



# 2022

## ANNUAL REPORT

& Future Plan

Centre for Spatial Data Infrastructures  
and Land Administration



# WELCOME

## TO CSDILA's 2022 ANNUAL REPORT

### CONTACT


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To drive the evolving concept of spatial data infrastructures and modernization of land administration systems by developing an advanced 3D virtual information system, that integrate, model, and visualise data and make it accessible for solving the demands faced by modern society.

Authorised by Professor Abbas Rajabifard, Director, CSDILA, 2023.  
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# MESSAGE FROM THE DIRECTOR

I am very pleased to present our report, which details the highlights and activities of our Centre in 2022 and our plan for 2023 and beyond.

The Centre for Spatial Data Infrastructures and Land Administration (CSDILA) focuses on world-class research and development, innovation and training in land administration and spatial data infrastructures, with the main focus on modernisation of land administration systems, Digital Twin, BIM, urban analytics, wider spatial data enablement and contribution to sustainability and wider SDGs. We continue to achieve success in these areas by building stronger research relationships with industry, government agencies and academia, and creating new links via national and international collaborations. We are continuing our work in building digital land and spatial data capacity and technical capabilities in government, industries, and more broadly in wider society.

There is an extraordinary level of collaboration by everyone at the Centre. We are fortunate to have outstanding academics and staff as well as diverse and capable research students who, together with our distinguished industry advisors, and international research scholars that have enabled us to achieve great accomplishments in 2022. As you go through this report, it will be evident that the Centre has continued its growth, success and contribution to science, knowledge and practice, and make a positive impact by enhancing the capabilities of industry and wider society. We are very proud that we are continuing our cutting-edge research, innovation and development as we train the next generation of geospatial practitioners and leaders.

Over the past one year, we have focused on selected strategic projects and partnerships with industry and substantially grown our industry relationships through new engagements. We are proud to have expanded our visibility and reputation and global reach through collaborative research and training activities around the state, national and wider international levels. In particular we continued our efforts in three areas:

- Strategic planning, roadmap development and policy inputs
- Proof of concepts, technical solutions and future proofing projects
- Offering advanced Trainings (intensive and executive)

In 2022 we have completed a number of major projects, and initiated a series of new projects, such as:

- Winning a major 5 years ARC-Research Hub, entitled “Resilient and Intelligent Infrastructure Systems” (RIIS), with 3 universities and 20 industries
- Winning a new ARC-Discovery Project
- SmartLand Indonesia, a strategic project in modernisation of land administration system in Indonesia (funded by World Bank and the Indonesian Government)

- Successful completion of “ePlan Project” a major 7 years collaboration project with Land Use Victoria
- A new and strategic project with industry on Geospatial Routing and Information Visualisation Research
- Digital Twin for Real -Time Water Sensitive Urban Design Decision Making.

Publication of another open access book on the “Science behind the COVID Pandemic and Healthcare Technology Solutions. Over the past one year, our Centre has published over 50 peer-reviewed high quality journal articles, 2 scientific books, conducted 8 research seminars, workshops and training for government and industry and academia, welcomed over 20 visitors from different countries, and participated in over 10 international and national events and conferences. In 2022, we also completed 4 PhD projects, and we welcomed 5 new RHD students.

Our successes and achievements are due to the support that we receive from several groups, which I would like to acknowledge our:

- Industry Advisory Committee for their strategic guidance and support in setting our work plan and future directions;
- Industry partners and research collaborators;
- Department of Infrastructure Engineering; School of EMI; Faculty of Engineering and IT; and the University of Melbourne for their continued support and facilitation; and
- our current and past Centre’s members (academics and professional), research associates and students for their contributions and quality work.

Starting a new year in 2023 and going beyond, we reflect on our achievements to date and we develop a strategic work plan for the future. To support the Centre, and based on our core capabilities, we have advanced our Organisational Structure by forming a number of Research Units and appointment of academic lead for each unit, and empower more flexibility in our human resource management. We will concentrate on our strategic approach in selecting projects and partners, research activities, funding and consulting opportunities with a focus on large, multi-year, multi-lateral, projects where we can add unique value, make a positive impact and enhance capabilities. We will start our first groups of projects under the Research Hub, and also we have several promising industry partnerships and projects in the pipeline, and look forward to developing further leading-edge projects with our partners.

I look forward to continuing our work in collaboration with all of our stakeholders as we collectively face the challenges and meet the opportunities ahead.

Professor Abbas Rajabifard  
Director

# ABOUT CSDILA

The Centre for Spatial Data Infrastructures and Land Administration (CSDILA) was established in University of Melbourne in November 2001. The vision for the Centre was to drive the evolving concept of spatial data infrastructures – to develop virtual information systems that integrate data and make it accessible for solving the demands facing modern society. CSDILA has successfully maintained its reputation, impacts and growth via funding for research and innovation through different sources, including competitive research grants from the Australian Research Council, Australian Federal Government, State Governments, industry consulting projects and international agencies.

Now in 2022-2023, via a world-class research program, focused postgraduate training program and visiting scholars, CSDILA continues to drive leading-edge spatial information research into modernisation of land administration systems, 3D cadastre and urban land administration, BIM, Digital Twin and sustainability research and SDGs and every advancing visualisation and spatial analytics.

## WHAT WE DO

The Centre for Spatial Data Infrastructures and Land Administration (CSDILA) provides a focus for research and innovation in Modernisation of Land Administration Systems, Spatial Data Infrastructures, and Spatial Enablement of society by building on ongoing research relationships, delivering tailored and specialised Capacity Building programs, and creating new links through extensive collaboration with government and industry internationally. The Centre also undertakes original world-wide research in Sustainable Development Goals (SDGs), Smart Cities, and Land Tenure, Policy and Management. The main key activities include:



### Strategic Planning & Policy Developments

- We are helping governments and industries with land and geospatial policies and strategic planning, and we develop roadmap for modernisation of land administration and geospatial data infrastructure.



### Prototype Development

- Proof of concept and prototype development via an in-house agile development team.



### Capacity Building and Training

- We are extending our world-class training to build capacity from practitioners to executives across our core capabilities.

We deliver these activities by relying on the following strategies:

- Competitive research grants CSDILA has successfully maintained funding through different sources, including competitive research grants from the Australian Research Council, the Australian Federal Government State Governments, and international societies.
- International Network connection to global, national and local universities, research organisations, and industry to build cross-disciplinary teams to solve research challenges.





**PEOPLE**

# INTERNATIONAL ADVISORY COMMITTEE

The Centre Advisory Board comprises distinguished Australian and overseas leaders in spatial science and technologies from academia and industry. Advisory Board members help with the strategic direction setting and encourage the promotion of networking linkages and research opportunities between the Centre researchers and their own institutions and networks.



**Hon. Gary Nairn AO-Chair CSDILA**

Advisory Committee; Chairman, Mulloon Institute



**Prof. Stig Enemark**

Former President, Int'l Federation of Surveyors; Development and Planning Dept., Aalborg University, Denmark



**Prof. David Coleman**

Professor Emeritus, The University of New Brunswick, Canada



**Prof. Harlan Onsrud**

Professor Emeritus School of Computing and Information Science University of Maine, USA



**Dr. Greg Scott**

Senior International Advisor, UN Global Geospatial Information Management; UN-GGIM, NY, USA



**Dr. Keith Clifford Bell AM RFD**

International Development Advisor Former World Bank technical advisory specialist, Former Surveyor-General of Victoria



**Craig Sandy**

Surveyor General of Victoria, Chair Intergovernmental Committee on Surveying and Mapping (ICSM) Department of Transport and Planning, Victoria, Australia



**Jamie Leach**

CEO & Founder, Open Data Australia



**Jan Wandek**

Director, Emerg Solutions Australia



**Tom Champion**

Director, Reeds Consulting Australia



**Dr. Daniel Steudler**

FIG Vice President, Federal Office of Topography Swisstopo, Switzerland



**Tony Burns**

Executive Director & Business Development, Land Equity International Pty Ltd, Australia

# MEMBERS AND RESEARCH TEAM

Research, Innovation and Development activities in the Centre are conducted by staff members of the University of Melbourne, research fellows, honorary affiliated national and international members, research higher degree students associated with the Centre, and collaborators from international academics and industry practitioners.



**Prof. Abbas Rajabifard**  
Director, CSDILA



**Emeritus Prof Ian Williamson AM**  
Senior Academic Advisor  
Former Director, CSDILA



**Chris McRae**  
Executive Advisor & Former  
Chief Executive Land Use  
Victoria



**Brian Marwick**  
Senior Advisor, Geoscape  
Australia



**Dr. Soheil Sabri**  
Senior Research Fellow,  
Lead Urban Analytics and  
Planning Support Unit



**Dr. Benny (Yiqun) Chen**  
Senior Research Fellow  
Lead Systems Architect and  
Development Unit



**Dr. Davood Shojaei**  
Senior Lecturer,  
Lead Visualisation Unit and  
D-Lab



**Enterprise A/ Prof Alice Kesminas**  
Lead Industry Engagement



**Dr. Katie Potts**  
Research Fellow,  
Disaster Resilience and Land  
Administration



**Dr. Behnam Atazadeh**  
Senior Research Fellow,  
Modelling for Urban Land  
Administration



**Associate Prof Jagannath Aryal**  
Lead Remote Sensing Unit



**Neda Rahmani**  
Executive Assistant to  
Director & Research  
Assistance

# MEMBERS AND RESEARCH TEAM



**DA/Prof. Mohsen Kalantari**  
Land Administration (CSDILA Until June, 2022)  
Honorary A/Prof Since July 2022 UNSW



**Dr. Farhad Laylavi**  
Research and Business Development Engineer (CSDILA Until July, 2022)



**Dr. Glen Currie**  
Sustainability Research Associate (CSDILA Until July, 2022)



**Dr. Behzad Rismanchi**  
Senior Lecturer, IE Dept.  
Lead Building Energy Efficiency



**Dr. Daniel Paez Barajas**  
Honorary Research Associate, Industry Engagement  
Until Dec 2022



**Kellee Ireland**  
Industry Engagemen



**Dr. Muyiwa Agunbiade**  
Research Associate, Urban and Land Development



**Dr. Hamed Olfat**  
Research Associate ePlan Land Use Victoria, DELWP (CSDILA Until July, 2022)



**Prof. Alexander Felson**  
Ecological Adaptation and RIIS Research Collaborator



**Dr. Amir Khodabandeh**  
Lecturer, IE Dept.  
Positioning Research Associate



**Dr. Bahador Bahadori**  
Enterprise A/Prof  
Industry Engagement



**Afshin Mesbahmarjani**  
Research Associate ePlan Land Use Victoria, DELWP (CSDILA Until July, 2022)

# MEMBERS AND RESEARCH TEAM



**Farshad Badiee**  
Database Developer  
Land Use Victoria, DELWP  
(CSDILA Until July, 2022)



**Yuke Xie**  
System Developer



**Dr. Ali Aien**  
Research Associate  
Navigation and 3D Platform



**Yibo Zhang**  
System Developer



**Yasi Kazemzadeh**  
Research Assistant



**Michael (Tong Long) Song**  
System Developer

# PHD CANDIDATES



## Atie Asadikia

### Research Title:

Prioritisation of Sustainable Development Goals (SDGs).

### Research Aims and Objectives:

This research aims to identify influential factors that should be incorporated into the SDGs prioritisation methods. This research also introduces novel prioritisation methods for different scales such as the Global, Regional, and National.

### Supervisors:

Prof Abbas Rajabifard, Assoc Prof Mohsen Kalantari Soltanieh



## Masoud Kahalimoghadam

### Research Title:

Enabling Sustainable Last-Mile Distribution Through the Implementation of Transportation Modeling

### Research Aims and Objectives:

This research aims to improve the efficiency and sustainability of LML by designing a novel last-mile distribution network that can reflect the impacts of new trends and newly emerged stakeholders in the modelling processes.

### Supervisors:

Prof Abbas Rajabifard, Prof Russell Thompson



## Bahram Saeidian

### Research Title:

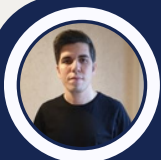
3D Data Modelling for Underground Land Administration

### Research Aims and Objectives:

The aim of this research is to develop a 3D underground data model to enable integrated management of underground assets by linking legal spaces to the physical reality.

### Supervisors:

Prof Abbas Rajabifard, Dr Behnam Atazadeh, Assoc Prof Mohsen Kalantari Soltanieh



## Peyman Jafary

### Research Title:

Application of Building Information Modelling (BIM) in Property Valuation

### Research Aims and Objectives:

This PhD program analyses existing utilizations of BIM for property valuation practices to discover the challenges, limitations and gaps of the current applications and present potential domains for future investigations

### Supervisors:

Prof Abbas Rajabifard, Dr Davood Shojaei, Prof Tuan Ngo

# PHD CANDIDATES



## Mark Allania

### Research Title:

A Performance Approach for Placemaking in Urban Renewal Projects to Support the UN SDGs

### Research Aims and Objectives:

The aim of this research is to develop an integrated and systematic framework supported by case studies which will be able to support local governments and urban practitioners to utilise information and data analytics to better plan, design and deliver public space in cities and promote sustainable urban regeneration improve human health and wellbeing.

### Supervisors:

Prof Abbas Rajabifard, Prof Greg Foliente



## Fatemeh Jahani Chehrehbargh

### Research Title:

Advancing Land Administration Systems Design-Required Parameters and Implications of Global Initiatives

### Research Aims and Objectives:

The aims of this research is to identify the required parameters for reforming LASs based on the implications of Global Initiatives and to design the LAS's reform framework.

### Supervisors:

Prof Abbas Rajabifard, Dr Behnam Atazadeh, Dr Daniel Steudler



## Reza Taban

### Research Title:

Teaching and Learning Building Information Modelling in Higher Education

### Research Aims and Objectives:

This research aims to facilitate the response to the constant change demand of engineering curriculum as the result of the evolving nature of BIM.

