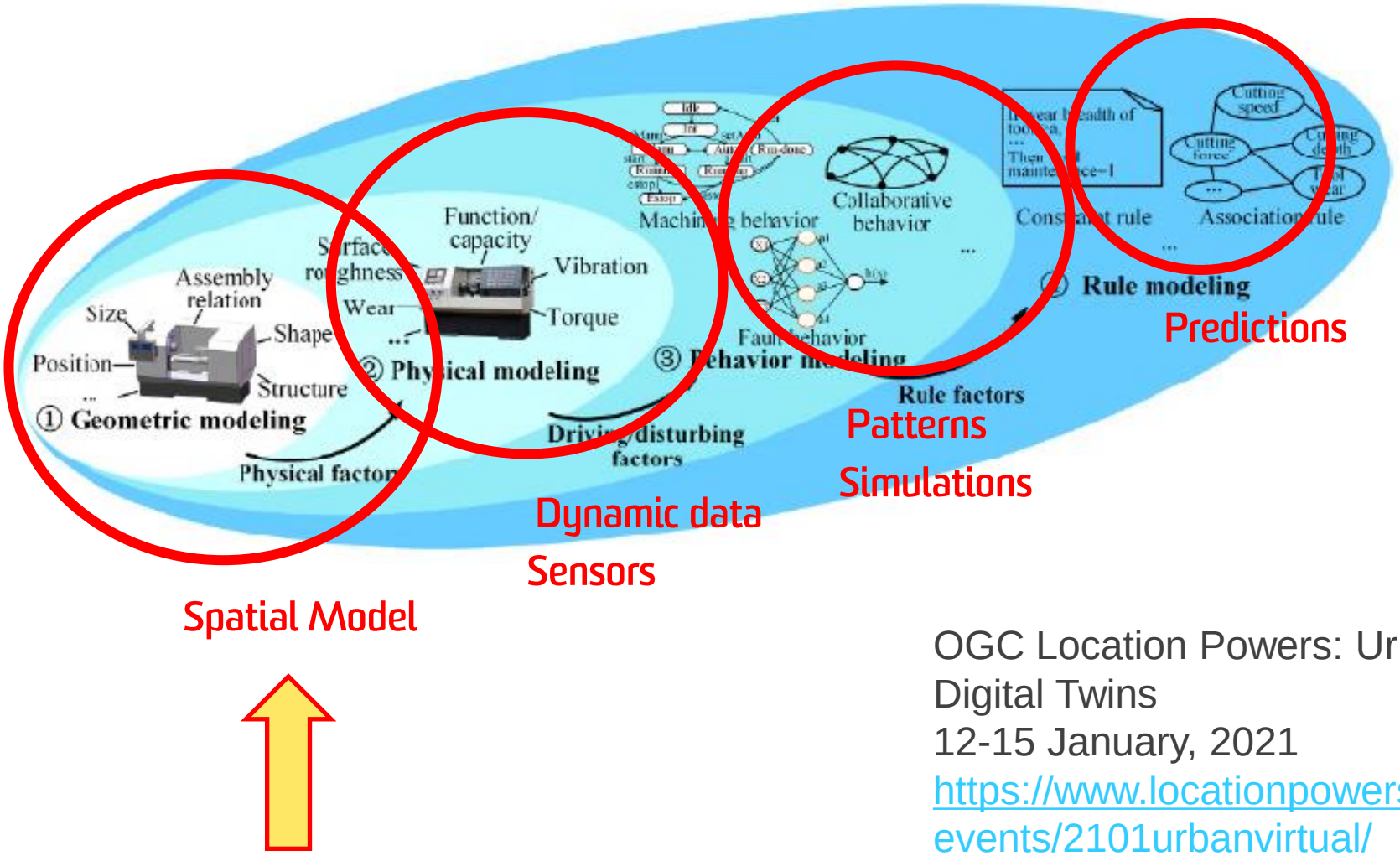
IEC/TC65 ISO/TC84 JWG21 (2)

Digital representation of **physical individuals** as well as of **virtual entities** in an information framework that **interconnects traditionally separated elements** and provides an **integrated view throughout life cycles** (digital twins and digital thread)."

