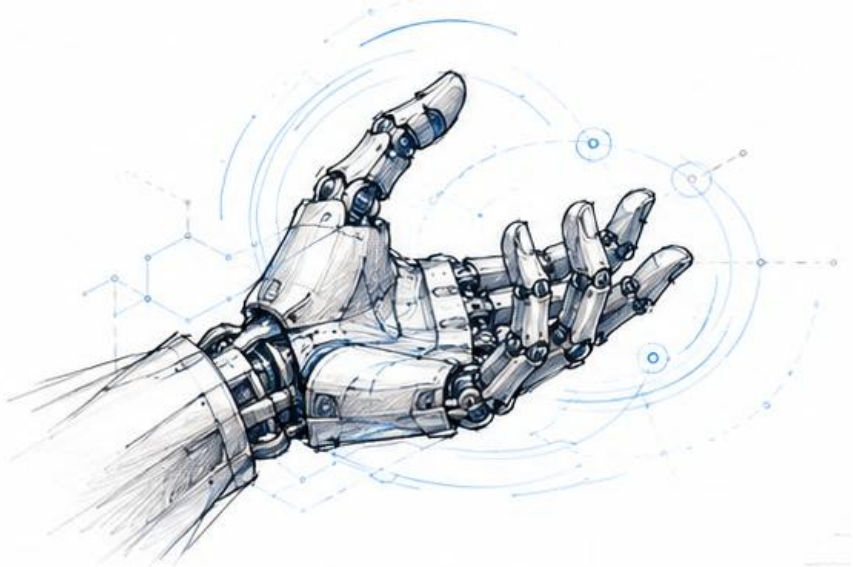
DIGITAL TWINS OF (URBAN) TRAFFIC

AIOS Guest lecture

By Floor Bontje

AIOS & DTS OF (URBAN) TRAFFIC

Inform e.g., institutional and governmental policy



HI!

- Background
  - Mechanical Engineer (**TU Delft**)
  - Specialized in biomechanical design and haptic interfaces
  - Graduated in Cognitive Robotics

- Current research
  - PhD candidate (**Utrecht University** & **TNO**)
  - *Modeling of Active Mobily in Urban Traffic: From Human Decision-Making to Digital Twins*
  - Cognitive models of decision behaviour of pedestrians and cyclists

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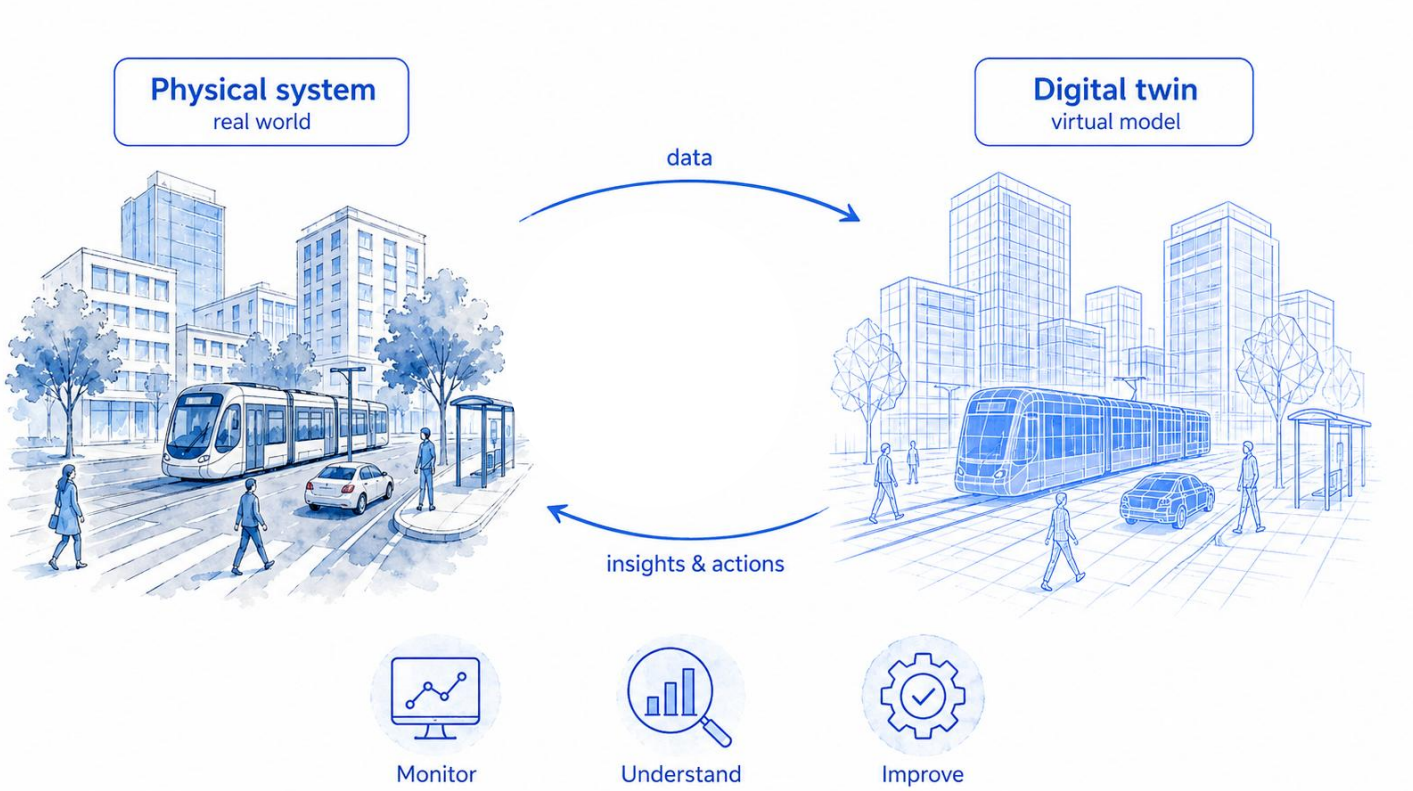
TOPICS

