DMI·ECOSYSTEEM

# XCARCITY-DMI Digital Twin Workshop 10th April 2025

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# Agenda

| | | |
|---|---|---|
| 10:00 - 10:10 | **Opening Statement** | Bart van Arem (TU Delft) and Roy Boertien (I&W) |
| 10:10 - 10:20 | **XCARCITY Introduction** | Bart (TU Delft) |
| 10:20 - 10:30 | **DMI Introduction (why DMI)** | Roy Boertien (I&W) |
| *10:30 – 10:50* | *Tea Break (20min)* | |
| 10:50 – 11:10 | **XCARCTY Digital twin federation** | Jingjun Li (TU Delft) |
| 11:10-11:30 | **DMI Digital twin overview** | Gineke van Putten (Geonovum) |
| 11:30 – 12:00 | **Car-low development and regulation** | Michiel Van Dongen (I&W); Sean van der Lee; Jyotsna Singh |
| *12:00-13:00* | *Lunch break (60min)* | |
| 13:00-13:15 | **Introduction of the Amsterdam Zuidas use case** | Barry Ubbels (Amsterdam) |
| 13:15 – 13:30 | **Introduction to Interactive Workshop + Results from the survey** | Bart van Arem (Tu Delft) |
| 13:30-14:00 | **Interactive workshop** | All - 4 groups |
| *14:00-14:15* | *BREAK* | |
| 14:15 – 14:45 | **Feedback and Discussion** | All |
| 14:45 – 15:00 | **Way Forward and Next steps** | Roy Boertien (IenW), Bart van Arem (TU Delft) |

# Opening

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# XCARCITY Introduction By Bart van Arem

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# Toward sustainable urban mobility using digital twins

Bart van Arem


NWO

TU Delft

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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 ?

.

- 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
---------- +
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

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# 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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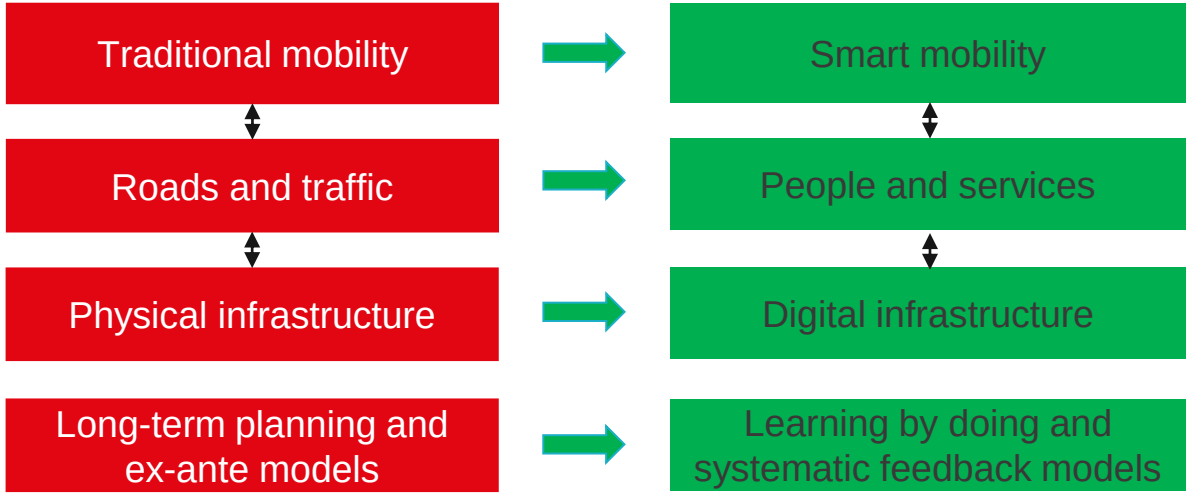
# Traditional theories and methods are out dated




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

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# Proposition XCARCITY

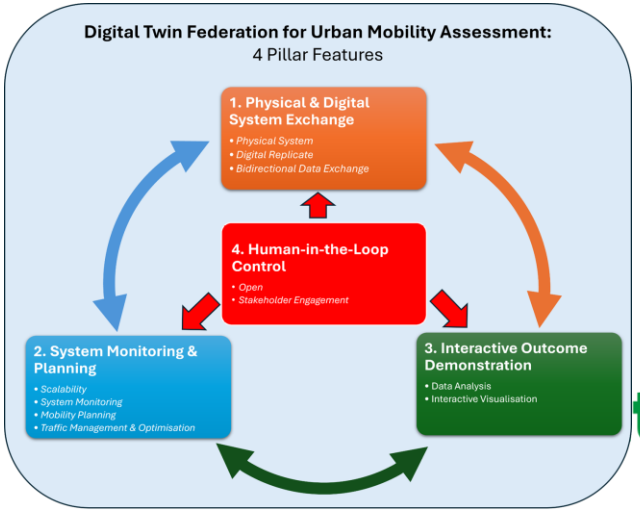
Digital twin federation
Real-time management & Strategic planning

Model-based scenario development

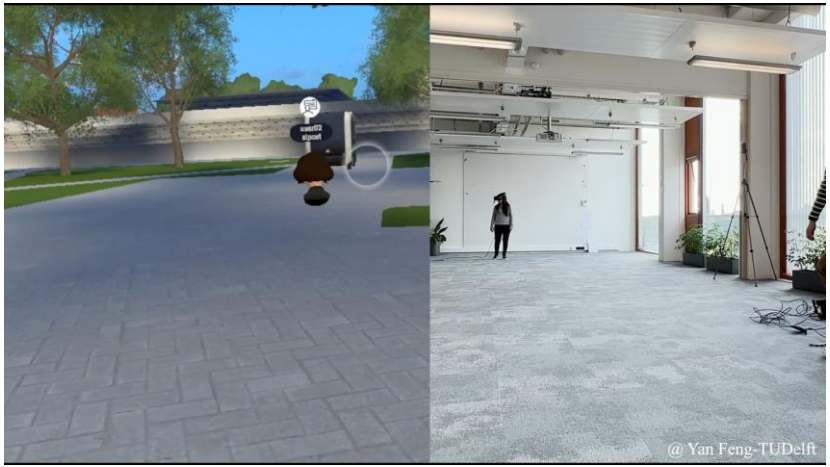
Implementation of interventions


Real-life and virtual reality data

Monitoring and analyses








**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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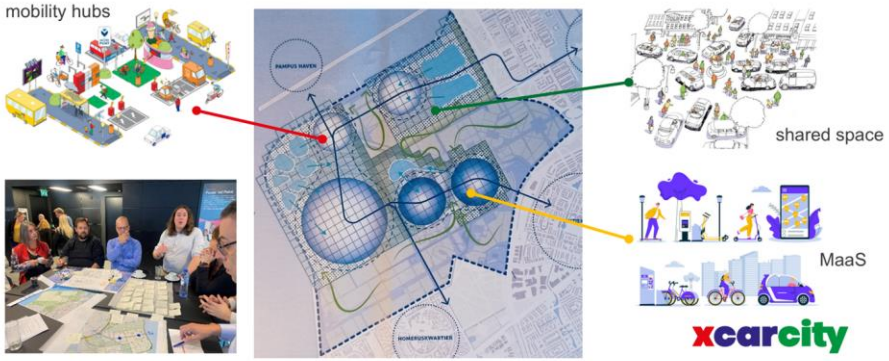
## Almere Pampus

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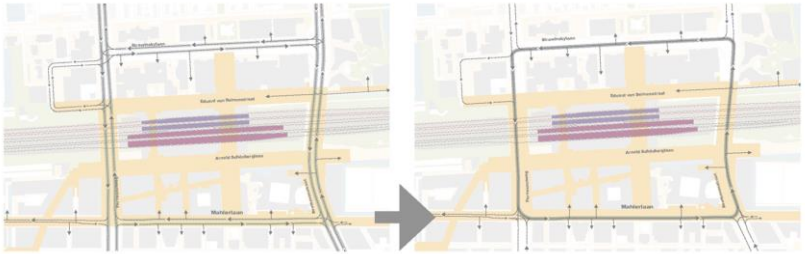
## Amsterdam Zuidasdok



Redesign Parnassusweg around Zuidas train station

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## Rotterdam Merwe4Haven

Immersive VR research by design Urban Community Vehicle (with BMW)

Integration of Rotterdam Open Urban Platform, Digital Twin Federation, Vehicle data (with BMW)

Modeling and optimisation of sustainable mobilty

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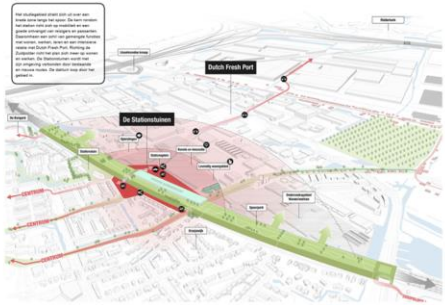
## Barendrecht Stationstuinen


Uit: Koersdocument Barendrecht – de Stationstuinen (2019)

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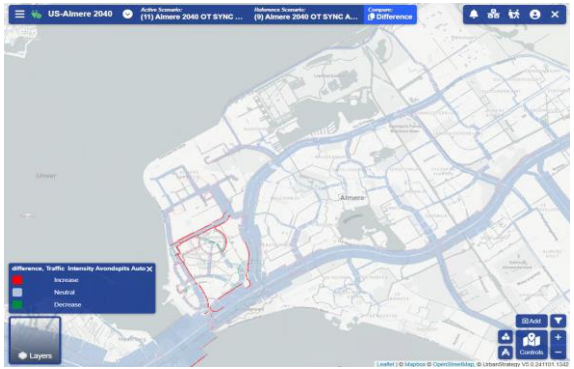
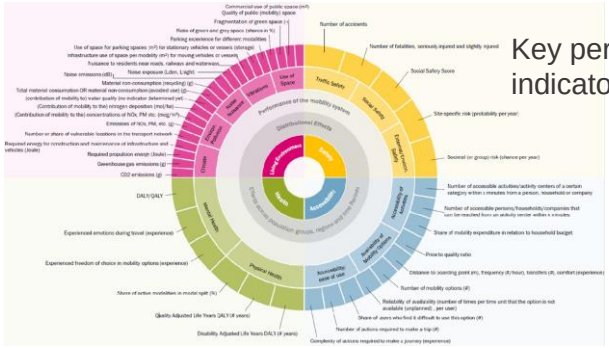
# DESIGN SESSION November 2024

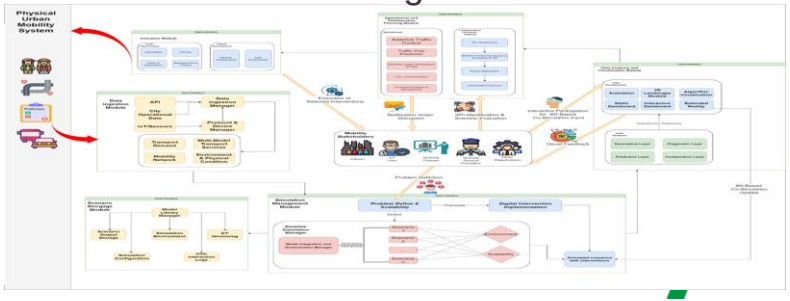


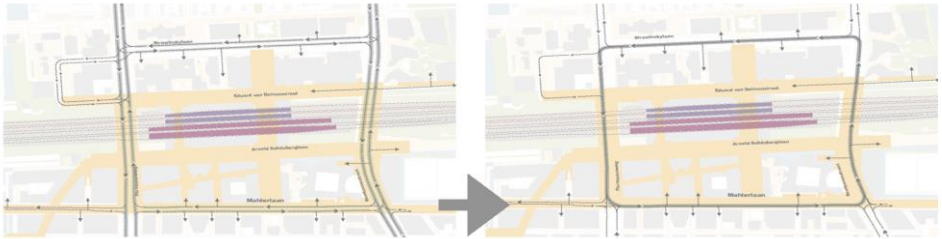

Digital twin assessment Almere Pampus



Key performance indicators

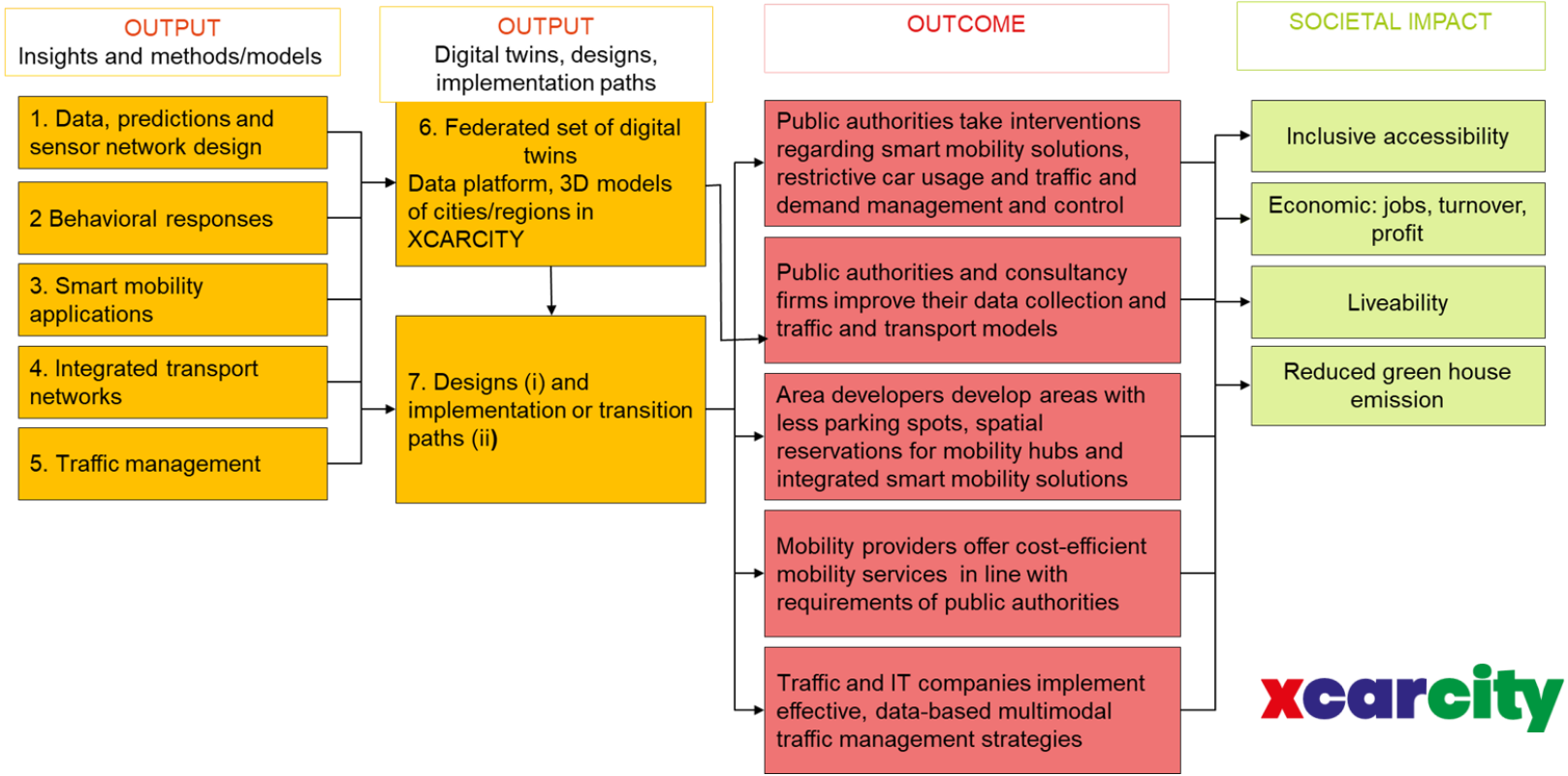
Digital twin federation



Redesign Parnassusweg

# Impact plan

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# Partner contributions

**Public authorities**

- Gemeente Almere
- Gemeente Amsterdam
- Gemeente Rotterdam
- Ministerie van Infrastructuur & Waterstaat
- MRDH-regio
- Rijkswaterstaat
- Vervoerregio Amsterdam

Define user needs
Provide data
Co-design areas
Pilots
Organise annual design sessions
Implementation paths
Organise consortium meetings
Co-program coordination

**Area and project developers**

- ABB
- BAM
- FSD

Contribute to digital twin development
User needs future residents
Implementation paths

**Mobility providers**

- PON
- RET

Contribute case studies
Pilots
Provide training
Implementation paths

**Traffic sector and IT industry**

- MapTM
- OpenRemote
- Technolution
- VRBase

Contribute expertise
Provide data
Support VR realisation

Contribute to digital twin architecture
Pilots
Implementation paths traffic sector

**Consultancy firms**

- Buck consultants International
- DTV consultants
- Future mobility Network
- Goudappel
- Mobycon
- RHDHV
- Witteveen en Bos

Execute case studies
Provide data
Provide tools
Provide test facilities
Contribute to digital twin development
Support pilots
Support implementation paths
Report annual design sessions
Develop training material
Design and manage website

**Research and knowledge institutes**

- AMS Institute
- CROW
- PBL
- SWOV
- TNO
- TU Delft
- TU Eindhoven
- Universiteit Twente

Support VR environment
Support intern studio
Knowledge dissemination
Yearly scan spatial and safety impacts

Research activities

**Other**

- Connekt
- Fietsersbond
- Toertje

Data cycling
Organise annual design sessions
Connekt network
Co-program coordination

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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

xcarcity.nl

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

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# DMI Introduction By Roy Boertien

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# National government, cities and the private sector working together to

NOG **1.728**

# **DAGEN** TE GAAN VOOR **2030**

**-55%**

$CO_2$

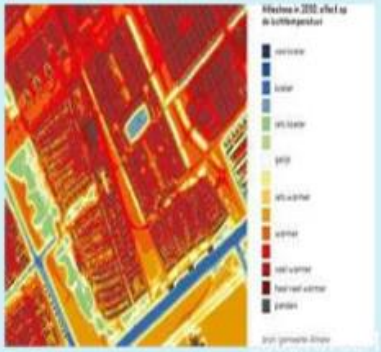
**-50%**

$NO_x$

**+900K**

Minimaal 50%:
- binnenstedelijk
- in nabijheid van ov-knooppunten

# We are reaching system boundaries

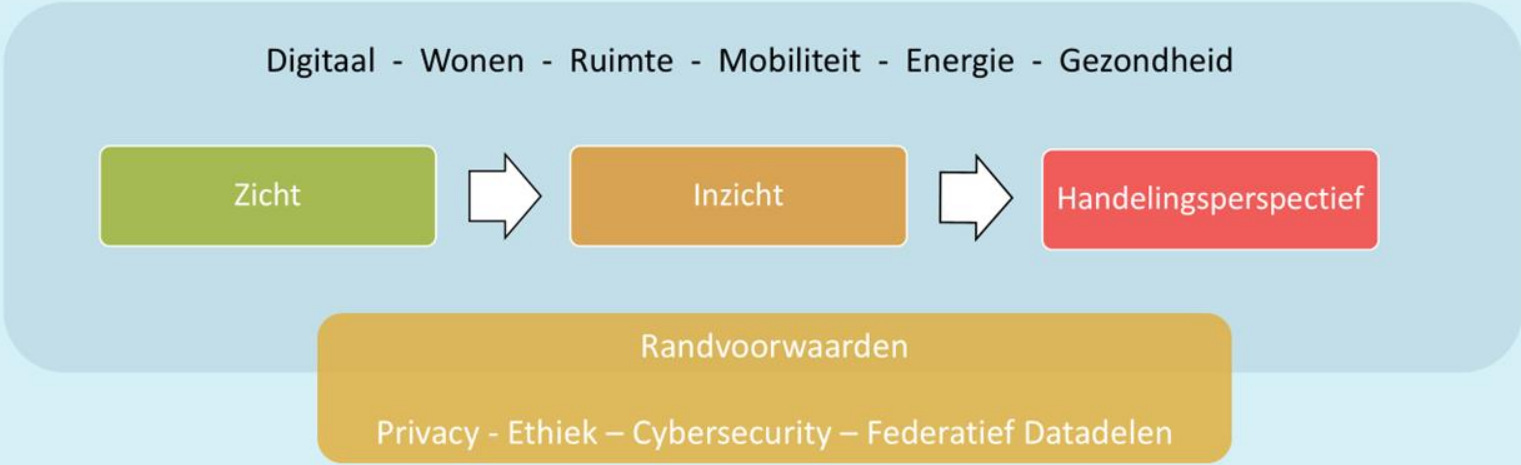



DMI·ECOSYSTEM


340+
Governmental Programmes Physical Domain
35+
Leading but sometimes opposing principles
489
Current arrangements from DGMo to G40
440+
Pilots by municipalities in the field of Smart City


DMI·ECOSYSTEEM

# Kennis structureren in het fysieke en / + het digitale domein




Beleid Beheer Management Vervanging Besturing



DMI·ECOSYSTEM

# Current participants in the DMI ecosystem


**2** Dutch ministries

**21** Cities

**80** Private organizations

**7** Knowledge Institutions

And counting.