### Supervisors:

Assoc Prof Mohsen Kalantari Soltanieh, Dr Elisa Lumantarna, Dr M Reza Hosseini



## Anthony Francis Burns

### Research Title:

Considering Political Economy in the Design of Land Administration Reform

### Research Aims and Objectives:

The research aims to demonstrate that political economy can be appropriately addressed within the well-established procedures, protocols and timeframes for project identification, assessment and design that are being followed by development partners interested in financing land administration reform.

### Supervisors:

Prof Abbas Rajabifard, Prof Ian Williamson, Dr Davood Shojaei

# PHD CANDIDATES



## Bipul Neupane

### Research Title:

Building Footprint Segmentation Using Transfer Learning: a Case Study of the City of Melbourne

### Research Aims and Objectives:

The aim of this research is to study the trade-off between the network's performance and computational expense with reduced training parameters and optimum learning rates. Our experiments on a case study from the City of Melbourne show that the modified U-Net is highly robust than the original U-Net and SegNet, and the dataset we develop is significantly more robust than an existing benchmark dataset.

### Supervisors:

A/Prof Jagannath Aryal, Prof Abbas Rajabifard



## Kriti Pradhan

### Research Title:

A Morphology Based Integrated Approach to Urban Sprawl Management in Support of Sustainable Cities

### Research Aims and Objectives:

This study aims to formulate a morphology based integrated framework for management of urban sprawl to support sustainable cities..

### Supervisors:

Prof Abbas Rajabifard, Prof Joep Crompvoets, A/Prof Jagannath Aryal



## Mohamed Zahlan

### Research Title:

Augmented Reality/mixed Reality Visualisation for Subsurface Utilities

### Research Aims and Objectives:

This research aims to resolve perceptual issues in AR scenes when visualising subsurface utilities using Mixed Reality (MR) technology that can merge virtual content with the virtual build of the real environment for an immersive visualisation, and develop a precise AR device localisation method to resolve localisation limitations in an indoor or GNSS-deprived environment.

### Supervisors:

Dr Davood Shojaei, Assoc Prof Kourosh Khoshelham



## Ricardo Camacho Castilla

### Research Title:

Spatial Dynamics of the Informal Urban Growth in Disaster-prone Cities: Impact on Resilience and Sustainability Practices

### Research Aims and Objectives:

This research will deliver an efficient framework to help decision-makers improve the lives of the people living in Informal Urban Settlements in disaster-prone cities.

### Supervisors:

Prof Abbas Rajabifard, A/Prof Jagannath Aryal

# PHD CANDIDATES



## Zezheng Zhang

### Research Title:

Automatic Electrical Pole Capturing Using Machine Learning

### Research Aims and Objectives:

This study will develop a fusion method and apply other state-of-art deep learning technology to integrate point cloud and image data to resolve the limitation of the current applications.

### Supervisors:

Dr Davood Shojaei, A/Prof Kourosh Khoshelham



## Aravind Poshnath

### Research Title:

Energy Entitlement in Multi-owned Buildings: A Land Administration Prespective

### Research Aims and Objectives:

This research is being conducted in partnership with the CSDILA and the Renewable Energy and Energy Efficiency group at the University of Melbourne. The research aims to develop a data-driven, stakeholder-inclusive framework for equitable energy allocation in MOB's with due consideration of the ownership of common properties from a land administration standpoint.

### Supervisors:

Dr Behzad Rismanchi, Prof Abbas Rajabifard



## Saroj Kumar Sharma

### Research Title:

Remote sensing-based bushfire severity prediction

### Research Aims and Objectives:

This research aims to develop a predictive model of bushfire severity risks assessment that can be used to assess the bushfire severity of the vegetated region

### Supervisors:

A/Prof Jagannath Aryal, Prof Abbas Rajabifard



## Mohammad Javad Shahidinejad

### Research Title:

A 3D Cadastral Database Management System - Design and Development

### Research Aims and Objectives:

This research aims to design and develop a database schema for 3D cadaster that meets legal and physical requirements.

### Supervisors:

Assoc Prof Mohsen Kalantari Soltanieh, Prof Abbas Rajabifard

# PHD CANDIDATES



## KAREN TANFIELD

### Research Title:

Digitisation of Repairs and Maintenance of Medium-Rise and High-Rise Strata-titled Residential Apartment Developments constructed in Melbourne/ Greater Melbourne between 2002-2022.

### Research Aims and Objectives:

The aim of this research is to establish how the building information that is required by the owners and management teams might inform the detailed development and proposed use of the associated building information model during residential 'operations'.

### Supervisors:

Assoc Prof Mohsen Kalantari Soltanieh, Assoc Prof Christopher Heywood, Dr Georgia Warren-Myers, Dr Davood Shojaei,



## Siqing Yu

### Research Title:

Data Governance Modelling for Inclusive Smart City Policies

### Research Aims and Objectives:

this research aims to identify and configure key data governance instruments to inform smart city policymaking that facilitates social inclusion in smart city development

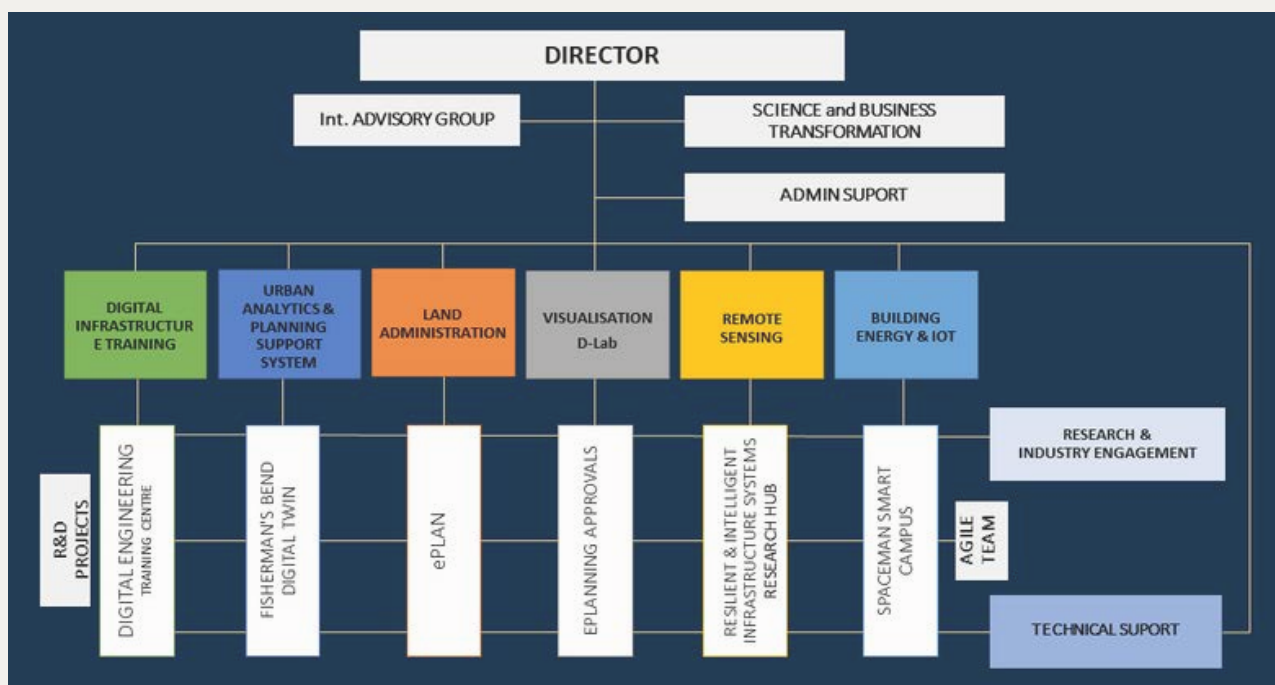
### Supervisors:

Prof Joep Crompvoets, Prof Abbas Rajabifard, A/Prof Jagannath Aryal



# CSDILA STRUCTURE

In order to support CSDILA operation inline with our 5 year strategic plan, and with CSDILA achievements and core capabilities to date, we have advanced our Organisational Structure by introducing a number of Research Units to empower the Centre to be agile with more flexibility in our operation and resource allocation and management. With this new structure, we have appointed an academic lead for each units.



# CSDILA R&D UNITS





**CAPABILITIES**

# WORLD CLASS RESEARCH & DEVELOPMENT CENTRE

We have a unique team: world-class researchers and innovators coupled with an evolving, agile software delivery group.



MODERN LAND  
ADMINISTRATION  
SYSTEMS



BUILDING INFORMATION  
MODELLING (BIM)



SPATIAL DATA  
INFRASTRUCTURES  
(SDI and NSDI)



DISASTER MANAGEMENT  
AND COMMUNITY  
RESILIENCE



DIGITAL TWIN  
TECHNOLOGIES



ADVANCED HOLOGRAM &  
AR/VR VISUALISATION



SUSTAINABLE  
DEVELOPMENT  
GOALS (SDGs)



URBAN ANALYTICS &  
PLANNING SUPPORT  
SYSTEMS



FUTURE SMART CITIES



MODERN LAND  
ADMINISTRATION  
SYSTEMS



# D-LAB THE MUSEUM OF FUTURE

CSDILA has developed Digital Lab (D-lab), a nationally unique space enabling industry collaboration and development of new research areas. There has been significant investment in the D-Lab which brings together the latest visualisation technologies. A cutting-edge hologram table, video walls, Virtual Reality (VR) headsets, sensors for data capture, cameras for 360 videos, and Augmented Reality (AR) devices highlight some of the major investments in equipment for the D-Lab.

## Capabilities and Services

- Data collection using state-of-the-art data capturing equipment;
- Data visualisation using a range of cutting-edge tools and technologies;
- Data analysis and simulation to generate novel digital solutions



## Supported projects and research topics

- Smart Cities and Digital Twin
- Digital Health
- Monitoring
- Advanced Manufacturing and Industry 4.0
- 3D Animation
- Simulation
- 3D Modelling
- Sustainability

## Supported technologies

- Virtual Reality (VR)
- Augmented Reality (AR)
- Mixed Reality (MR)
- Other 3D visualisations and 3D modelling technologies



# COLLABORATIONS AROUND THE WORLD

Over the past year, we have built strong international links across the globe to bring together new research technologies and scientific partners in varied domains and to draw on a wealth of experience and expertise in addressing local and global challenges. Our international visits and visitors have been and will continue to be an essential part of creating and strengthening our international collaboration and improving our research-industry links.



