City Information Modelling and Urban Digital Twins

Dr Chunlan Guo 5 May 2022
IEC SyC Smart Cities

Content

- Definitions
- Case study: A city level CIM platform in Nanjing, China
- Case study: New South Wales spatial digital twin
- The overlaps and differences between CIM & UDT
- The challenges to the deployment of CIM & UDT
- Standards required for CIM & UDT and most updated progress

3 Definitions

city information modelling

CIM

development of digital representations and simulations of a city made up of large quantities of geospatial data, often including real time data, which enable better city planning and management

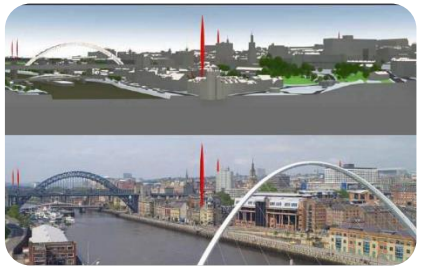
Note 1 to entry: The geospatial data is provided using an integration of building information modelling (BIM) and geographic information systems (GIS).

Note 2 to entry: The real-time data is obtained through extensive use of IoT sensors within the city.

Note3 to entry: city information modelling involves handling large amounts of big data, which is generally brought together using cloud computing.

Note4: Artificial intelligence is often used to generate and evaluate different scenarios using city information modelling data to help manage the city better.

[Source: IEC SRD 63273 ED1 CD]



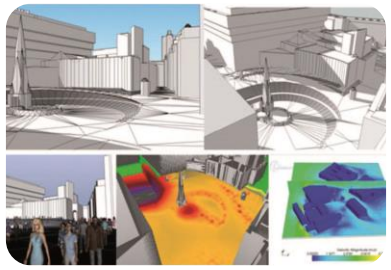


Figure: Charlton et al., 2015; Reitz & Schubiger-Banz, 2014.

digital twin

DT

digital representation of a target entity with data connections that enable convergence between the physical and digital states at an appropriate rate of synchronization

Note 1 to entry: Digital twins have some or all of the capabilities of connection, integration, analysis, simulation, visualization, optimization, etc.

Note 2 to entry: Digital twin may provide an integrated view throughout the lifecycle of the target entity.

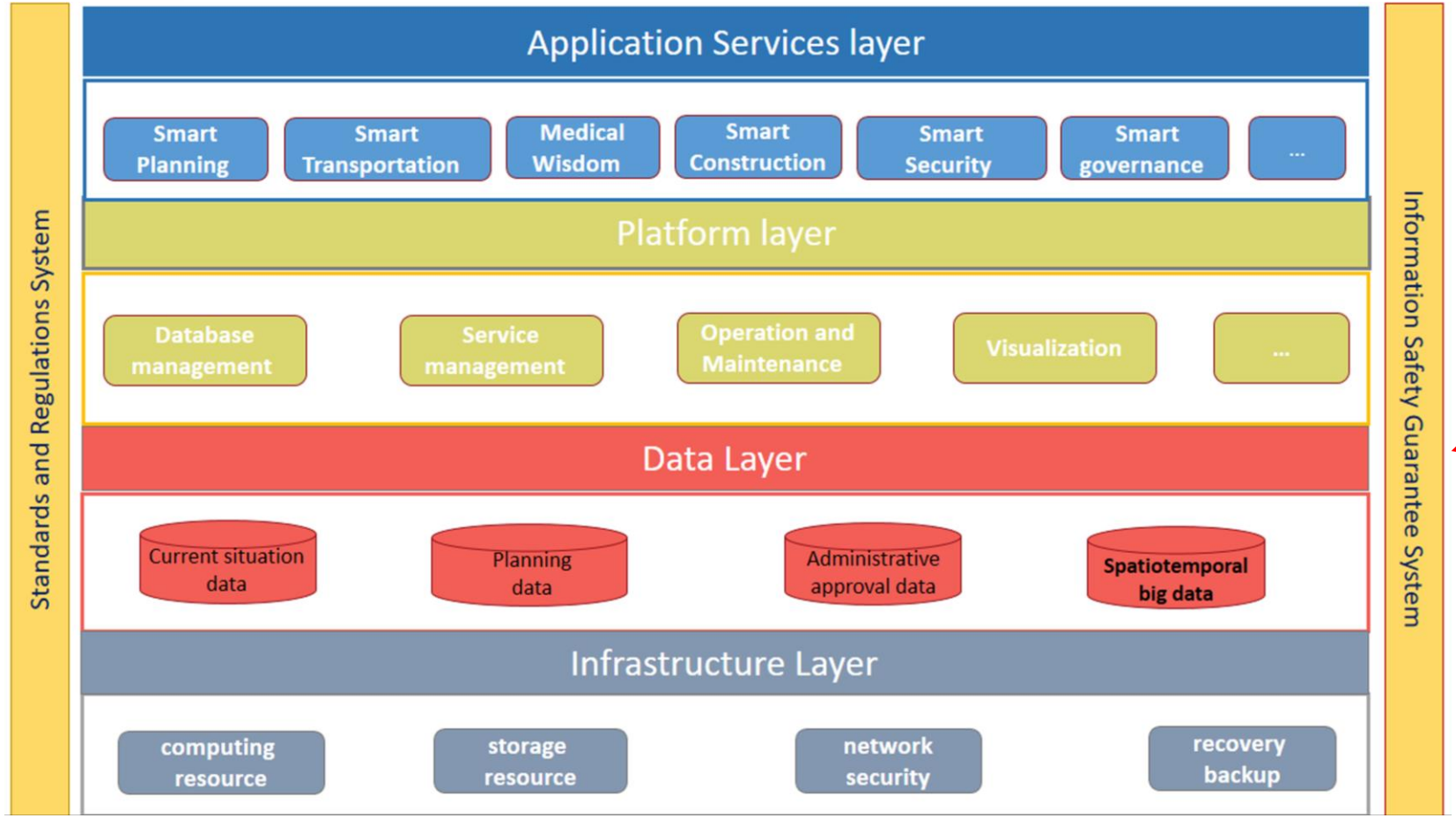
[Source: ISO/IEC CD 30173]