- What is a digital twin?
- Digital twins of urban areas & traffic
- Digital twins in the Netherlands
- Emerging techniques & challenges
- Relationship to IOS themes & SWOT analysis



WHAT IS A DIGITAL TWIN?

DIGITAL TWINS OF URBAN AREAS/TRAFFIC

Why?

- Cities are complex and constantly changing.
- Data from DTs can help make this complexity visible.
- DTs support faster and better-informed decisions.
- Traffic, air pollution, etc.

DIGITAL TWIN OF URBAN AREAS

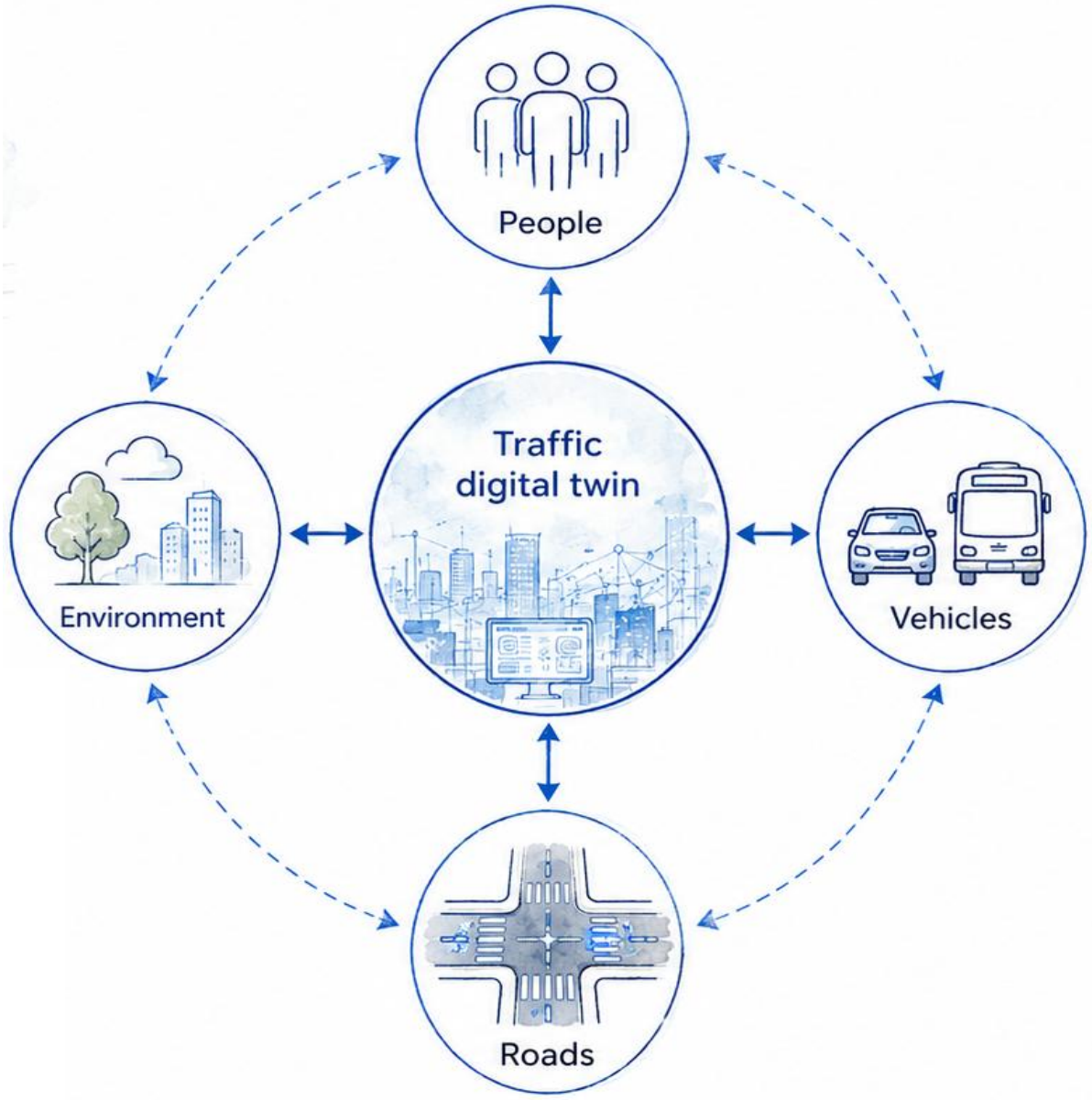
- Creates a virtual bi-directional model of the physical city.
- It can visualise urban processes in real time.
- It can support planning, management and decision-making.