📍 Australia

📍 Indonesia

📍 India

📍 China

📍 Canada

📍 Colombia

📍 Poland

📍 Portugal

📍 Germany

📍 France

📍 USA

📍 Singapore

📍 Switzerland

📍 Finland

📍 Malaysia

📍 Nepal

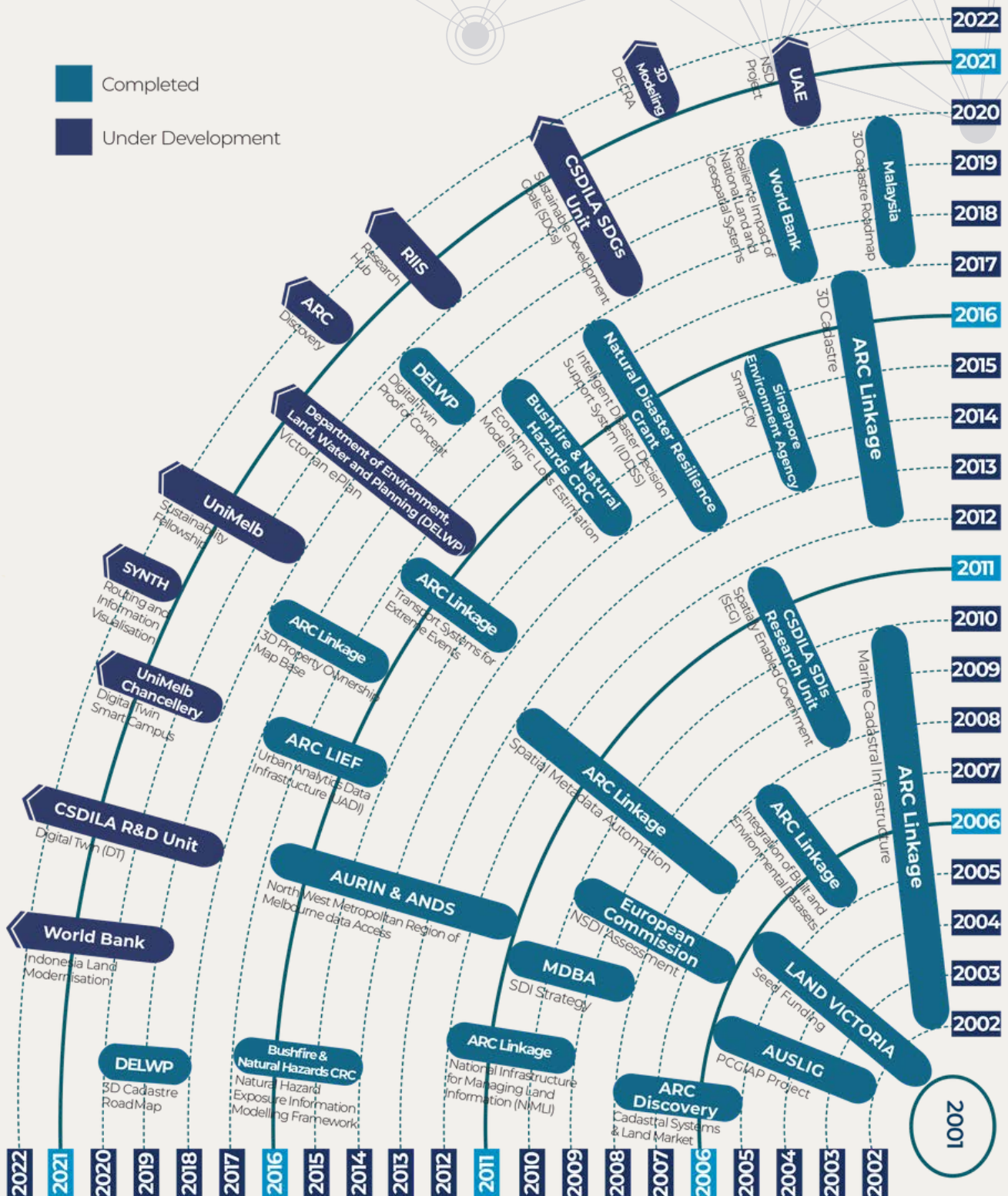
# CSDILA

## THE CENTRE FOR SPATIAL DATA INFRASTRUCTURE & LAND ADMINISTRATION

# SELECTED PROJECTS



# MAJOR PROJECTS SNAPSHOT





**RESILIENT AND INTELLIGENT  
INFRASTRUCTURE  
SYSTEM (RIIS)**



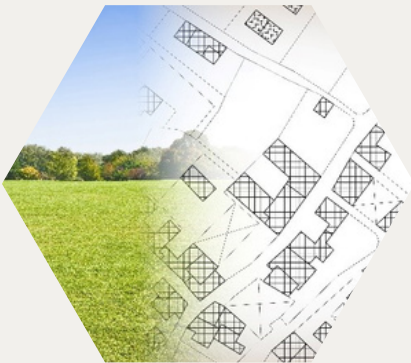
**SYNTH**

**GEOSPATIAL ROUTING AND  
INFORMATION VISUALISATION  
(SYNTH)**



**3D**

**3D DATA MODEL TO  
INTEGRATE UNDERGROUND  
LAND INFORMATION**



THE WORLD BANK

**SMARTLAND INDONESIA  
(THE WORLD BANK GROUP)**



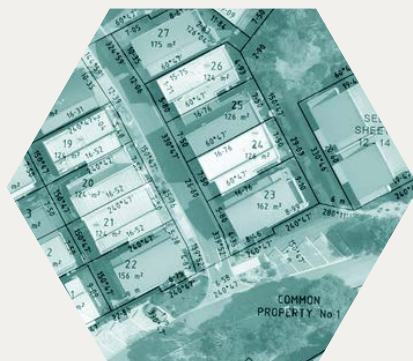
**INFRASTRUCTURE PROTECTION  
UTILISING REAL TIME  
MONITORING OF AFFECTED  
CATCHMENTS BY DEVELOPING  
PREDICTIVE MODELS DURING  
FLASH FLOODING EVENTS**



**INTEGRATING SPATIAL DIGITAL  
TWIN WITH AUTOMATION  
SYSTEM IN SMART  
INFRASTRUCTURE ASSET  
MANAGEMENT**



**DATA INTEGRATION WITH  
SPATIAL DIGITAL TWIN  
FOR NO SPILL NETWORK  
AND FIBRE OPTIC SYSTEM  
FOR PIPELINE MONITORING**

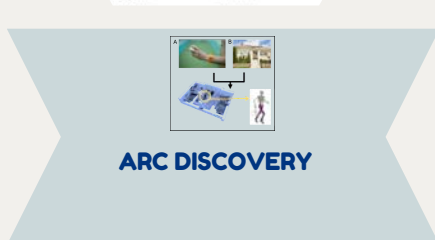
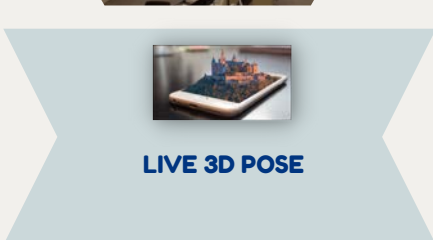
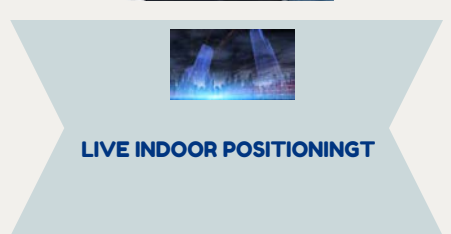
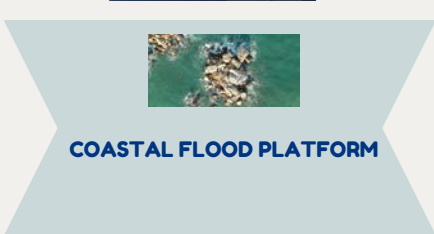
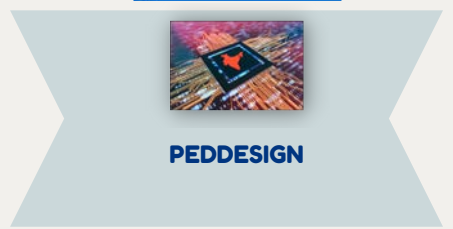


Environment,  
Land, Water  
and Planning

**ePlan  
LAND USE VICTORIA**



**SUSTAINABLE  
DEVELOPMENT GOALS  
(SDGs)**





## ARC RESEARCH HUB RESILIENT AND INTELLIGENT INFRASTRUCTURE SYSTEM (RIIS)

2022-2027

The RIIS Research Hub is co-funded by 20 industries and four universities (UNSW, University of Melbourne, Queensland University of Technology, and Western Sydney University) and the ARC, to develop technology to address infrastructure resilience needs across Australia. The CSDILA initiated projects under the RIIS Research Hub in July 2022. During its setup phase, the Hub has attracted significant interest from the industry, welcoming a number of new industry partners, including Emerson, Rockfield, and Hawk. Also, CSDILA invited industry partners at the University of Melbourne for a major ARC-funded Hub (RIIS) workshop in Oct. The workshop was very successful with all the industry partners and their representatives who are involved in the Hub.

### First round projects defined in 2022

1

**Project 1-RIIS ARC Research Hub: Infrastructure protection utilising real-time monitoring of affected catchments by developing predictive models during flash flooding events 2023-2025**

Australia, like many countries, have developed modern cities on flood plains. This coupled with the lack of real-time data to augment flood models means that emergency services lack vital information to alert communities in a timely way when flood events arise, especially flash-floods. These problems will undoubtedly become more acute with climate change over the coming decades. With the advent of IoT equipment and digital twins, it is timely to rethink how warning systems operate. Geoscape recently provided 3D data on buildings for flood response in Queensland. Geoscape can work with partners to integrate 3D built infrastructure data with sensor data to provide to enhance flood response capabilities.

#### Key Objectives:

- To capture data from distributed sensors (water level, rainfall, soil moisture) across a river catchment in real time
- To develop a pipeline in transmitting live data in RIIS database for integration into a digital twin
- To develop predictive modelling and ML/AI algorithms within a system development architecture to flood maps in protecting infrastructure utilising live data sets
- To create real-time, or near real-time flood maps and modelling and visualising them in different scenarios for infrastructure resilience

2

**Project 2-RIIS ARC Research Hub: Integrating Spatial Digital Twin with Automation System in Smart Infrastructure Asset Management 2023-2025**

Industries are lacking a central platform to gather and analyse disparate OT (Operational Technology) data sources. These data can be location-based, multi-dimensional format with various frequencies and fidelity. Current industrial automation systems need to be improved to aggregate dispersed OT data, for robust management of asset's health, operation, and root-cause analysis in the Water, Waste-Water, Mining, and Oil & Gas industries.

Furthermore, there is a lack of spatial dimension in those automation systems, which is essential in developing a smart, resilient, and mature Digital twin integrated with industrial IoT (IIoT), where 2D, 3D, and 4D (time-based) data are used and connected to in-built or third-party analytical tools to better identify and predict production and process bottlenecks. As such, a composable system architecture is crucial to address these challenges and improve the efficiency, smartness, and resilience of infrastructure.

#### Key Objectives:

- To predict failure, its location, and automated root cause analysis
- To move from preventative to location-based predictive maintenance and more efficient operations
- To identify and predict process bottlenecks
- To address both static and dynamic data processing



## ARC RESEARCH HUB RESILIENT AND INTELLIGENT INFRASTRUCTURE SYSTEM (RIIS)

2022-2027

# 3

Project 3-RIIS ARC Research Hub:  
Data Integration with Spatial Digital  
Twin for No Spill Network and Fibre  
Optic System for Pipeline Monitoring  
2023-2025

Water utility service providers are facing increased climate events that can result in network spill, which damages assets and businesses. For example, South East Water indicated that spills in Mornington Peninsula, Victoria, could damage critical locations and businesses, including Mussel Farms. Furthermore, it is difficult to detect and mitigate the faults for underground assets. To address these issues, multi-dimensional (2D,

3D) digital asset inventory combined with a real-time climate predictive model is necessary to support spill mitigation measures. The application of innovative sensors including Fibre Optic Systems integrated with Spatial data in a Digital Twin will enable pipeline monitoring and reduced contingency.

Key Objectives:

- To formulate a framework for 3D spatial data integration with signal processing for underground assets (LOD)
- To design an automated detection process for the health of underground and above-ground infrastructure (based on FOS and other IoT)
- To design a predictive scenario builder for climate models for mitigation and future proofing
- To develop a prototype system to examine the validity of the designed frame work



### Management Team:

Prof Abbas Rajabifard (Research HUB Deputy & Director of Rsearch Committee, Lead CI)  
Assoc Prof Jagannath Aryal & Prof Alex Felson (Cheif Investigators)





## ARC RESEARCH HUB INFRASTRUCTURE PROTECTION UTILISING REAL-TIME MONITORING OF AFFECTED CATCHMENTS BY DEVELOPING PREDICTIVE MODELS DURING FLASH FLOODING EVENTS

### Industry Problem:

The recent flood events (2022) in SE QLD and NSW have resulted in enormous hardships to major infrastructures and indeed local communities. In QLD alone, the social, financial, and economic costs have been predicted by Deloitte's to be \$7.7B. The impact is profound: Residential and commercial damage; public infrastructure, lost economic activity, lost agricultural production, emergency response and clean-up costs, facilities and injuries; Health social and community impacts. For a country like Australia with modern infrastructure, and local government associations and government agencies who plan for prevention, preparedness, response, and recovery, in great detail, one has to question what's missing. The basic problem is that Australia, like many countries, have developed modern cities on flood plains. This coupled with the lack of real-time data to augment flood models means that emergency services lack vital information to alert communities in a timely way when flood events arise, especially flash-floods. These problems will undoubtedly become more acute with climate change over the coming decades. With the advent of IoT equipment and digital twins, it is timely to rethink how warning systems operate. Geoscape recently provided 3D data on buildings for flood response in Queensland. Geoscape can work with partners to integrate 3D built infrastructure data with sensor data to provide to enhance flood response capabilities.

### Deliverables:

- Digital Twin for Catchments – ready for ingestion of high-resolution spatial and temporal data for enrichment to create a Real-Time Dynamic Digital Twin
- Methodology to locate sensors throughout a catchment to maximise data collection efficiency.
- Develop pipelines for integrating, analysing and visualising real-time sensor data in the digital twin.
- Mobile Phone Application
- Design and develop a sensor management component in digital twin



## Industry Problem:

- Industries are lacking a central platform to gather and analyse disparate OT (Operational Technology) data sources. These data can be location-based, multi-dimensional format with various frequencies and fidelity.
- Therefore, current industrial automation systems need to be improved to aggregate dispersed OT data, for robust management of asset's health, operation, and root-cause analysis in the Water, Waste-Water, Mining, and Oil & Gas industries.
- Furthermore, there is a lack of spatial dimension in those automation systems, which is essential in developing a smart, resilient, and mature Digital twin integrated with industrial IoT (IIoT), where 2D, 3D, and 4D (time-based) data are used and connected to in-built or third-party analytical tools to better identify and predict production and process bottlenecks.
- As such, a composable system architecture is crucial to address these challenges and improve the efficiency, smartness, and resilience of infrastructure.

### Deliverables:

1. Design and prototype a novel system architecture to integrate multi-dimensional georeferenced data (e.g. BIM, utilities, and other scanned environments) with a numerical automation system
2. Design and develop a sensor management component in the spatial digital twin
3. Build analytics modules to support self-correcting system
4. Create a case study to demonstrate and validate the usability and effectiveness of the prototype to improve the automation processes.





## ARC RESEARCH HUB DATA INTEGRATION WITH SPATIAL DIGITAL TWIN FOR NO SPILL NETWORK AND FIBRE OPTIC SYSTEM FOR PIPELINE MONITORING

### Industry Problem:

- This project is commencing with an application use case with the water utility South East Water but will have broader relevance across the RIIS
- Water utility service providers are facing a severe impact of network spill, which damages internal and external assets and businesses. For example, South East Water indicated that their Water Tank spill in Mornington Peninsula, Victoria, damaged critical locations and businesses, including Mussel Farms. Furthermore, it is difficult to detect and mitigate the spill of underground assets.
- To address these issues, multi-dimensional (2D, 3D) digital asset inventory combined with a real-time micro-climate predictive model is necessary to support spill mitigation measures. Furthermore, the application of innovative sensors including Fibre Optic Systems integrated with Spatial data in a Digital Twin will enable pipeline monitoring, no spill network and reduced contingency.

### Deliverables:

- Design and develop pipeline for location-based, underground 2D and 3D and sensor data integration (i.e graph database)
- Build analytics modules to support quantitative leakage detection, and enable preventive and corrective actions decision making (based on FOS and other IoT)
- Create a real-time dashboard for monitoring the spill status in the entire utility network



The ePlan Partnership program between Land Use Victoria (LUV) and CSDILA was officially launched in June 2016.



This project aimed to modernise the Victorian land administration system (LAS) by conceptualising, designing, developing and maintaining a suite of innovative tools and services. The ePlan project developed the required infrastructure for creation, pre-lodgement validation, visualisation, and submission of spatially accurate digital cadastral data required by the Victorian land administration stakeholders for different purposes, such as map base adjustment and update, plan examination, land subdivision and development, asset/infrastructure/transport/disaster management and smart cities.