urban digital twin

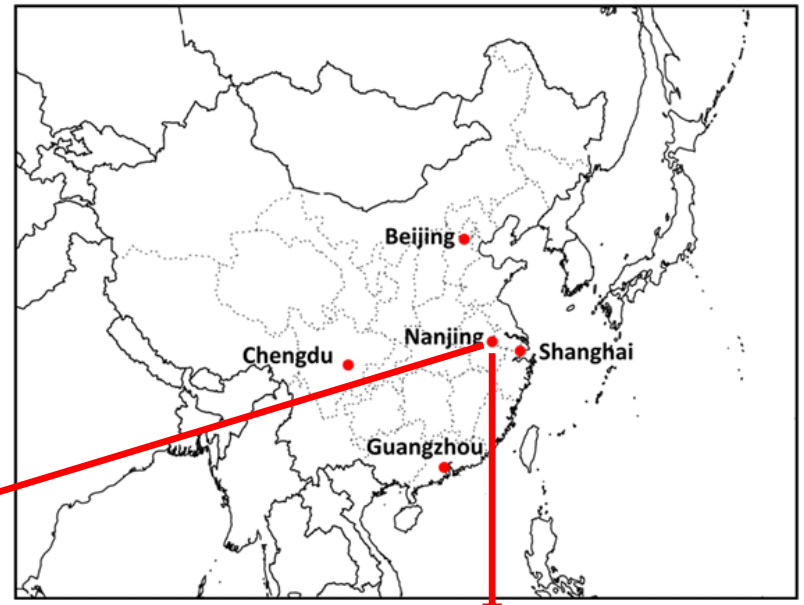
UDT

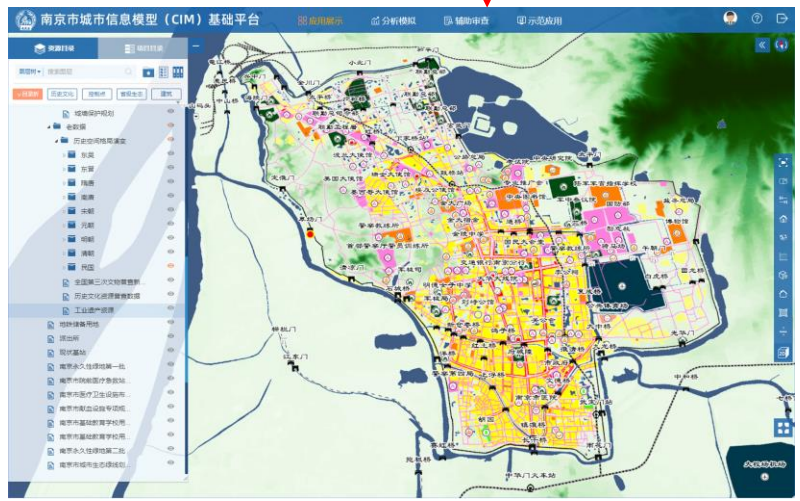
digital twin at the urban scale deployed to enable the transformation of how cities are planned, built and managed in order to deliver better services to make the urban environment more livable, inclusive, safe, resilient and sustainable