DMI·ECOSYSTEM

# Deelnemers DMI-ecosysteem


DMI·ECOSYSTEEM

# Deelnemers DMI-ecosysteem


DMI·ECOSYSTEEM

# Deelnemers DMI-ecosysteem

# TEA BREAK

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# XCARCITY Digital Twin Federation By Jingjun Li

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# DTs in Transport Planning

(a) Current Street View

(b) Current Digital Twin

3D Modelling of Infrastructure
in Dublin
(White et.al 2021)

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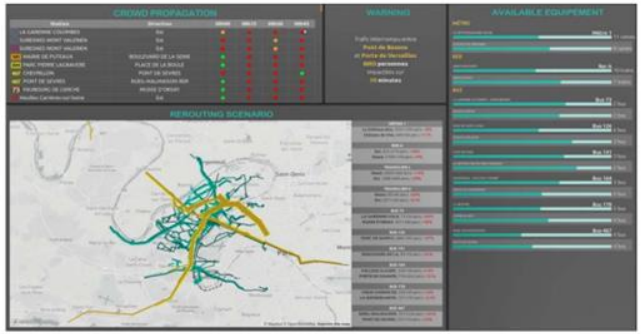
# DTs in Transport Planning

(a) Current Street View

(b) Current Digital Twin




Regional Public Transport Supervision DT in Paris (Amrani, et.al 2020)

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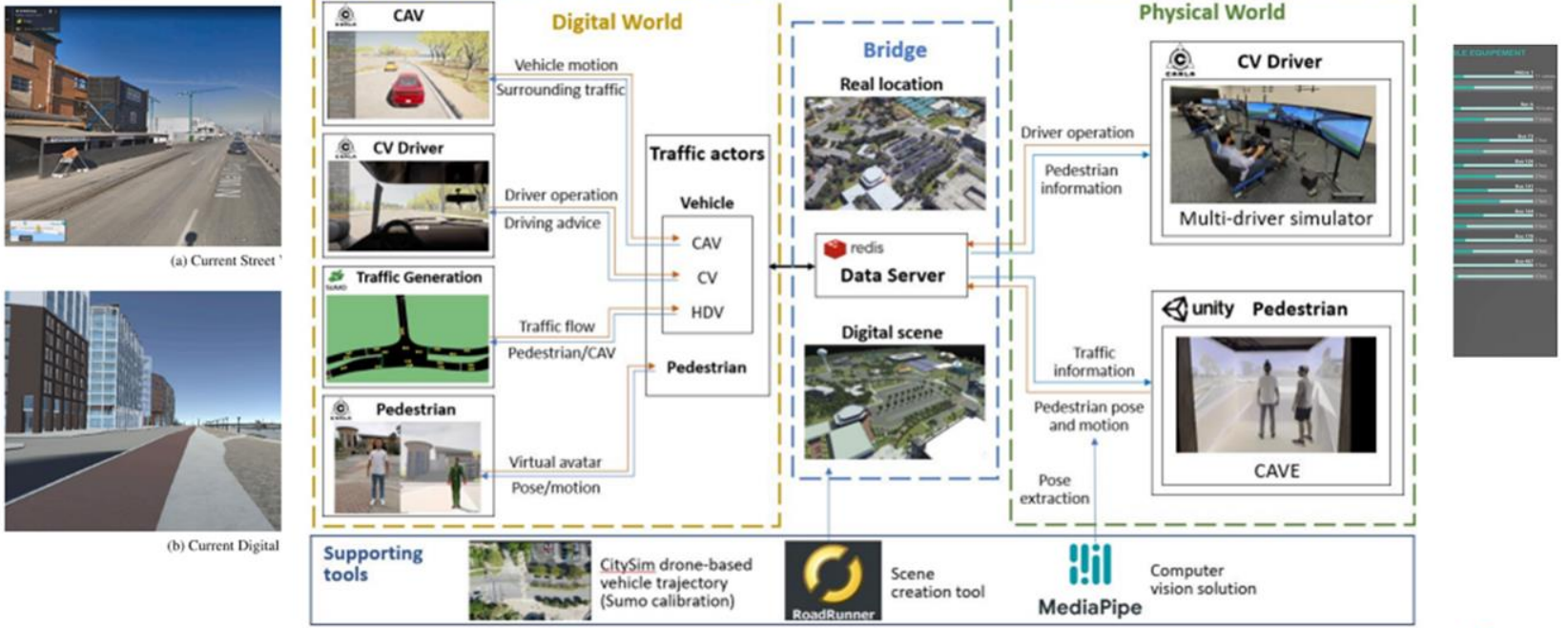
# DTs in Transport Planning




DT for the management of intelligent vehicular systems (Wang, et.al 2022)

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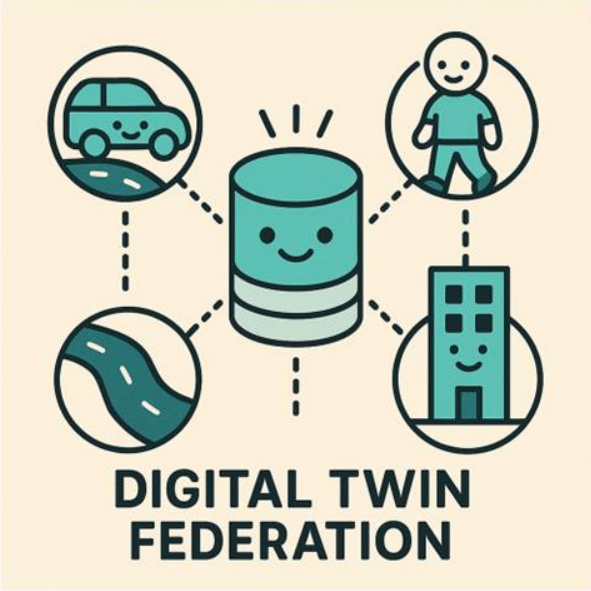
# Towards a Digital Twin Federation




Single (technical) DT is not sufficient for a comprehensive evaluation of mobility systems with fewer private vehicles!

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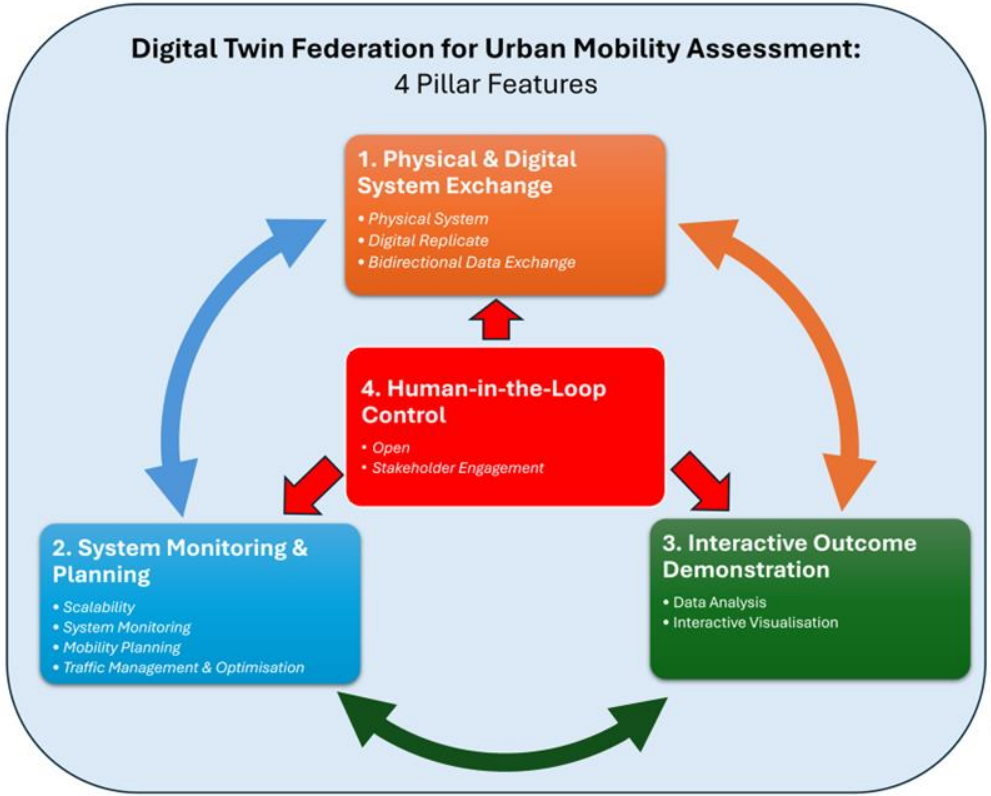
# Features of Digital Twin Federations

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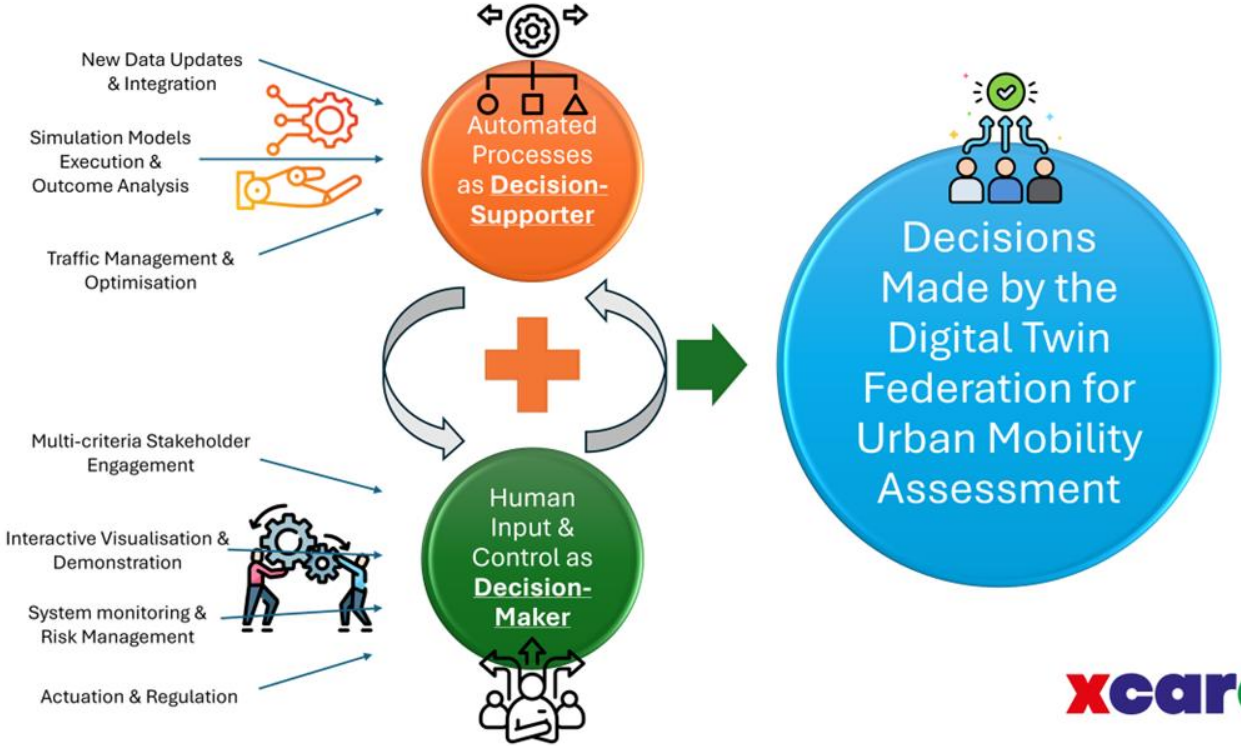
# Joint Decision-Making Between Automation & Human

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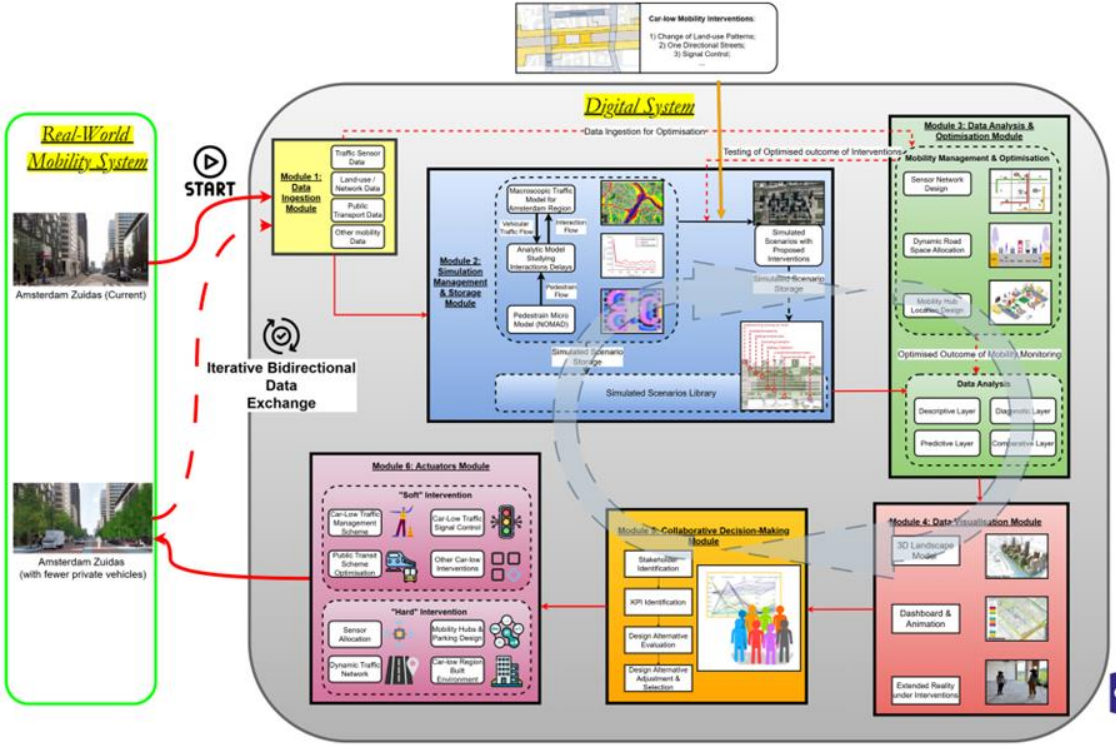
# FedDT Use Case Zuidas

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# References

White, G., Zink, A., Codec´a, L., Clarke, S., 2021. A digital twin smart city for citizen feedback. Cities 110, 103064. doi:10.1016/j.cities.2020.103064;

Amrani, A., Arezki, H., Lellouche, D., Gazeau, V., Fillol, C., Allali, O., Lacroix, T., 2020. Architecture of a Public Transport Supervision System Using Hybridization Models Based on Real and Predictive Data. Proceedings - Euromicro Conference on Digital System Design, DSD 2020 , 440–446doi:10.1109/DSD51259.2020.00076;

Wang, Z., Zheng, O., Li, L., Abdel-Aty, M., Cruz-Neira, C., Islam, Z., 2022. Towards Next Generation of Pedestrian and Connected Vehicle In-the-loop Research: A Digital Twin Co-Simulation Framework. IEEE Transactions on Intelligent Vehicles 8, 2674–2683. URL: http://arxiv.org/abs/2212.05090http://dx.doi.org/10.1109/TIV.2023.3250353, doi:10.1109/TIV.2023.3250353;

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# DMI Digital Twin By Gineke van Putten

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# Digital Twin as a Service / NLDT

## Geonovum: Verkent, verbindt, verankert

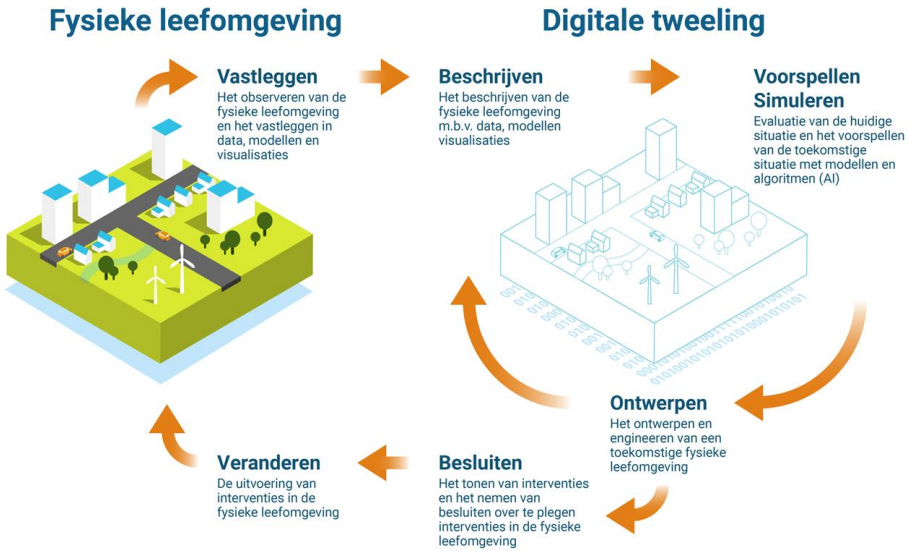
**Auteur** Geonovum

**Datum** April 2025

GEONOVUM

# Geonovum

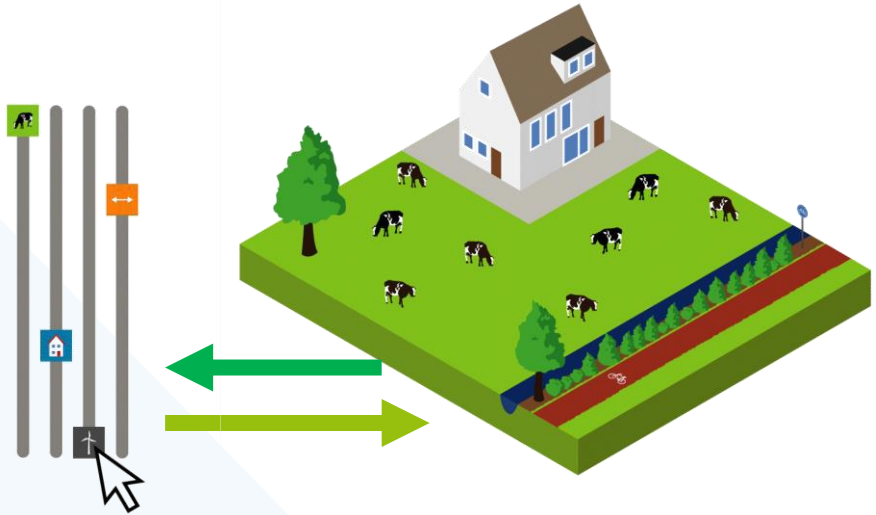
- Government foundation
- Knowledge and network partner
- Develop standards for the national spatial data infrastructure


GEONOVUM
Verkent, verbindt, verankert
Zoek binnen de website...
Geo-standaarden
Thema's
Nieuws
Agenda
Over Geonovum
English
De verbindende kracht van standaardisatie
Vindbare, toegankelijke, uitwisselbare en herbruikbare geo-informatie
Aan de slag
BGT|IMGeo standaarden
Digital twins
EU Datastrategie
Kennisplatform APIs
Omgevingswet
Overzicht standaarden documenten
Zoek binnen de website...

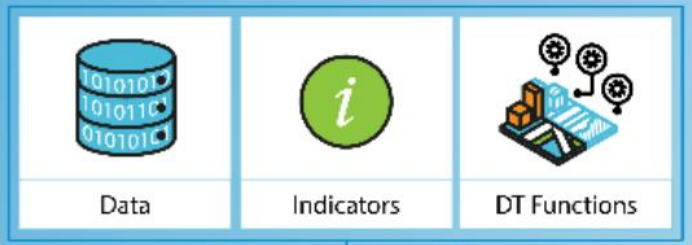
# Why

‘A digital twin enables information from different domains to be brought together in an integrated, dynamic and interactive way. This provides a holistic insight into complex issues and supports the development of sustainable solutions.’

# Digital Twins: a powerful connector

Digital twins connect data, people and policy. Connection is also needed when creating a Digital Twin. Between the technical world and the policy world. Two worlds, each with their own language.





