Toward sustainable urban mobility using digital twins

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Plenary presentation at the “Mobility Innovation Workshop” organized jointly by Mobility Innovation Alliance Japan and ITS Japan, 14th November 2023, Asano Campus, The University of Tokyo

NWO

TU Delft

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Urbanisation increasing

Population growing world-wide; number of mega-cities increasing

EU: limited population growth; population in cities increasing, population in rural areas decreasing

https://www.un.org/development/desa/pd/
https://urban.jrc.ec.europa.eu/thefutureofcities/

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The Netherlands

17,5 Million population
41.850 km²

Randstad area
(Amsterdam, Rotterdam, The Hague, Utrecht)
8,5 Million population
11.370 km²

Population large cities growing (Amsterdam, Rotterdam, The Hague, Utrecht)

1 Million new houses planned by 2030

Mostly densification within existing cities

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1 Million new houses? What about accessibility and liveability ?

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- The road transport system has reached the limits of what is:
  - usage of space
  - externalities
- Public transport system has also reached capacity limits.

Can we imagine a city without private cars?

Scarcity of space
eX Car City
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XCARCITY?

XCARCITY facts and figures

- Duration: 1st June 2023 -1st June 2029
- Budget: 4 M€ by NWO, 2 M€ by partners
- 9 PhD candidates, 2 postdocs, 1 programmer, TNO researchers (60 person years)
- 33 partners from academia, public and private sector
- Lead by TU Delft: Bart van Arem (PI), Maaike Snelder (co-PI)

Perspectief programme of NWO (Dutch Research Council)

New, challenging research projects within the application-oriented and technical sciences that generate economic and social impact in thematic areas relevant to the Netherlands.

https://www.nwo.nl/en/researchprogrammes/perspectief/previous-awards

Smart mobility – promising solutions

Flexible combinations of:

- walking and cycling
- shared electric vehicles
- transport hubs
- traffic management

Building on service orientation and electrification of mobility.

Will this work?

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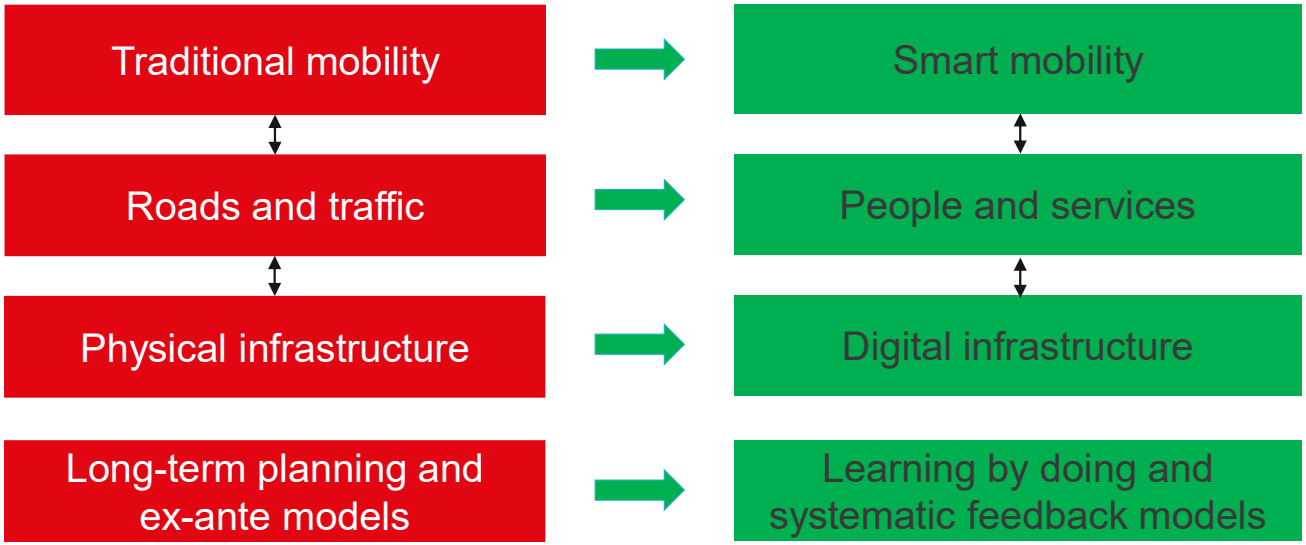
Traditional theories and methods are out dated



We need new theories and methods to start collecting evidence what works (and what doesn't).

