Urban digital twins

Mobilising Mobility

Like two peas in a pod - Digital Twins for urban planning

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European Commission

Digital twin: digital replica of an object, process or service that exists in the physical world, with a connection between the physical object and its virtual representation

- Notion originally developed for industrial systems and is widely used in manufacturing, construction and aerospace

- Digital twins are used for real-time monitoring, remote control of systems, scenario-testing and strategic planning

- 75% of organisations implementing IoT already use Digital Twins or plan to, within a year (Gartner, 2019)

- Urban digital twins and city modelling deployments are expected to grow from just a handful in 2019 to more than 500 by 2025 (ABI Research, 2019)

- **Promising use cases for sustainability & resilience**:
  - Extreme weather events
  - Reaction to acute shocks and crisis management
  - Efficient, sustainable, urban planning
  - Economic development and growth
  - Mobility, logistics
  - Built environment
  - Open and participatory city governance

Source: LEAD project

- Urban digital twins are the **virtual representation of a city's physical assets, processes and services**

- Connected to **data** related to those 'assets' facilitates AI algorithms, data analytics and machine learning

- Combining numerous technologies to create digital **simulation models** that can be updated and changed (**real-time**) as their physical equivalents change

- Providing **a risk-free testing environment** that increases the precision of long-term predictions, improves monitoring and impact assessment of certain decisions for the city's ecosystem

- **Possible benefits**: operational efficiencies, cost savings, more informed decisions, adaptation to climate change, increased resilience, effective urban planning and urban infrastructure management, crisis management, effective coordination of emergency services, participatory governance, improved services for citizens and increased safety and security

Urban digital twins can change the way cities are planned, operated, monitored and managed (*'policy-ready-data-as-a-service'**)
'A playground for city planners' **

* DUET project
** OASC
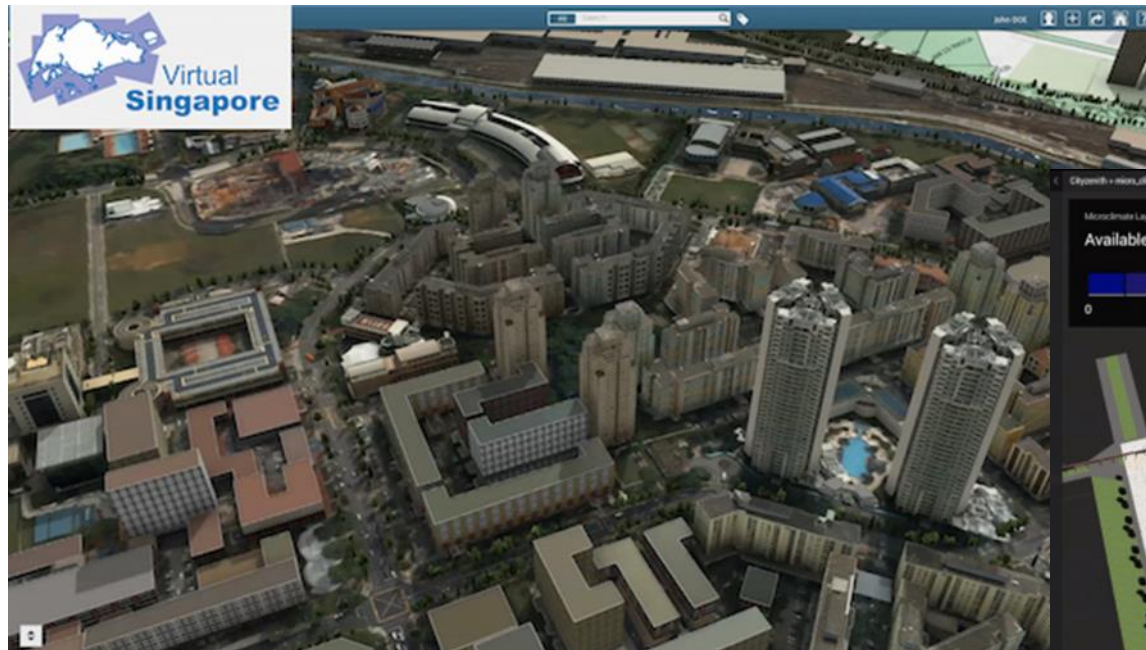
Virtual Singapore
(Virtual testing of 21 buildings leading to energy savings of 31% and cost savings of USD 4.7 m)*