## Where policy and technology meet

Be more concrete. This helps us better understand each other.

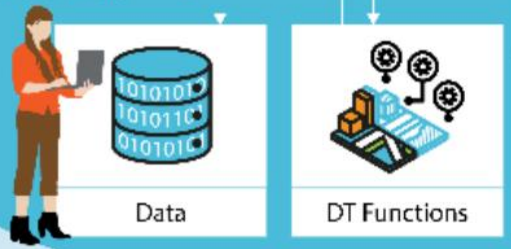
On the one hand, the technological side, we reduce the 64 possible functions of a digital twin to 16. On the other hand, the policy side, we translate major policy themes into concrete indicators.

Together, we determine which data sources and functions contribute to implementing the indicators in one or more Digital Twins.


**Nature policy:**
Every citizen needs access to a park/forest by 202X


**Indicator:**
Presence of nature reserve


**Indicator:**
Wooded nature reserves within a radius of 300 m




**Data source:**
BGT

**Functionalities:**
Visualization, Prediction, Simulation, Time travel...

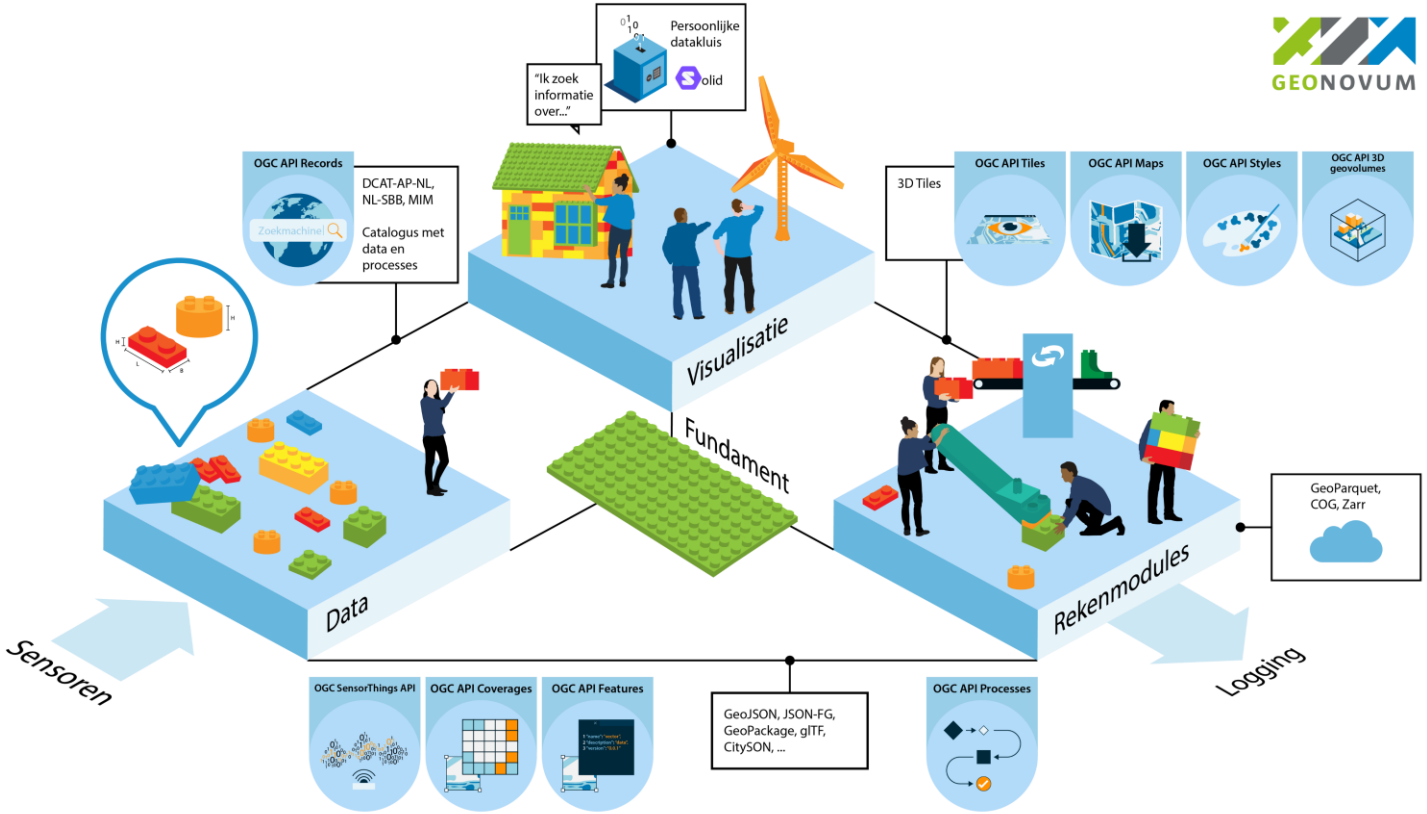

[Policy processes and building blocks for Digital Twins]

# Digital Twin Building Blocks (NLDT)

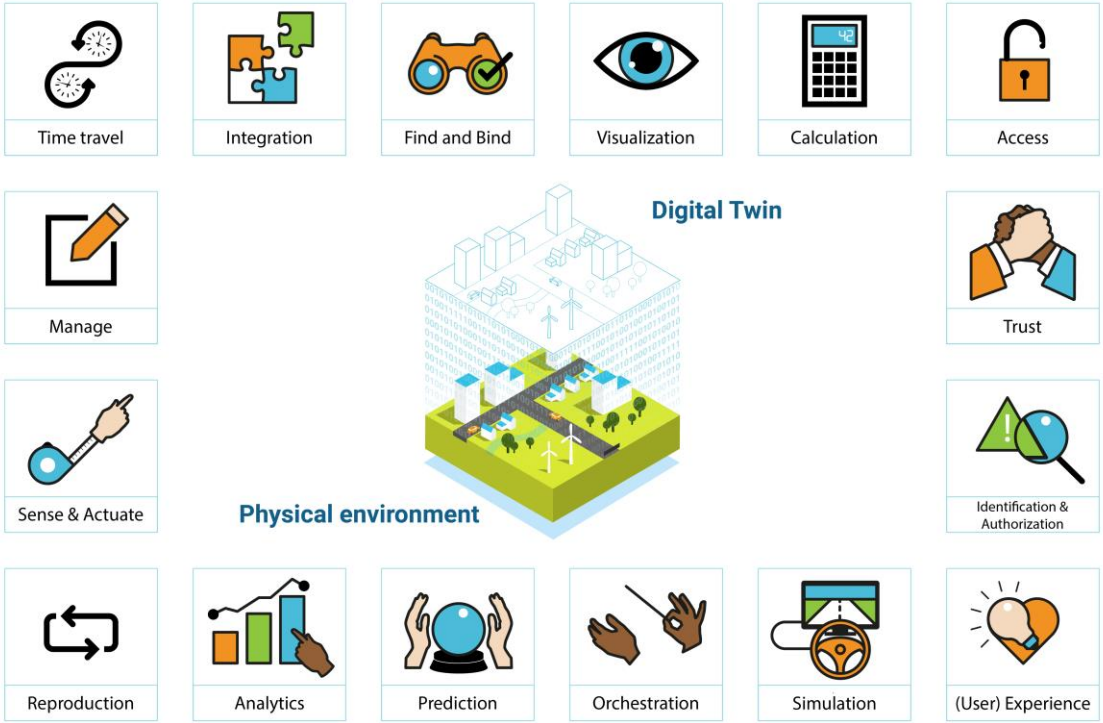
## Interoperable, modular, scalable

GEONOVUM

# Standards in play between building blocks



# Basic Capabilities for NLDT



1 Data Acquisition & Ingestion

9 Synthetic Data Generation

2 Data Streaming

10 Ontology Management

3 Data

11 Digital Twin (DT)

Ontsluiten

Bewerken

Zoeken/vinden

Tijdreizen

7 Data PubSub Push

15 Simulation Model Repository

8 Data Aggregation

16 AI Model Repository

17

Reproduceren

Meten/Aansturen

Integreren

52 Device Management

54 Event Logging

53 System Monitoring

54 Data Governance

23 Edge AI & Intelligence

29 Prediction

Analyseren

Voorspellen

35 Prescriptive Recommendations

Orkestratie

Simuleren

Rekenen

28 Data Analysis & Analytics

34 Mathematical Analytics

38 Composition

39 Basic Visualization

45 Dashboards

40 Advanced Visualizatio

46 ntinuous telligence

41 Real-time Moni

47 ss Intelligence

Visualiseren

42 Entity Relatior Visualizatio

48 & Workflow

Beleven

43 Augmented Re AR

49 ning Engine Visualization

44 Virtual Reality VR

50 3D Rendering

56 Data Encryptior

60 Safety

51 Gamification

Vertrouwen

Identificeren

57 Device Security

61 Reliability

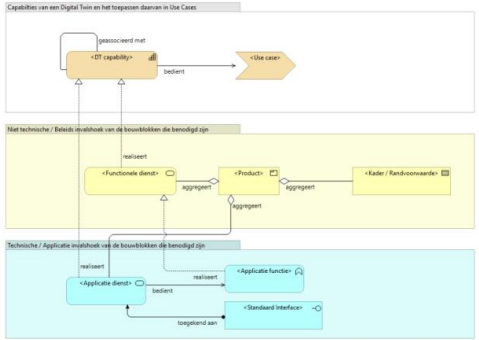
62 Resilience

# NLDT reference architecture

**NLDT**
Architectuur

Geonovum Handreiking
Werkversie 12 maart 2025

**Deze versie:**
https://geonovum.github.io/NLDT-Architectuur/
**Laatste werkversie:**
https://geonovum.github.io/NLDT-Architectuur/
**Redacteurs:**
Bart De Lathouwer (Geonovum)
Niels Hoffmann (Geonovum)
Michel Grothe (Geonovum)




https://geonovum.github.io/NLDT-Architectuur/

**Technical Framework for Local Digital Twins - Twins4Resilience project**

Geonovum Handreiking
Werkversie 19 februari 2025

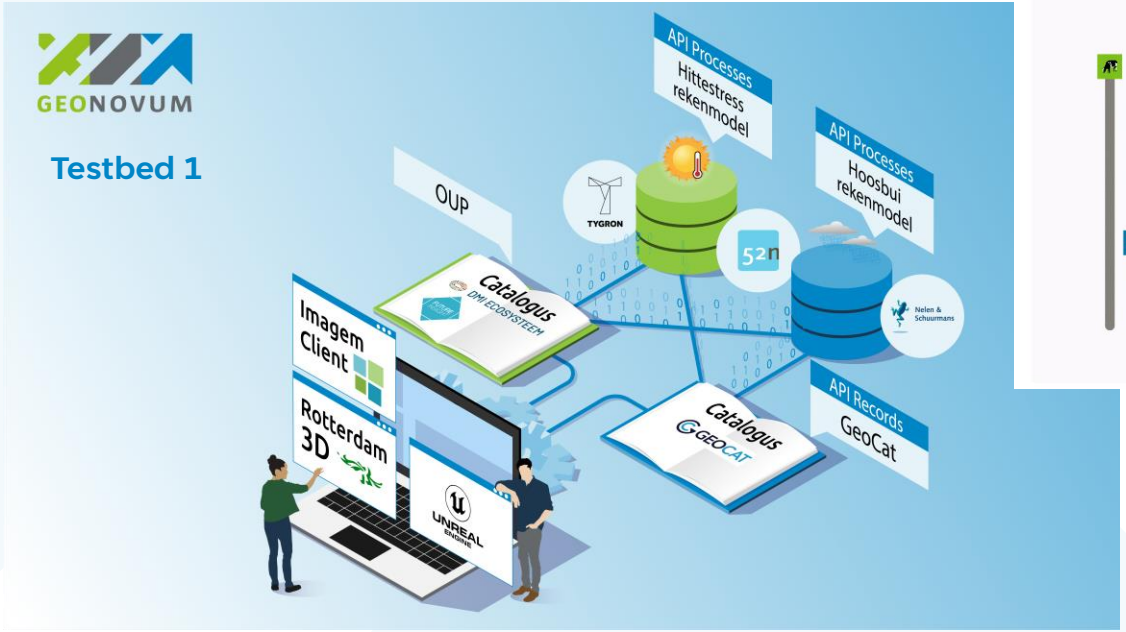
**Laatste werkversie:**
https://geonovum.github.io/T4R/
**Redacteurs:**
Niels Hoffmann (Geonovum)
Bart de Lathouwer (Geonovum)

https://geonovum.github.io/T4R/

# Testbeds

GEONOVUM

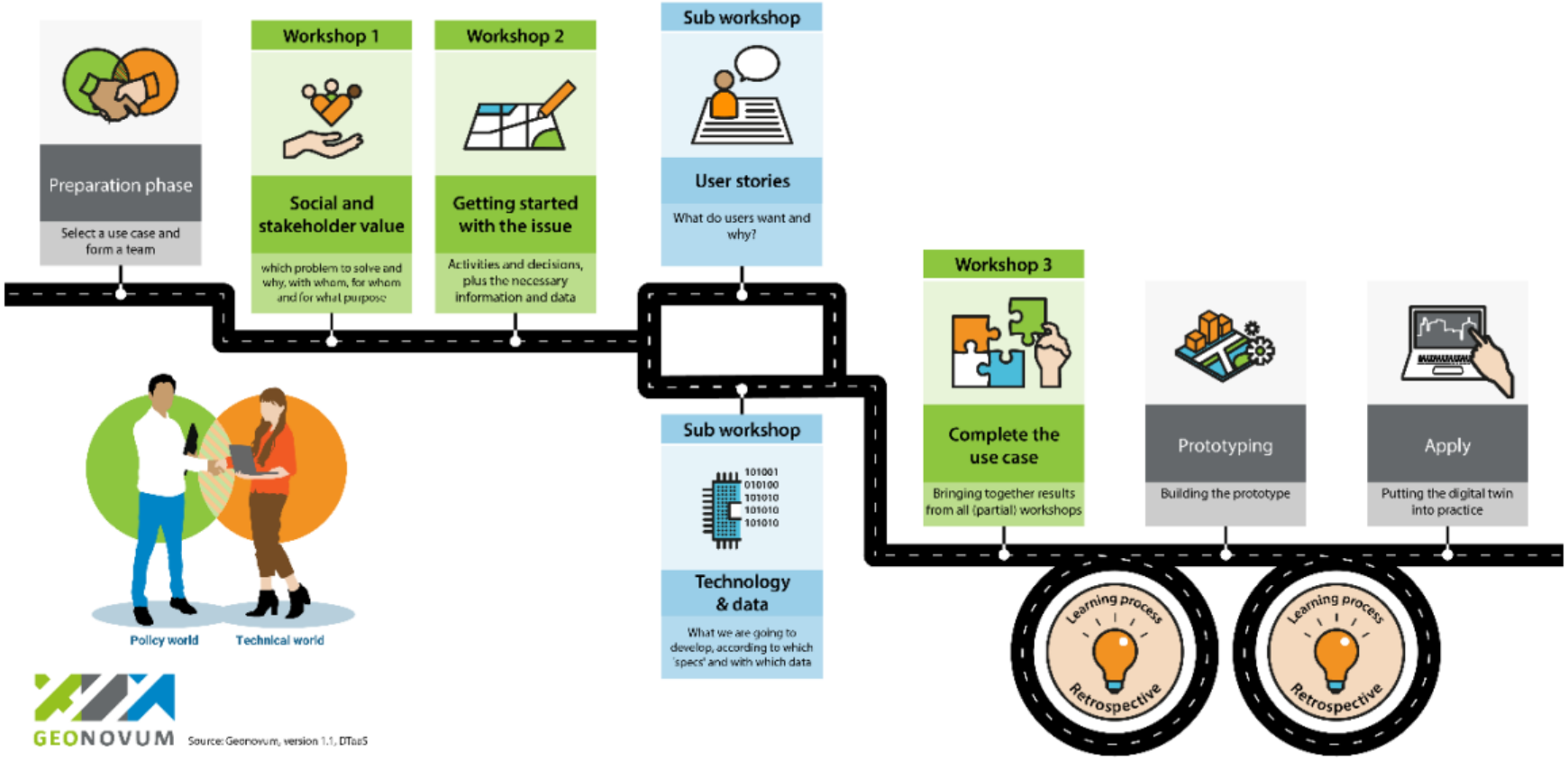
## Testbed 1




Invitation to tender | call for Testbed nr. 2 Digital Twin as a service is published

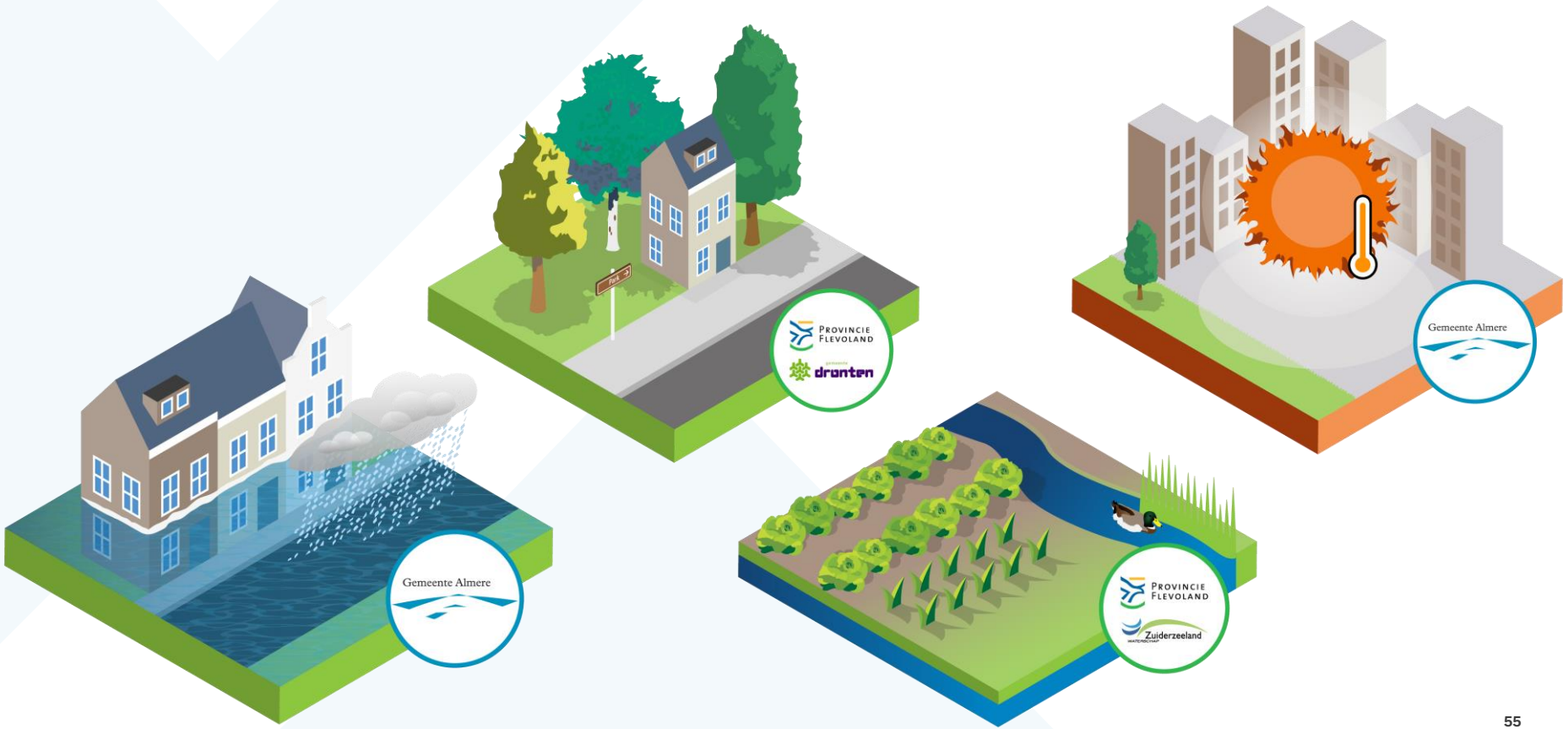
11 MAART 2025

# Process of learning to develop and embed a digital twin

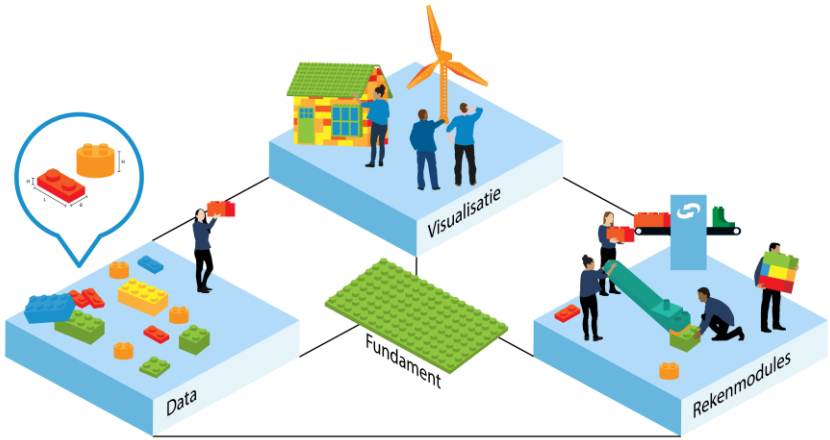



GEONOVUM Source: Geonovum, version 1.1, DTap5

# Fieldlabs


Provincie Flevoland
dronten
Gemeente Almere
Gemeente Almere
Provincie Flevoland
Zuiderzeeland

# From pioneers and frontrunners to a system of Digital Twins


NLDT

Reusable recipes for data, computational models & visualizations

Avoiding silo formation: platform and vendor independence

Collaborating and sharing data/ computational models.