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Proposition XCARCITY

Digital twin federation
Real-time management & Strategic planning

Model-based scenario development

Implementation of interventions

Real-life and virtual reality data

Monitoring and analyses

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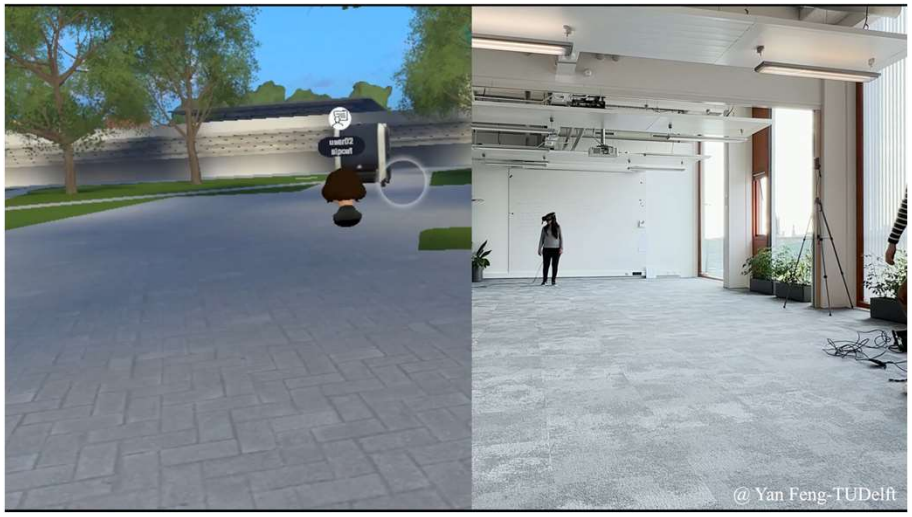

Interactive urban planning digital twin

Real-time mobility digital twin

Immersive, multi-user VR digital twin

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Scientific challenges

Measuring the behaviour of individuals and flows while respecting privacy and security

Developing smart mobility services that meet travel demands

Assessing the contribution of smart mobility to sustainable and inclusive accessibility.

In a context characterized by:

Multiple stakeholders

Highly dynamic interaction and feedback

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Towards content-rich digital twins

SP1 Framework, method and guidelines for optimal **sensor network design** and predictions

SP2 Insights in **behavioral responses**

SP3 Algorithms for and insights in the design of **smart mobility applications**

SP 6 Digital twin

SP4 Algorithms for and insights in the design of integrated transport networks

SP5 Algorithms for large-scale collection of mobility data for **traffic management**

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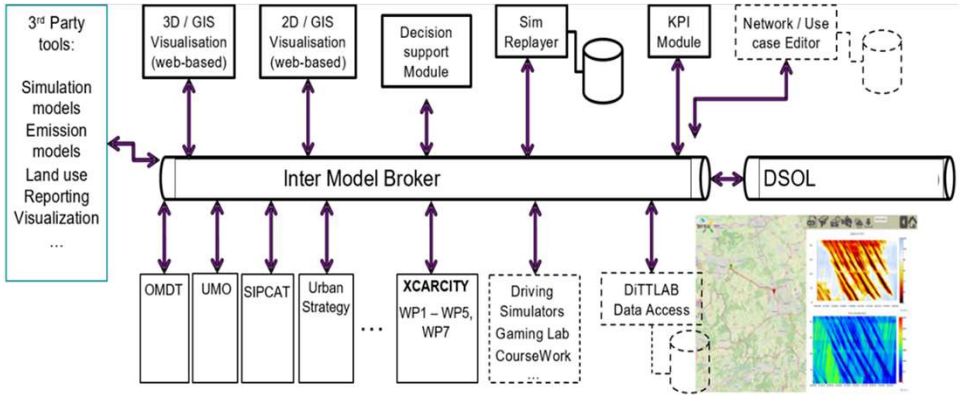
Digital twin federation



- 3D models of the cities selected for the use cases
- Open source model architecture of XCARCITY DT and communication protocol
- Visualisation dashboard and user interface
- Scenarios for selected use cases, with interactive options, visualisations and KPIs