DIGITAL TWIN OF URBAN TRAFFIC

- Traffic is one of the most important urban systems.

- Goal: predict and control traffic

But is this real or just a concept?



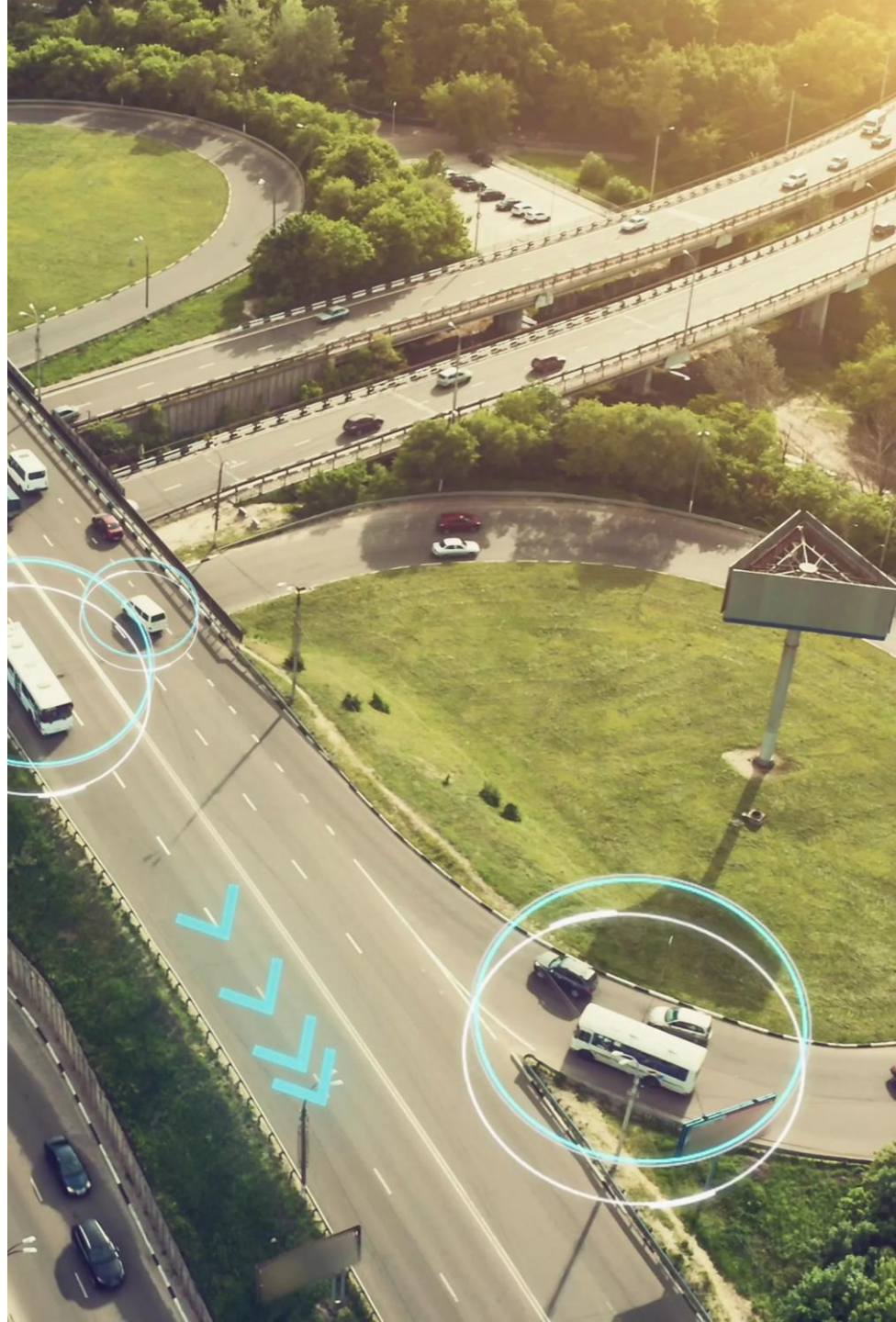
DIGITAL TWINS IN THE NETHERLANDS

- Digital **copies** of urban areas
- Used for spatial planning and decision-making
- Traffic is one important use case

- Dutch government aims to create **a network of local digital twins** (DMI project)
  - Each city its own twin
  - Knowledge interchangeable

DIGITAL TWINS IN THE NETHERLANDS: CURRENT STATE

- No “network” yet
- Shared data, models and visualizations
  - 3D city models
  - Dashboards
  - Simulations
  - Fieldlabs and practical pilots of (elements of) DTs



DIGITAL TWINS IN THE NETHERLANDS: CURRENT STATE

- Use Case: Traffic
- Safety and accessibility analysis
- Event planning/crowd management

- Scenario testing: “What if we close a road?”

But is this real business or just a concept?