+ Australia & New Zealand, Jakarta, Indonesia, and Cauayan City in Philippines, municipalities in Turkey …

Amaravati, India - the first entirely new city to ever be born as a Digital Twin

* Source: Weekes, 2019

Newcastle

Port of Rotterdam

3D copy of Antwerp

Helsinki

SPHERE
BIM DIGITAL TWIN PLATFORM

Buildings in Finland, Austria, Italy and Netherlands

LEAD

Madrid, The Hague, Budapest, Lyon, Oslo and Porto

DUET

Flanders, Athens, Pilsen

+ Amsterdam, Angers, Cambridge, Gothenburg, Herrenberg, Kongsberg, Paris region, Rennes, Stockholm…

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Challenges:

- Governance & orchestration
- Value models
- Data
    - Data availability and sharing
    - Data governance and stewardship
    - Shared data models and standards
- Cybersecurity and privacy
- Interoperability
- Limited access to appropriate infrastructure and computing resources
- Skills
- May be less effective in modelling complex social challenges at city-scale (e.g. social inequalities, disparities in pollution impacts)

Enablers:

- **Minimum Interoperability Mechanisms** (MIMs)
- Interoperable urban digital platforms to manage large amounts of cross-domain data (**Living-in.eu movement**)
- Common European dataspaces / Green Deal dataspace including '**data ecosystem for climate-neutral and smart communities**'
- Interoperability Framework for smart cities and communities (**IF4SCC**)
- Compliance with the **FAIR** (Findability, Accessibility, Interoperability, Reusability) data management principles
- **Cities for Digital Rights coalition**, supported by EUROCITIES

- Common European dataspaces / Green Deal dataspace & '**Destination Earth**' (digital twin of the Earth)

- High-Level Expert Group to improve the **trustworthiness of artificial intelligence** applications (including safety, privacy, transparency, fairness and social and environmental well-being and full accountability of outcomes)

- **Gemini Principles** for developing digital twins (Centre for Digital Built Britain, UK), including public good, security, openness, etc. and **Information Management Framework**, to guide practitioners to implement the Gemini Principles

- Towards the era of the **Spatial Web** (computing environment that exists in three-dimensional space—a twinning of real and virtual realities—enabled via billions of connected devices and accessed through the interfaces of virtual and augmented reality)

- **Discussion fora:**
  https://www.cdbb.cam.ac.uk/what-we-do/national-digital-twin-programme
  https://www.digitaltwinhub.org/
  https://www.digitaltwinconsortium.org/

- Common definition of urban digital twins, taxonomy, categories

- Shared understanding of the potential challenges / Common business requirements

- Ecosystem building

- Shared technical requirements (e.g. infrastructure, interoperability, information model, data exchange, modelling, analytics, simulation and visualisation tools and techniques)

- Agreement on data governance (through data spaces)

- Ensuring ethical use of AI (procurement conditions)

- Defining required skills

- Implementation paths for specific use cases

Source: DUET project

- Join the **Living-in.eu movement** (http://Living-in.eu) to share experience among cities, work with standard-based, interoperable and re-usable solutions

- Explore how your urban digital twin could support your city's **green/sustainability ambitions**

- Tap into possible funding through the new MFF and NextGenEU/Recovery and Resilience Facility

- Benefit from a forthcoming Coordination and Support Action, to build cities' capacity to create their own digital twin, under the **Digital Europe Programme** (Work Programme 2021-22)

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Join the movement:
European way of digital transformation in cities and communities

- Political Declaration: over 80 signatories

- Principles:
  - **Citizen-centric approach**
  - **a city-led approach at EU level**
  - **the city as a citizen-driven and open innovation ecosystem**
  - **ethical and socially responsible access, use, sharing and management of data**
  - **technologies as key enablers**
  - **interoperable digital platforms based on open standards and technical specifications, Application Programming Interfaces (APIs) and shared data models**

- Measures:
  - **Financial**
  - **Technical**
  - **Legal**
  - **Education and capacity building**
  - **Measuring and monitoring**
  - **+**
  - **Steering Board**

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LIVING-IN.EU
The European way of digital transformation in cities and communities

European Commission

The digital twin is one of the icon projects of living-in.eu
(http://beta.living-in.eu/)

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