(1) IS0/TC184/SC4/WG15 ISO CD 23247-1: *Digital Twin manufacturing framework - Part 1: Overview and general principles.*

(2) Draft technical report of IEC/TC 65 ISO/TC 84 JWG 21 on Smart Manufacturing Reference Models.

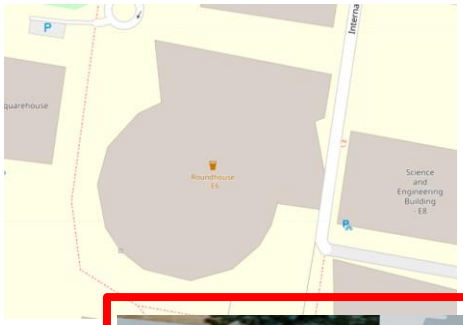
Spatial Digital Twin (DT)



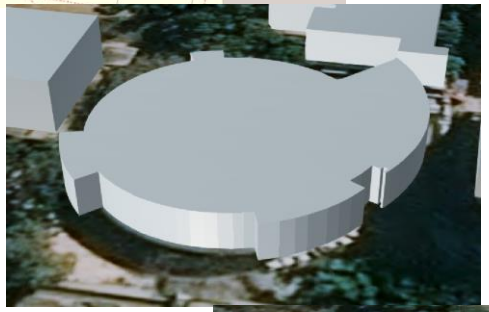
OGC Location Powers: Urban Digital Twins
12-15 January, 2021
https://www.locationpowers.net/events/2101urbanvirtual/

Spatial models are many and complex

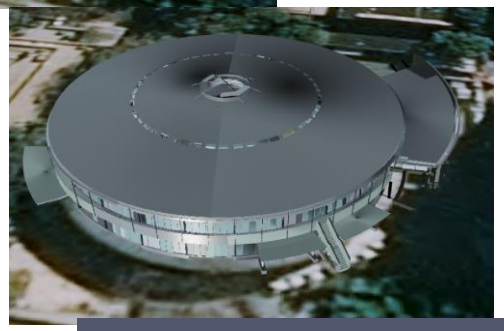
Round House, UNSW



OSM 2D map



CityGML, LOD1
LOD 2, LOD3



BIM, IFC

Point clouds
Reality Meshes
…CAD model

Voxels, 2.5 cm
5, 10, 20…

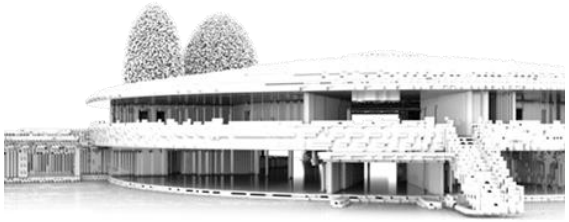
3D models

Mostly for visualisation (objects identification is missing)

Semantically poor (automation is still low)

Difficult to integrate

Not validated (3D geometry is complex)



Agreements on standards are missing (spatial schemas vary)

⇒ 3D geospatial data is hard to keep up-to-date and re-used

⇒ 3D analysis are lagging

Digital Twin for Estate Management

Very complex:

- **7 Departments:**

Asset Management, Development, Facilities Management, Strategy and Business Systems, Security and Traffic, Environmental Sustainability and Property Management.

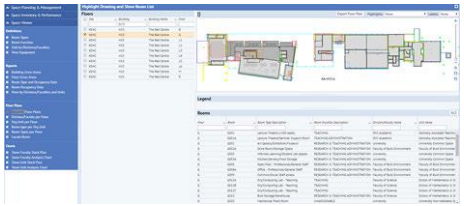
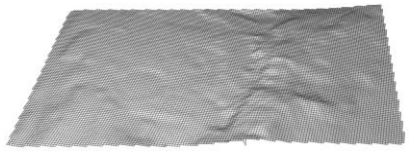
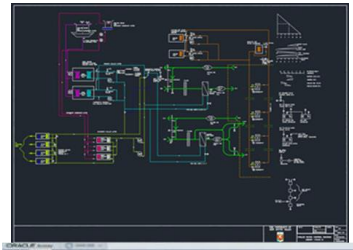
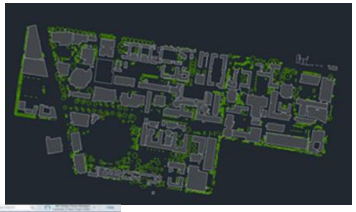
- **5 Software packages:**