Being able to share applications at the national & European level.

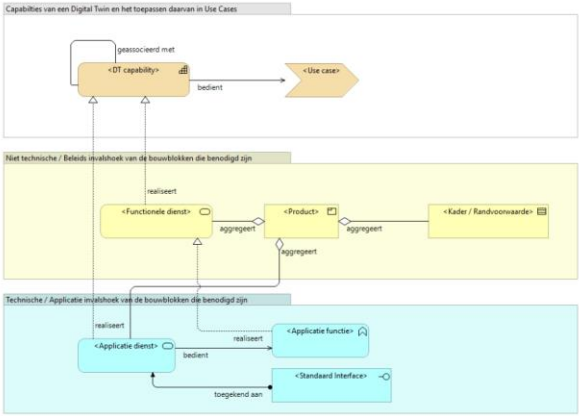
# NLDT reference architecture

**NLDT**
Architectuur

Geonovum Handreiking
Werkversie 31 maart 2025

**Deze versie:**
https://geonovum.github.io/NLDT-Architectuur/
**Laatste werkversie:**
https://geonovum.github.io/NLDT-Architectuur/
**Redacteurs:**
Bart De Lathouwer (Geonovum)
Niels Hoffmann (Geonovum)
Michel Grothe (Geonovum)
**Auteurs:**
Bart De Lathouwer (Geonovum)
Niels Hoffmann (Geonovum)
Michel Grothe (Geonovum)

https://geonovum.github.io/NLDT-Architectuur/




**Technical Framework for Local Digital Twins - Twins4Resilience project**
Geonovum Guide
Candidate recommendation April 08, 2025

**Latest editor's draft:**
https://geonovum.github.io/T4R/
**Editors:**
Niels Hoffmann (Geonovum)
Bart de Lathouwer (Geonovum)
**Authors:**
Niels Hoffmann (Geonovum)
Bart de Lathouwer (Geonovum)

https://geonovum.github.io/T4R/

Zicht op Nederland
1,584 followers
14h •

Het Ministerie van Volkshuisvesting en Ruimtelijke Ordening en de zes grote gemeenten hebben een convenant getekend voor samenwerking in het European Digital Infrastructure Consortium (EDIC) op het gebied van digitale tweelingen. Hoofddoel is het opzetten van een netwerk van Lokale Digitale Tweelingen (nLDT), die onderling en over de grenzen heen opereren. Met elkaar kunnen landen veel efficiëntere instrumenten ontwikkelen om maatschappelijke en ecologische vraagstukken op EU-schaal aan te kunnen pakken.

Lees verder: https://lnkd.in/eEW-sV-U

Geonovum City of Amsterdam Gemeente Rotterdam Gemeente Den Haag Gemeente Utrecht Gemeente Eindhoven Gemeente Groningen

#digitaletweelingen #digitaltwins #EDIC #ZichtopNederland

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# Car-low development and regulations By Michiel van Dongen

xcarcity

# Developing car-low cities within a regulatory and policy framework for Dutch sustainable urban mobility planning and the role of DTs

Xcarcity Digital Twin workshop

# Cities with effective car-low measures

| | City | Mobility Focus | Tech Used | Policy Type | Impact Metrics |
|---|---|---|---|---|---|
| 1 | Amsterdam, Netherlands | Bike infrastructure, reduced parking, car-free zones | Mobility data, modeling (no full digital twin) | Car-lite agenda, street redesign | Reduced car use, increased cycling |
| 2 | Ljubljana, Slovenia | Pedestrian-only city center | Data-backed policy, no digital twin | Pedestrianization | Improved air quality, increased public transport use |
| 3 | Pontevedra, Spain | Extensive car-free zones | Minimal tech, people-first approach | Car ban in city center | 90% reduction in traffic injuries |
| 4 | Paris, France | 15-minute city, pedestrianization | Modeling, participatory tools | Car-free zones, urban redesign | Increased walking/cycling, cleaner air |
| 5 | Berlin, Germany | Neighborhood traffic reduction | GIS, traffic data | Kiezblocks (superblocks) | Reduced traffic, increased livability |
| 6 | Vienna, Austria | Car-free development (Aspern) | Simulation and planning models | Transit-oriented development | High transit use, low car ownership |
| 7 | Oslo, Norway | Car ban in city center | Smart city strategy, data analysis | Car ban, public space reclaiming | Fewer accidents, more pedestrians/cyclists |
| 8 | Copenhagen, Denmark | Cycling, pedestrian infrastructure | Live cycling data, dashboards | Cycling priority, parking limits | 62% bike commuting, carbon neutrality goal |
| 9 | Ghent, Belgium | Car-free zones via circulation plan | Data-informed planning | Circulation plan | 20% drop in car traffic, rise in active travel |
| 10 | Barcelona, Spain | Superblocks (car-free neighborhoods) | Simulations, environmental sensors | Urban superblocks | More public space, reduced traffic |
| 11 | Montreal, Canada | Pedestrian-priority downtown | GIS, urban models | Pedestrianization, transit integration | Improved public realm, reduced car dependence |
| 12 | Zurich, Switzerland | Transit and walking priority | Traffic light prioritization, data use | Parking limits, transit-first | Reduced car use, high transit ridership |

# Quick polling some experts within I&W

**What are the most effective measures to achieve car-low cities?**

- Parking policies (rates, norms for spaces)
  - Levers exist within the housing and energy challenges
- Densification with alternatives to car
- Prioritise accessibility (through safe and fast physical infrastructure) for non-car modes
- Applying traffic rules and regulations differently
- Fiscal policy

➔None are “easy”, due to path dependencies and human behaviour, and there are variations based on region, size and character of cities involved.

➔System view with broad set of economic and wellbeing indicators is preferred. See e.g. KAW-Ecorys study

# Over to the researchers ☺

- Sean and Shyotsa max max 15min in total (prefer 10min)
- Add comment or 1pager on KPIs (“Delphi”?)

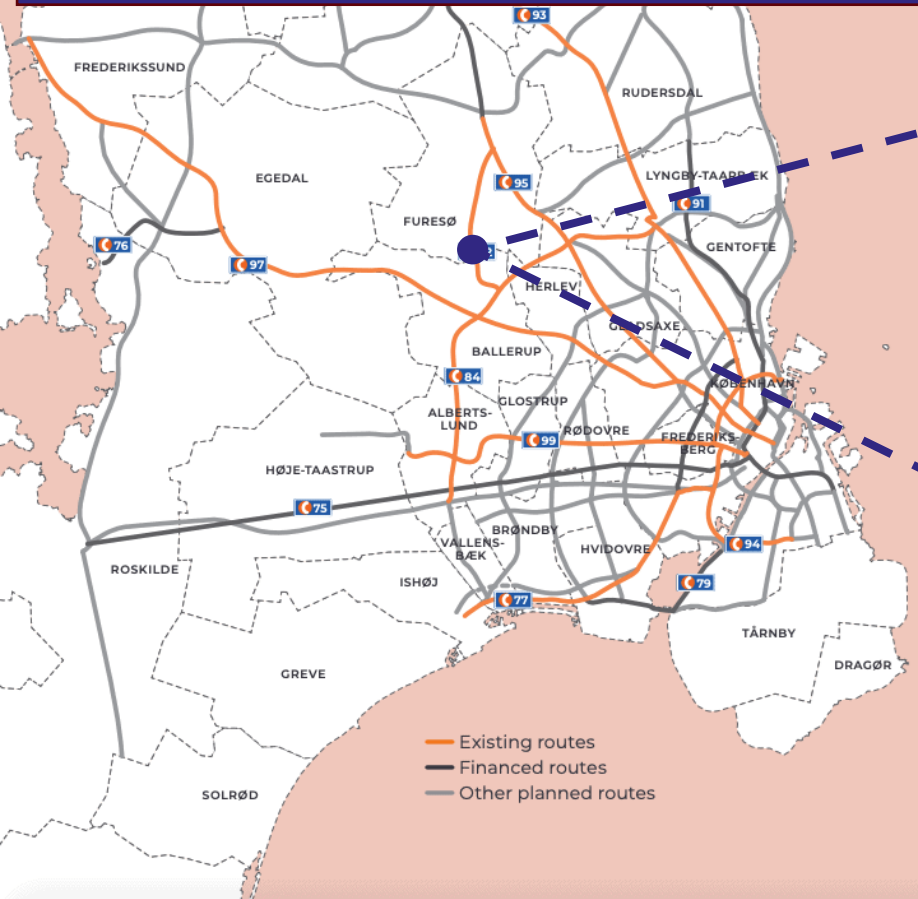
# Reducing the number of cars in European cities

## What are the keys to success?


Sean van der Lee
10/04/2025

xcarcity

# Copenhagen Cycle Superhighways




## Success factors

Strategic communication

Organising responsibility

Showing openness and flexibility


## Barriers

Resources

Policy & institutional

# Barcelona Superblocks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## Success factors

Trials to create legitimacy

Organising responsibility

Timing and windows of opportunity


## Barriers

Social

Policy & institutional

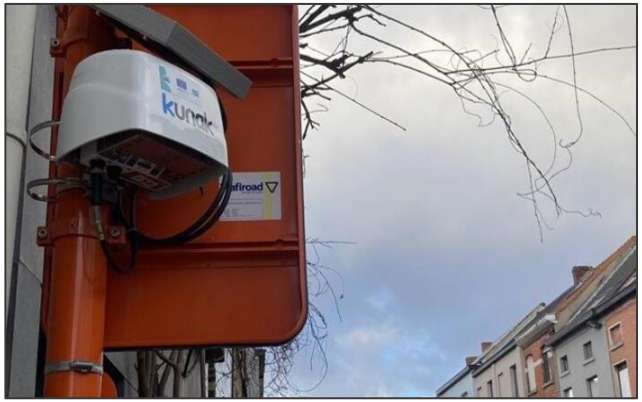
# Success factors

- Trials to create legitimacy
- Organising responsibility
- Strategic communication
- Showing openness and flexibility
- Timing and windows of opportunity
- Combining sticks and carrots

# Barriers

- Social
- Path dependence
- Policy & institutional
- Resources
- Legal

# Additional success factors

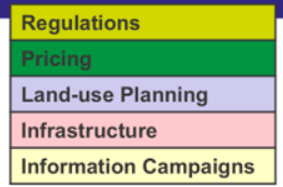


The undeniability of hard evidence

The inarguability of schools

# General Lessons

1. **Continuously explore new possibilities**
2. Be aware of the context and stakeholders' needs
3. Create and identify windows of opportunity
4. Test new measures




| City | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Antwerp | X | | X | | X | | X | X | X | | | X | | - | | X | X | X | | X |
| Brussels | X | X | X | X | X | | X | X | X | | (X) | | | - | X | X | X | X | | X |
| Ghent | X | X | X | X | X | | X | | X | | | | | - | | X | X | | | X |
| Leuven | | | X | X | X | | X | X | X | | | | | - | | X | X | | | X |
| Copenhagen | X | | X | | X | | X | X | X | | | | | - | | X | X | | X | |
| Helsinki | X | | X | | X | | X | | X | | | | | - | | X | X | X | | |
| Paris | X | (X) | X | | X | | X | X | X | | | X | | - | | X | X | X | X | |
| Strasbourg | X | X | X | | X | | X | | X | | | X | | - | | X | X | | | |
| Berlin | X | | X | | X | | X | X | X | | | | | - | | X | X | X | | |
| Bremen | X | | X | | X | | | | X | | | | | - | | X | X | | | |
| Hamburg | | | X | | X | | X | | X | | | | | - | | X | X | | | |
| Heidelberg | X | | X | | | | | | X | | | | | - | | X | X | | | |
| Nuremberg | | | X | | | | | | X | | | | | - | | X | X | | | |
| Bologna | X | X | X | | X | | X | | X | | | X | X | - | | X | X | (X) | | X |
| Milan | X | X | X | | (X) | | (X) | | X | | | X | | - | | X | X | (X) | X | |
| Venice | X | X | X | | | | X | | X | | | X | | - | | | X | | | |
| Valletta | | | | | | | (X) | | X | | X | | | - | X | X | X | X | | |
| Amsterdam | X | | X | | X | | X | X | X | | | | (X) | - | | X | X | X | | |
| Groningen | | | X | X | X | | X | X | X | | | | | - | | X | X | (X) | X | |
| Houten | | | | X | X | | | X | X | | | | | - | | | X | | | |
| Utrecht | X | | X | | X | | X | X | X | | | | | - | | X | X | (X) | X | |
| Bergen | X | | X | | | | | | | X | | | | - | | X | X | | | |
| Oslo | X | | X | | X | | X | X | X | | | X | | - | (X) | X | X | (X) | | |
| Barcelona | X | X | X | | X | | | | X | | | X | | - | X | X | X | X | X | |
| Madrid | X | | X | | X | | X | | X | | | X | | - | X | X | X | X | X | |
| Götheborg | X | | X | | X | | | X | X | | | | | - | | X | X | X | | |
| Stockhom | X | | X | | X | | X | X | X | | | | | - | | X | X | X | | |
| Zurich | | | X | | X | | X | X | X | | | X | | - | | X | X | X | | |
| Birmingham | X | | (X) | | X | | X | X | X | | | X | X | - | X | X | X | (X) | (X) | |
| Glasgow | X | | X | | X | | | | X | | | | | - | X | X | X | | X | |
| London | X | | X | | X | | X | X | X | X | (X) | X | | - | | X | X | (X) | | X |
| Oxford | X | | X | X | X | | X | X | X | | | X | | - | X | X | X | | (X) | X |

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# General Lessons

1. Continuously explore new possibilities
2. **Be aware of the context and stakeholders' needs**
3. Create and identify windows of opportunity
4. Test new measures


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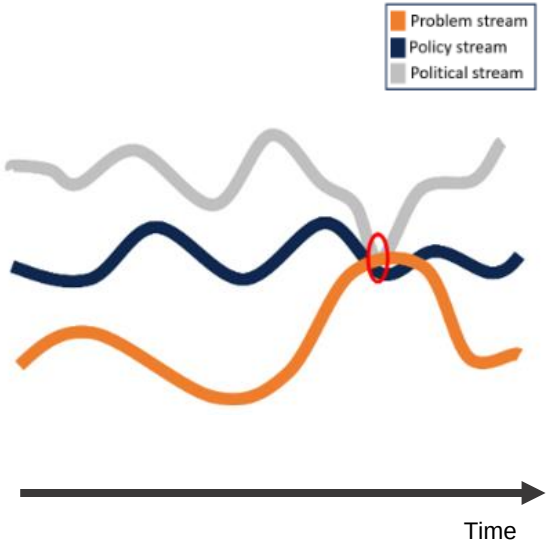


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# General Lessons

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# Reducing the number of cars in European cities

## What are the keys to success?


Sean van der Lee
10/04/2025

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# Why Low Car/No Car?

**Environmental Impacts**

**Traffic Congestion**

**Reduced Social Equity**

**Space Requirements**

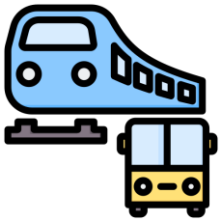

**Deteriorated Health**

**Accidents/ Safety Problems**

Pressure on authorities

Liveability for People

# Popular Interventions


- Land-Use Density & Diversity
- Constraining Traffic
- Pricing
- Limiting Traffic
- Alternatives
- Fare/Subscription Schemes

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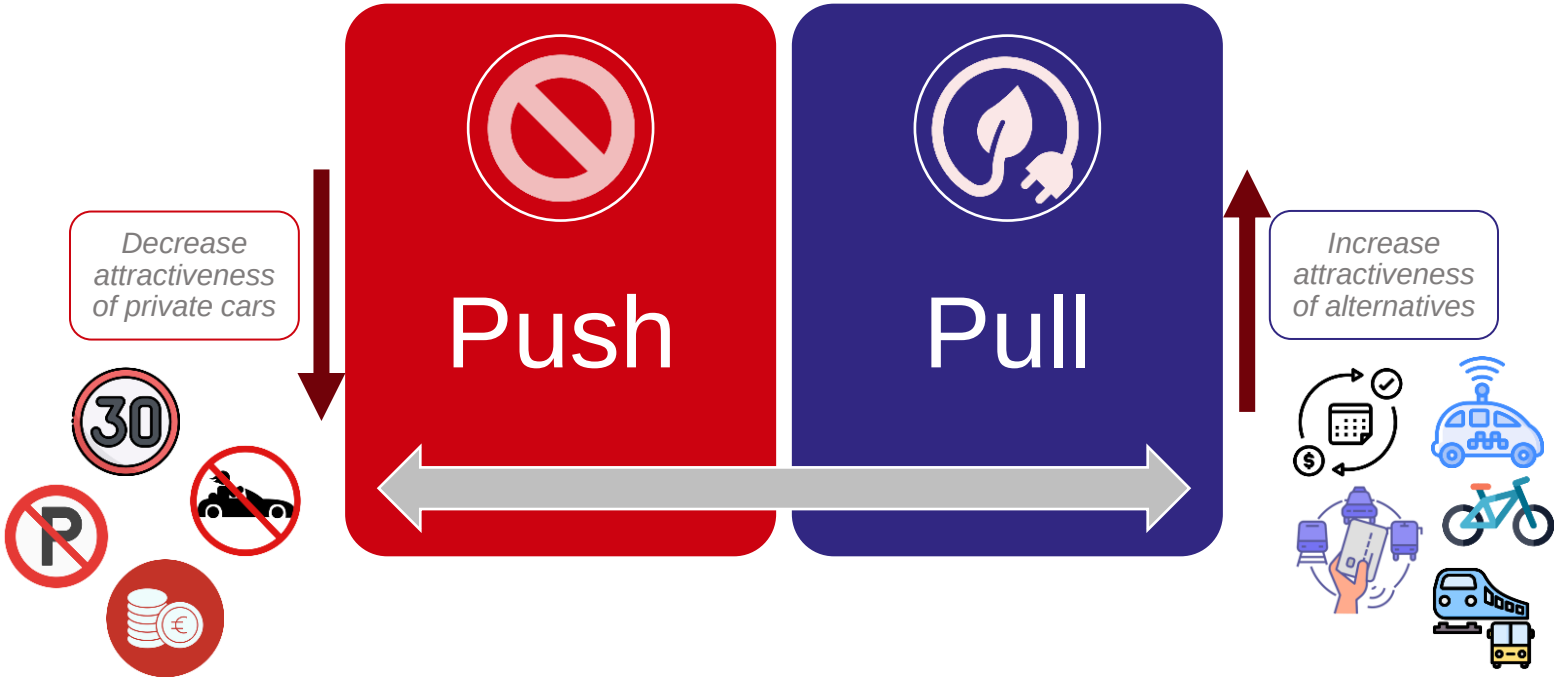
# Push & Pull Interventions