4 Case study: A city level CIM platform in Nanjing, China (1)

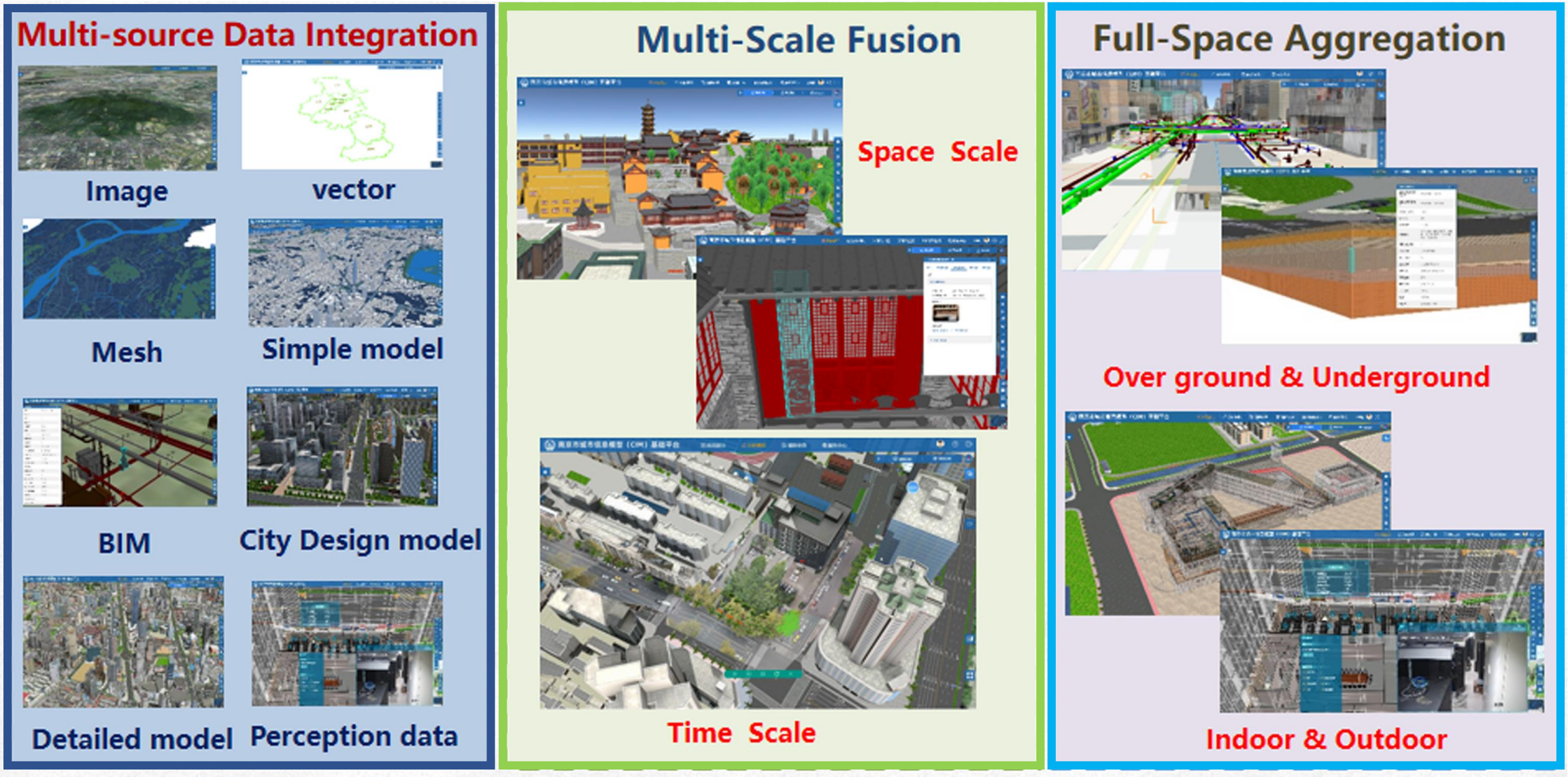


The architecture of the Nanjing CIM platform



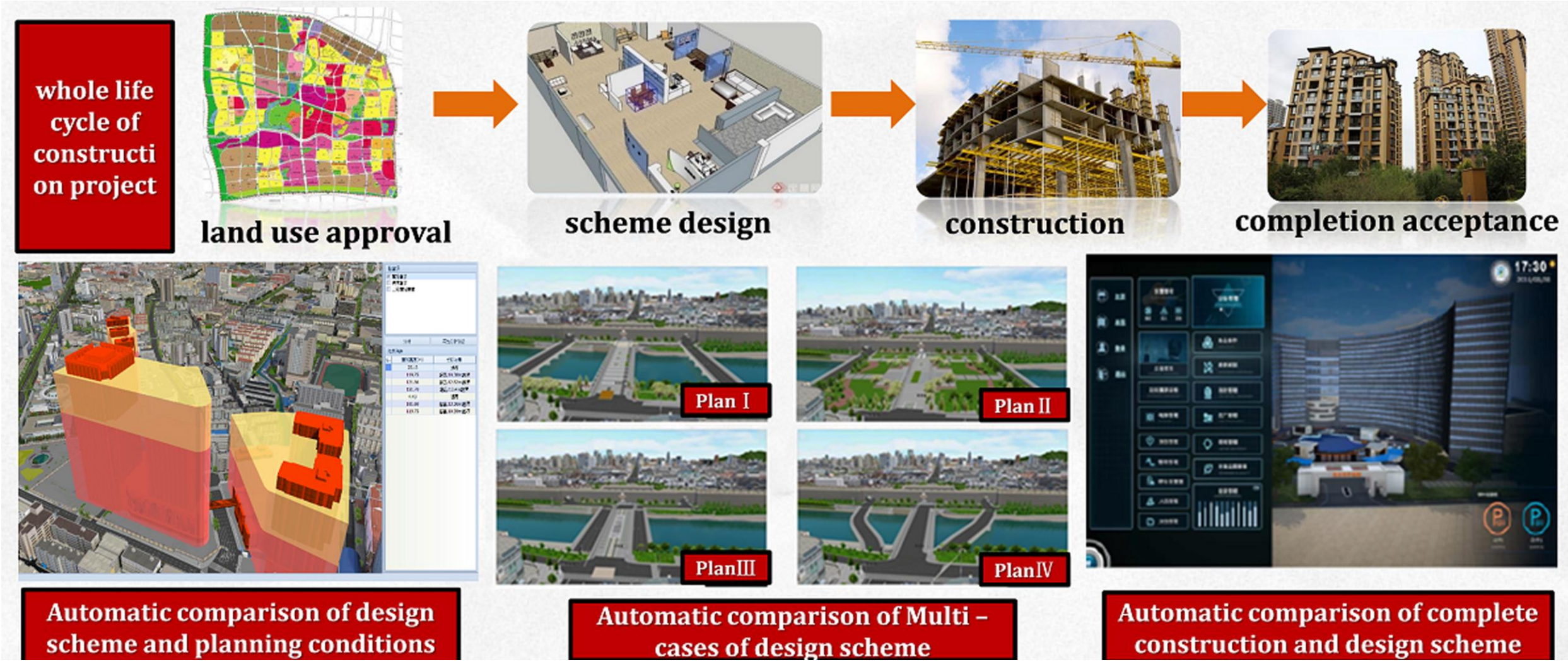


Case study: A city level CIM platform in Nanjing, China (2)



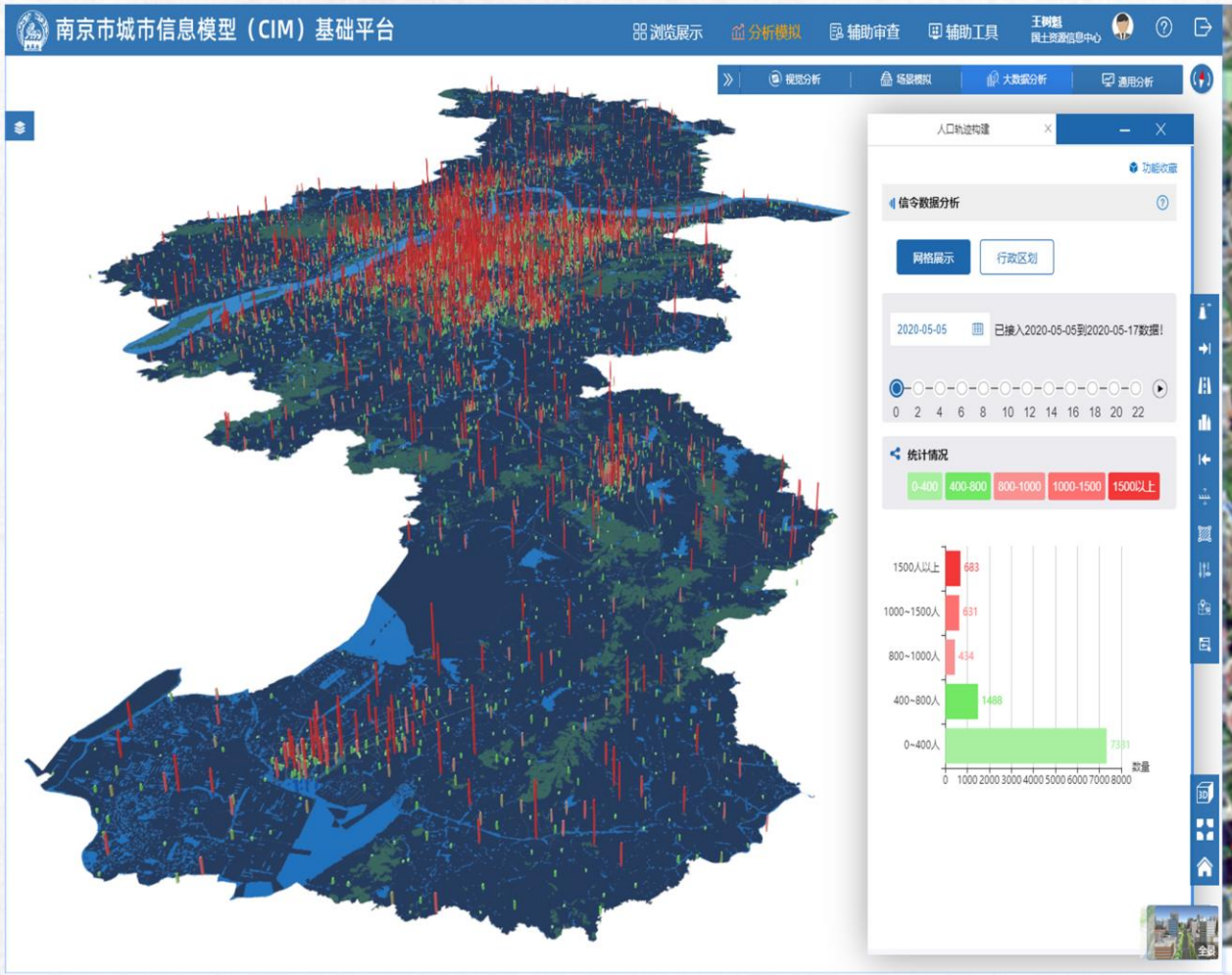
Different data in the Nanjing CIM platform