- Project goal: conceptualise, design, develop and maintain a suite of innovative tools and services to support advanced land administration.
- Partners: CSDILA within the Faculty of Engineering and IT, Land Use Victoria (LUV) within the former Department of Environment, Land, Water and Planning (DELWP)

In 2016, CSDILA was contracted to LUV within DELWP to provide technical expertise to advance and modernise the Victorian LAS. An initial 18 months engagement was followed by a further five-year partnership agreement launched in 2017.

Total funds for the partnership were over \$6 million for the period 2016-2022.

Through the ePlan partnership, the CSDILA team successfully translated research findings into practice to address real-world problems.

ePlan contains all the information in a cadastral survey and subdivision plan including surveying measurements; land parcel description and identifiers; dimensions of the parcels and interests in land such as easements; administrative information on the subdivision; annotations; plan approval status; and the surveyors' details



ePlan benefits the Victorian LAS stakeholders because it:

- Provides a standard data exchange format for cadastral data sharing among stakeholders
- Provides a workflow for the exchange of digital cadastral data among stakeholders
- Enables stakeholders to re-use the existing digital cadastral data for different purposes, such as re-establishing subsequent surveys, updating databases and populating data into other systems
- Provides spatially accurate input data for updating the Digital Cadastre
- Provides the stakeholders with the spatially accurate cadastral data required for different applications such as planning, development, subdivision, asset management and disaster management
- Improves the quality of the cadastral plan and survey data through validation checks
- Standardises the presentation of cadastral plans through visualisation service
- Improves access to/delivery of cadastral and survey information
- Assists with improved digital plan examination/checking process
- Reduces errors, anomalies and requisitions in cadastral plans and surveys
- Improves cadastral plans examination and registration turnaround times.

Through the ePlan partnership, LUV achieved a major milestone in late 2021 in the progress toward 100 per cent digital cadastral lodgement with the launch of the 'ePlan Portal' in SPEAR. According to the LUV website [link to be provided], embedding the ePlan Portal in SPEAR makes it world-leading: the first digital data-driven cadastral system that facilitates end- to-end processes when combined with the SPEAR Electronic Lodgement Network (ELN) as lawyers and conveyancers can electronically lodge ePlans in SPEAR to LUV for registration.

This crucial new digital infrastructure is also the connecting piece with the Digital Cadastre Modernisation (DCM) program, enabling Victoria's property boundary spatial data to be born-digital, breaking the current cycle of PDF digitisation.

The ePlan Portal (shown below) houses the suite of all ePlan services, as follows:

- Single CAD Format File (SCFF) Validation Service which ensures that the cadastral plan and survey data have been captured based on a standard co-designed with the surveying industry, namely SCFF. This service comprises 24 validation checks.
- SCFF Viewer which assists surveyors to address any non-compliance issues of SCFF by previewing the CAD features causing validation errors.
- ePlan Creation Service which converts SCFF into LandXML and pre-populates ePlan attributes from cadastral systems and databases, such as SPEAR, Vicmap, Survey Marks Enquiry Service and Surveyors Registration Board of Victoria. All pre-populated data can be reviewed and edited, and new data entered using an ePlan Editor. ePlan Validation Service which checks the completeness and correctness of the ePlan file against 130 rules covering schema compliance, surveying, and plan examination business requirements.
- ePlan Visualisation Enhancement Tool (VET) which enables surveyors to enhance plan presentation, particularly for heavily detailed and complex plans.
- ePlan Visualisation Service which converts the ePlan file along with any enhancements made in VET to a PDF plan. The PDF plan becomes the legal title diagram in Victoria when the plan is registered.

The ePlan partnership was successfully completed in July 2022 in accordance with the agreement and the outcomes have been transferred to LUV. We appreciate the contributions of the ePlan project team in delivering a world-class infrastructure for the lodgement and processing of digital subdivision plans in Victoria. Most especially, we acknowledge the efforts of Dr. Hamed Olfat, Farshad Badiiee, and Afshin Mesbahmarjani who are now continuing their career journey at DELWP and progressing the project to its next phases.



# GEOSPATIAL ROUTING AND INFORMATION VISUALISATION (SYNTH)

2022-2023

# SYNTH

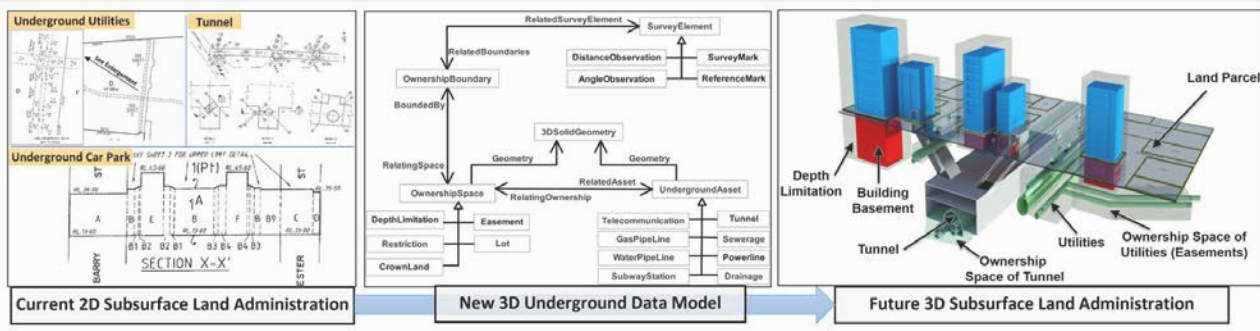
DMTC, Synthesis Technologies (Synth), and the CSDILA Centre Urban Analytics and Infrastructure Engineering (UoM) teams are working to define a collaborative body of work and resource research supporting the ongoing development of Synth's state-of-the-art 3D visualization tool. The University of Melbourne researchers are considering two tasks for this project.

- Review the state-of-the-art and analyse the opportunities and gaps for developing new features in the current solution provided by Synth Maps visualisation.
- Testing the ideas and developing a workflow for the implementation of new features.



# 3D DATA MODEL TO INTEGRATE UNDERGROUND LAND INFORMATION

This project aims to develop a novel 3D digital approach to managing subterranean ownership spaces by referencing these spaces to the physical reality of the underground environment. This project expects to generate new knowledge in the area of underground land administration using new 3D data modelling techniques. Expected outcomes of this project include a new underground 3D data model to improve management and communication of physical location and ownership extent of Australia's underground assets. This should provide significant benefits such as protecting underground assets, decreasing the risk of damaging utilities, avoiding unnecessary disruptions and delays when planning, constructing and managing underground infrastructure.





# SMARTLAND INDONESIA (THE WORD BANK GROUP) 2019-2023

## Summarized aim of the project

This project aims to improve the existing land surveying and cadastral flow/process/system, improve the data exchange system employed by relevant stakeholders in the surveying and cadastral process, and produce valid and reliable textual and 2D data to be used for providing information for internal and external use.



smoothly, the Ministry of Land Affairs and Spatial Planning (the Ministry of ATR/BPN) has developed a strategic roadmap for Modern Land Information System (MLIS). SmartLand Indonesia is one of the projects that fulfill the objectives of this roadmap and supports the MLIS implementation in the whole nation through the aims highlighted below:

- Analyse the current state of land administration in the Ministry of ATR/BPN as well as in regional and local offices
- Provide recommendations for improving land surveying and cadastral workflows, business processes, and systems
- Implement a modern cadastral workflow and system based on best practices, and
- Developing a prototype system that produces valid and reliable 2D spatial data using advanced technologies, including CSDILA land administration modernisation solutions, as a world-class model

## Description of the project

As part of the focus of the Government of the Republic of Indonesia on digital transformation and to ensure that the digital transformation journey will be planned and executed well and

CSDILA will provide the Work Packages listed in Figure 1 as part of their collaboration with the Digital Transformation Project Management Office (PMO).





# SUSTAINABLE DEVELOPMENT GOALS (SDGs)

This year our team has continued our work in sustainability to advance our efforts and contributions toward sustainable development goals. From across our research team, sustainability has been addressed from many angles. Through our work in urban planning, liveability in cities and how it can be improved has been a focus, as well as embedding sustainability and resilience in the design and development of land and spatial information systems.

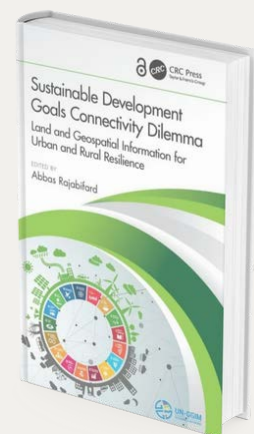
A key project to date has been the mapping of subjects across the Faculty of Engineering and Information Technology (FEIT) to assess the integration of sustainability in the curriculum, which directly addresses an indicator identified by the University. Our progress on this puts us ahead at the University level, and we will continue to map and refine our process for this, as well as share it with other faculties across the University.

message from the University's Sustainability Plan 2030 and translates it to the faculty level through the creation of a number of actions that faculty members can participate in to further the sustainability agenda of the University, which is guided by the UN SDGs. The guide is centred around the three domains for action as presented by the University, and indicates, for each sustainability priority, how FEIT is responding and how each target will be addressed – at the faculty level. This guide leverages off research already conducted through our work in the Centre and knowledge gleaned from our various research projects that investigate the challenges in effective and sustained access to trusted and secure digital technology, the Internet of Things (IoT), emerging data, information systems, analytics and associated enabling tools, and technologies to support the timely and reliable implementation and monitoring of the progress in SDGs.

Now that the goals for increasing sustainability at the faculty level have been identified, our focus areas for the future are clear. Combined with the work we are conducting within the Centre we will continue to contribute to the faculty and University level goals, as well as continue to support the global SDGs. We will continue our journey to help create the world's sustainable future.



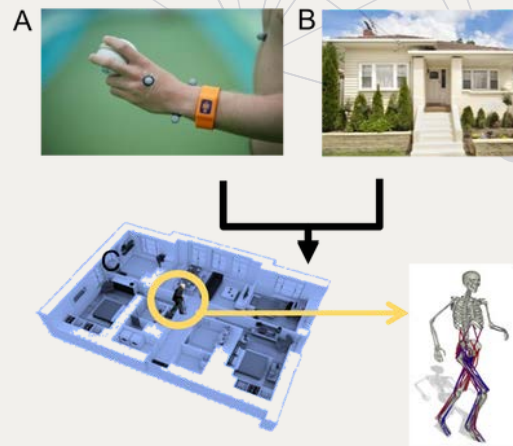
In addition to the good work taking place within CSDILA, our researchers have also been collaborating and supporting the faculty in their sustainability activities through the development of the FEIT Sustainability Guide. The guide, developed within our Centre takes the



# A DIGITAL TWIN FRAMEWORK FOR HUMAN MOBILITY MEASUREMENT IN THE HOME SETTING

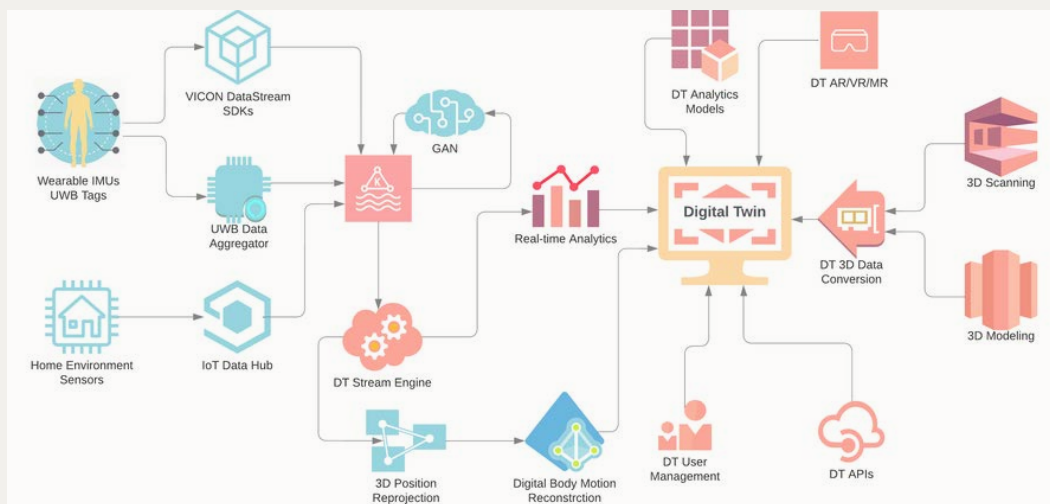
The objective of this Discovery Project is to develop the “digital twin”, a digital replica of a person moving in real-time within a 3D digital render of their own living environment. This technology, which will be supported by advanced deep neural networks, will facilitate accurate measurement of joint angles, as well as identification of motor tasks and task performance continuously over extended periods of weeks or months. Deployed on an iPad, the digital twin will allow a person, without any technical expertise, to use wearable technology to collect accurate and robust mobility data independently and with ease in almost any location. Integrating the 3D living environment with human movement data has not been achieved to date and will provide next-level human movement visualisation capability. It will extend our understanding of how individuals move within their home (beyond conventional clinical joint motion assessment), by revealing what tasks individuals do and how, as they physically interact with their own living space.

This digital twin technology is low cost and will advance telehealth and telerehabilitation, particularly for those in remote or disadvantaged communities. It will help improve design, development and testing of aged care infrastructure to ensure safe mobility and healthy ageing for Australians. More broadly, the monitoring, visualisation and data processing capability will have applications, including defence/military (monitoring front-line soldiers), elite sports (sports training and game strategy), film and animation, and space/aerospace/naval



industries (vehicle design, and habitual motion monitoring in confined spaces). The tasks required to achieve this project’s objective are:

- Aim 1: Develop a ‘digital twin’ framework of an individual in their home setting by combining accurate human motion from IMUs, UWB data and 3D digital mapping.
- Aim 2: Discover and validate algorithms to calculate joint angles using IMUs, and automatically classify activities of daily living in the home using the digital twin, employing the minimum number of IMUs possible.
- Aim 3: Deploy the use of wearable motion measurement technology and 3D indoor digital mapping for the home and residential aged care facility of older adults for real-time mobility measurement, visualisation and data logging over a long-term continuous data acquisition period.