Archibus, ArcGIS, AutoCAD, Revit, Greensense

- **Many data formats in 2D and 3D**

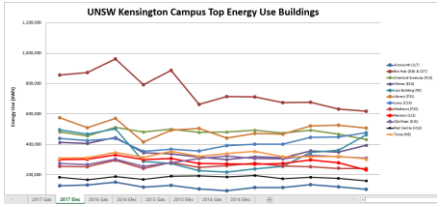
DXF/DWG, Shape, IFC

- **Various geometries**
- **Little semantics**





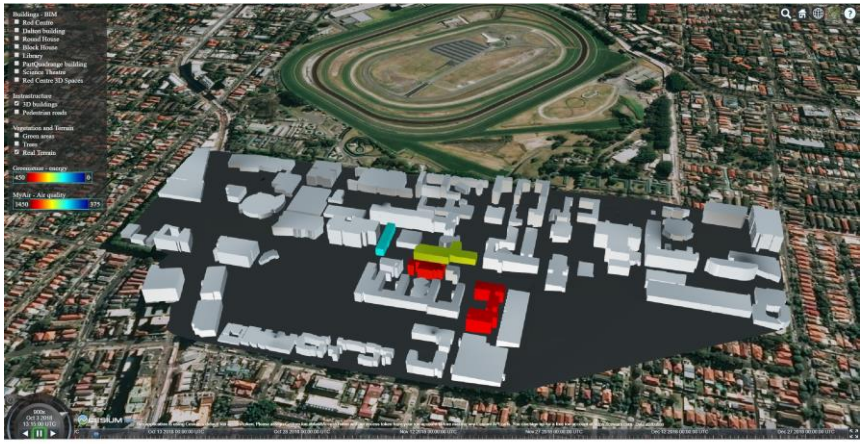


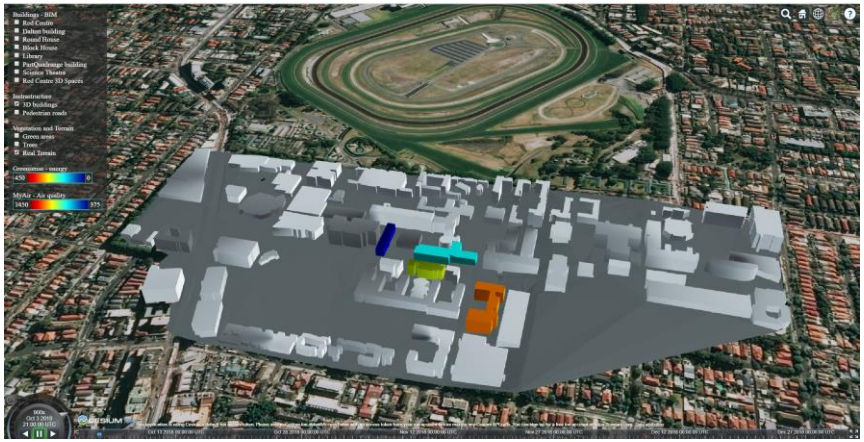
LOD, Integration with sensors:

Energy Consumption and Air Quality

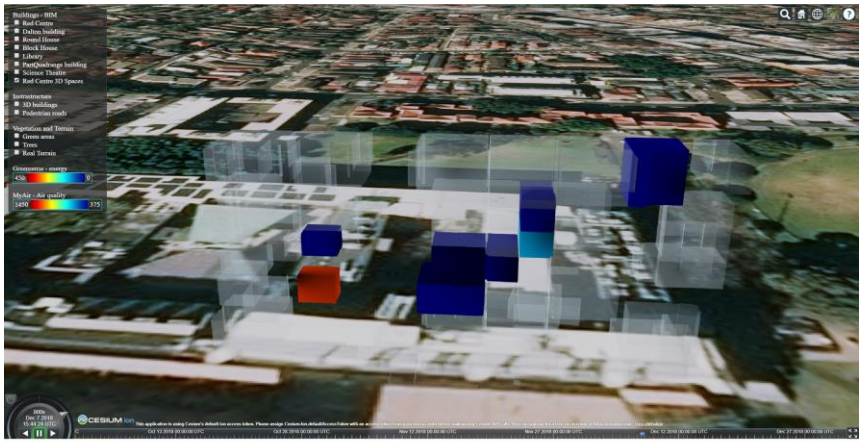
https://vimeo.com/336699901

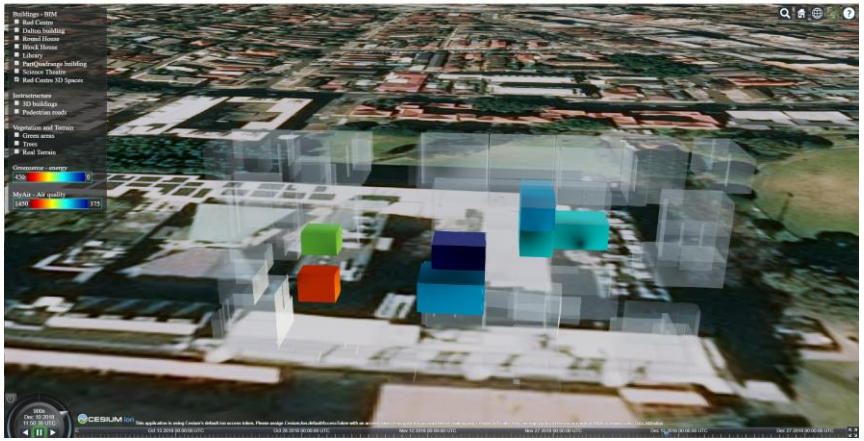
CityGML LOD1 and energy consumption





IFC and data from air quality sensors

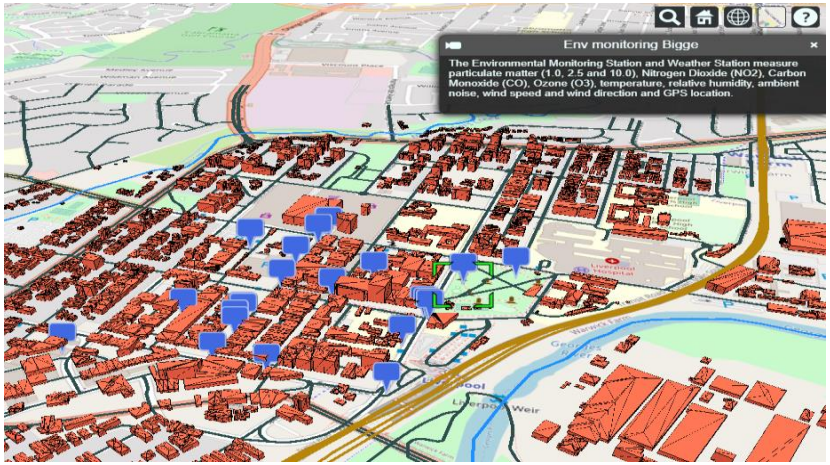




Liveable City Digital Twin: Analytics for agile decision making

The purpose: Analysis!