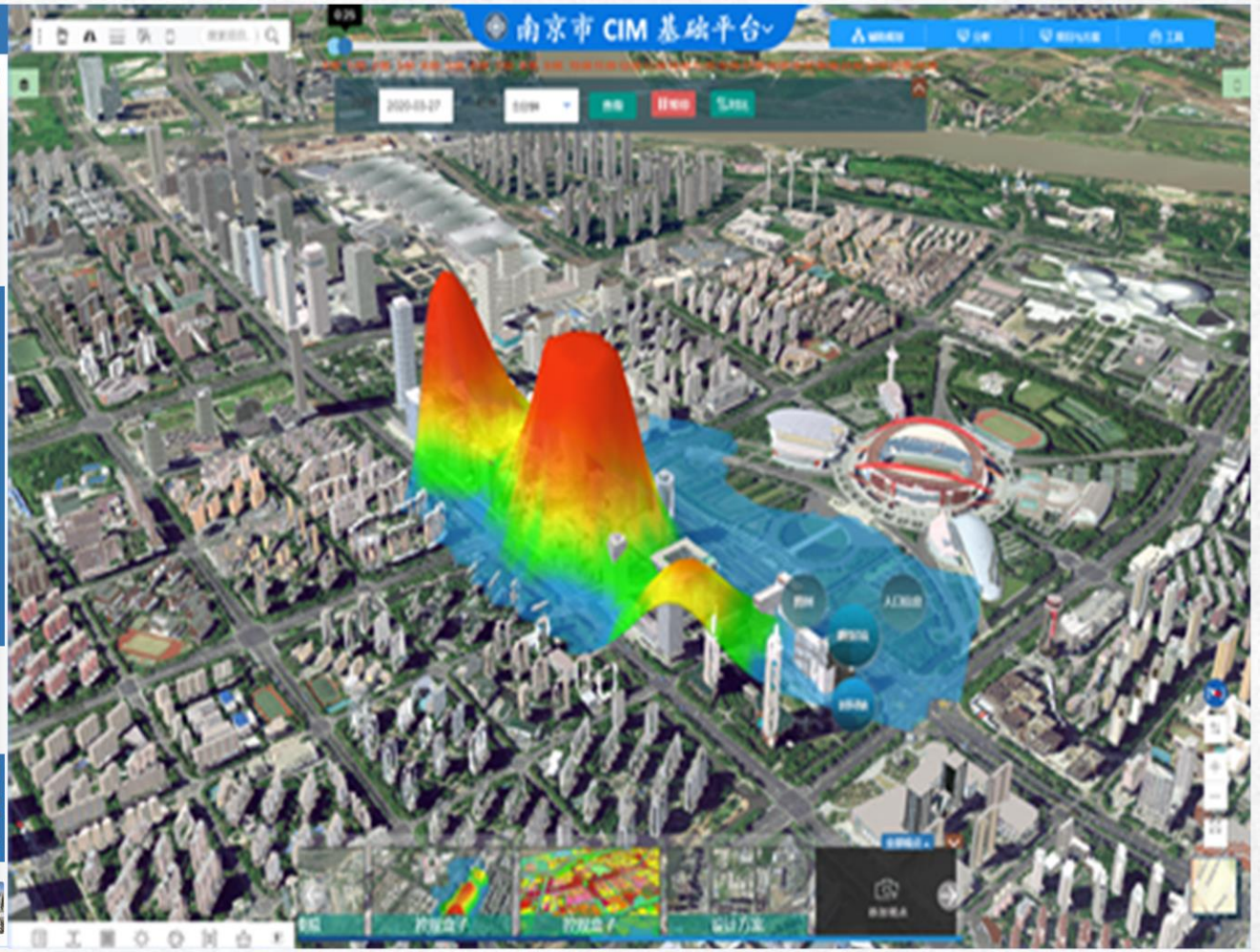
Case study: A city level CIM platform in Nanjing, China (3)