## EPLANNING AND EAPPROVALS PROJECT - BUILDING 4.0 CRC

This project aimed to study the current processes of planning and building permits and develop a roadmap to modernise these processes.

### Project Parties

- Building 4.0 CRC Limited (CRC Entity)
- Lendlease Digital Australia Pty Ltd
- uTecture Australia Pty Ltd
- Sumitomo Forestry Australia Pty Ltd
- A.G.Coombs Group
- SFDC Australia Pty Ltd the Australian affiliate of salesforce.com, inc.
- The Master Builders Association of Victoria
- Victorian Building Authority
- Victorian Government, Department of Environment, Land, Water and Planning
- Monash University
- The University of Melbourne

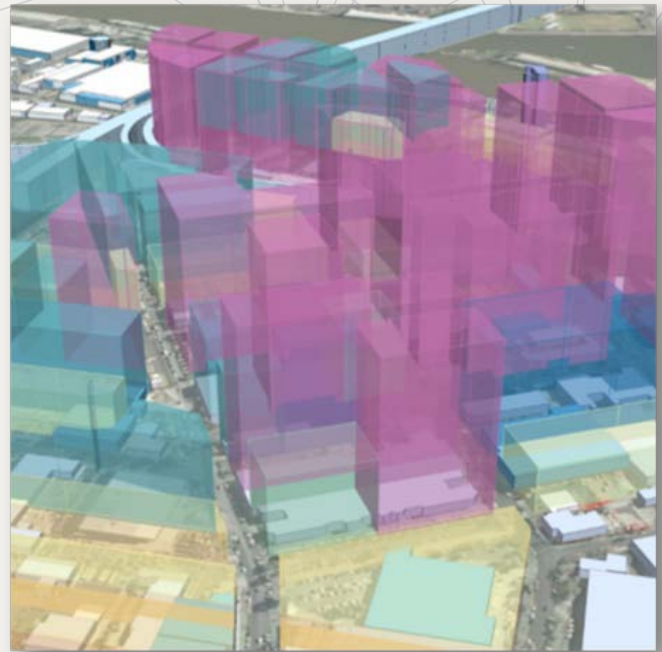
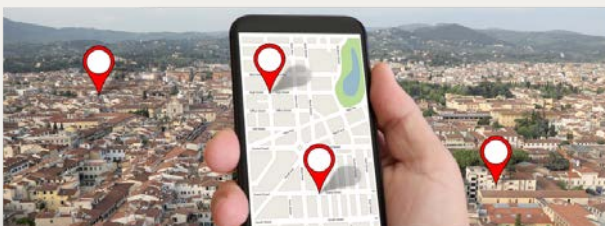
Planning and building approval processes are still largely paper (PDF) based, which make them inefficient and time-consuming, imposing significant costs on both industry and government. Industry is effectively unable to test plan compliance against planning controls and building regulations, track progress of their applications, and efficiently track compliance through construction. The long-term objective of the CRC's work in this area is to embrace the opportunities that digital workflow and digital twin technology provide to design, develop and deliver an innovative digital platform to facilitate effective, efficient and timely planning, building permits, approvals, ongoing compliance with planning controls, building regulations and other regulatory requirements.

### Final deliverable:

- A road map including several work packages. The road map will also discuss the problems, challenges, barriers and opportunities;

### DATE COMMENCED AND DURATION

22 March 2021; 6 months



Environment,  
Land, Water  
and Planning



SUMITOMO FORESTRY

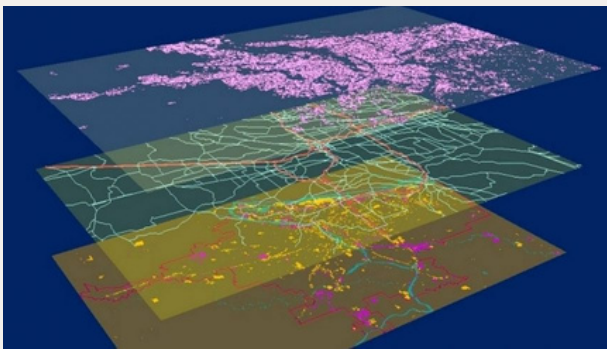
A.G.Coombs 75 YEARS



# DIGITAL TWIN DEVELOPMENTS

## ECOLOGICAL ADAPTATION DECISION MAKING

This interdisciplinary project brings together landscape architectures, geospatial scientists, and city modellers to design and implement an ecological adaptation scenario builder in a Digital Twin (DT) environment. The scenario builder is capable of measuring inundation and modelling climate change impacts, as the urban planning and design tools.



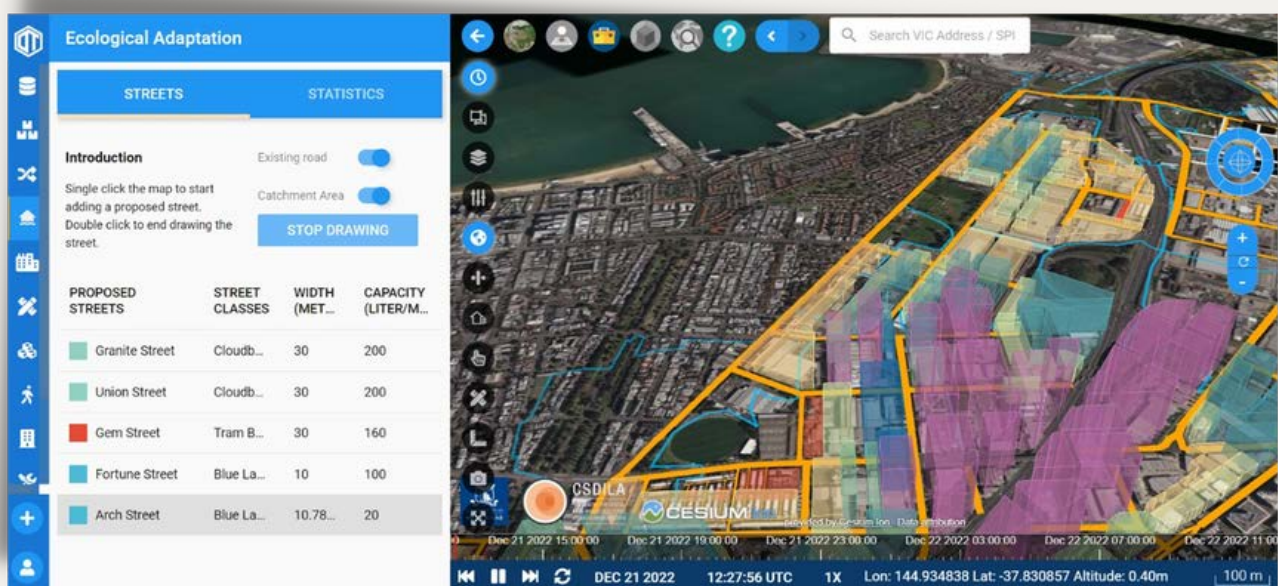
This will enable the visualisation and testing of incremental flood defense and adaptation

planning scenarios to be explored by decision makers and other stakeholders to directly inform the planning process. The idea will be tested at Fishermans Bend, Australia's largest urban renewal project, near the Melbourne's CBD. The aim is to develop a holistic and near- to long-term resilient floodplain redevelopment analytic. Therefore, this project will answer following question:

- What are effective near- mid- and long-term incremental design scenarios for the Fishermans Bend precinct development and landscape that can planned and built to make the site resilient to climate change in 30,70 years and 100 years?

### Capabilities

- A panel in CSDILA Digital Twin for water sensitive urban design scenarios and decision making
- Utilising road network drawing and modification functions for stormwater management
- Developing an interface between stormwater management, buildings and streets



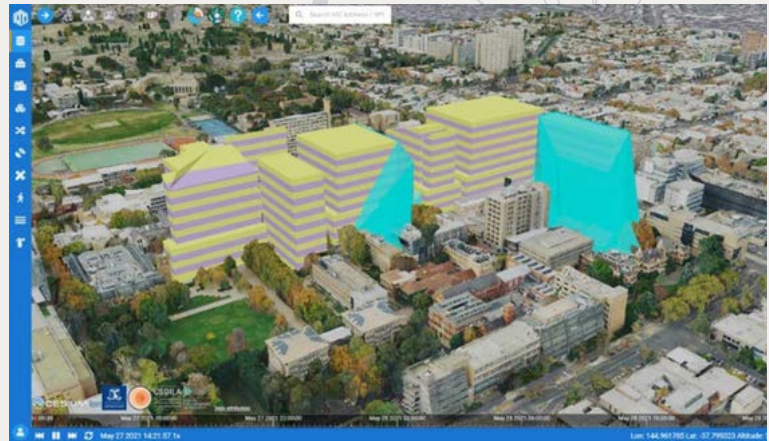
# DIGITAL TWIN DEVELOPMENTS

## DEVELOPMENT ENVELOP CONTROL (DEC)

Currently, there is a challenge for urban planners and designers to understand the environmental and physical implications of design rules including building height and setback on development of an area. The collaboration leveraged our Digital Twin for the design and development of an intelligent tool for generating an optimised building envelop based on planning controls. This tool can assist urban planners and designers to achieve good design outcomes that respond to character, microclimate, and heritage.

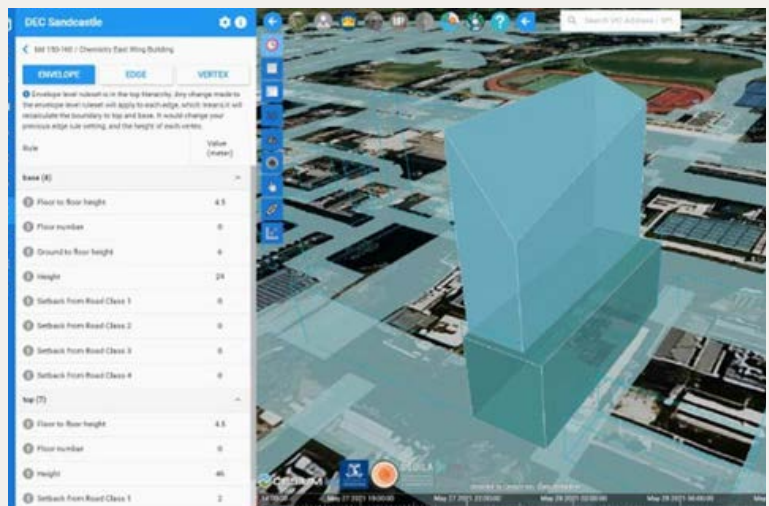
Our research team developed a method of generating development envelopes with statistics by analysing building footprints, setback rule sets, road network and other constraints.

This project is a collaboration between CSDILA and the University of Melbourne's Campus Planning and Design team.



The current capabilities include:

- Development Envelope Control Creator: create new development envelop control and define default rulesets and constraints including corridors rules.
- Development Envelope Control Editor: designing three hierarchy level of ruleset constraints include envelope level (height constrains, number of floors, setbacks based on road classes), edge level (setbacks), vertex level (vertex height)
- Rule-based Development Envelope Control Evaluator: Generate 3D building blocks with statistics includes total lot area, number of floors, top area, envelope height, envelope discrepancy area, total gross floor area, floor area.
- Shadow analysis: generate single or animated 2D & 3D shadows from selected building envelopes and also highlight the shadow impacted buildings.
- Styling: define the model appearance based on the floor types

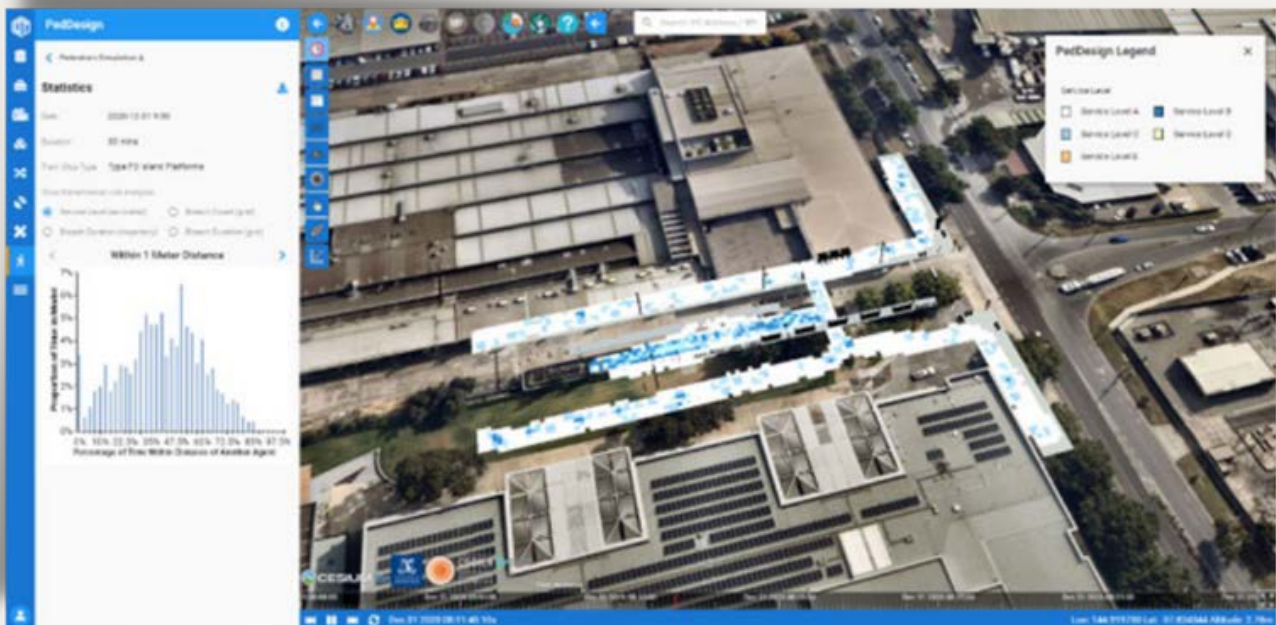


# DIGITAL TWIN DEVELOPMENTS

## PEDDESIGN

With the new normal shaped by COVID-19, spatial information can no longer be neglected. No matter the location and the occupation, people tend to interact with each other spatially and temporally. The understanding of how people move and interact is only more crucial in the design and operation of infrastructure.