TNO innovation for life | Sustainable | Healthy | Safe | Digital | Sectors | Careers | More | EN

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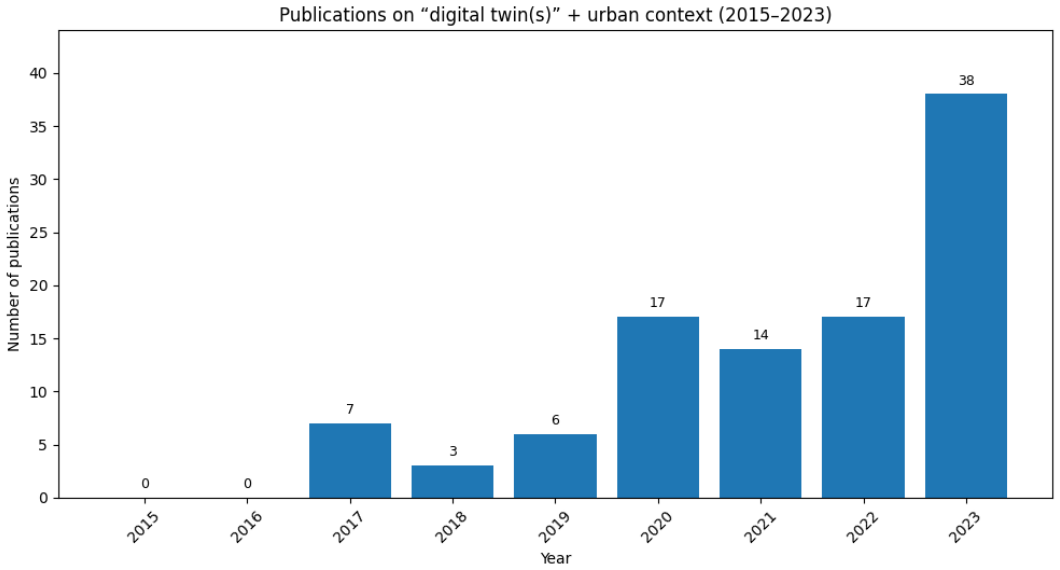
TNO spin-off Scenexus secures 1.6 million euro investment

Digital twinning 15 January 2025



* Indication of number of publications, not a result of a literature review

uCrowds

Home SimCrowds Projects Integration Blog

Advancing digital twins and crowd simulation with uConnect

By Roland Geraerts - 2025-01-09

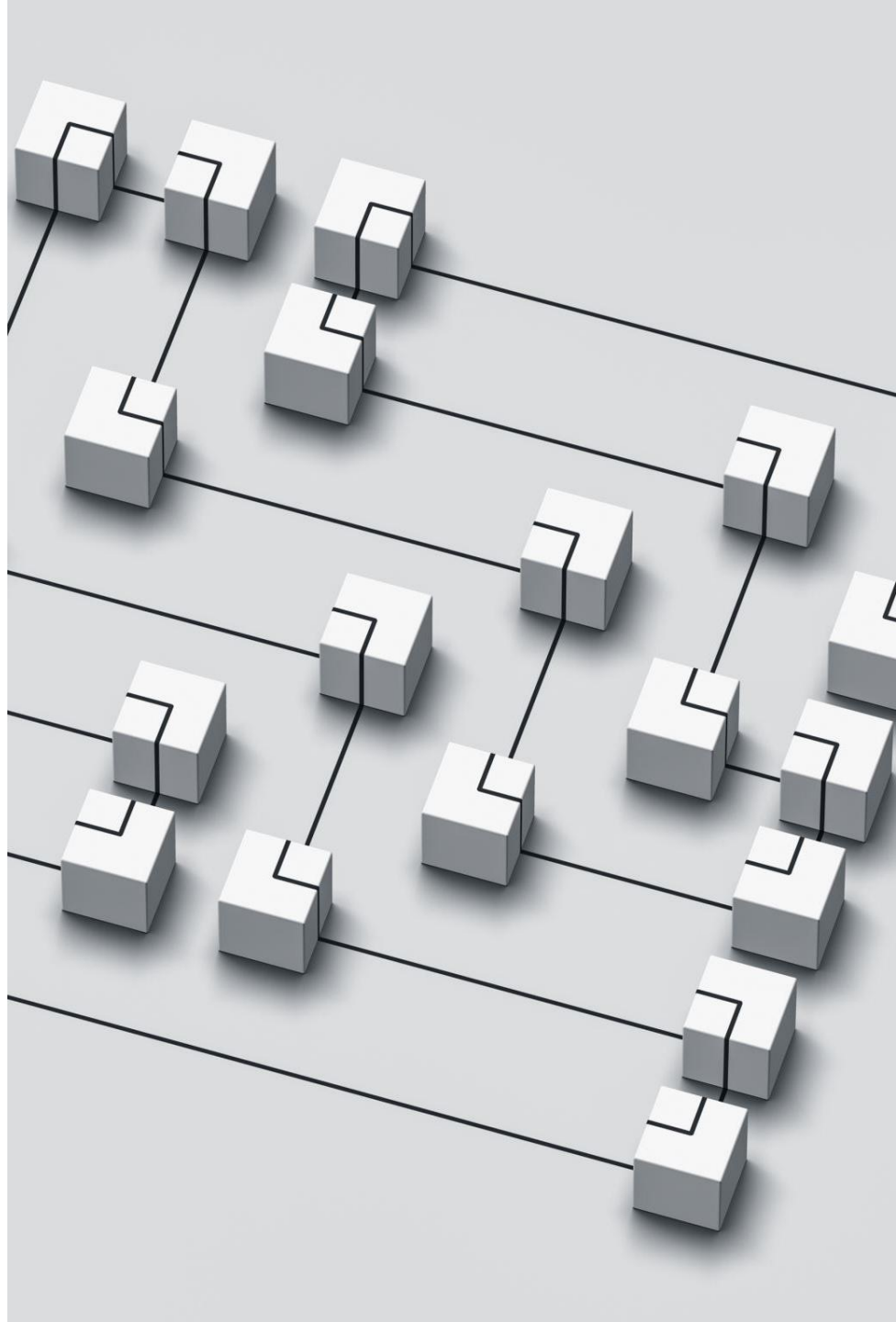
We’re continuously pushing the boundaries of crowd simulation and real-time data integration. Our latest development in the uConnect framework takes a significant leap forward—enabling live streaming of simulations from our SimCrowds product (powered by TerraCrowds) directly into any application.