Applying CIM in the whole life cycle of construction projects

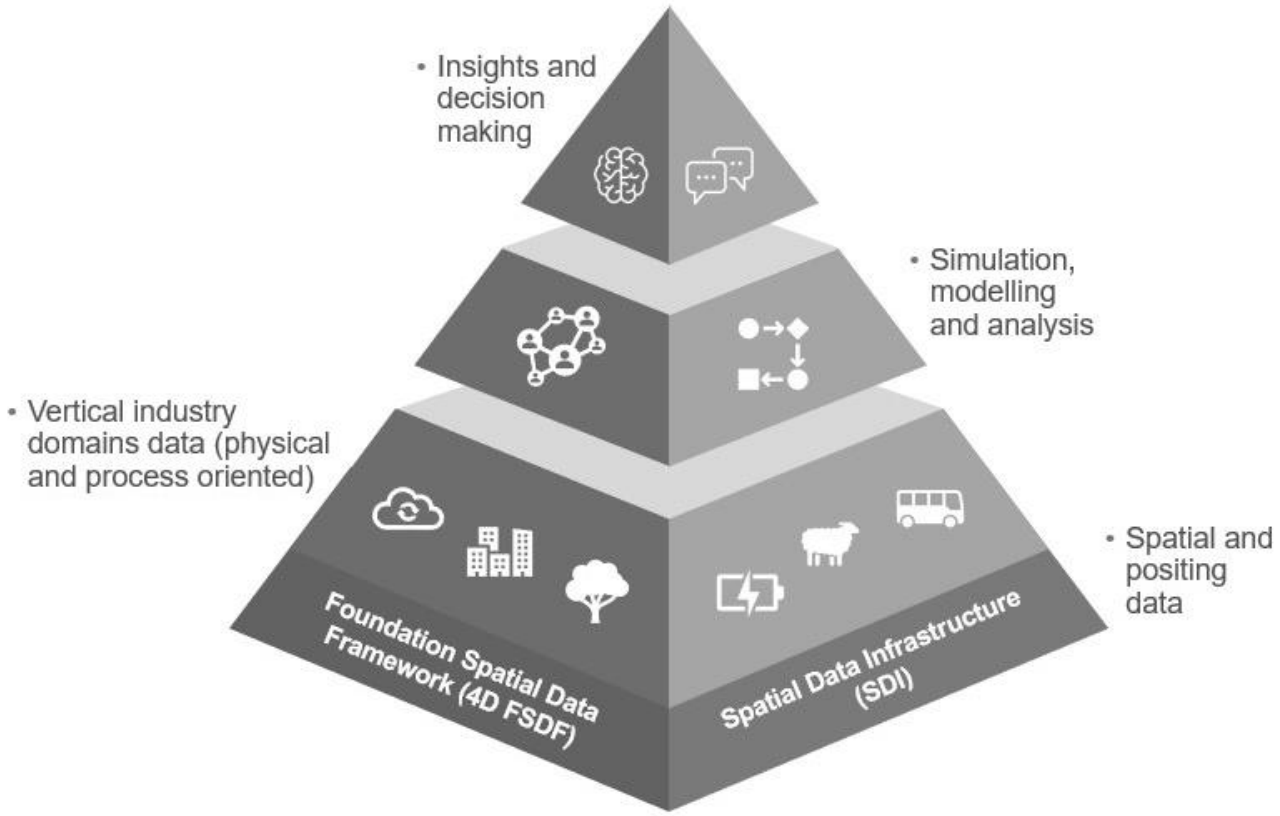
Case study: A city level CIM platform in Nanjing, China (4)





Application of “flow” data (e.g. population, mobile phone signals)

Case study: New South Wales spatial digital twin (1)