Given that the prevalent way of tracking COVID is still through contact tracing when someone has been infected, we want to be more precautionary by knowing how infrastructure design and layout can impact people's movement and predicting the risks of virus transmission using data analysis methods. With this foresight, CSDILA started our collaboration with ARUP to provide the PedDesign tool in our Digital Twin to enable this insight in depth.



ARUP's pioneering crowd simulation software MassMotion provided us with the simulated people movement data. Our team then developed different levels of analysis models and presented in our Digital Twin to assist the design and operation of infrastructure with the consideration of physical distancing parameters.

### Capabilities

The design of the new tram stops and entrances to the University of Melbourne's Fishermans Bend campus have been selected to test the concept and technology. Specifically, four scenarios are implemented with the following capabilities:

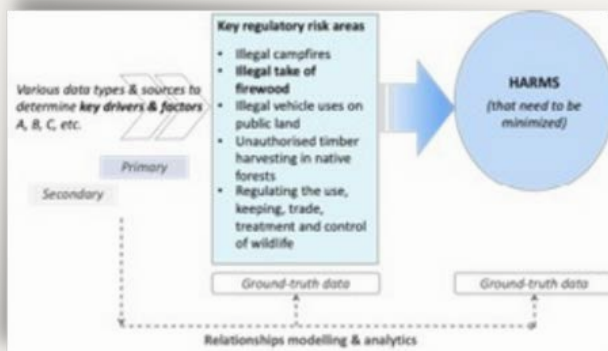
- Service Level Analysis: Presents the density of pedestrian movement for selected areas and periods, and users can view the level of services through a time-dynamic graphical scene.

- Breach Count Analysis: Individual interactions between pedestrians are weighted by physical distance and visualised in colour-coded space.
- Breach Duration Trajectory Analysis: Captures and visualises the trajectories of continuous breaches where pedestrians are paired with each other within a certain distance.
- Breach Duration Grid Analysis: Continuous trajectories are aggregated to units of space to indicate where in the space continuous exposures are more likely to occur.
- Statistics and charts: Various analytics are provided to help users analyse the data from different perspectives, such as temporal trends and correlations.

# DIGITAL TWIN DEVELOPMENTS

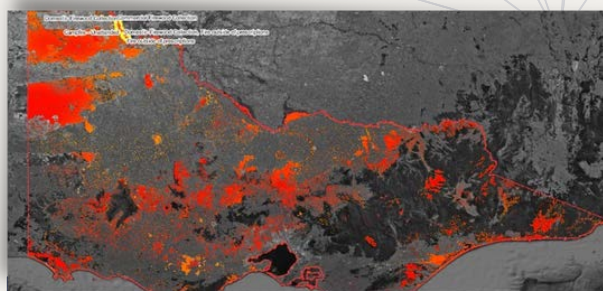
## DEVELOPING STRATEGIC INTELLIGENCE FOR THE CONSERVATION REGULATOR (ERP7)

The project Developing Strategic Intelligence for the Conservation Regulator (ERP7) aimed to contribute to the Office of the Conservation Regulator's (CR) ability to regulate in a way that was risk-based and intelligence led. This was to be achieved through the exploration of new and emerging data and technologies to more proactively identify emerging issues and trends, as well as potential data driven patterns and relationships. The project focused on identifying and developing capabilities including systems and tools that would allow CR to capture, analyse and use data in more dynamic ways to assess the performance and functioning of its environmental compliance regulatory demands.



The exploration of historic and current data through advanced data modelling and analytics can help to identify and tackle gaps in strategic intelligence to improve strategic outcomes for CR. We prototyped the ERP7 product that could be used to understand and analyse historical trends from a wide array of data. Building on this baseline information, new modelling and analytical capabilities were applied to explore how existing but unused datasets and additional datasets could enhance analysis to gain insights,

and subsequently shape new questions that might be addressed. This process was undertaken in close collaboration with CR.



to minimise biodiversity harms, from our analysis, we observed that:

- Illegal domestic and commercial firewood collection activities count for most of the offences around Habitat Information Maps (HIM) for Victorian Rare or Threatened Species (VROT) species;
- The North-East regions contain the most critical IR (offences), and many of these happen close to HIM grids;
- The East and West regions contain vast VROT species but IR are rarely reported in these regions.
- In the findings based on the very limited 6-8-month Incident Report data from Gumnut, we identified that a high likelihood of incidence occurring is linked to:
- Proximity to regions with a high degree of socio-economic disadvantages;
- Proximity to road networks, specifically, the "Local", "2wd" and "4wd" road classes;
- Places with relatively flat (less than 5 degrees) topography and based on south-southwest-west facing grounds, which receive less sunlight.



# DIGITAL TWIN DEVELOPMENTS

## COASTAL FLOOD PLATFORM

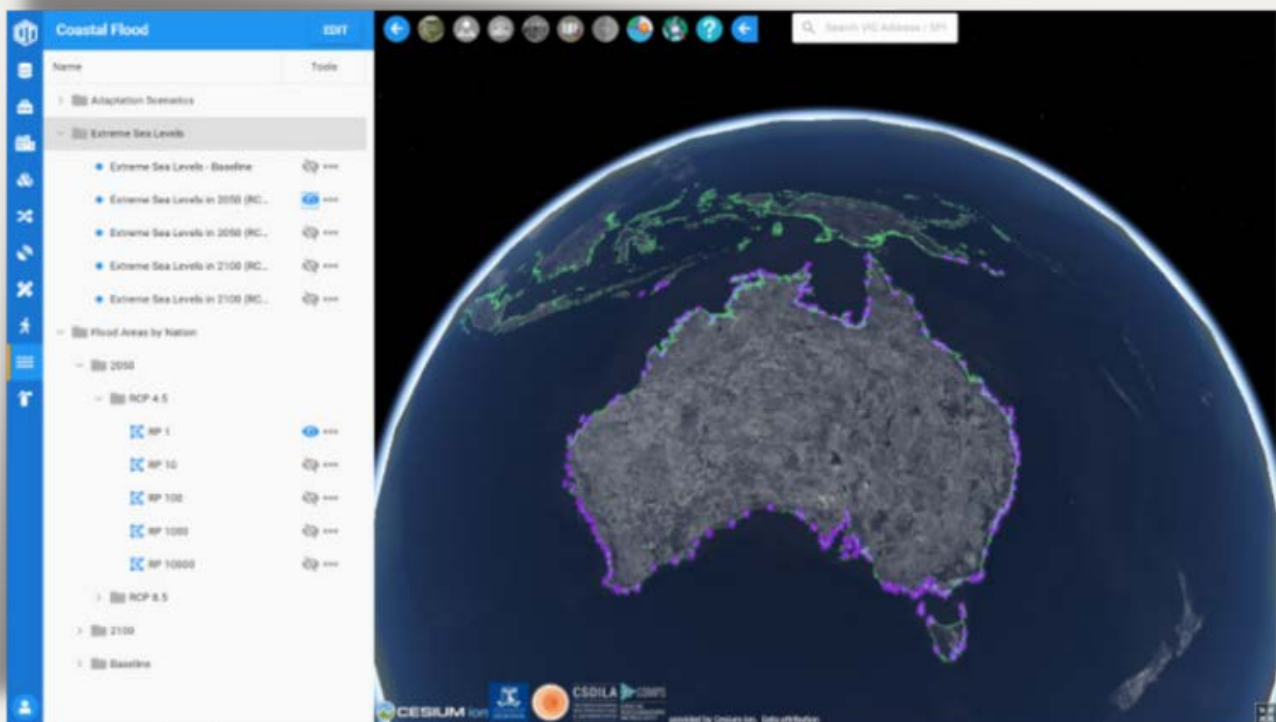
A data visualiser and distributor to share with those interested in visualising the coastal flood impacts both globally and regionally.

The dataset presented in this module is an improved version of the data from Kirezci et al (2020). At the global extent, this dataset consists of extreme sea levels (ESLs) at more 9,800 coastal locations under various return periods, and the coastal flooding extents corresponding to these ESLs at the present conditions (baseline), by 2050 and 2100. The ESLs are projected into the future by using intermediate (RCP4.5) and high-end (RCP8.5) sea level rise scenarios from values of IPCC-Special Report on the Ocean and Cryosphere in a Changing Climate. Relatedly, based on three different coastal adaptation scenarios, the 'Expected Annual People Affected' and the 'Expected Annual Damage' are demonstrated at the country scale. The visualisation of this data has a crucial role for the public understanding of the coastal extremes and flooding impacts for the present conditions and planning for the future.

Digital Twin has the modular capabilities of data visualiser and data distributor and can be integrated to different data panels. Therefore, we designed the coastal flood platform as a data container to host the data set from Ebru Kirezci.

The current capabilities include:

- Data hosting
- Online data visualisation
- Metadata management and editing
- Data filter and query
- Data download



# DIGITAL TWIN DEVELOPMENTS

## LIVE INDOOR POSITIONING

The CSDILA's Digital Twin team has been working on a system that is capable of gathering live spatial data of an object, processing and transmitting the data and visualize the position on DT's live panel. To do this, our research team have designed and developed a dataflow pipeline that will connect from a live indoor position device developed by Pozyx, processing and transmitting the data on air and visualize the final result on DT's live panel. The team have also developed a strategy to validate the data received and report on the precision of the system, as well as the optimal placement of the system to improve the accuracy of the live indoor positioning.

The current capabilities include:

- A fully automated system that will gather raw data from indoor position of a Pozyx device, process and transmit the data to the DT end.
- Visualization of the spatial data on the DT front panel live.
- Power supply solution: the whole system can be running without access of power outlet.
- Installation solution: the whole system is able to be installed without permanent damage on the installation site, i.e. no nails.
- Data storage and analysis: live data can be stored on the server and can be gathered to do analysis.



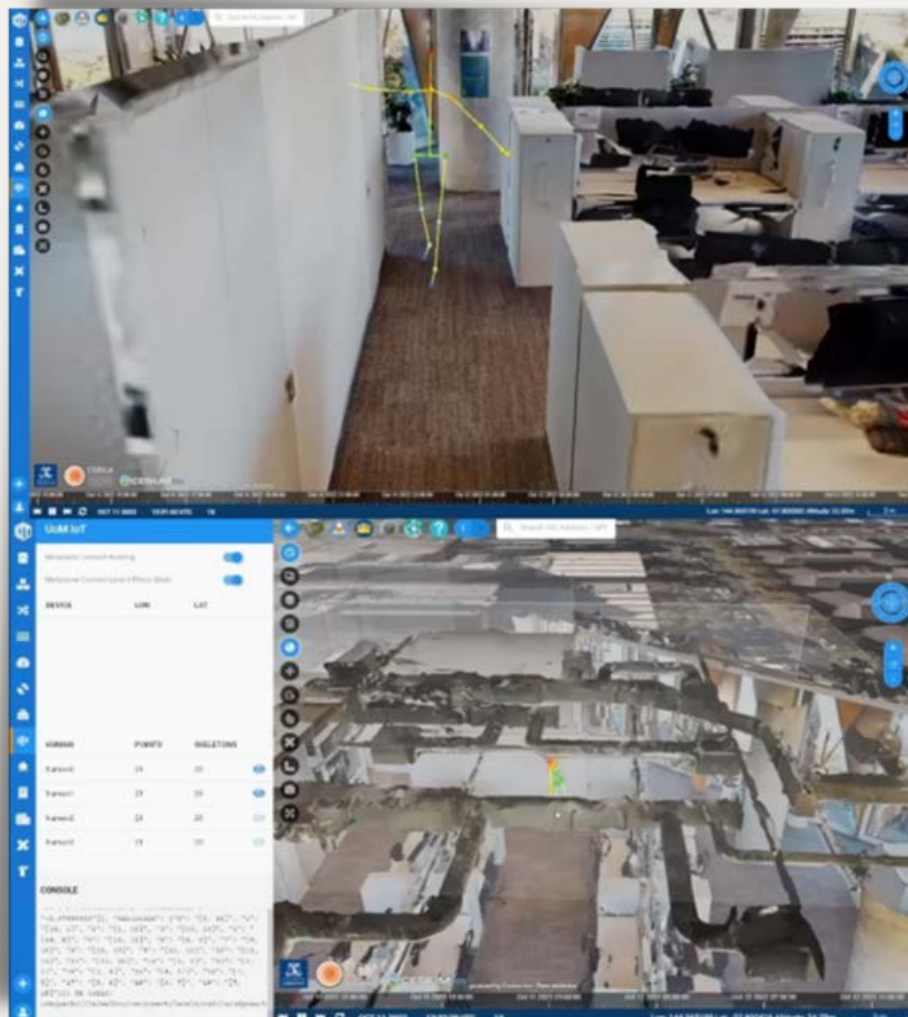
# DIGITAL TWIN DEVELOPMENTS

## LIVE 3D POSE

The CSDILA's Digital Twin team has been working on a system that is able to capture live data of a person's location and pose information, process and transmitting the data to the DT end, recreate and visualize the position & pose information on DT's live panel. To do this, our research team have developed a system that capture the raw data with a camera system, process the raw data with AI model on cloud server, and transmitted the processed data to the DT's live panel where the information will be recreated and visualized.

The current capabilities include:

- Fully automated system that connects from the camera system that gathers raw data to the DT end.
- Fully automated data processing pipeline that is able to extract location and pose information from raw image data provide by camera system.
- Visualization of the position and pose data on the DT front panel live.
- Power supply solution: the whole system can be running without the access of power outlet.
- Installation solution: the whole system is able to be installed without permanent damage on the installation site, i.e. no nails.
- Data storage and analysis: live data can be stored on the server and can be gathered to do analysis.