Understanding walking behaviour as a function of heat, time of day



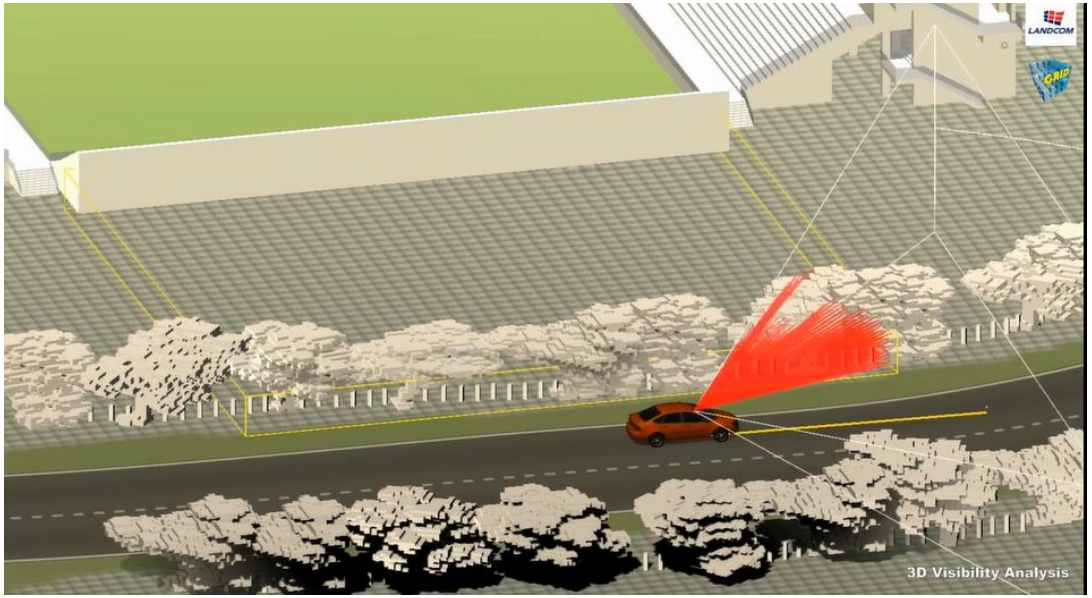
Test site: City of Liverpool, Sydney

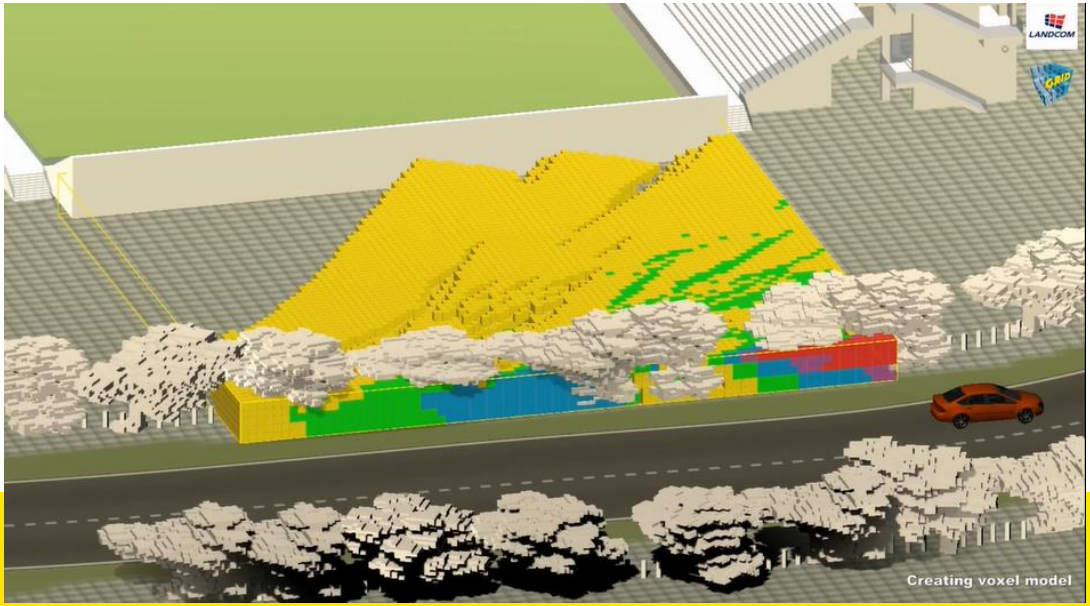
Data: 3D City Models, meteorological and air quality sensors, mobility sensors

Visualisation: Cesium, GIS and BIM software

https://www.be.unsw.edu.au/research/research-clusters-and-groups/grid/projects/liveable-city-digital-twin

Analysis of ‘free’ space





Strategies for planning safe and secure public domains

Aleksandrov, M., S. Zlatanova, L. Kimmel, J. Barton, and B. Gorte, 2019, Voxel-based visibility analysis for safety assessment of urban environments, ISPRS Ann. Photogramm. Remote Sens. Spatial Inf. Sci., IV-4/W8, 11–17, 2019.

https://vimeo.com/338157627

LANDCOM

GRID

UNSW SYDNEY

Centre of Excellence
BREATHE - mitigating airborne threats to health

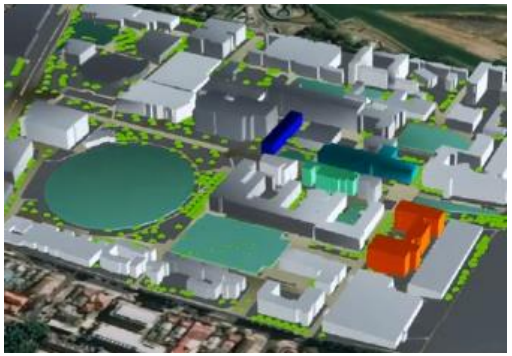
1. Risk of contamination with SARS-COV-2 in intensive care units
2. Carbon dioxide monitoring and modelling of hospital airflow
3. Respiratory emissions and indoor aerosol dynamics:
4. Informing aerosol dynamic models with sensor technology and artificial intelligence