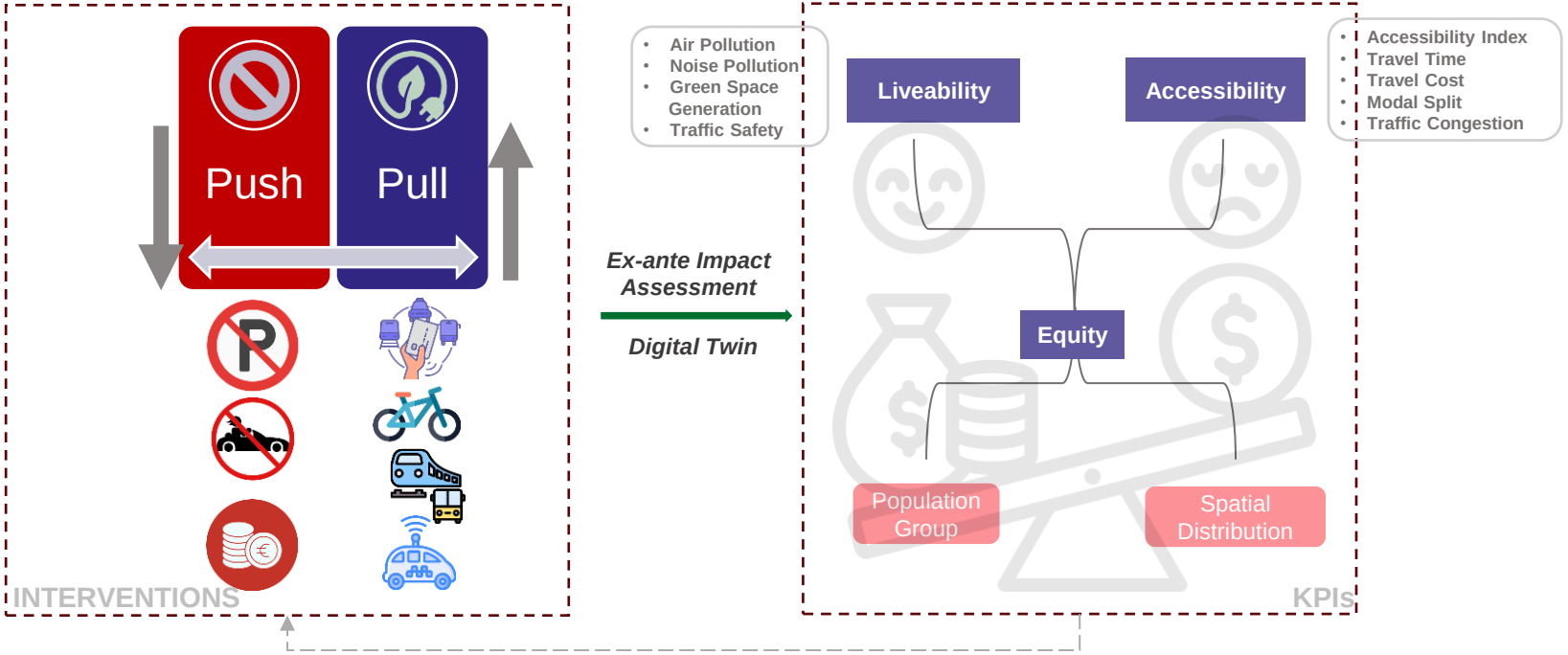


# But if not planned properly..

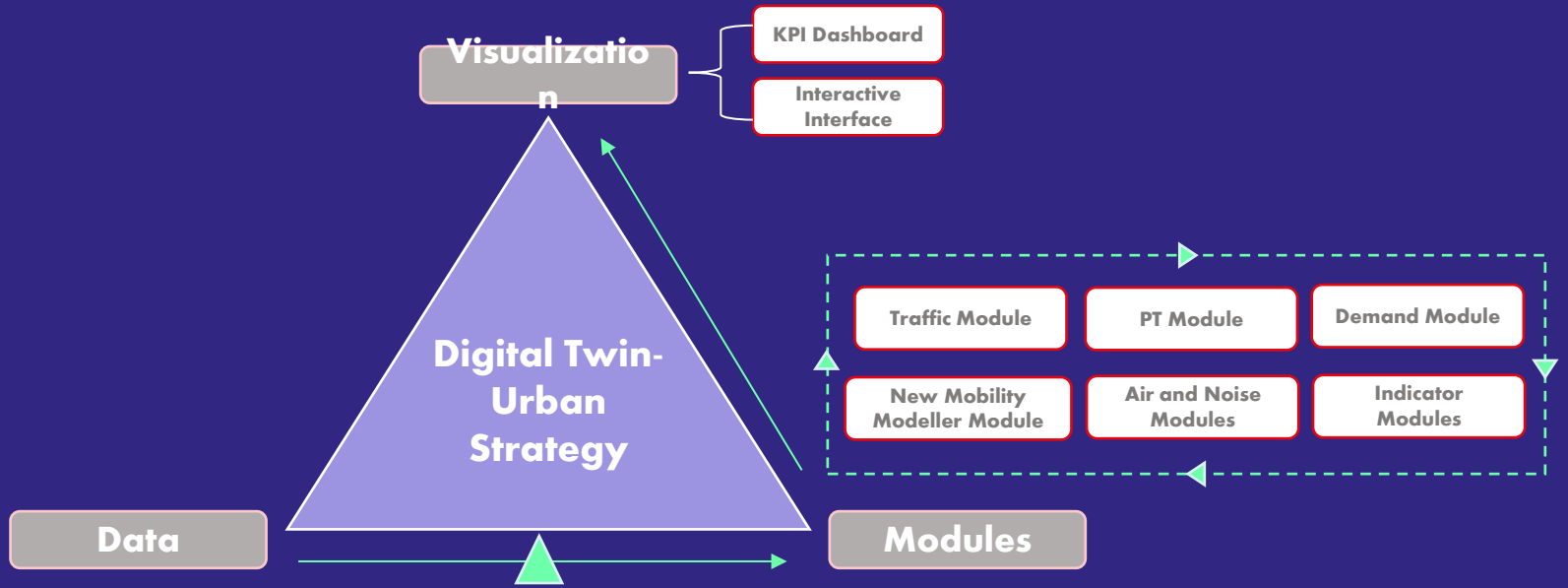

**Ex- Ante Detailed Quantitative Studies**

**Shift towards new set of indicators**

# Framework


Push
Pull
INTERVENTIONS
Ex-ante Impact Assessment
Digital Twin
Air Pollution
Noise Pollution
Green Space Generation
Traffic Safety
Liveability
Accessibility
Accessibility Index
Travel Time
Travel Cost
Modal Split
Traffic Congestion
Equity
Population Group
Spatial Distribution
KPIs

# Digital Twin-Urban Strategy




Working on better cities with less cars

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# Almere Delphi Study Approach

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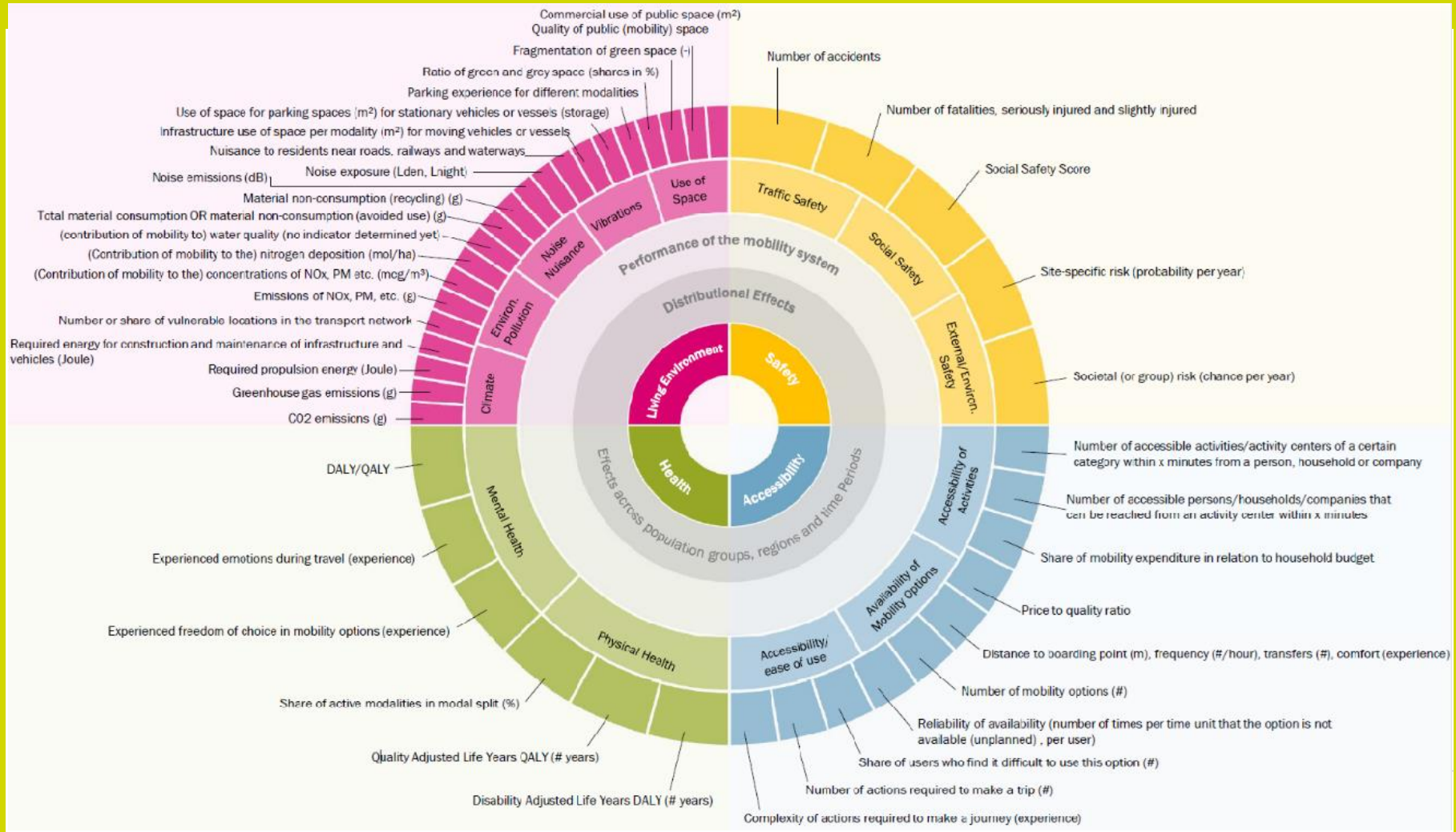
# Defining KPI – approach in detail

- Interviewee organisations:

BAM, Fietsersbond, FSD, Gemeente Amsterdam,
Ministerie I&W, MRA, MRDH, RET,
Rijkswaterstaat, SWOV

*Interviewees invited, questions developed,*
*and interviews conducted*
*by Azarakhsh Salem*


Commercial use of public space (m²)
Quality of public (mobility) space
Fragmentation of green space (-)
Ratio of green and grey space (shares in %)
Parking experience for different modalities
Use of space for parking spaces (m²) for stationary vehicles or vessels (storage)
Infrastructure use of space per modality (m²) for moving vehicles or vessels
Nuisance to residents near roads, railways and waterways
Noise emissions (dB)
Noise exposure (Lden, Lnight)
Material non-consumption (recycling) (g)
Total material consumption OR material non-consumption (avoided use) (g)
(contribution of mobility to) water quality (no indicator determined yet)
(Contribution of mobility to the) nitrogen deposition (mol/ha)
(Contribution of mobility to the) concentrations of NOx, PM etc. (mcg/m³)
Emissions of NOx, PM, etc. (g)
Number or share of vulnerable locations in the transport network
Required energy for construction and maintenance of infrastructure and vehicles (Joule)
Required propulsion energy (Joule)
Greenhouse gas emissions (g)
CO2 emissions (g)
Use of Space
Vibrations
Noise Nuisance
Environ. Pollution
Climate
Number of accidents
Number of fatalities, seriously injured and slightly injured
Social Safety Score
Site-specific risk (probability per year)
Societal (or group) risk (chance per year)
Traffic Safety
Social Safety
External/Environ. Safety
Performance of the mobility system
Distributional Effects
Living Environment
Safety
Health
Accessibility
Effects across population groups, regions and time Periods
DALY/QALY
Experienced emotions during travel (experience)
Experienced freedom of choice in mobility options (experience)
Share of active modalities in modal split (%)
Quality Adjusted Life Years QALY (# years)
Disability Adjusted Life Years DALY (# years)
Mental Health
Physical Health
Number of accessible activities/activity centers of a certain category within x minutes from a person, household or company
Number of accessible persons/households/companies that can be reached from an activity center within x minutes
Share of mobility expenditure in relation to household budget
Price to quality ratio
Distance to boarding point (m), frequency (#/hour), transfers (#), comfort (experience)
Number of mobility options (#)
Reliability of availability (number of times per time unit that the option is not available (unplanned) , per user)
Share of users who find it difficult to use this option (#)
Number of actions required to make a trip (#)
Complexity of actions required to make a journey (experience)
Accessibility of Activities
Availability of Mobility Options
Accessibility/ ease of use

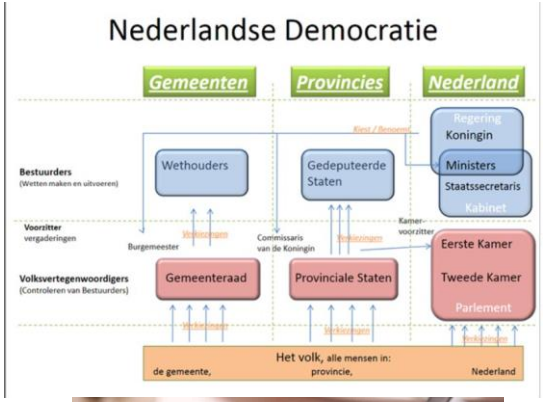
# Defining KPI – longlist ‘families’

- Accessibility and Mobility
- Quality & Price of mobility
- Environment & Livability, Emissions & Concentrations
- Spatial Quality
- Social and Traffic Safety

# With measures and KPIs defined, from which framework are we implementing? Welcome to the Dutch governance lasagna.

Five Key Components:

1. National-Level Framework
2. Regional-Level Framework
3. Municipal-Level Implementation
4. Funding & Incentives
5. Guiding Principles for Mobility Planning




# 1. National Framework – Overview

SETS STRATEGIC DIRECTION AND LEGAL BASIS

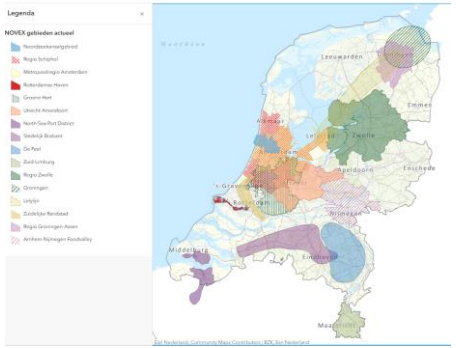
ANCHORED IN SUSTAINABILITY, ACCESSIBILITY, EQUITY AND INNOVATION

INTERLINKED WITH SPATIAL PLANNING AND CLIMATE GOALS

# National Mobility Vision (Mobiliteitsvisie)

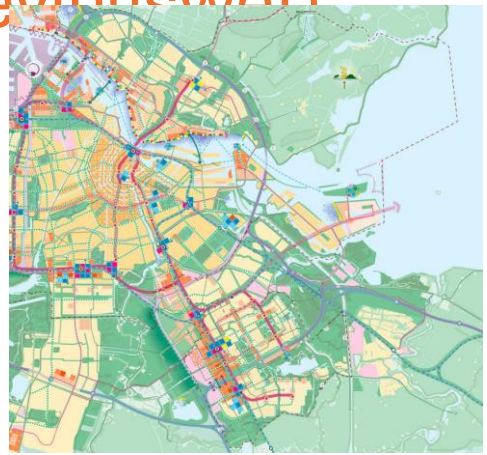
- Strategic vision to 2050 by Ministry of Infrastructure (IenW)
- Goals: Multi-modal networks, inclusive and climate-neutral transport, innovation
- Supports economic growth and quality of life
- Calls for multi-governance operationalisation in regions
- Feeds into NOVi -> NOVEX areas

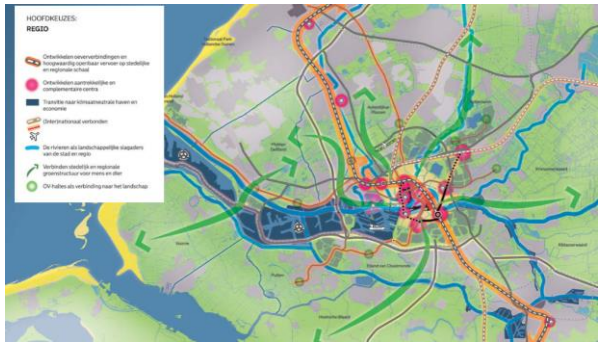

NOVEX-gebieden en woningbouwlocaties



# Environment and Planning Act (Omgevingswet)

- In force since 2024 – merges 26 laws into one
- Integrated land use, mobility, environment, health
- Municipalities must create environmental visions/plans (Omgevingsvisies)
- Emphasizes citizen participation and faster processes





# Accessibility Monitoring – Bereikbaarheidspeil (brand new!)

- National tool for measuring access to jobs, services, etc.
- Multi-modal: cycling, transit, car
- Supports data-driven evaluation and prioritization

# Future Outlook – Car, rail and PT (Toekomstbeeld Automobiliteit & OV en spoor)

- Strategy for sustainable car use
- Smart infrastructure, EV transition, shared mobility
- Urban restraint, rural access, dynamic pricing
- Vision through 2040 for public transport
- Investments in rail upgrades, TOD, electrification
- High-frequency trains and integrated mobility
- Agenda for developing stations (Stations agenda)

# Climate Agreement & Energy Policy

ALL NEW CARS EMISSION-FREE BY 2030

CHARGING INFRASTRUCTURE AGENDA (NAL PROGRAM OF WORK)

ZERO-EMISSION URBAN ZONES

PROMOTES CYCLING, TRANSIT, CLEAN LOGISTICS

INCENTIVES AND SUBSIDIES (SEPP, SEB, ETC)

# Strategic Tools & Funding

- MIRT – long-term investment program
- National Growth Fund – innovation, infrastructure
- Smart Mobility Agenda – digital and automated mobility
- EU co-financing – Green Deal, Horizon, SCF, CEF, EIB

# 2. Regional-Level Framework & Programs

- Managed by Vervoerregio's (regional transport authorities)
- Align national goals with local needs
- Public transport, cycling highways, logistics
- Coordinate across municipalities
- Integrate housing, employment, mobility
- Projects: bike corridors, P+R, clean logistics

# 3. Municipal-Level Implementation

- Local Mobility Plans (Mobiliteitsplannen)
- Address walking, cycling, parking, logistics
- Align with Environment and Planning Act
- Active mobility prioritized: woonerven, bike lanes, fietsstraten, safety
- Smart tools: MaaS, traffic flow data, mobility hubs, smart traffic lights and digital access management

# 4. Funding & Incentives

- National Growth Fund – major projects
- MIRT – spatial/mobility co-investment
- Local tools: parking fees, congestion pricing
- EU funds: CEF, Horizon, Green Deal

# 5. Guiding Principles

- Avoid–Shift–Improve framework
- 15-Minute City model and compact planning
- Inclusive mobility: accessibility for all
- Aligned with health, climate, land use

# Reality can bite back

# Enter: SUMPs

- Mandatory tool from the TEN-T directive (2024), delivery dec 2027
- Focus on multi-governance, comprehensive and system based based approach to sustainable urban mobility planning
- Key elements:
  - **Urban Nodes** with a **Functional Urban Area (FUA**)
  - **Analysis of current mobility system**
  - **Long term vision** AND **short term action plan** with financial underpinnings
  - **Participation** + **monitoring and evaluation** (M&E)
  - **A long list of guidelines** towards seamless mobility, accessibility, sustainability, health and safety, and **use of ICT and ITS** (begging for operationalisation)
- Basic requirement: **a common operational view** of past, present and future to guide KPI-based, comprehensive, and internally consistent mix of policy measures.

Question:

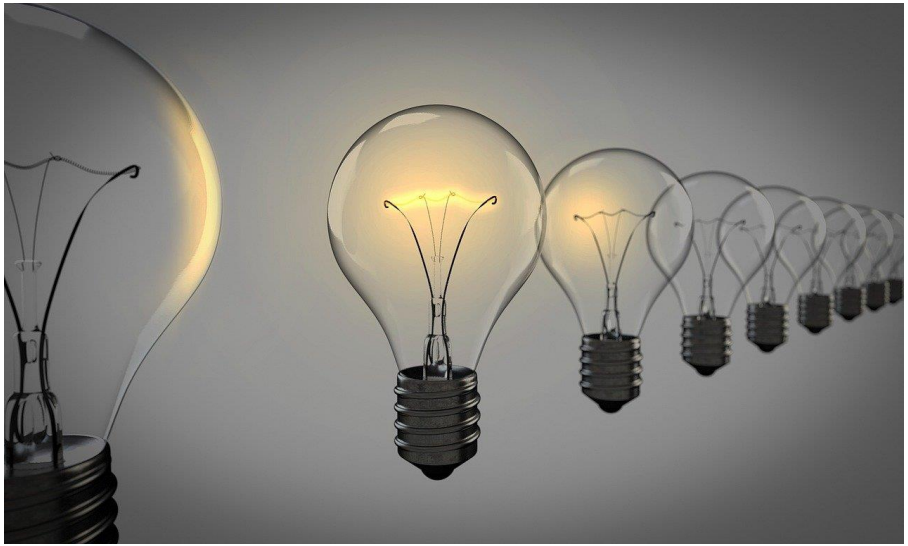
- Why would 26 Dutch or 431 European urban nodes go through this ordeal?!