Bringing Crowd Simulation to GIS

We’ve implemented a GIS server in uConnect, allowing it to generate dynamic data outputs in response to web requests. This makes it fully compatible with OGC standards like WMS and WFS, enabling seamless integration with GIS clients such as MapLibre, which is used in the MapGallery platform. This means we can now stream real-time crowd density maps and pedestrian locations into GIS systems, enhancing situational awareness and decision-making.

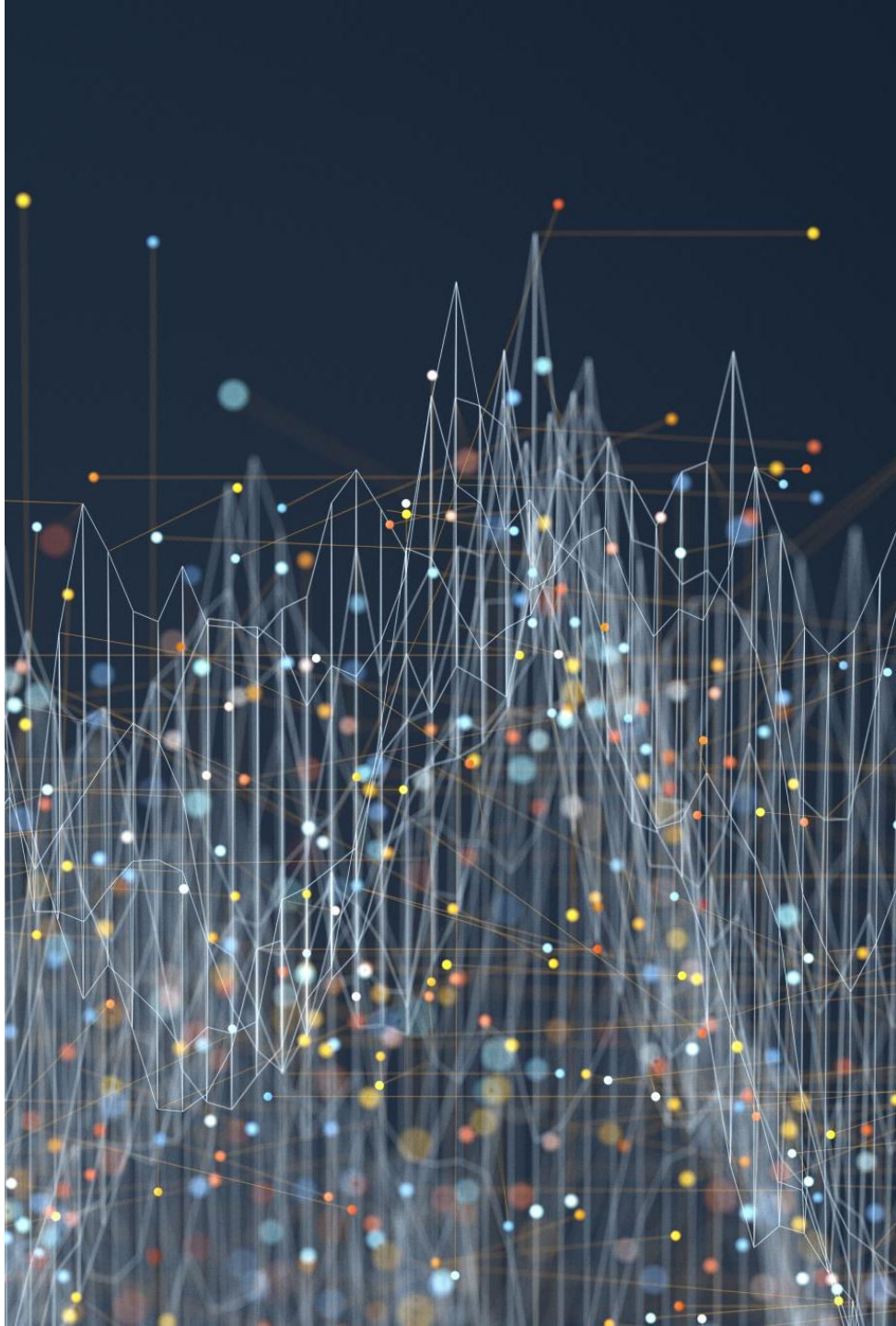
DIGITAL TWINS IN THE NETHERLANDS: FUTURE GOAL

- The aim is to move away from isolated pilots and closed systems toward open, modular reusable systems. (DMI project)
- A network of local digital twins
  - Reusable building blocks
  - Shared standards
  - Digital Twin as a Service
  - European Digital Twin Appstore