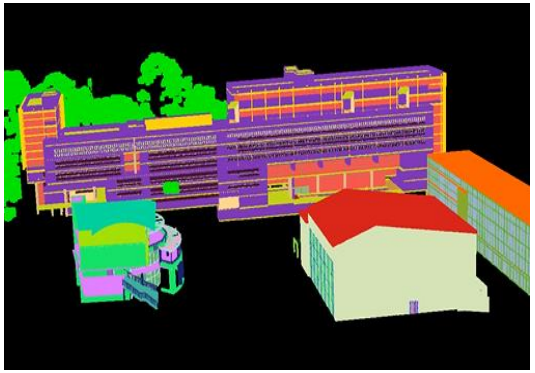
Aged care and other high-risk community settings

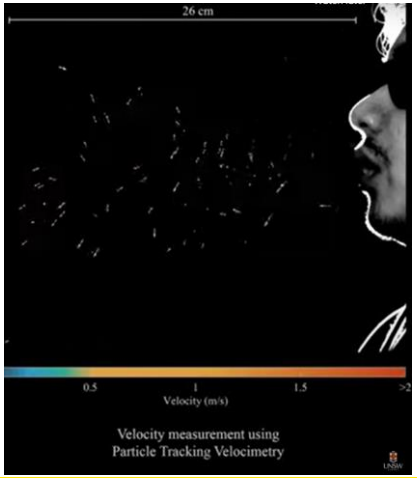
1. Aerosol and pathogen dynamics in the built environment in Aged Care and other Settings
2. Ventilation and respiratory protection for COVID-19 in aged care.
3. Spatial design of aged care facilities and outbreak risk

Community and other occupational settings

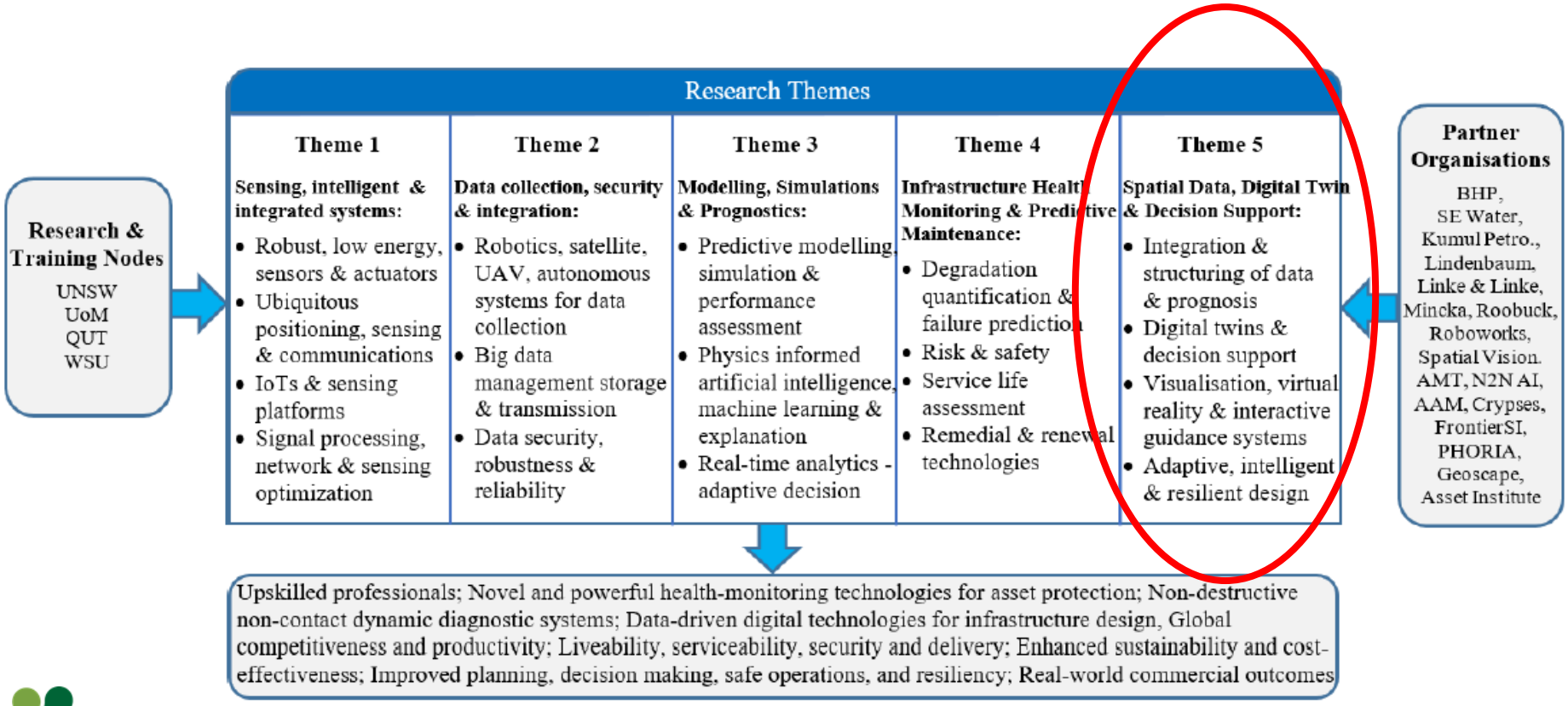
1. Aerosol transmission in mass transport vehicles
2. Multistorey apartment blocks and the risk of aerosol transmission through sewage
3. Plume modelling of an airborne anthrax attack
4. Chimaera Evolution: immersive 3D Modelling and Simulation. Health Systems Risk and Response Modeling and Simulation
5. Bushfire smoke, air quality and geospatial risk analysis