# A word on data collection…

- ITS Richtlijn https://eur-lex.europa.eu/eli/dir/2010/40/oj en de herziening https://eur-lex.europa.eu/eli/dir/2023/2661 (zie m.n. annex III)
- MMTIS verordening https://eur-lex.europa.eu/eli/reg_del/2024/490/oj
- RTTI verordening https://eur-lex.europa.eu/eli/reg_del/2022/670/oj
- SRTI verordening https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32013R0886
- SSTP verordening https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32013R0885
- eCall verordening https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32024R1084
- TEN-T urban mobility indicators

# Not starting from scratch:

- Helsinki 3D+
- DUET (Rotterdam)
- Smart Cambridge
- Smarter Together (Lyon)
- Virtual Singapore
- Etc



# Conclusions

Car-low measures are nothing new, but to achieve desired effects we need to solve a few challenges related to governance and implementation

(Mandatory) SUMPs offer an promising instrument for a more holistic approach to sustainable urban mobility planning

(On the back of good data) Digital Twins can support SUMP development by visualising possible futures, improve participation, modeling desired outcomes, evaluating policy mixes, and providing a common operational picture across siloes and governance levels

At the neighbourhood level, DTs with car-low focus can help with visualising solution space for other domains (housing, energy, etc) and bridge the gap with the Climate Neutral Cities mission

# Call to action

- Join a SUMP pilot or the SUMP practice of your organisation
- Likewise, connect with the ClimateNeutral team in the G5, Helmond or Groningen
- Share knowledge and best practices with expert groups from within the SUMP (and UMI) and NZC space
- Start thinking about how to apply XCARCITY findings to make the Dutch lasagna more digestible

# LUNCH BREAK

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# Amsterdam Zuidas Barry Ubbels


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# Amsterdam is growing (2020-2030)

| | |
|---|---|
| Population | + 200.000 |
| Tourists | + 9.000.000 |
| Jobs | + 88.000 |
| Mobility | +23 – 58% in 2050 |

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# Zuidas is developing

- Zuidasdok
- Redevelopment of Zuidas (city area with businesses, housing and public spaces)
- 50% more users: citizens, students, commuters and visitors
- Jobs + 47%-73% in 2040, population from 6000 to 20000 (+233%)

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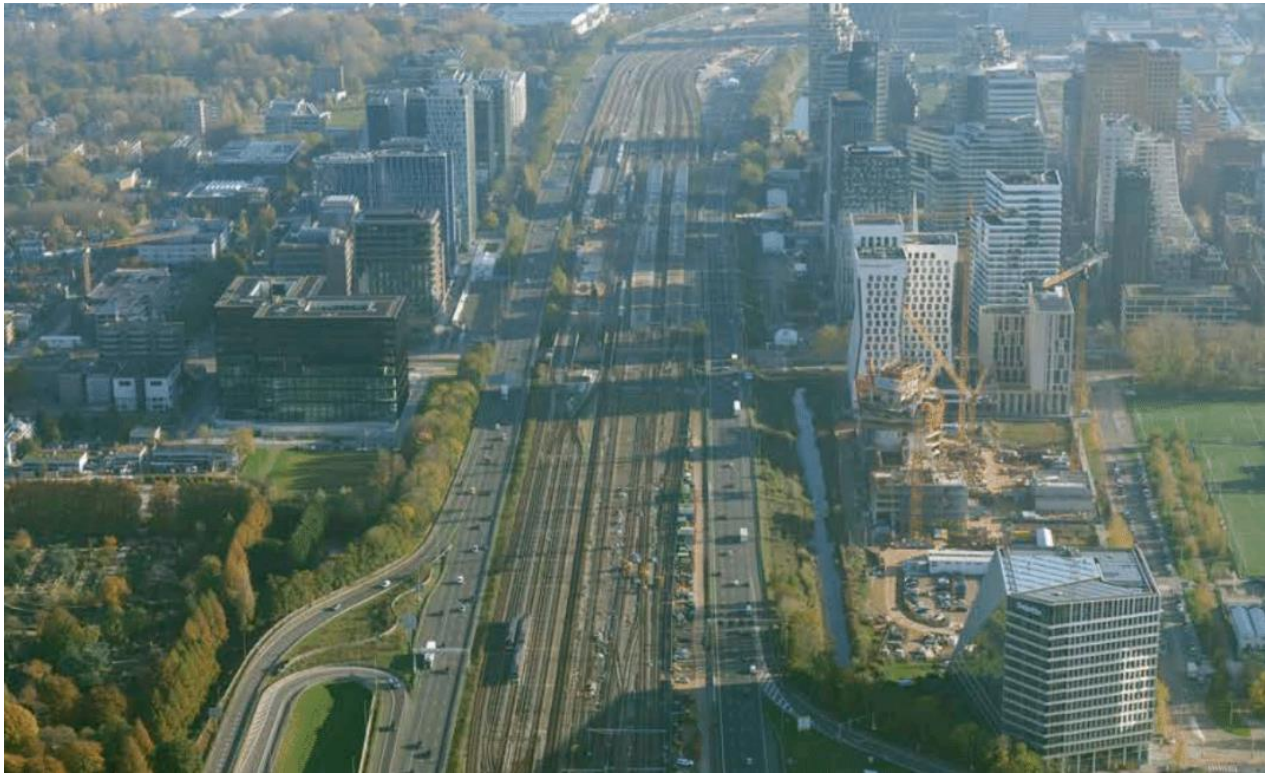
# Use case Zuidas (now)



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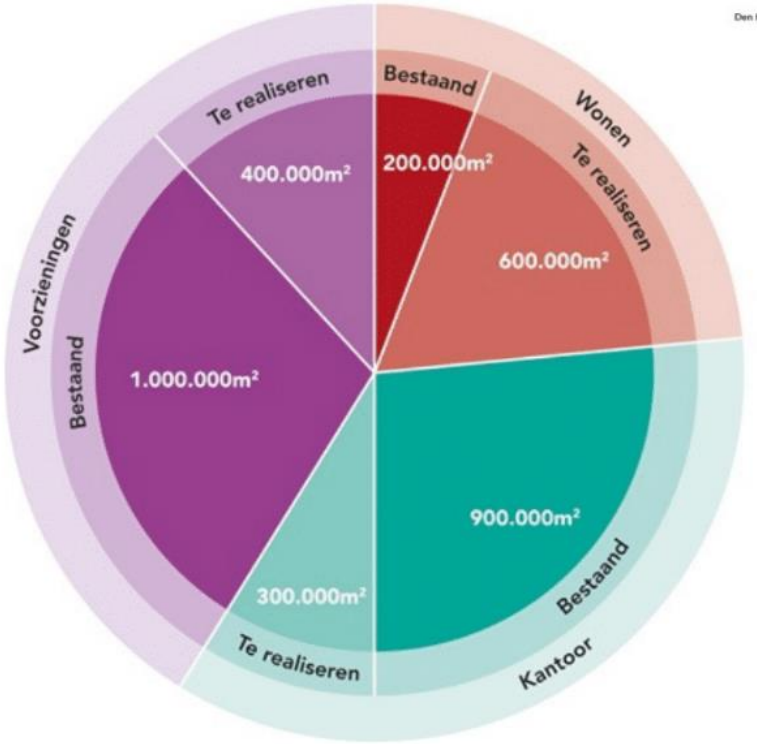
# Use case Zuidas (planned)

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# Policy making (Amsterdam city)


***Policy programmes***

- ***Autoluw***
- ***Walking***
- ***Traffic safety***
- ***Cycling***
- ***Logistics***
- ***Shared mobility***

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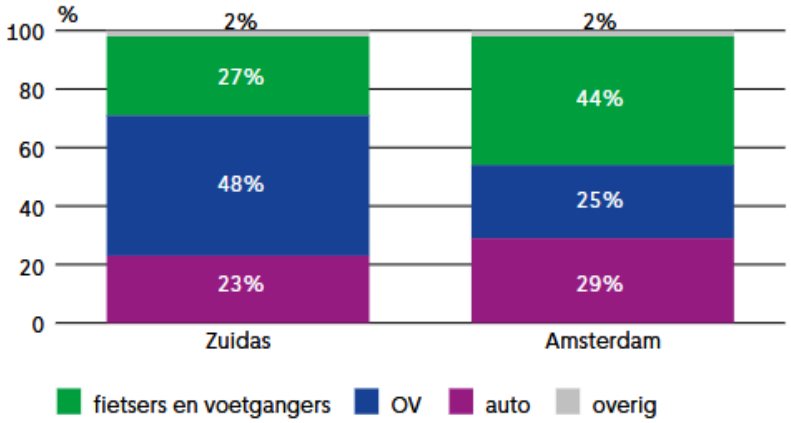
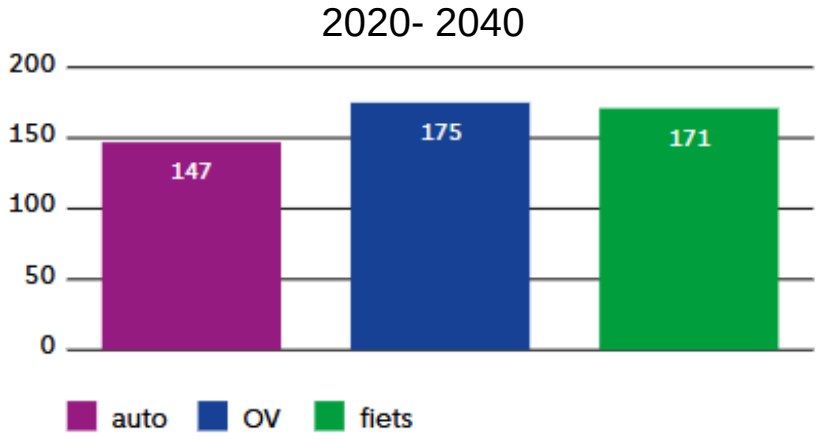
# Amsterdam Zuidas Mobility policy (2023)

# Zuidas area

- Objective: keep Zuidas accessible and liveable
- Now: well accessible by car and public



# Zuidas policy interventions (4 pillars)

- Redevelop public space (space to meet, enjoy, play etc.) to support walking and cycling
- Change mobility behaviour (off peak travelling, less car traffic)
- Less car parking
- Development programme and impact on mobility

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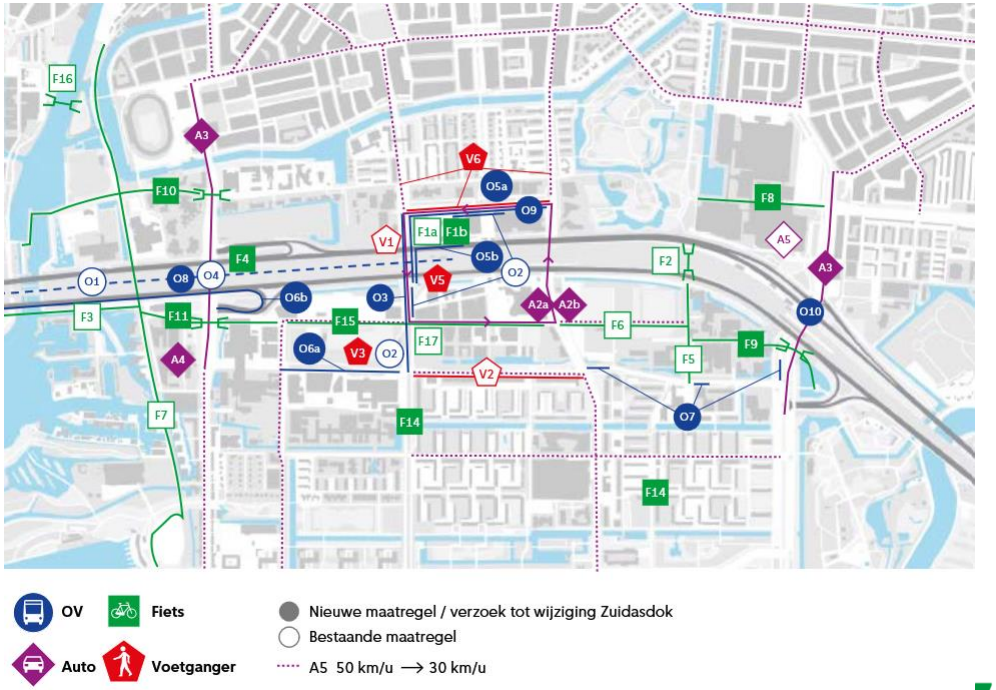
# Different policy measures

- One way traffic Mahlerlaan – Beethovenlaan – Parnassusweg
- Car sharing support
- Support cycling and walking
- Redesign intersections



# New tooling to support decision making

- Zuidas relies on tools such as 2D mapping and traditional transport model (VMA)
- Need for new visualization tools (3D) that support in spatial planning choices (how to divide space between staying and moving)
- Special attention for walking (large pedestrian flows expected)
- Use case design Parnassusweg

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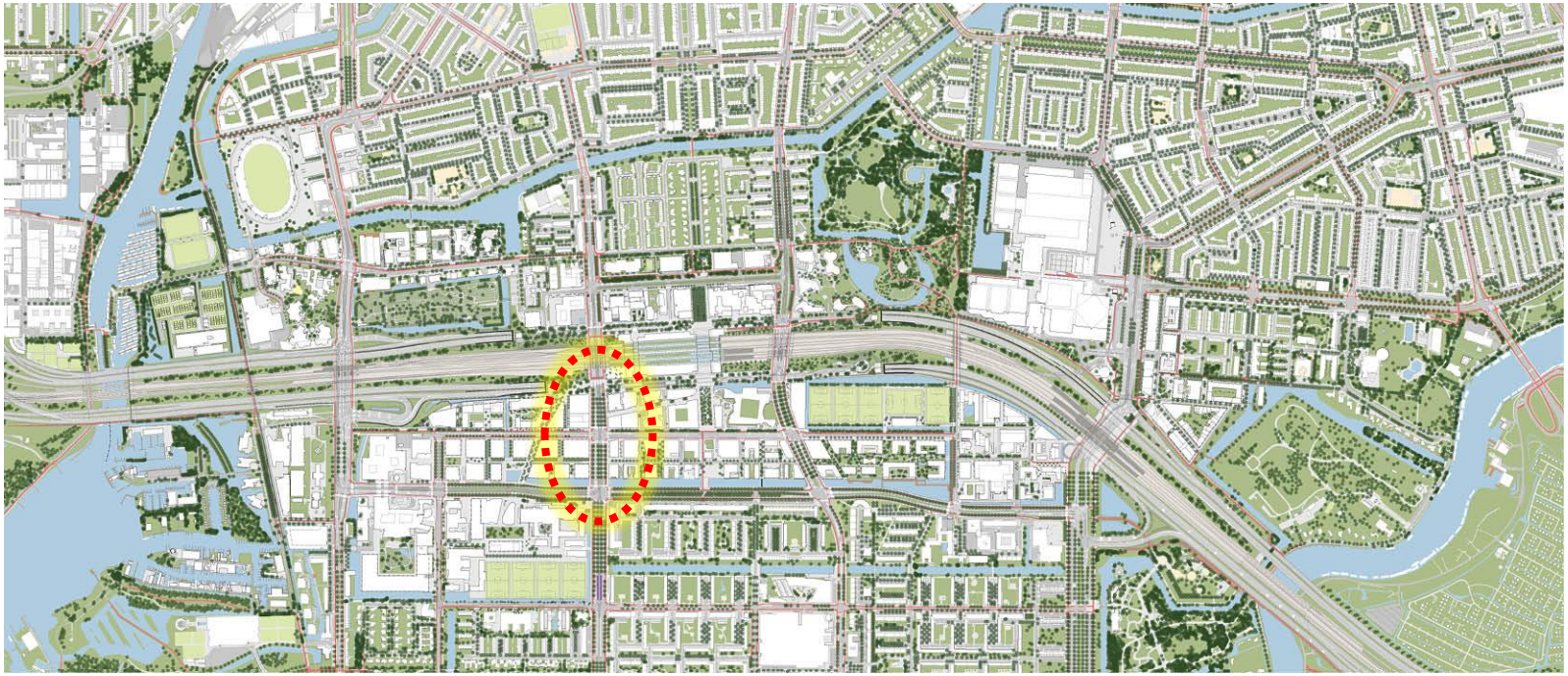
# Case Parnassusweg (intersection)



**Proposed (Zuidasdok finished)**

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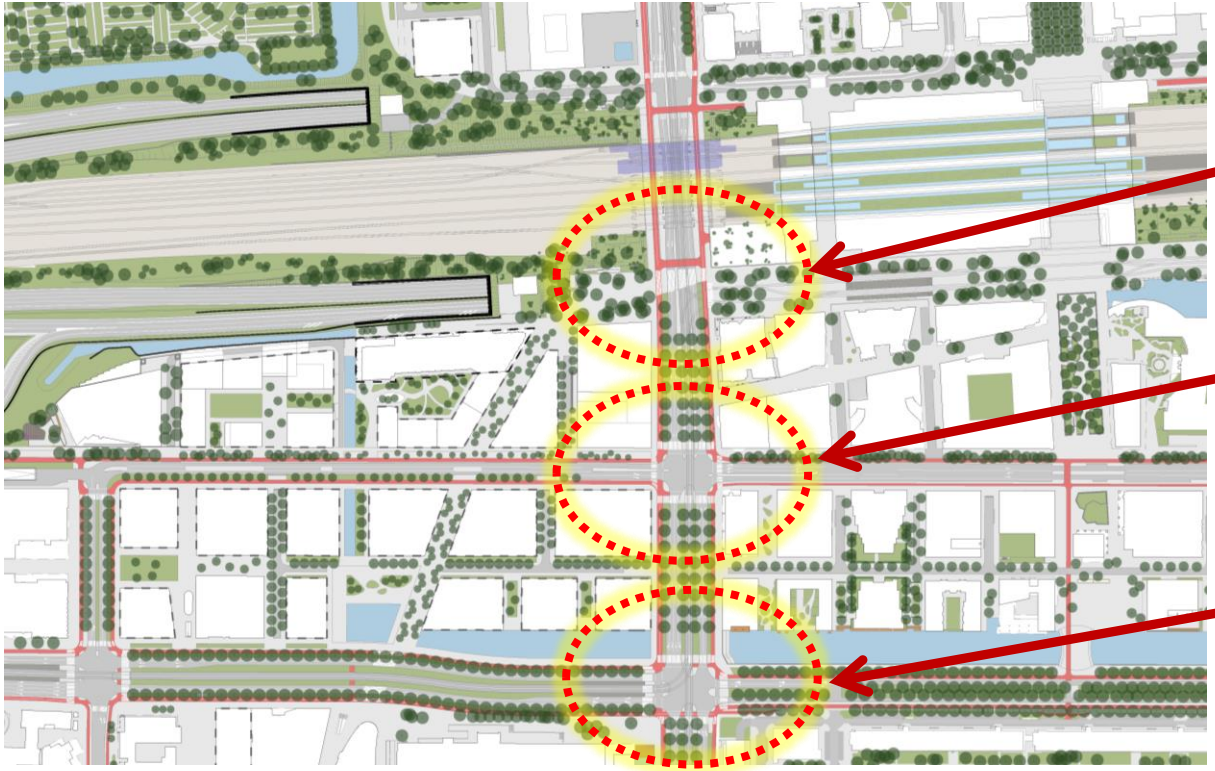
# Case Parnassusweg - Interventions