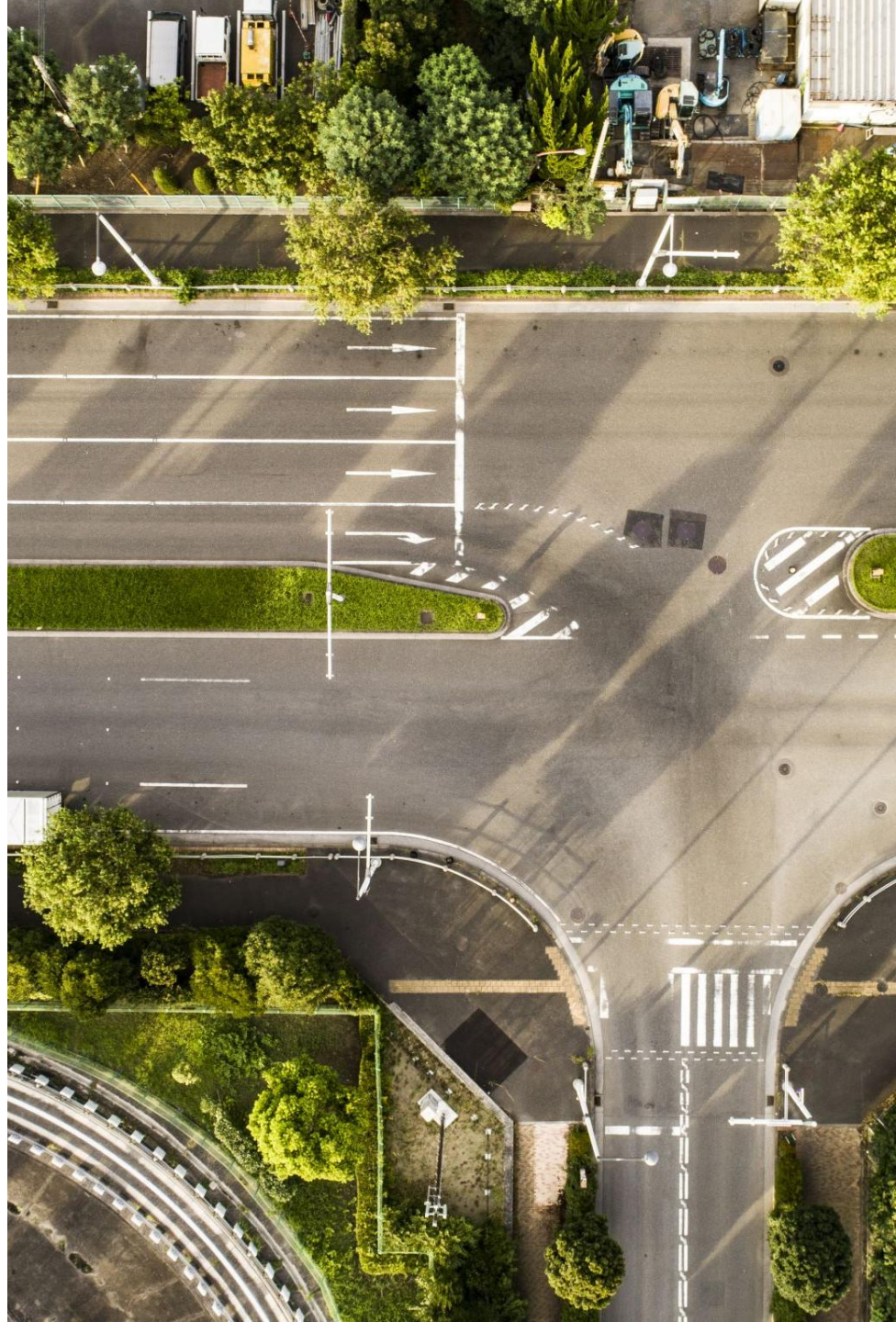
EMERGING TECHNIQUES

- 2D/3D visualisation
- AI and language-models
- Dynamic sensor data incl. real-time traffic detection with local AI