The framework of urban digital twins in New South Wales, Australia

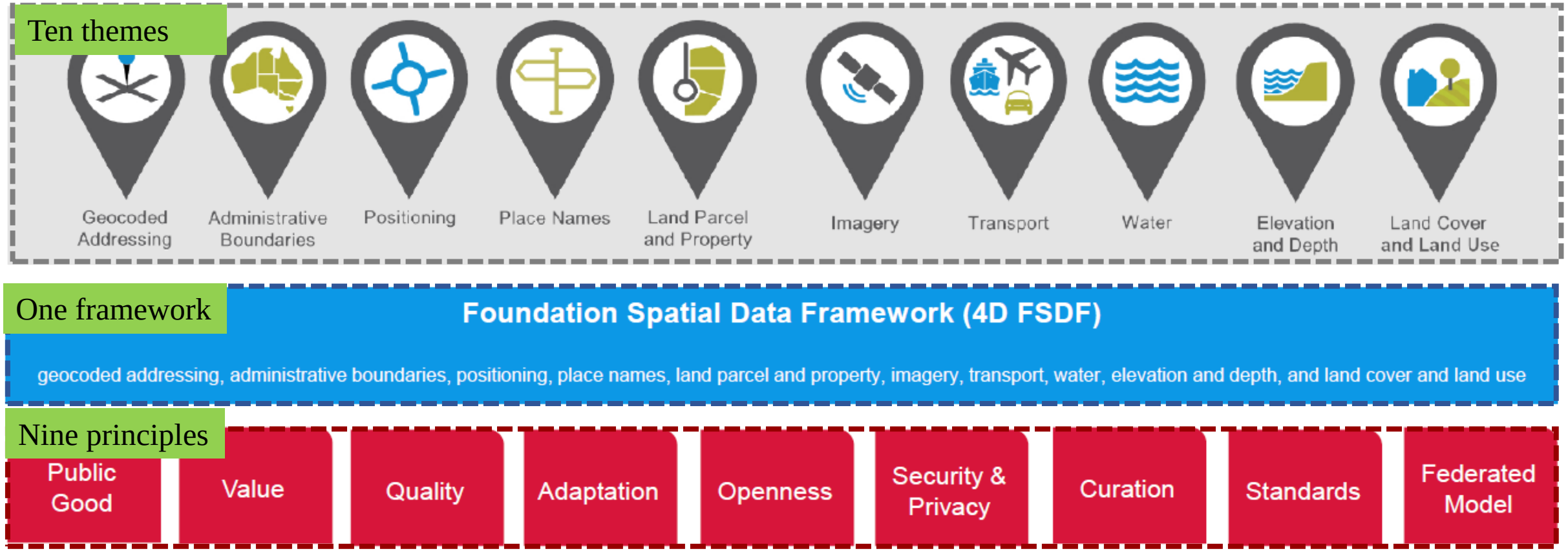
NSW GOVERNMENT Spatial Services

NSW GOVERNMENT NSW Spatial Digital Twin

Urban decision-making: focus and tools

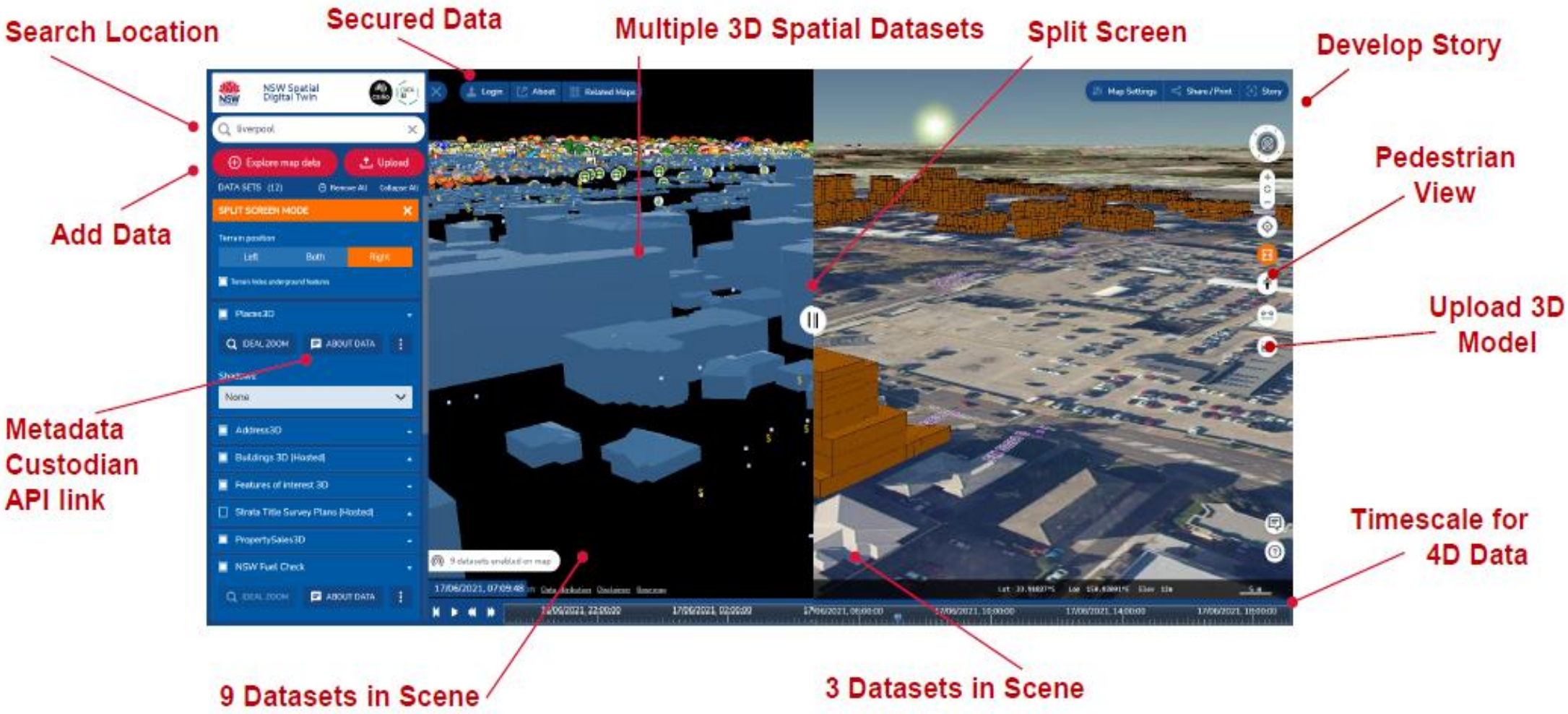
Urban decision-making	Spatial analysis tools
Place-based design	Cluster
Land use	Proximity
Planning	Simulation
Liveability analysis	Modelling
Subterranean infrastructure	Nearest neighbour analysis
Resilience planning	Buffer zone
Health	Geometry analysis

Case study: New South Wales spatial digital twin (2)



The structure of New South Wales spatial digital twin

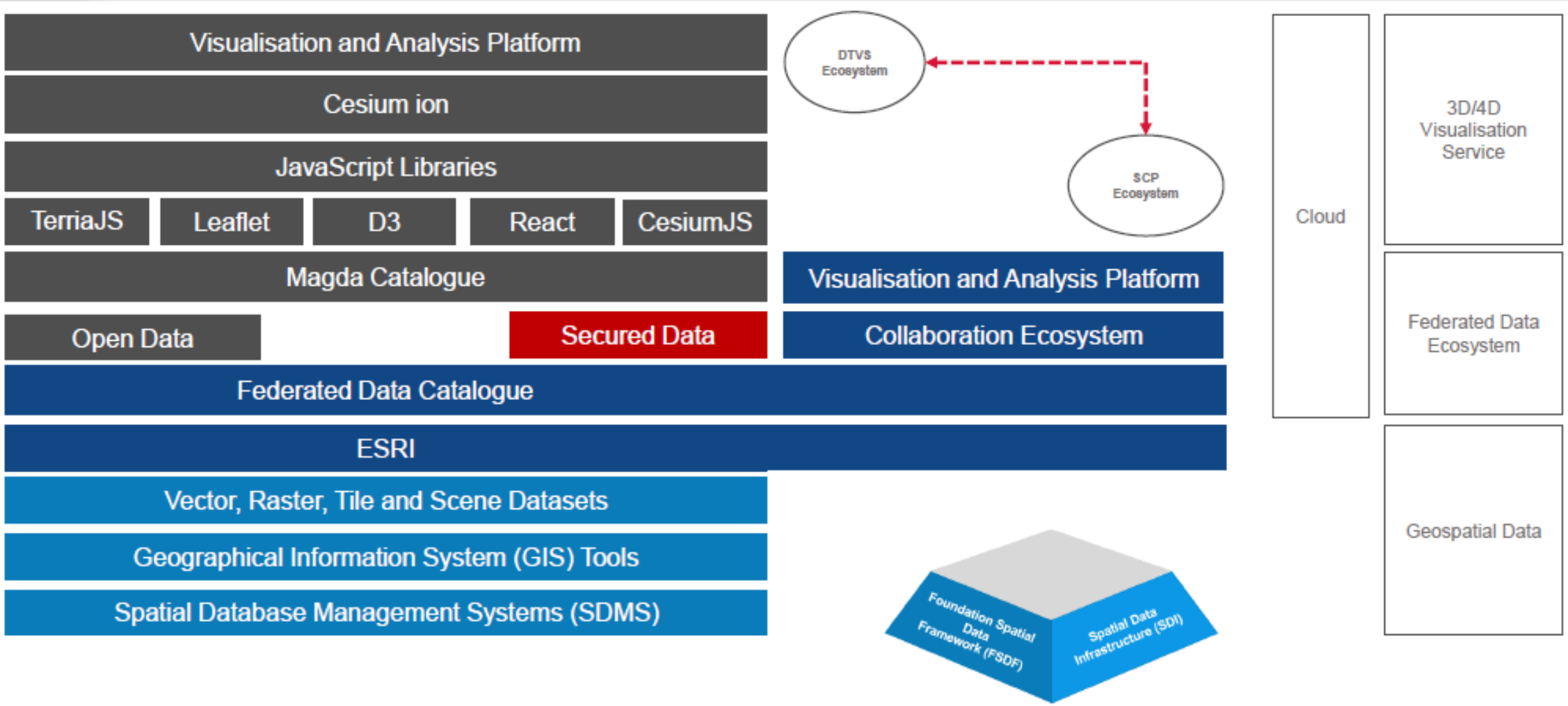
Case study: New South Wales spatial digital twin (3)