Case Parnassusweg

Intersection
Schonberglaan

Intersection
Mahlerlaan

Intersection
Boelelaan

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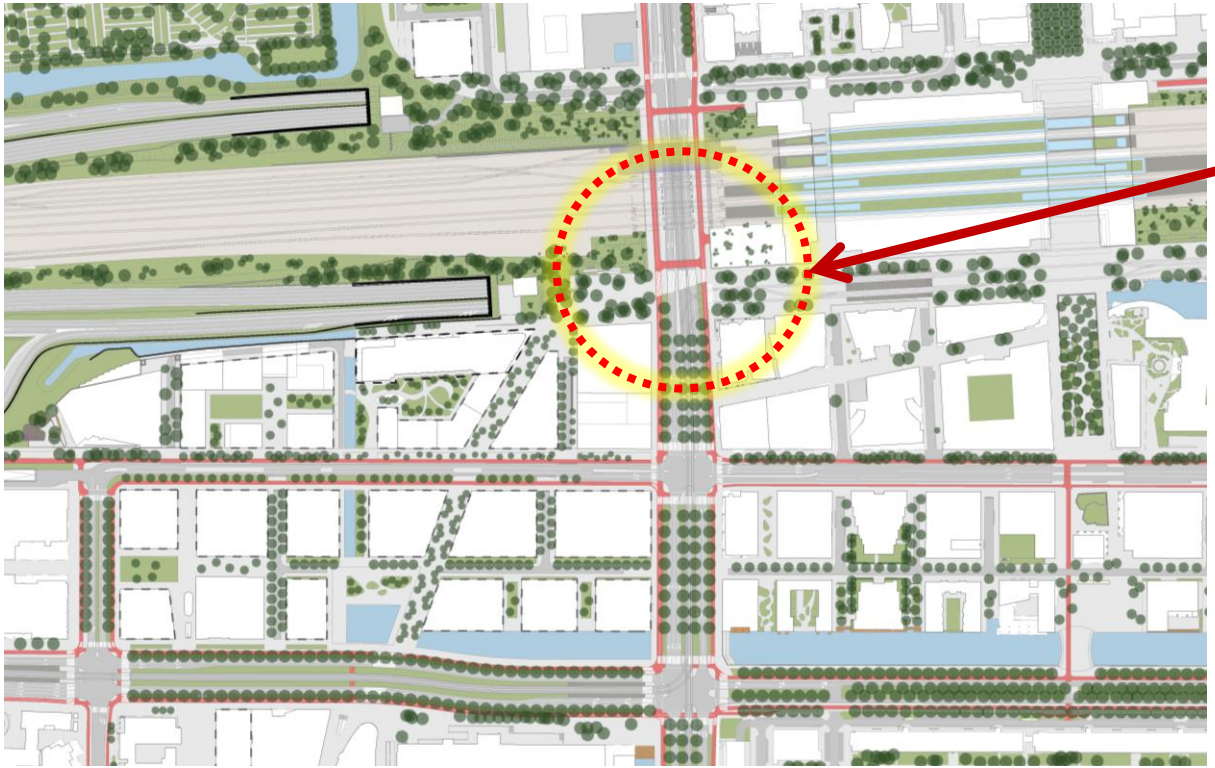
# Case Parnassusweg



**Case Parnassusweg**

**Intersection 1**
**Schonberglaan**

**Microlevel**

**Interaction between modalities PT/Bike /Pedestrians/cars**

**Interfering flows of pedestrians**

**Insight for design decisions in public realm**

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# Case Parnassusweg

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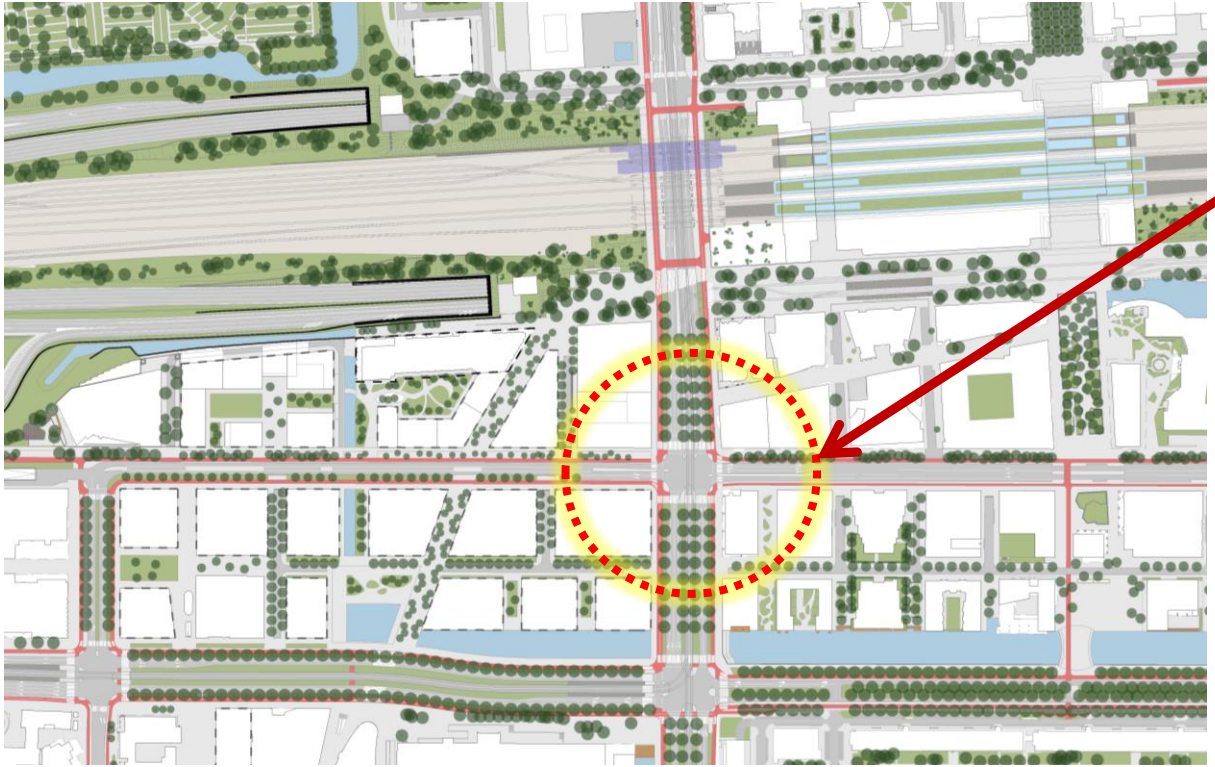
# Case Parnassusweg



**Case Parnassusweg**

**Intersection 2**
**Mahlerlaan**

**Intermediate level**

**Impact of reducing cars (traffic flows and spatial qualities)**

**Insight for strategic decisions (in space and time)**

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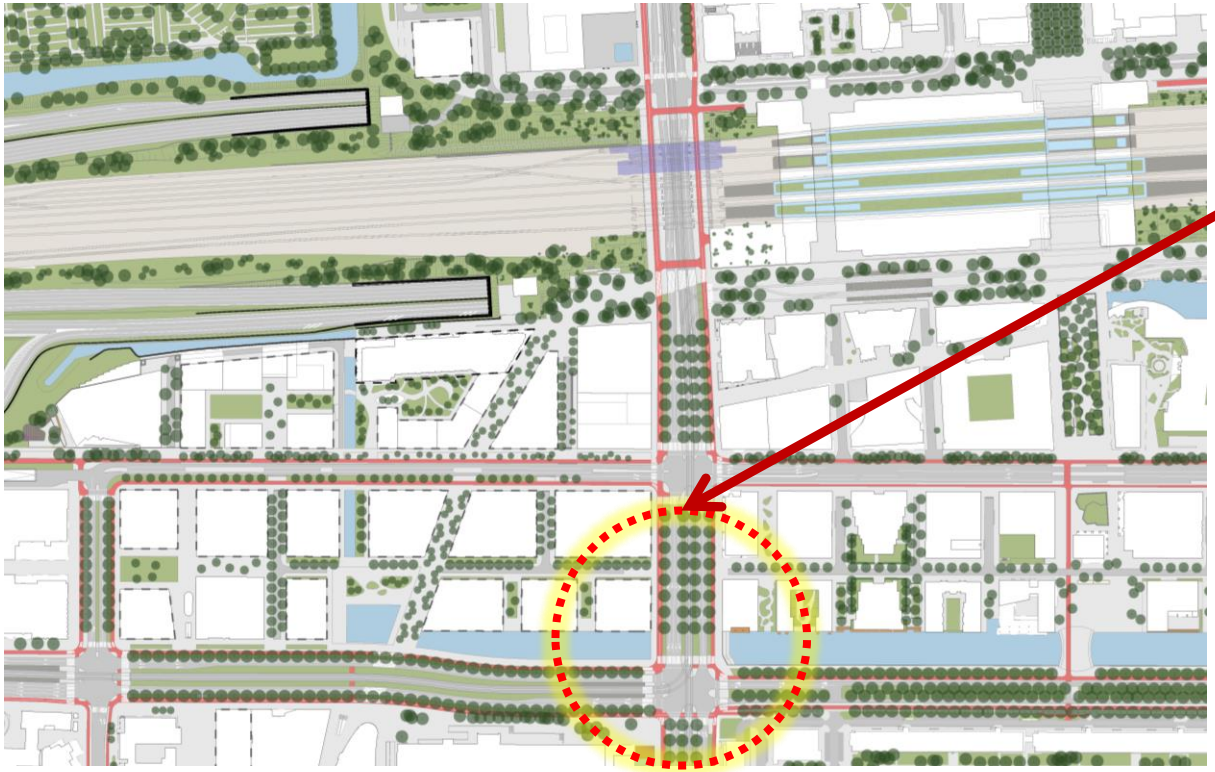
# Case Parnassusweg



**Case Parnassusweg**

**Intersection**
**Boelelaan**

**Macro level**

**Impact of set of interventions of behavioral changes**

**Insight for policymaking**

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# Interactive session

Bart van Arem

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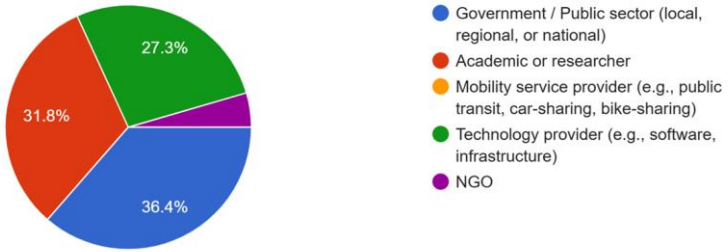
# Our collective understanding…

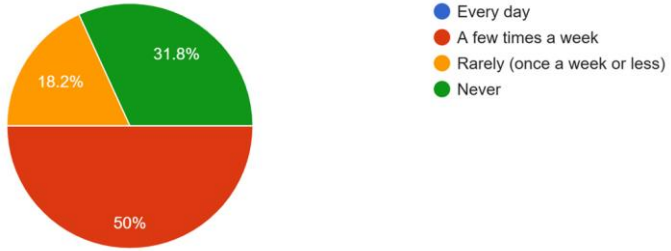
1. Which stakeholder group in urban mobility best describes your role? (Please select one)

22 responses




8. How often do you use a car for your daily commute or travel?

22 responses




Awareness of National Digital Twin Initiative: yes(10), no (6), no response (6)

Worked with DT technology: Yes (19), no (3)

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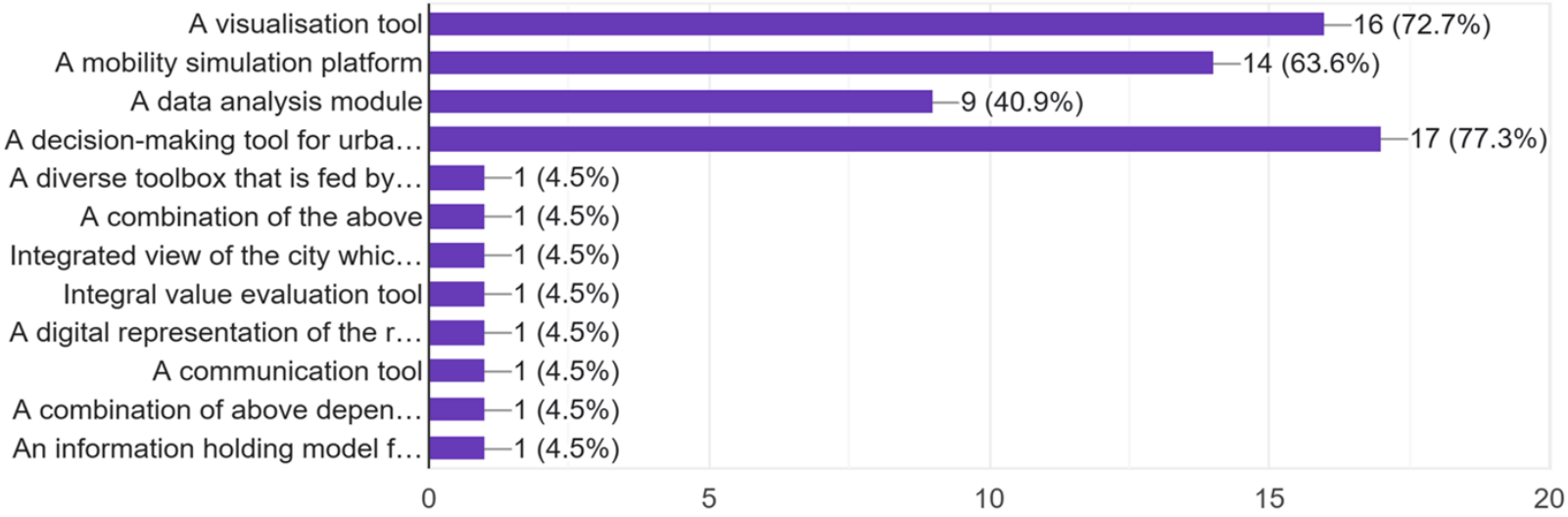
## 3. In your opinion, what is a Digital Twin? (Please select all that apply):

22 responses

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5. What do you believe is currently lacking in the digital twins that you are using in your organisation or today's digital twin solutions in general? (Please select all that apply)

16 responses


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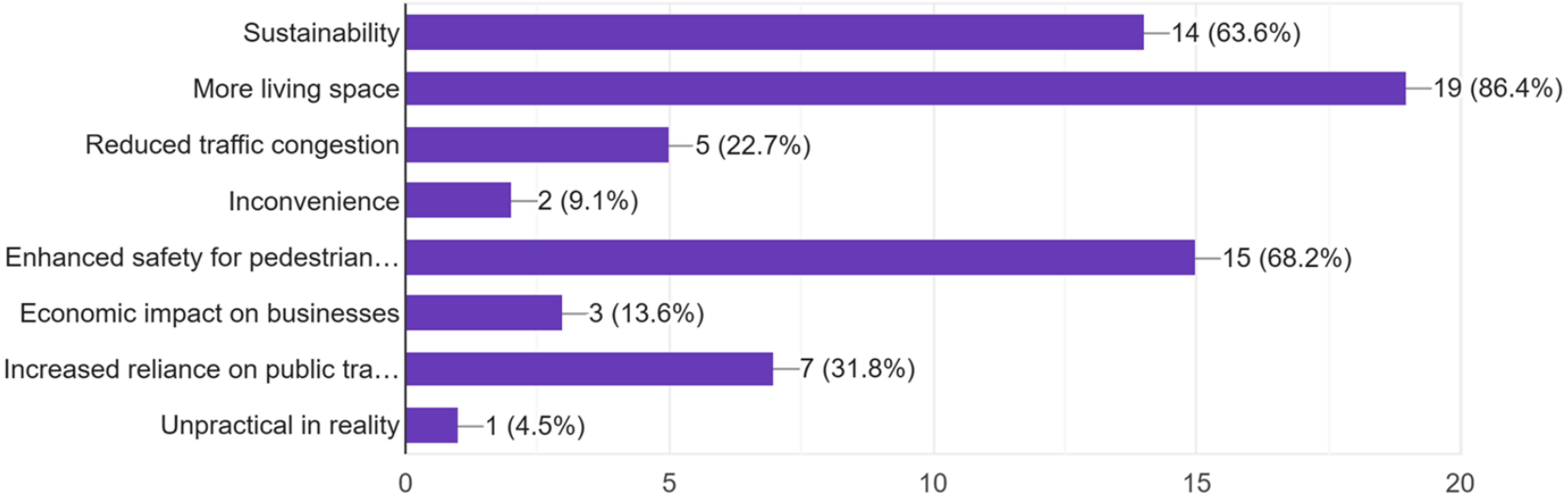
7. Which of the following are the top 3 features that describe your overall impression of car-low cities? (Please select top 3 that apply)

22 responses

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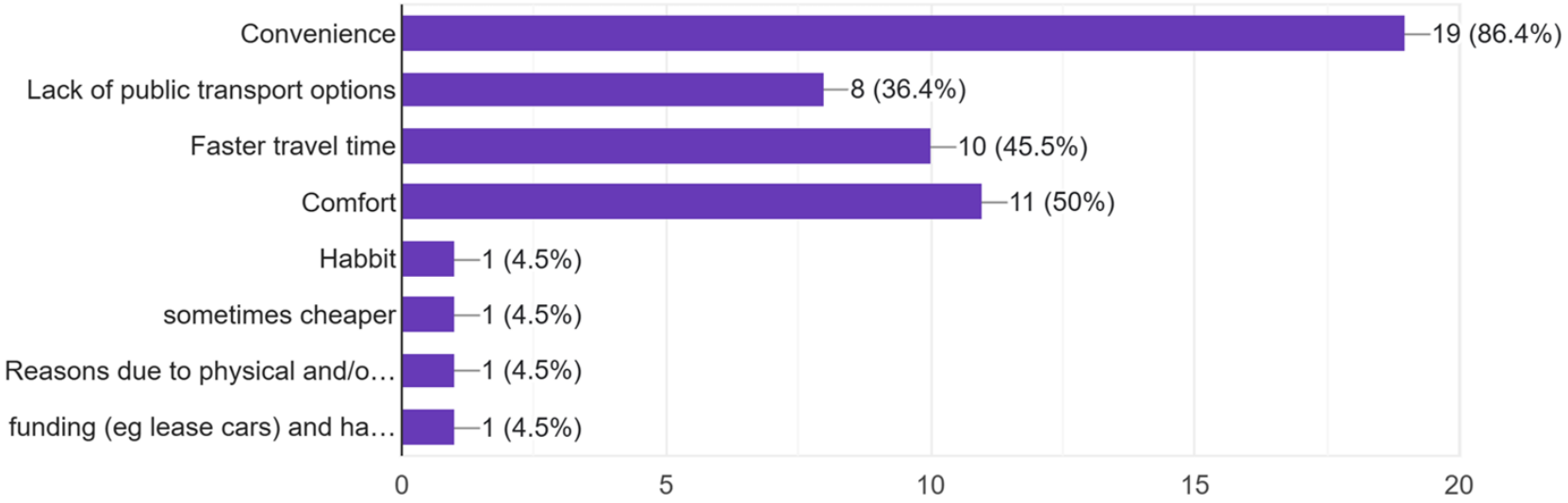
9. What do you think are the main reasons for choosing private cars other than other modes of transport? (Please select all that apply)

22 responses

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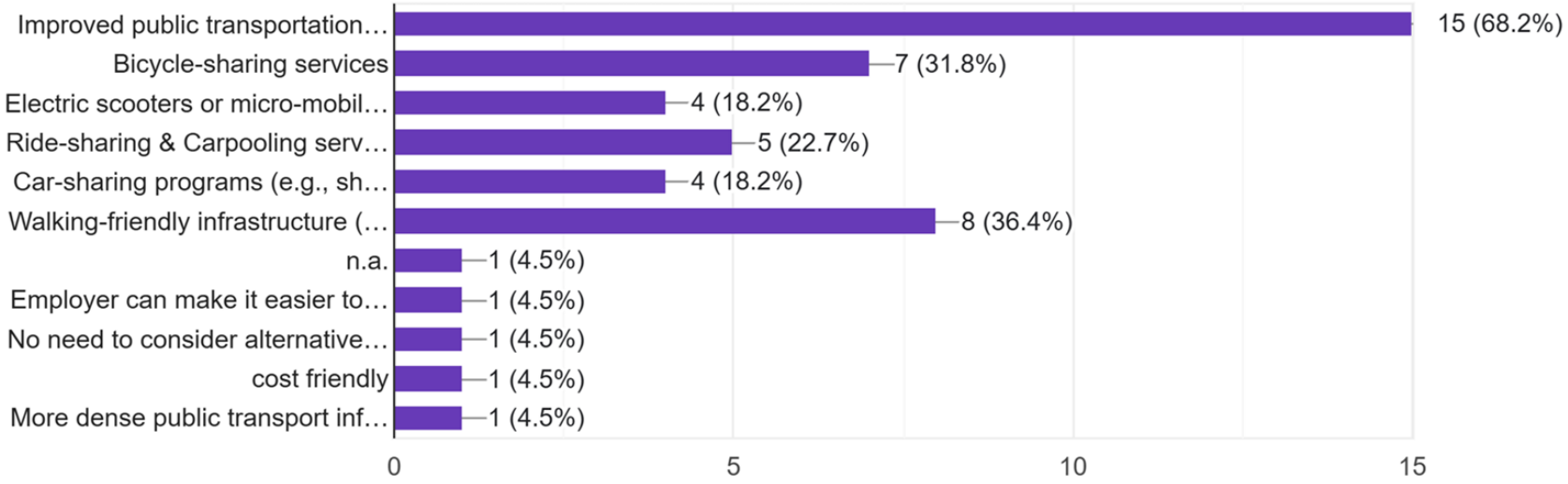
10. If offered the following alternatives in the Amsterdam Zuidas region, which one(s) would you consider using so that you no longer need to use your car? (Please select all that apply)