ARC Industrial Transformation Research Hubs for Resilient and Intelligent Infrastructure Systems (RIIS) in Urban, Resources and Energy Sectors



RIIS
RESILIENT, INTELLIGENT INFRASTRUCTURE SYSTEMS

GRID

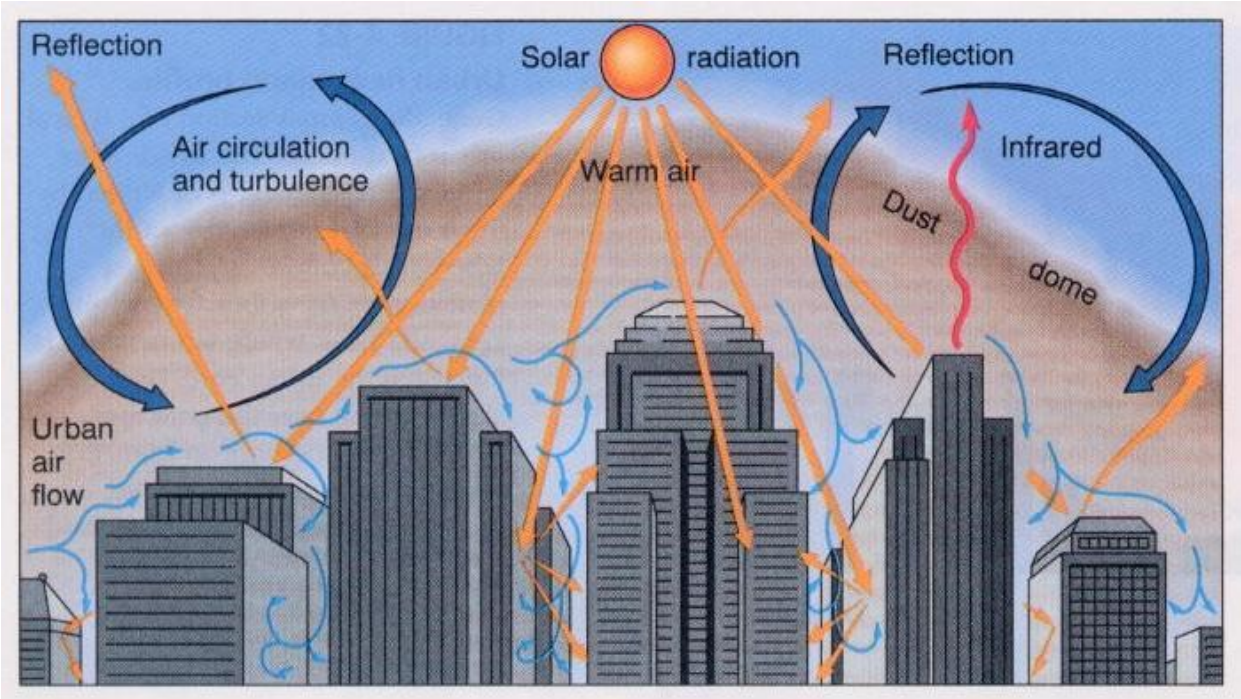
UNSW SYDNEY

3D data integration => Spatial Digital Twins

1. **Critical part of Digital Twins for any spatially-enables application**

2. **Data models!**
   - **Semantics**
   - **Rules for validation**
   - **Multiple geometries**

3. **Legislation**
   - **Management of data**
   - **Access to data**
   - **Update of data**



Activities

1. Smart Cities Forum: DTW 18-22 October 2021
   https://anz.smartcitiescouncil.com/partner-opps-calendar/digital-twin-week

2. SSSI Spatial Digital Twin Special Interest Group: https://sssi.org.au/sssi-community/special-interest-groups/spatial-digital-twin

WG 1.0 Events: Identify digital twin specific or related content, topics and speakers suitable for webinars, face-to face and any other types of events. The WG will also identify and promote external events that may be of interest to the wider digital twin community.