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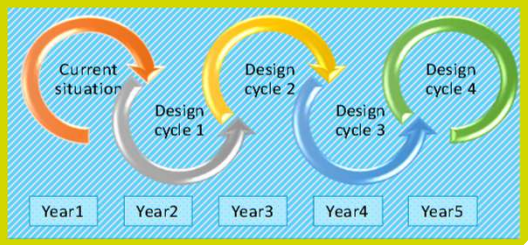
Utilisation approach

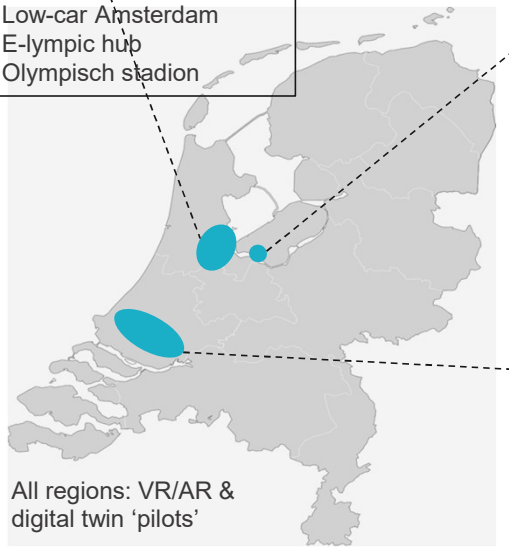
Pilots and applications, research by design, stakeholder interaction



Amsterdam and surroundings: centralized trip patterns

Pilots, e.g.
- Low-car Amsterdam
- E-lympic hub
- Olympisch stadion

Almere Pampus: a new city district



All regions: VR/AR & digital twin 'pilots'

Metropolitan region Rotterdam-The Hague: decentralized trip patterns

Pilots, e.g.
- BMW shared mobility
- MaaS pilots
- Dynamic road spaces

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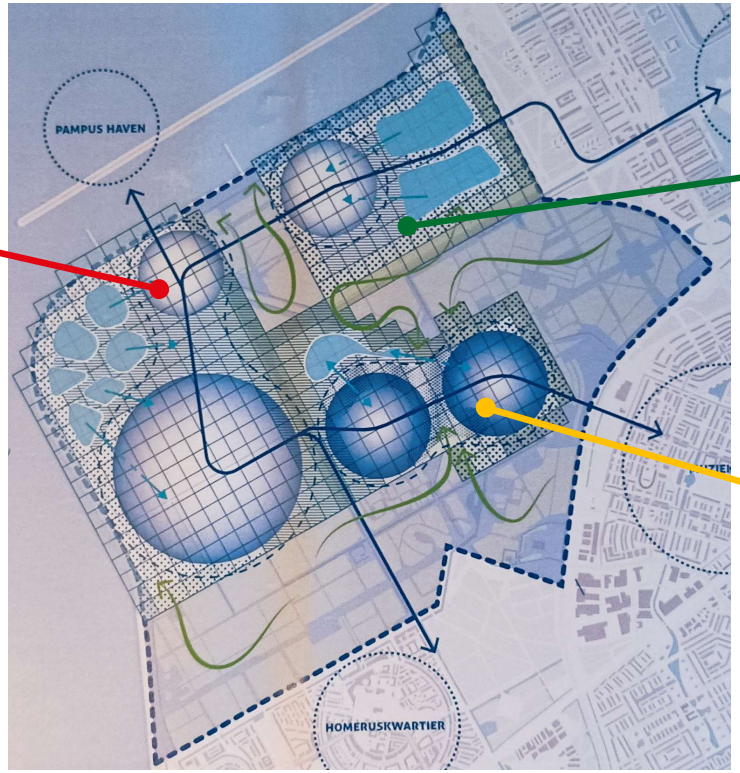
Annual Research by Design Sessions

mobility hubs



shared space

MaaS

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Toward sustainable urban mobility using digital twins

From transportation infrastructure to smart mobility service orientation.

Digital twin federation integrating data-driven and model-based approaches.

Collaborative what-if analyses of new smart mobility approaches to ensure sustainable and inclusive accessibility.

THANK YOU!

Future work:

Automated Vehicles in Shared Space
XCARCITY and climate change

SUM Lab
Sustainable Urban Multimodal Mobility

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https://www.linkedin.com/groups/12822203/

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