22 responses

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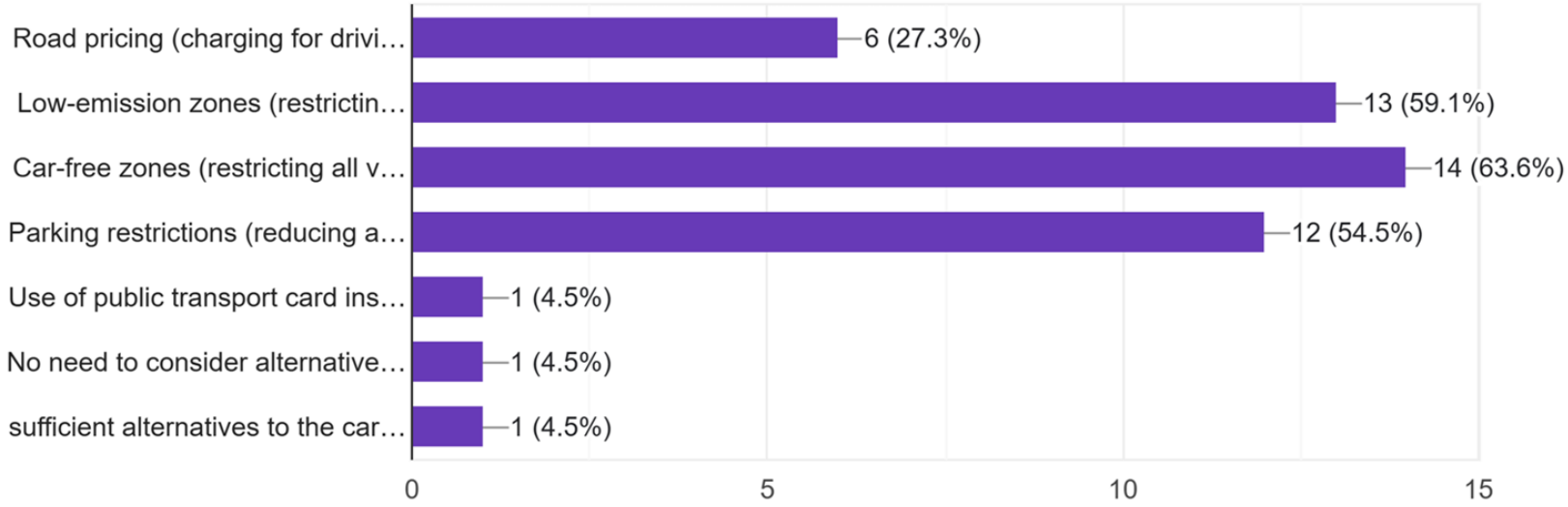
11. If offered the following interventions to reduce car usage and promote sustainable transport in the Amsterdam Zuidas region, which one(s) do you th...urrent experience? (Please select all that apply)

22 responses

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# Interactive Workshop Details:

1. How can a digital twin help to understand the contribution of the interventions on policy goals
2. What are the components of the digital twin in terms of data, models and visualisation

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# Group 1

## Intersection 1: Microlevel

**Interaction between modalities PT/Bike /Pedestrians/cars + Interfering flows of pedestrians - Insight for design decisions in public realm**

(1) How can a digital twin help to understand the contribution of the interventions on policy goals

(2) What are the components of the digital twin in terms of data, models and visualisation

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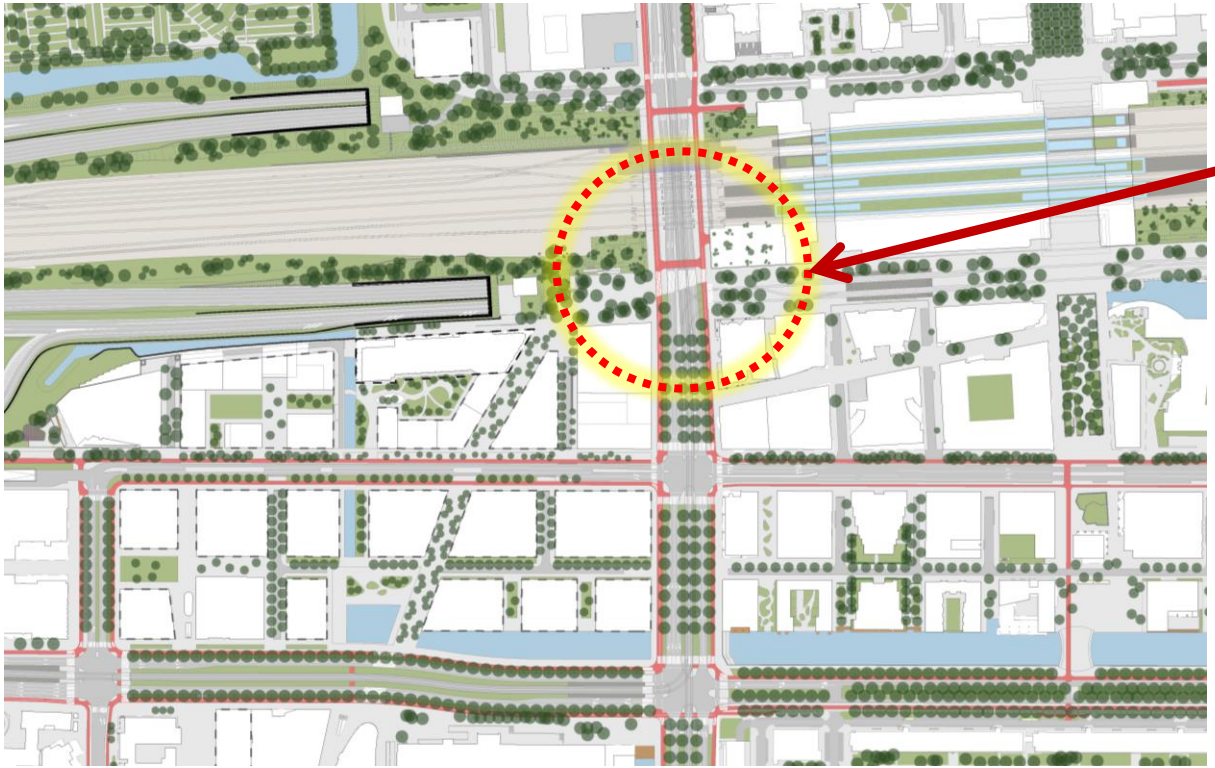
# Case Parnassusweg



**Case Parnassusweg**

**Intersection 1**
**Schonberglaan**

**Microlevel**

**Interaction between modalities PT/Bike /Pedestrians/cars**

**Interfering flows of pedestrians**

**Insight for design decisions in public realm**

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# Group 2

**Intersection 2: Intermediate level**

**Impact of reducing cars (traffic flows and spatial qualities) + Insight for strategic decisions (in space and time)**

(1) How can a digital twin help to understand the contribution of the interventions on policy goals
(2) What are the components of the digital twin in terms of data, models and visualisation

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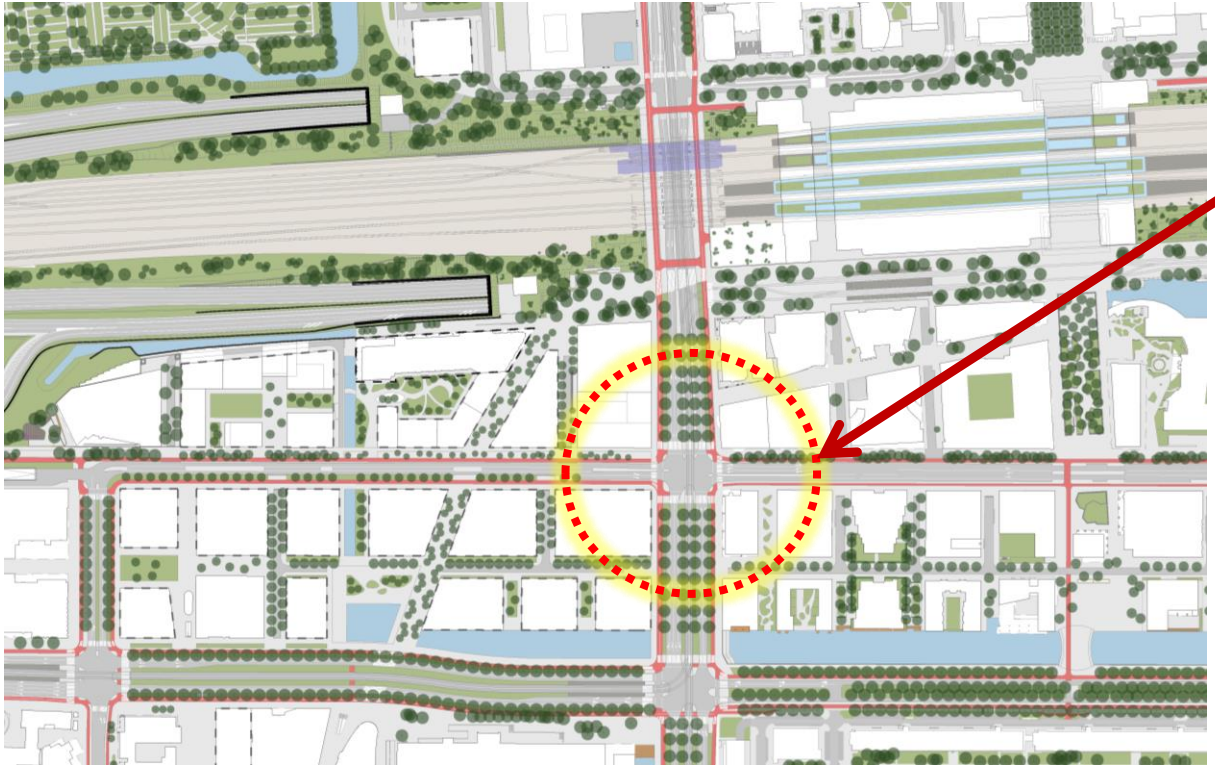
# Case Parnassusweg



**Case Parnassusweg**

**Intersection 2**
**Mahlerlaan**

**Intermediate level**

**Impact of reducing cars (traffic flows and spatial qualities)**

**Insight for strategic decisions (in space and time)**

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# Group 3

## Intersection 3: Macro level

**Impact of set of interventions of behavioral changes + Insight for policymaking**

(1) How can a digital twin help to understand the contribution of the interventions on policy goals
(2) What are the components of the digital twin in terms of data, models and visualisation

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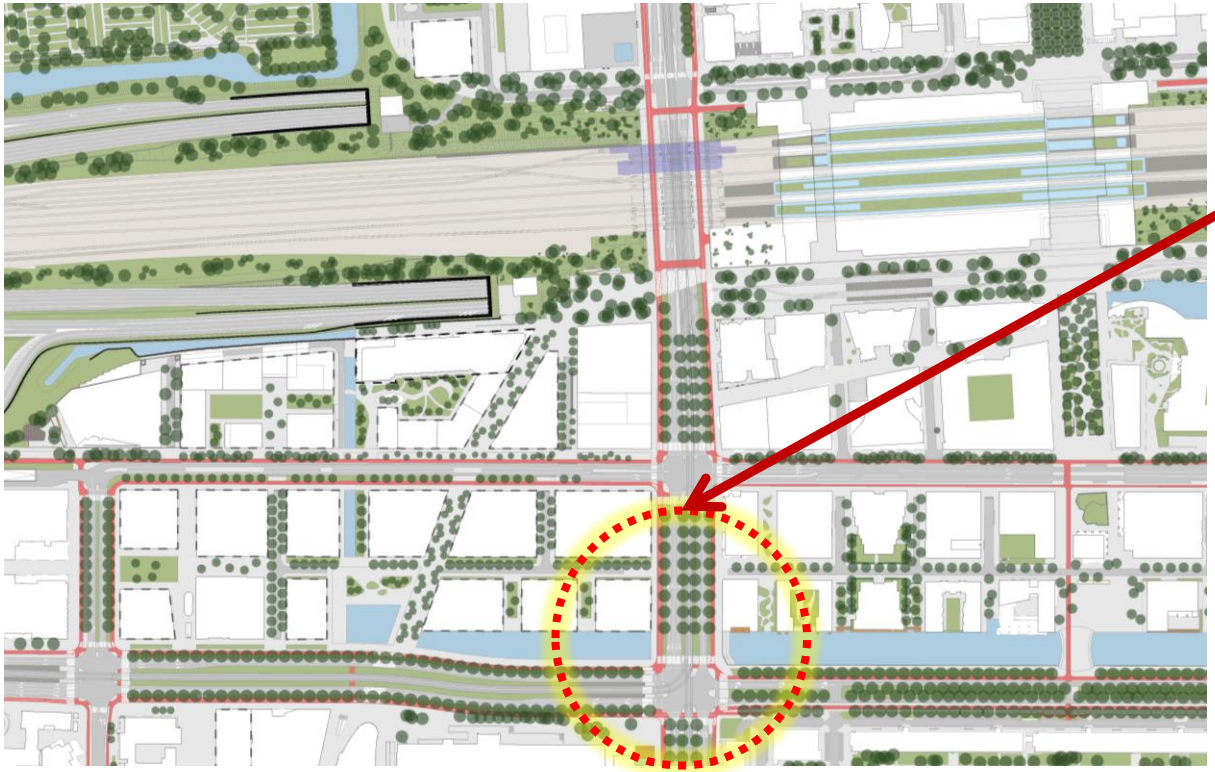
# Case Parnassusweg



**Case Parnassusweg**

**Intersection**
**Boelelaan**

**Macro level**

**Impact of set of interventions of behavioral changes**

**Insight for policymaking**

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# Group 4

**All three intersections: How does this work together?**

(1) How can a digital twin help to understand the contribution of the interventions on policy goals?
(2) What are the components of the digital twin in terms of data, models and visualisation?

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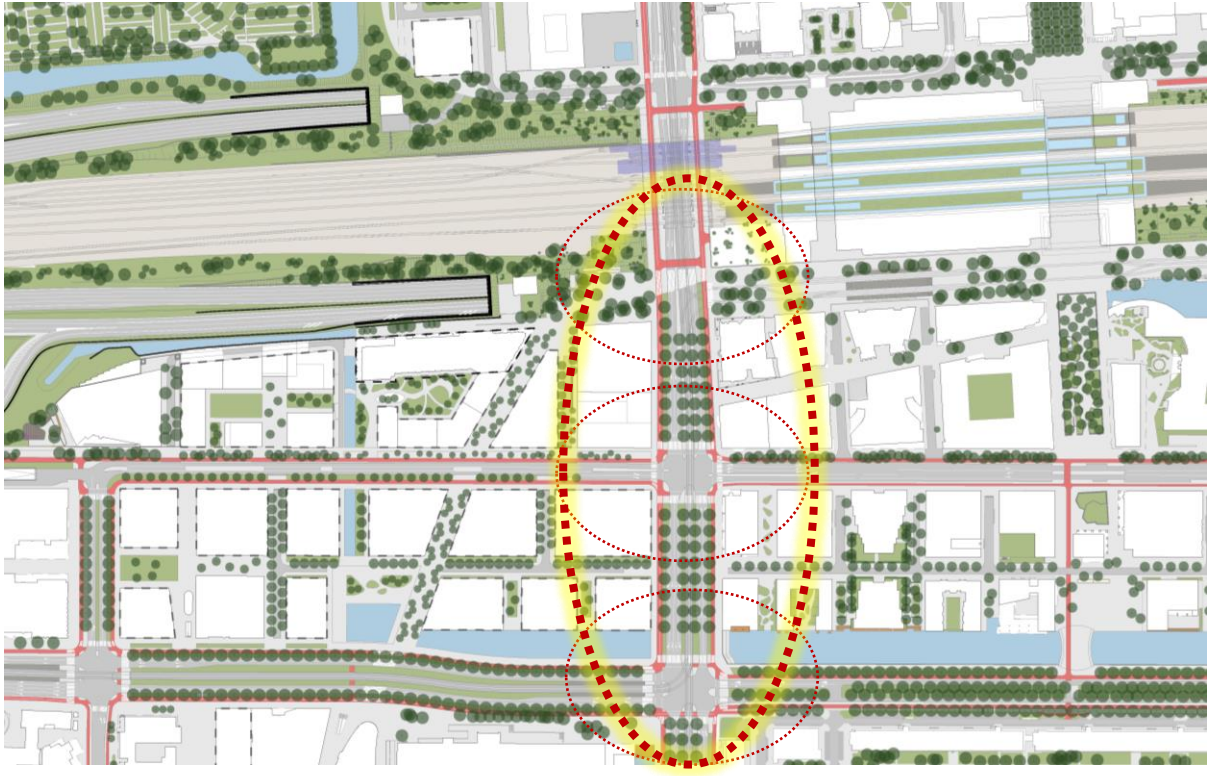
# Case Parnassusweg



**Case Parnassusweg**

**Intersection 1**
**Schonberglaan**

**Intersection 2**
**Mahlerlaan**

**Intersection 3**
**Boelelaan**

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# Break

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# Feedback Session

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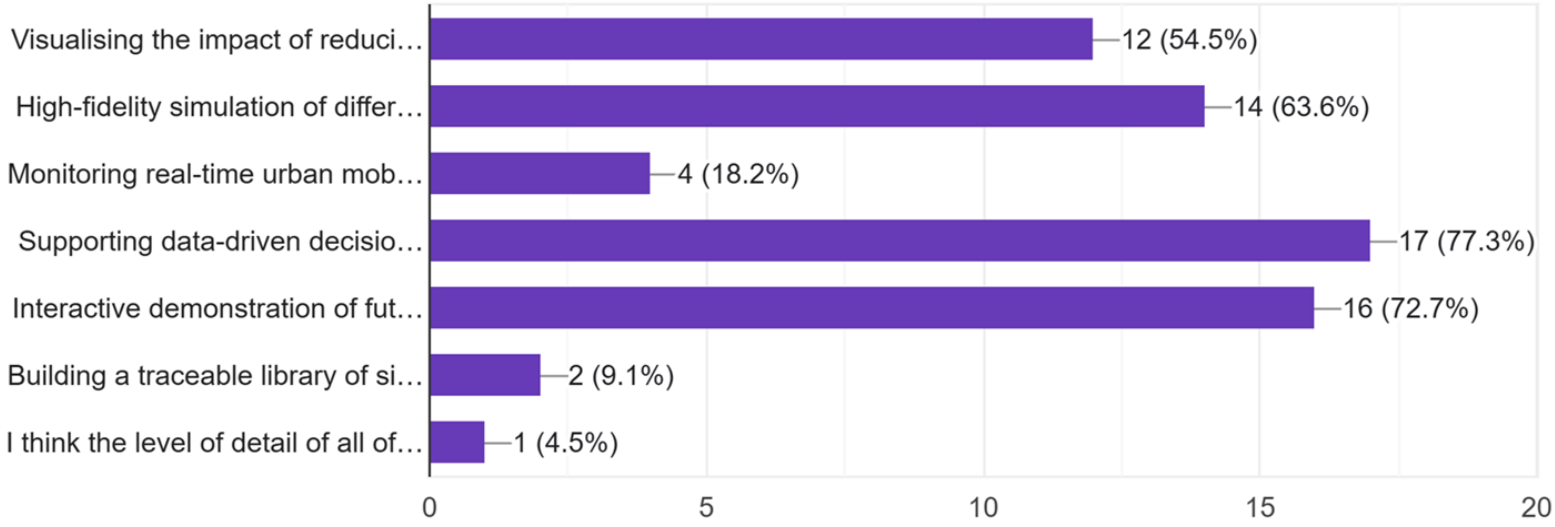
12. In your opinion, which of the following features are the top 3 most important for using Digital Twin technology to study the impact of car-low cities?

22 responses

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# Close out and Next Steps By Bart van Arem

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# Thank you!

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