# CURRENT PILOTS OR PROOF OF CONCEPTS

The CSDILA team have been working on a number of pilots or proof of concepts, to showcase CSDILA capabilities for different industries or jurisdictions with aim in securing new projects. In this context here are the main projects that we have been done in 2022:

## Sydney Science Park



The project objective is to leverage the Digital Twin platform in assisting urban planning in Sydney Science Park and external. The CSDILA's Digital Twin team has been working on hosting and visualising the spatial planning data and the historical data to the real world to assist urban planners and designers to test design and modeling scenarios as well as capture data and analyse trends.

### Capabilities:

- Hosting and visualising the 3D model of the Sydney Science Park in point cloud format with different resolutions
- Visualising the urban planning and zoning information for the Sydney Science Park
- Visualising the flood and catchment areas for various time series on the map

Visualising the geographic information of the Sydney Science Park on the map

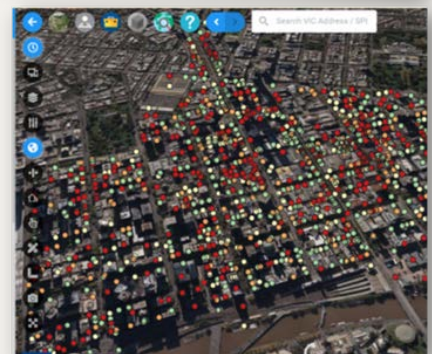
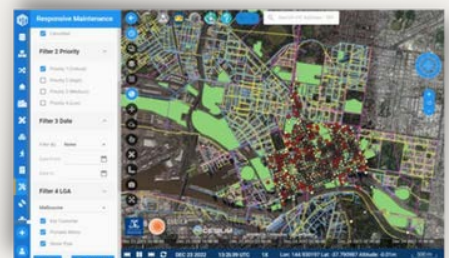
## O-Lab (GWW)

The project aimed to enrich the capability of Digital Twin (DT) in the water sector to assist decision-making in site maintenance and asset management. The project validated the use of DT for urban water utility companies in cities with a low-risk and cost-effective solution to testing changes and predicting faults. To achieve this, our research team developed a series of filtering methods for the maintenance data as well as a feature of interest function for users to flexibly add information they need to locations on the map.

This project is a collaboration between CSDILA, Great Western Water and the O-Lab research team.

### Capabilities:

- The main features that have been developed for the Visualization of Incidents include a series of filtering methods.
- Colour code selection: coloring the sites based on the priorities or the due date
- Visualising the table of cases on the left side of the window with attributes of the maintenance sites (with red dates representing overdue cases)
- Creating the animation to show the trend of cases being created and completed within the selected time period by users.
- The features that have been developed for the Feature of Interest (FOI) panel



## CONSERVATION FUTURES KNOWLEDGE SYSTEM



The ultimate aim of the collaboration between the CSDILA and the Conservation Ecology team, led by Professor Brendan Wintle, is to tailor the CSDILA's Digital Twin system to create an integrated Conservation Future Knowledge System. So far, six user roles and more than 30 user stories have been identified, discussed, and scoped as part of this effort. In June 2022, the Conservation Future project team held a workshop to demonstrate the current capabilities of the system, including its ability to integrate, visualize, and manage data.



## DIGITAL TWIN PILOT PROJECTS

The CSDILA's Digital Twin team has been working to improve the capabilities and usability of digital twins through various pilot projects around the world. As part of this effort, they have designed and developed an enterprise solution that follows open standards and allows for seamless integration of data and technology components. This solution is also built to adhere to the FAIR Data Principles, which promote data that is findable, accessible, interoperable, and reusable. By using a standards-based approach, the CSDILA's Digital Twin system makes it easy to search, discover, aggregate, and visualize spatial information regardless of the database management system, data model, data content, data server, or preferred applications. CSDILA DT team targets on applying research into the following domains:

- Spatially enabling government and society
- Designing and developing SDIs
- Multi-source data conversion, integration, harmonisation and hosting capabilities
- 2D and 3D Cadastral systems
- IoT and Sensor systems
- Real-time data analytics and visualisation
- Sustainable and smart cities



The background of the slide features a blurred photograph of a large crowd of people, likely at a conference or event. Overlaid on this image are several thick, white, geometric lines that form a series of connected zig-zags or chevrons, creating a dynamic, abstract pattern. The bottom right portion of the slide is a solid dark blue triangle that serves as the background for the title text.

# **MAJOR EVENTS**



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## CONFERENCES, SEMINARS AND EVENTS

The Centre has participated and contributed scientifically to several international and national events and conferences as well as hosted a number of workshops and events. Here are the selected events in 2022.



## INDONESIAN SENIOR EXECUTIVES DELEGATION VISITED CSDILA

(Nov-Dec 2022)

Over the last two weeks, CSDILA was delighted to host two groups of Indonesian Senior Executives Delegations as part of our collaboration with the Ministry of Land Affairs and Spatial Planning / National Land Agency, the Republic of Indonesia. These delegations were here for an International Comparative Study of Spatial Planning and Land Administration System. The aim was understanding best practices from the Australian Land Administration and Spatial Planning Systems, and this visit provided a forum to see the state-of-the-art digital capabilities of the Victorian State and Local Government, academia, and industries capabilities in Land Administration Modernisation and Spatial Planning domains.

In addition, we provided learning experience regarding best practices in spatial data and urban analytics including 3D land and property information, 3D city models, Building Information Model (BIM), Internet of Things (IoT), and associated analytics, to help realise SmartLand and Digital Twin technologies.



## DR KIRSIKKA RIEKKINEN THE ACADEMIC VISITOR FROM AALTO UNIVERSITY FINLAND

(OCT-Dec 2022)



Dr. Kirsikka Riekkinen an assistant professor of land management at Aalto University, Finland visited CSDILA to collaborate with the Centre's Digital Twin project team and to contribute to our active research and development efforts

on the Urban, Land and Property Management areas. Dr. Riekkinen holds a PhD degree in real estate economics and her research is focused on land administration, cadastral systems, and land consolidation. During her visit to the Centre, she was significantly involved in several workshops and events related to sustainability, urban environment and land administration. We are looking forward to welcoming her again in the Centre in future and further strengthen our research and development cooperation with Aalto University.





## ARC COMMITTEE BOARD VISITED THE CSDILA TO STRENGTHEN PARTNERSHIP

(JUL 2022)

On July 27th, CSDILA as one of the co-leading research partners of the RIIS hub hosted and welcomed the RIIS Board for a strategic workshop to open the Hub for execution. The workshop has provided an excellent chance to discuss the major executions of the Hub, and project formulations to support collaboration among all researchers and industry partners to support Australia's critical research needs. With twenty industry partners already on board, and twenty-four leading academics as chief investigators, RIIS is equipped, approved, and set to embark on its mission - the development and delivery of transformational technologies. As part of the workshop, there was a presentation on the CSDILA research capabilities and also a tour of the CSDILA Melbourne Connect land including D-Lab and the University of Melbourne facilities. The RIIS Hub has expert leadership, with UwoM CSDILA Director Professor Abbas Rajabifard as RIIS Deputy Director and Research Committee Chair, and Dr. Jagannath Aryal and Prof Alex Felson contributing as Chief Investigator. We're excited to provide updates on the Hub's activities throughout its five-year duration. Exciting times ahead for CSDILA and its members!



## MINISTER AND EXECUTIVES MEETING IN JAKARTA, INDONESIA FOR SMART LAND PROJECT

(AUG 2022)

We're very delighted to announce that as part of the 'SmartLand Indonesia' project the CSDILA team has planned a visit to the government of Indonesia to better understand the current status of the Indonesian land administration system and discuss the modernisation of the cadastral system and moving towards a Digital Twin. In the kick-off session, we had the privilege to meet with the Minister of Agrarian and Spatial Planning, Air Chief Marshal Hadi Tjahjanto AO, executives including Secretary General (Mr Ir. Himawan Arif Sugoto), Director General of Spatial Planning (Mr Ir. Gabriel Triwibawa), Director General of Survey and Mapping (Mr Ir. Virgo Eresta Jaya), Director of Land Registration (Mr Ir. Suyus Windayana), other directors, as well as Project Management Office (PMO).





## THE SECOND UNITED NATIONS WORLD GEOSPATIAL INFORMATION CONGRESS, HYDERABAD, INDIA (OCT 2022)



Professor Abbas Rajabifard, Chair of the UNGGIM Academic Network, presented on Transitioning from geospatial data to geospatial knowledge for enhanced national development at the Second United Nations World Geospatial Information Congress (UNWGIC).

The objective of the event was to share and develop knowledge about GKI, including its relevance to national and global development, the Integrated Geospatial Information Framework (IGIF), the

the emerging geospatial information ecosystems and broader digital infrastructures on 14th Oct 2022 in Hyderabad, India.

Also, Prof Rajabifard was part of a panel that took place as a side session to the 'Bridging academia and the industry in geospatial research, education and training event along with the UNGGIM Academic Network on October 10, 2022, which was a part of the 2nd #UNWGIC.



## FIG CONGRESS WARSAW, POLAND (SEP 2022)

The FIG congress took place in Warsaw, Poland in September and a team comprised of Prof Abbas Rajabifard, Dr. Benny Chan, Dr. Soheil Sabri, and Dr. Davood Shojaei represented our CSDILA. Our team participated in multiple technical sessions. Professor Abbas Rajabifard was part of the moderator panel of the Keynote speakers in session one with the overall topic of geospatial excellence for a better living - digitalisation and modern surveying and cadastre in a post-covid19 era. Also, he was the chair of the "Global Challenges and the Role of Land Administration Systems" session which different approaches to improve land administration and address the global challenges in a collaborative and responsible way were discussed. The CSDILA team presented in the "Framework for Effective Land Administration NMCA Good Practices and Further Developments" session and during the presentation, they highlighted the main points of advancing land administration systems and using Digital Twin for the next generation of Urban Land Administration





## 7TH SMART DATA AND SMART CITIES & 17TH 3D GEOINFO CONFERENCE IN SYDNEY

(OCT 2022)

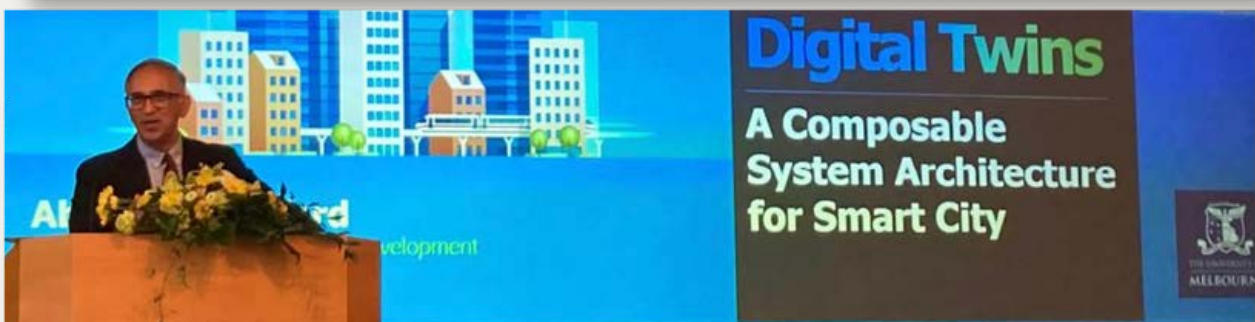
CSDILA research team (Dr. Davood Shojaei, Dr. Behnam Atazadeh, Mr. Bahram Saiedian, Mr. Peyman Jafari, and Mr. Mohamed Zahlan Abdul Muthalif) participated in and presented a series of peer-reviewed papers in 7th Smart Data and Smart Cities & 17th 3D GeoInfo Conference in Sydney. 3D GeoInfo is an annual international conference that focuses on theoretical, standardisation, technical, implementation, and applications in the 3D domain. Every year, researchers from around the world attend the Smart Data and Smart Cities Conference to exchange ideas on new techniques and applications in city analytics, GIS, digital twins, smart cities, and data science.

Dr. Shojaei and Dr. Atazadeh also presented CSDILA's research on the topics of "Digital Twin in Construction Approvals" and "3D Subterranean Land Information and Digital Twins for Underground Infrastructure". These presentations were part of the workshop on Digital Twin for Infrastructure and Construction, chaired by A/Prof Mohsen Kalantari.



## MEETING WITH DIRECTOR-GENERAL OF NATIONAL LAND SURVEY OF FINLAND AND PRESENTED AT THE AT FINLAND'S SURVEY DAYS 2022

Professor Abbas Rajabifard gave a keynote presentation at Surveying Days 2022, in Helsinki, Finland and met with the Director-General of the National Land Survey of Finland, Mr. Arvo Kokkonen; his Deputy and agency executives; and Dr. Kirsikka Riekkinen from Aalto University. The meeting was an exciting chance to discuss future opportunities for collaboration





## PRESENTING AT THE SECOND INTERNATIONAL IFAC WORKSHOP ON INTEGRATED ASSESSMENT MODELLING FOR ENVIRONMENTAL SYSTEMS IN TARBES, FRANCE

Professor Abbas Rajabifard delivered an opening keynote address, “Digital Transformation: A New Era – Environmental Modelling by Digital Twins” at the Second IFAC Workshop on Integrated Assessment Modelling for Environmental Systems in early June. In his presentation, Professor Rajabifard discussed current trends in digital analytical capabilities, location intelligence, and the use of digital twins as an enabling platform. The address explored opportunities to apply digital twin technology to better understand our changing environment and support our societies in using location intelligence and digital capabilities to address problems. Hosted by the University of Toulouse Engineering Faculty, the Workshop presented an excellent opportunity to discuss common research interests and future areas for collaboration with both hosts and attendees.