WG 2.0 Advocacy & Communications: Scope ideas and prepare content for spatial digital twins related communications and communicate outcomes and achievements of the SDT-SIG and its various working groups.

WG 3.0 Partnerships: Nurture and develop collaborative partnerships with key stakeholders and other industry sectors involved in digital twins.

WG 4.0 Education & Training: Identify the gaps that exist in digital twin education and training for industry and identify what education and training is required to fill these gaps.

WG 5.0 Standards: Work with relevant standards bodies to create a National Standard for Digital Twins

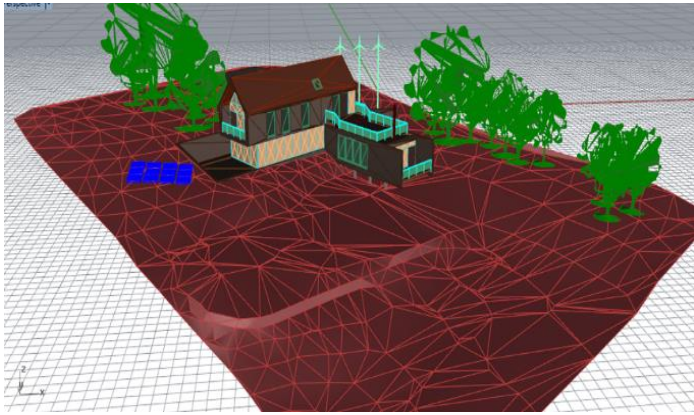
WG 6.0 Capability: Identify national and international technology and data available to effectively produce and maintain spatial digital twins. In addition, monitor spatial digital twin programs and developments across Australia and overseas.

3. OGC Integrated Digital Built Environment (IDBE) pilot:
   https://www.ogc.org/projects/initiatives/idbepilot

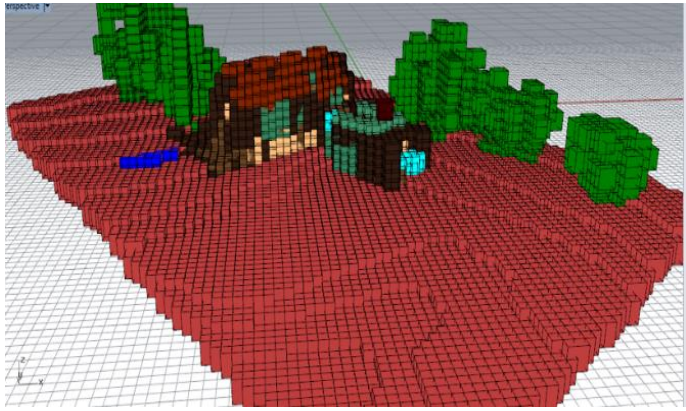
UNSW SYDNEY | Australia's Global University

Faculty of Arts, Design and Architecture

School of Built Environment



http://GRID.undw.edu.au



Thank you!