The platform interface: selected key features

Website of New South Wales spatial digital twin: https://nsw.digitaltwin.terria.io/

Case study: New South Wales spatial digital twin (4)



Technology stacks and systems of the New South Wales spatial digital twin platform

The overlaps and differences between CIM & UDT

Overlaps

- **Aims:** To enable better urban planning and city management (maintenance, monitoring and modelling the city and urban environment) by using data and smart technologies
- **Functions:** comprehensibly model city infrastructure digitally, trace the physical object in the city, monitor and simulate the object in virtual spaces, progress through physical to digital transformation activities, monitor the interaction between the digital and physical worlds
- **Data:** Integrate multiple data from different sources and involve different formats and different levels (micro, meso, and macro)
- **Technology support:** Both CIM and UDT are reliant on developing technologies, such as GIS, IoT, big data, could computing and AI.

The overlaps and differences between CIM & UDT

Differences

City Information Modelling	Urban Digital Twins
• CIM has arisen from BIM as foundational data in the modelling and development of city data management • BIM and GIS are two critical important foundations for CIM	• The concept of digital twins originated in mechanical engineering and the Finite Element Method • Digital twins emerged from manufacturing such as those conducted by NASA and Formula One racing cars
• CIM can be seen to show a preference for the model, tooling and technologies	• UDT can be seen in their composition as discrete ecosystems that can be linked, this reflecting back to the origins of technology within the product and facility twinning
• CIM employed a built environment context at an early stage of its theoretical developments	• UDT focus on the transformation of the physical into the virtual world, and the reactions and simulations that occur between the virtual and physical environment
• CIM starts from the perspective of the whole city and solutions affecting the city as a whole	• UDT can be seen emerging from this smaller product and component viewpoint to the larger contextual environment
• Proponents of CIM see the value of the model of the city they can generate, not only to plan but also to help with the ongoing management of the city	• UDT brings the experience from industry of using digital models not only to predict, but also to monitor and manage performance

The challenges to the deployment of UDT and CIMs

Challenges

- Both CIM and urban digital twins are still at an early stage, and they face common challenges and questions for their future development
  - Including data silos, the usability and usefulness of applications for stakeholders, integration/interoperability, openness, regulation, and the development of the necessary skills and education
- Models, data, and software are important components for both CIM and UDT and both need to meet the challenges of data collection, data management and security sharing
- We need standards that address the following issues:
  - How can the different disciplines be aligned, and technologies be linked in CIM and UDT?
  - What are the standards for convergence of different types of data in CIM and UDT?
  - How can the public be involved in the development and usability of CIM and UDT when used for consultation and to support citizens in managing their lives in the city?
  - How can CIM and UDT support the communication between humans and virtual environments?

Standards and other developments required for CIM and UDT

- An integrated reference architecture of CIM and UDT needs to be developed.
- Enabling the connection of different types of city data needed by CIM and/or UDT should be one of the focuses for standards work.
- A full set of use cases of CIM and UDT for different application areas/scenarios is needed to identify the requirement of standards for CIM and UDT.
- Standards for CIM and UDT platforms are needed.
- Collaborative standards work among the different SDOs is vital to develop effective standards for CIM and UDT.
- The above challenges/work required the researchers, front-line practitioners, standards workers, policy makers and other stakeholders to work together for a breakthrough.

Standards and other developments required for CIM and UDT

Technology Report

IEC

City information modelling and urban digital twins

iec.ch/basecamp/city-information-modelling-and-urban-digital-twins

Advanced search | Webstore | e-tech | Online learning | Contact us | My IEC

International Electrotechnical Commission

Standards development | Conformity assessment | Where we make a difference | Who benefits | News & resources | Programmes & initiatives | Who we are

Home / Basecamp / City information modelling and urban digital twins

City information modelling and urban digital twins

2021-12-01

Available for download: English

Download | Share | Order paper copy

The development and delivery of smart cities involves many different systems, types of data, and sets of information. This complexity, and the dynamic interaction between the large numbers of stakeholders and city systems, makes planning and managing cities a great challenge. Without a tangible operational model to combine cross-sector data and information, the holistic, cross-boundary planning of cities, districts and neighbourhoods remains constrained. Therefore, new and effective tools are needed to enable the delivery of better city services and to make the urban environment more liveable, inclusive, safe, resilient and sustainable.