EMERGING TECHNIQUES: USE OF AI

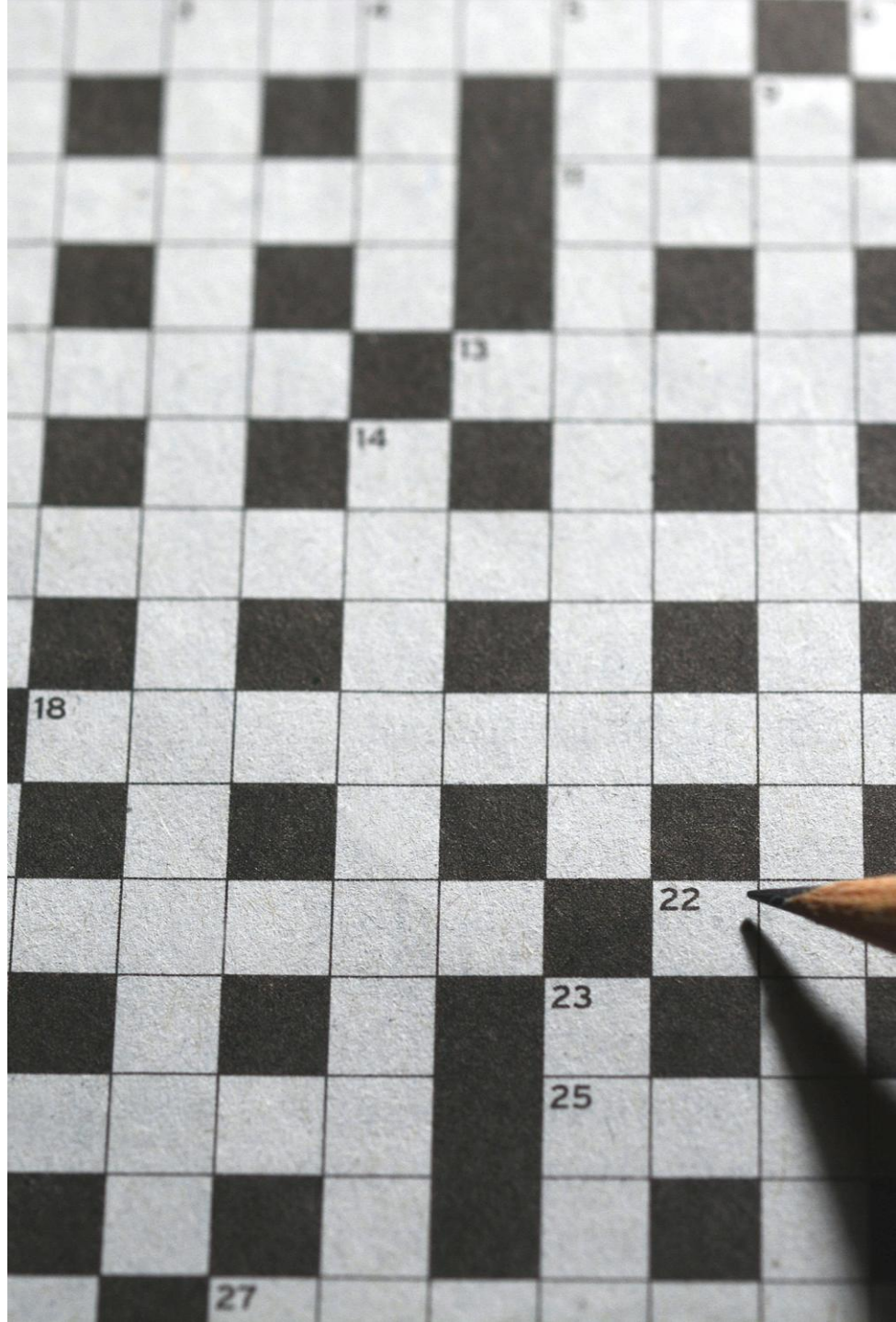
- Sensors collect real-time traffic data.
- Local computing processes data close to the street.
- AI can recognise traffic situations
- The system can give feedback to vehicles or traffic infrastructure.



CHALLENGES

- Many twins are still pilots
- Expensive custom solutions
- Dependence on one software provider
- Need for standards

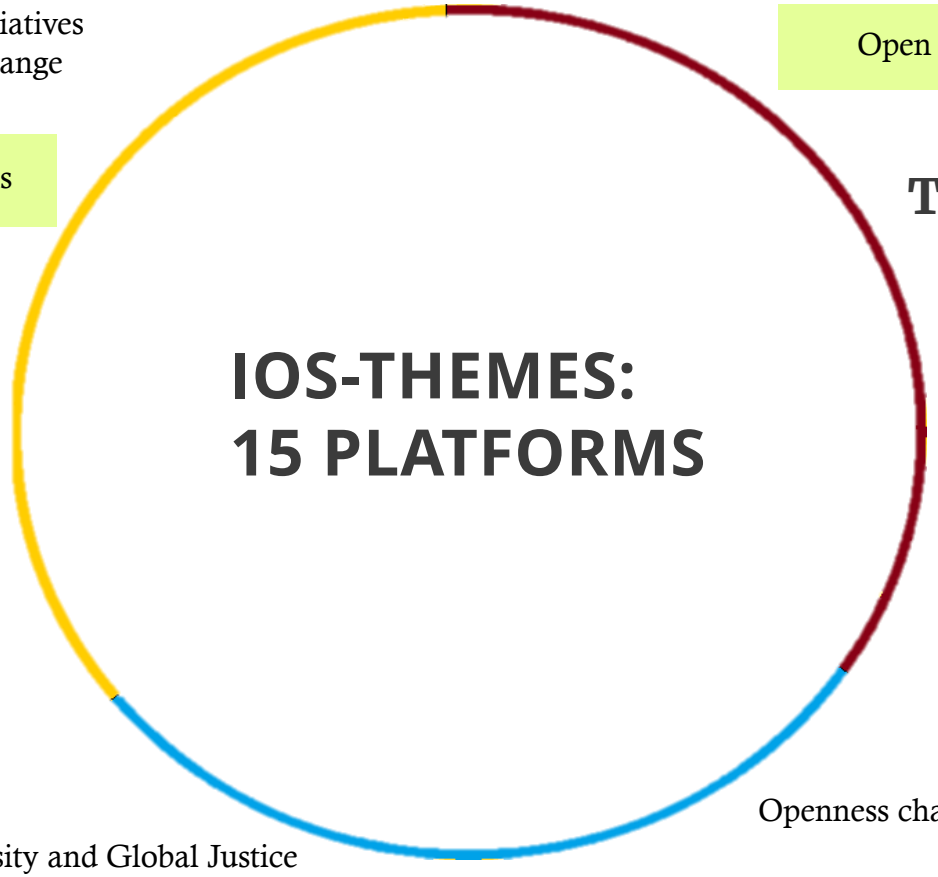
- Uncertainty in models



DT: MORE THAN A SIMULATION

- Represents the city virtually
- Connected to the real world
- Supports planning and decisions

The Netherlands is moving from pilots to a digital-twin infrastructure for urban and traffic applications.