## THE UNIVERSITY OF BONN HELD THE SHAPING SUSTAINABLE, RESILIENT, AND SMART COMMUNITIES SEMINAR IN GERMANY

Professor Abbas Rajabifard was a Keynote Speaker on the Role of Digital Twins and Composable System Architecture at the University of Bonn.

He discussed the Role of Digital Twins and Composable System Architecture in our life. He will share CSDILA's latest research and development at this seminar, also he will speak about digital transformation the role of land administration and location intelligence in sustainability and resilience.



**Hybrid Seminar on**  
**Shaping Sustainable, Resilient, and Smart Communities:**  
**The Role of Digital Twins and Composable System Architecture**

**Moderator:**  
 **Prof. Theo Köter**  
University of Bonn  
Institute of Geodesy and Geoinformation

**Speaker:**  
 **Prof. Abbas Rajabifard**  
University of Melbourne  
Centre for Spatial Data Infrastructures and  
Land Administration

**Discussant:**  
 **MSc Mahsa Moghadas**  
University of Bonn  
Institute of Geodesy and Geoinformation

**Date:** Monday 19 September 2022  
**Time:** 10:00-11:30 CET

**Location for in-person participation:**  
Lecture Hall I (Hörsaal I), Nussallee 1, 53115,  
Bonn, Germany

**Online participation:**  
<https://uni-bonn.zoom.us/j/6666666666>  
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## CSDILA PARTICIPATION AT LOCATE-22 CONFERENCE IN CANBERRA, AUSTRALIA

(May 2022)

The CSDILA is proud to have had strong participation in this year's Locate 22 Conference in Canberra, with a large team contributing four talks and a closing panel in the conference. Additionally, CSDILA researchers presented research projects:

- "A Performance Approach for Placemaking in Urban Renewal Projects to Support SDGs" by Mark Allan
- "BIM and the Future of 3D Digital Cadastre" by Jihye Shin
- "Advancing Land Administration Systems in the Context of the Latest Global Initiatives" by Fatemeh Jahani Cheherebargh
- "Augmented Reality Visualisation Methods for Subsurface" by Mohamed Zahlan Abdul Muthalif As part of the conference's closing panel, Professor Abbas Rajabifard highlighted the role of academia in preparing the next generation of geospatial practitioners, and the importance of close collaboration between industry, government, and academia in preparing students for the market.

As Australia's premier spatial and surveying conference, Locate provides attendees with a unique opportunity to learn about the latest trends, research, and applications in geospatial technologies. CSDILA is very pleased to have had such strong presence and participation at this conference.



## MELBOURNE UNIVERSITY RIIS-RESEARCH HUB WORKSHOP

On 26th Oct Wednesday, CSDILA invited industry partners at the University of Melbourne for a major ARC-funded Hub (RIIS) workshop. The workshop was very successful with all our university of Melbourne industry partners and their representatives who are involved in the Hub. We have had a lively discussion with our industries: Emerson, AAM, SouthEast Water, Hawk, Rockfield, Spatial Vision and Geoscape.

At the workshop, we discussed all the potential projects and had great contributions from industries and received their full support. We have also discussed the current challenges and opportunities in our current emerging market. Our industries have shown commitment, excitement, enthusiasm, and concrete planning for the projects in partnership with us and potential opportunities for future projects.



## THE UNIVERSITY OF MELBOURNE WORKING EXPERIENCE WEEK

CSDILA team, including Dr Soheil Sabri, Dr Benny Chen, and Mr Yibo Zhang contributed to the coordination, preparation, and delivery of presentations, and hands-on workshops on Digital Twin for Year 10 students' visit to the Faculty of Engineering and IT during work Experience Week from 20th to 24th June 2022.

Every year, Faculty of Engineering and IT hosts a number of Year 10 students to experience different domains of research and projects activities. The CSDILA team has always been instrumental to represent the Department of Infrastructure Engineering and Geomatics group in these programs. The delivery of topics during 2020 and 2021 were in on-line mode. But this year a group of 33 students attended to the campus and CSDILA team ran several workshops and hands-on training for using the Digital Twin capabilities in developing City Profiles and Critical Decision Making.



## PHD COMPLETIONS

### Ali Asghari

Research Title:

3D Spatial D Validation in Urban Land Administration

Supervisors:

Prof. Abbas Rajabifard & Associate Prof. Mohsen Kalantari



### Maryam Barzegar

Research Title:

Spatial query and analysis for 3D urban land administration

Supervisors:

Prof. Abbas Rajabifard & Associate Prof. Mohsen Kalantari & Dr. Behnam Atazadeh



### Jihye Shin

Research Title:

BIM-based Property Ownership Evaluation in Land Administration

Supervisors:

Prof. Abbas Rajabifard & Associate Prof. Mohsen Kalantari & Dr. Behnam Atazadeh



### Zahra Assarkhaniki

**Research Title (Under Examination):**

Data infrastructure design and analysis requirements to improve community resilience and disaster risk management in rapid developing urban area

Supervisors:

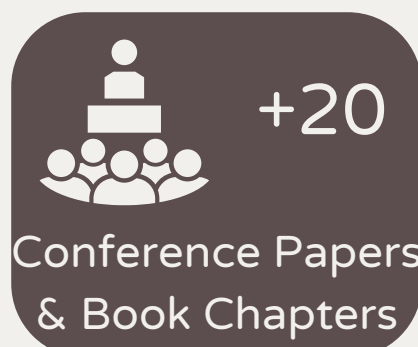
Prof. Abbas Rajabifard & Dr. Soheil Sabri





# PUBLICATIONS

# 2022 PUBLICATIONS QUICK GLANCE



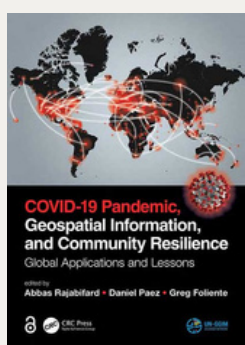
## Published Books

- The Science behind the COVID Pandemic and Healthcare Technology Solutions



This book offers a timely review of modern technologies for health, with a special emphasis on wireless and wearable technologies, GIS tools, and machine learning methods for managing the impacts of pandemics. It describes new strategies for forecasting the evolution of pandemics, optimizing contact tracing, and detecting and diagnosing diseases, among others. Written by researchers and professionals with different backgrounds, this book offers extensive information and is a source of inspiration for physiologists, engineers, IT scientists, and policymakers in the health and technology sector.

- COVID-19 Pandemic, Geospatial Information, and Community Resilience



Geospatial information plays an important role in managing location dependent pandemic situations across different communities and domains. Geospatial information and technologies are particularly critical to strengthening urban and rural resilience, where economic, agricultural, and various social sectors all intersect. Examining the United Nations' SDGs from a geospatial lens will ensure that the challenges are addressed for all populations in different locations. This book, with worldwide contributions focused on COVID-19 pandemic, provides interdisciplinary analysis and multi-sectoral expertise on the use of geospatial information and location intelligence to support community resilience and authorities to manage pandemics.

## Journal Papers

- Shringi, A., Arashpour, M., Golafshani, E. M., Rajabifard, A., Dwyer, T. & Li, H. (2022). Efficiency of VR-Based Safety Training for Construction Equipment: Hazard Recognition in Heavy Machinery Operations. *Buildings*, 12(12), pp. 2084-2084. doi:10.3390/buildings12122084
- Khanmohammadi, S., Arashpour, M., Golafshani, E., Cruz, M., Rajabifard, A. & Bai, Y. (2022). Prediction of wildfire rate of spread in grasslands using machine learning methods. *Environmental Modelling and Software*, 156 doi:10.1016/j.envsoft.2022.105507
- Saeidian, B., Rajabifard, A., Atazadeh, B. & Kalantari, M. (2022). Data lifecycle of underground land administration: a systematic literature review. *Survey Review*, pp. 20-. doi:10.1080/00396265.2022.2119744
- Haghani, M., Kuligowski, E., Rajabifard, A. & Kolden, C. A. (2022). The state of wildfire and bushfire science: Temporal trends, research divisions and knowledge gaps. *SAFETY SCIENCE*, 153 pp. 28-. doi:10.1016/j.ssci.2022.105797
- Asghari, A., Kalantari, M., Rajabifard, A. & Shin, J. (2022). Developing an integrated approach to validate 3D ownership spaces in complex multistorey buildings. *INTERNATIONAL JOURNAL OF GEOGRAPHICAL INFORMATION SCIENCE*, pp. 28-. doi:10.1080/13658816.2022.2109159
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- Tzachor, A., Sabri, S., Richards, C. E., Rajabifard, A. & Acuto, M. (2022). Potential and limitations of digital twins to achieve the Sustainable Development Goals. *NATURE SUSTAINABILITY*, 5(10), pp. 822-829. doi:10.1038/s41893-022-00923-7
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- Shojaei, D., Badiie, F., Olfat, H., Rajabifard, A. & Atazadeh, B. (2022). Requirements of a data storage infrastructure for effective land administration systems: case study of Victoria, Australia. *JOURNAL OF SPATIAL SCIENCE*, pp. 19-. doi:10.1080/14498596.2022.2027291
- Haghani, M., Kuligowski, E., Rajabifard, A. & Lentini, P. (2022). Fifty years of scholarly research on terrorism: Intellectual progression, structural composition, trends and knowledge gaps of the field. *International Journal of Disaster Risk Reduction*, 68 doi:10.1016/j.ijdrr.2021.102714
- Crespo, R. & Rajabifard, A. (2022). INVERSE MODEL USING LAND AND PROPERTYSUB-SYSTEMS FOR PLANNING FUTURE CITIES: A GENERAL FRAMEWORK. *Journal of Urban and Regional Analysis*, 14(1), pp. 5-22. doi:10.37043/JURA.2022.14.1.1
- Jafary, P., Shojaei, D., Rajabifard, A. & Ngo, T. (2022). BIM and real estate valuation: challenges, potentials and lessons for future directions. *Engineering, Construction and Architectural Management*. <https://doi.org/10.1108/ECAM-07-2022-0642>

- Neupane, B., Aryal, J., Rajabifard, A.(2022). BUILDING FOOTPRINT SEGMENTATION USING TRANSFER LEARNING: A CASE STUDY OF THE CITY OF MELBOURNE. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 10 (4/W3-2022), pp. 173-179.
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- Sharma, S.K., Aryal, J., Rajabifard, A.(2022). Remote Sensing and Meteorological Data Fusion in Predicting Bushfire Severity: A Case Study from Victoria, Australia. *Remote Sensing*, 14 (7), art. no. 1645
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- Aryal, J., Sitaula, C., Aryal, S.(2022).NDVI Threshold-Based Urban Green Space Mapping from Sentinel-2A at the Local Governmental Area (LGA) Level of Victoria, Australia Land, 11 (3), art. no. 351
- KC, U., Hilton, J., Garg, S., Aryal, J.(2022).A probability-based risk metric for operational wildfire risk management. *Environmental Modelling and Software*, 148, art. no. 105286 A
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- Sakti, A.D., Ihsan, K.T.N., Anggraini, T.S., Shabrina, Z., Sasongko, N.A., Fachrizal, R., Aziz, M., Aryal, J., Yulianto, B., Hadi, P.O., Wikantika, K.(2022).Multi-Criteria Assessment for City-Wide Rooftop Solar PV Deployment: A Case Study of Bandung, Indonesia. *Remote Sensing*, 14 (12), art. no. 2796.
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- Li, Z., Pinacho-Davidson, P., Martínez-Marin, M., Cabrera-Vives, G., Chen, Y., Rodríguez, M., ... Ranjan, R. (2022). Bonus computing: towards free-of-charge metacomputing in the public cloud. *Computing*, 104(1), pp. 123-147. doi:10.1007/s00607-021-01036-3
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# JOURNAL SPECIAL ISSUES EDITED BY CSDILA MEMBERS



## SPECIAL ISSUE OF REMOTE SENSING

Members of CSDILA, in collaboration with colleagues at LEISMARS, Wuhan University, and Beihang University, acted as Special Issue guest editors in the journal Remote Sensing belonging to the Urban Remote Sensing section. The issue is entitled “Geospatial Understanding of Sustainable Urban Analytics Using Remote Sensing”.



## SMART LAND ADMINISTRATION AND MODERN CADASTRE: NEW FRONTIERS

This Special Issue contributed to the new frontiers of smart land administration and modern cadastre, based on technological innovations to meet the rapidly changing requirements of the societies. The current land administration and cadastral systems are not smart enough to satisfy the stakeholders' expectations and maximize the property industry's economic return. On the other hand, there are emerging boundaries in smart technologies, such as digital twins, blockchain, Internet of Things (IoT), machine learning, artificial intelligence (AI), and semantic web, that have the potential for improving land administration and cadastral systems' effectiveness and efficiency. This Special Issue focuses on scientific and technical approaches for leveraging technological innovations to support smart land administration and modern cadastral systems.

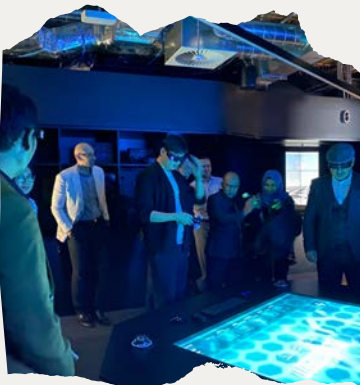


## PRODUCTIVE, LIVABLE AND ACCESSIBLE CITIES - THE ROLE OF 3D CITY MODELS

Digitally enhancing cities is essential for a sustainable, prosperous, healthy, and inclusive future for citizens. The digital enhancement of cities requires diverse and numerous technologies that are integrated and operate in space and time. Among these technologies, 3D above- and underground spatial models have proven to be helpful in many aspects of the management of cities. However, the adoption of 3D spatial data is very much fragmented across different aspect of management. There is a knowledge gap about how the use of 3D spatial models in the administration of cities can help with the overall productivity, accessibility, and livability of cities. This Special Issue invited original contributions to address this gap, towards an evidence-based understanding of the impact of using 3D spatial data in cities.



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