City information modelling (CIM) and urban digital twins (UDT) are two emerging technologies for smart cities that aim to provide such tools. Both offer solutions for data processing, urban analysis, design, simulation and modelling. They connect all involved stakeholders and actors to collaboratively deliver the vision of a smart city: a sustainable, inclusive, healthy, prosperous and participative city. They provide solutions for smart cities based on open standards and a multiscale and multitemporal database that integrates a wide variety of data sources presenting the full range of smart urban features, systems and processes.

https://www.iec.ch/basecamp/city-information-modelling-and-urban-digital-twins

City Information Modelling and Urban Digital Twins Joint Working Group (CIM & UDT JWG)

CIM & UDT JWG core:

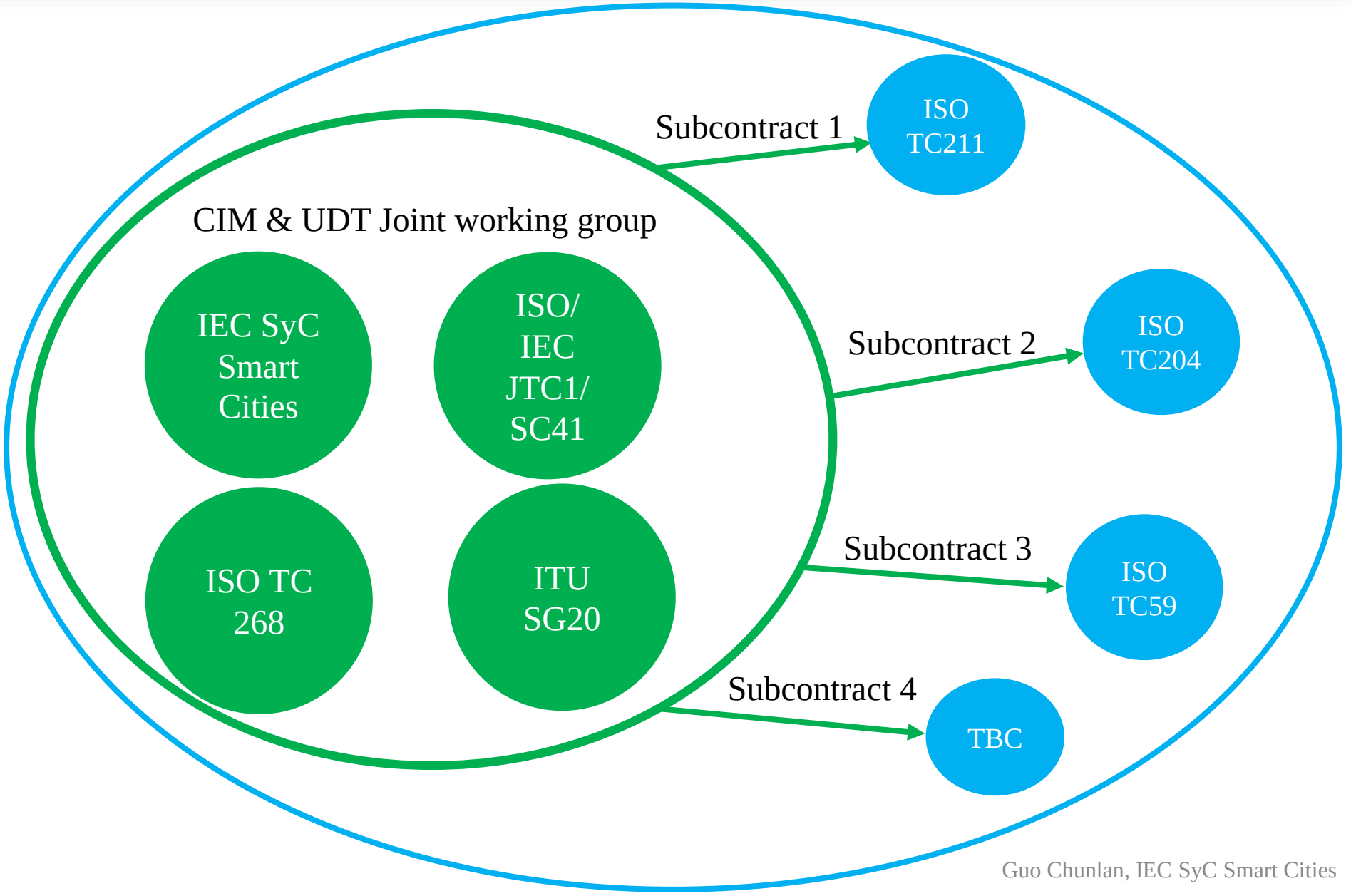
- IEC SyC Smart Cities
- ISO/IEC JTC 1/SC 41 Internet of things and digital twin
- ISO/TC 268 Sustainable cities and communities
- ITU SG20 Internet of things (IoT) and smart cities and communities (SC&C)

CIM & UDT JWG collaborators:

- ISO/TC 211 Geographic information/ Geomatics
- ISO/TC 204 Intelligent transport systems
- ISO/TC 59 Buildings and civil engineering works

This JWG will be mandated to:

- Examine the state-of-art of CIM & UDT through worldwide case studies
- Collect and analyse use cases of CIM & UDT, and use these to develop requirements for the standards needed for the implementation of CIM & UDT
- Develop those standards relating to CIM & UDT that are within its competence, including an integrated reference architecture for CIM & UDT



Acknowledgement

- Michael Mulquin, IEC SyC Smart Cities
- François Coallier, École de technologie supérieure, Montréal, Canada and ISO/IEC JTC 1/SC 41
- Furong Wang, Nanjing Land & Resources Information Center, China
- Prudence Lawrence, Spatial Services, NSW Government, Australia
- Dan Rossiter, British Standards Institution, UK
- Gavin Cotterill, Professional Construction Strategies Group, Australia
- Honghui Zhang, Guangdong Guodi Planning Science Technology Ltd., China
- John Turner, Gafcon Inc, San Diego, US
- Jorge Gil, Chalmers University of Technology, Sweden
- Josh Lieberman, Open Geospatial Consortium
- Jun Zhu, AsiaInfo Technologies Ltd., China
- Richard Ferris, Independent Consultant, Australia
- Sha Wei, ISO/IEC JTC 1/SC 41
- Vi Le, BridgePoint Advisory, Australia
- Wayne Patterson, Spatial Services, NSW Government, Australia
- Yiling Jian, Guangdong Guodi Planning Science Technology Ltd., China
- Biao Liu, IEC SyC Smart Cities

Thank you!

TACK!

- Contact:
- Dr. Chunlan Guo, chunlanguo@outlook.com