Security in Open Societies

Bottom-up Initiatives
for Societal Change

Behaviour and Institutions

Democracy and good governance

Contesting Governance

Futures of Democracy

The Transactional State
as an Institution for Good

Future of Work

Open Cities

Transitions and well-being

Fair Transitions

Longtermism and Institutional Change

Markets and Corporations

Openness challenged: the university at risk?

Equality and diversity

Gender, Diversity and Global Justice

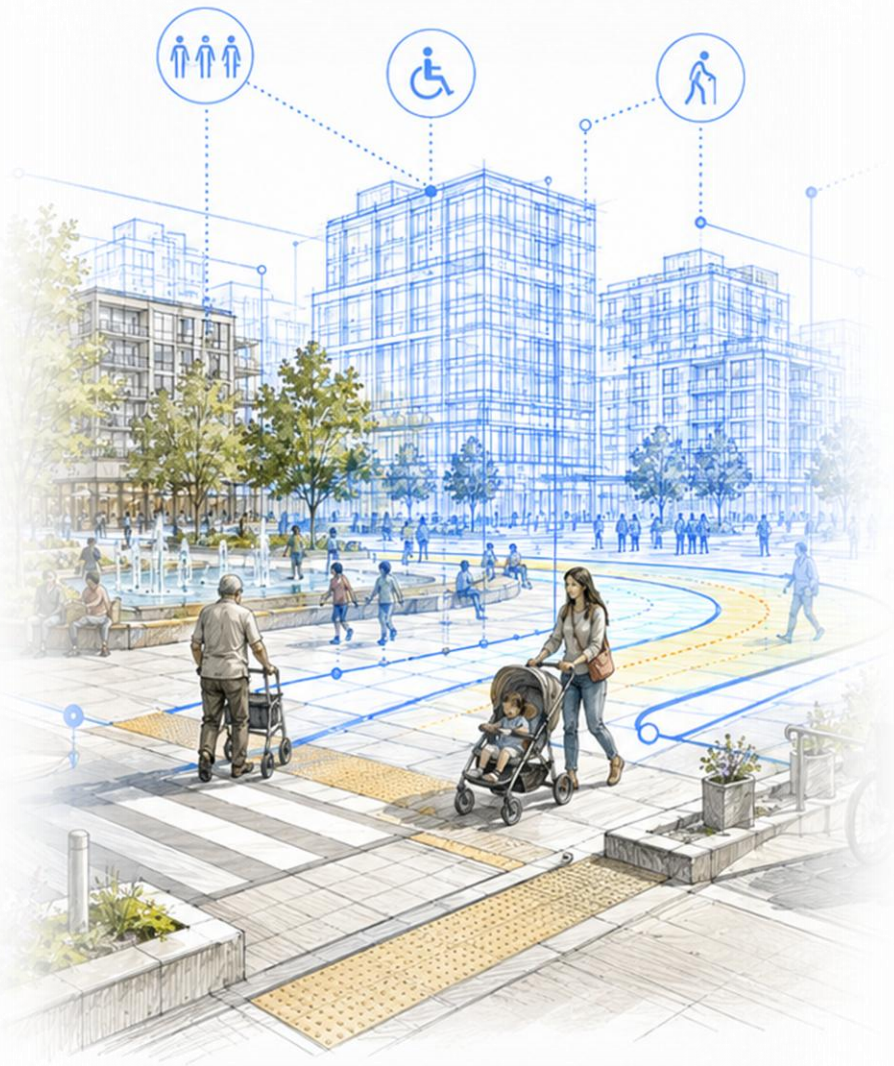
In/Equality

OPEN CITIES

- Digital twins as tools to understand and redesign mixed-use urban spaces.
- Test redevelopment scenarios before implementation.
- Compare effects on movement, accessibility, safety and liveability.

BEHAVIOUR AND INSTITUTIONS

- Digital twins can include behavioural and cognitive models.
- Simulate how pedestrians and cyclists perceive, decide and move.
- Explore how rules, norms and design influence spatial behaviour.



FAIR TRANSITIONS

- Digital twins can make redevelopment impacts visible.
- Compare effects across different user groups.
- Support more inclusive, accessible and transparent decisions

IOS-Themes:

SWOT analysis of DTs of Urban Traffic

	Positive	Negative
Internal	**Strengths** • Scenario testing • Better data-based decisions	**Weaknesses** • Limited real-time traffic data • Model uncertainty
External	**Opportunities** • National network of local DTs • Reusable standards/modules • AI + sensor data	**Threats** • Privacy risks • Overreliance on models

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