

Goudappel

MOBILITY MOVES US

Hub Dynamics

A data driven dynamic
microsimulation model for public
transport hubs

Alejandro Montes

Reference: Hub Dynamics
Date: 20th May 2025



Who am I?



Alejandro Montes Rojas

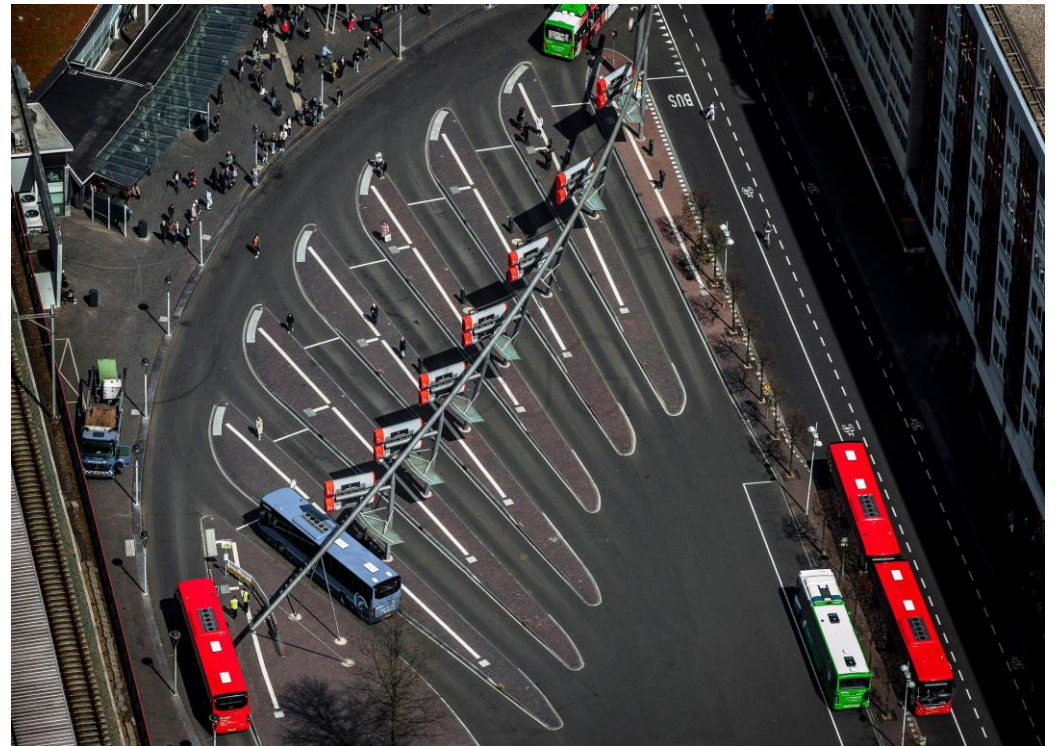
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Civil Engineering (BSc), Universidad del Cauca

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Agenda

- Why do we simulate public transport (PT) hubs?
- Our solution
- Theory put into practice



Why do we simulate PT hubs?

Background and motivation



Importance of PT hubs

- PT hubs (but also normal stops/stations) play a **very important role in the public transport network**
- Influence in the **experience of public transport journeys**
- **Many actors** in a limited space
Pedestrians, cyclists, buses, taxis, shared mobility ...
- Influence in the **neighbouring network(s)**

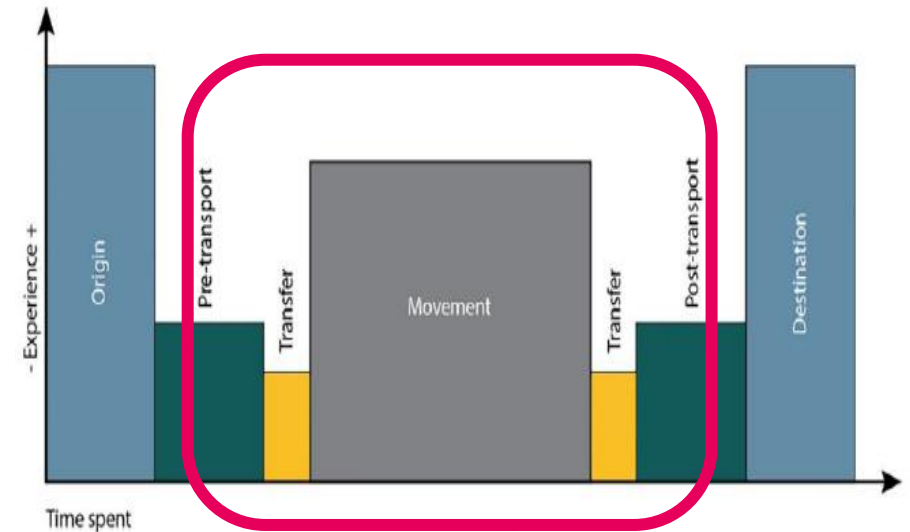


Fig. 1. Experience of a public transport journey (Peek and Van Hagen, 2002).

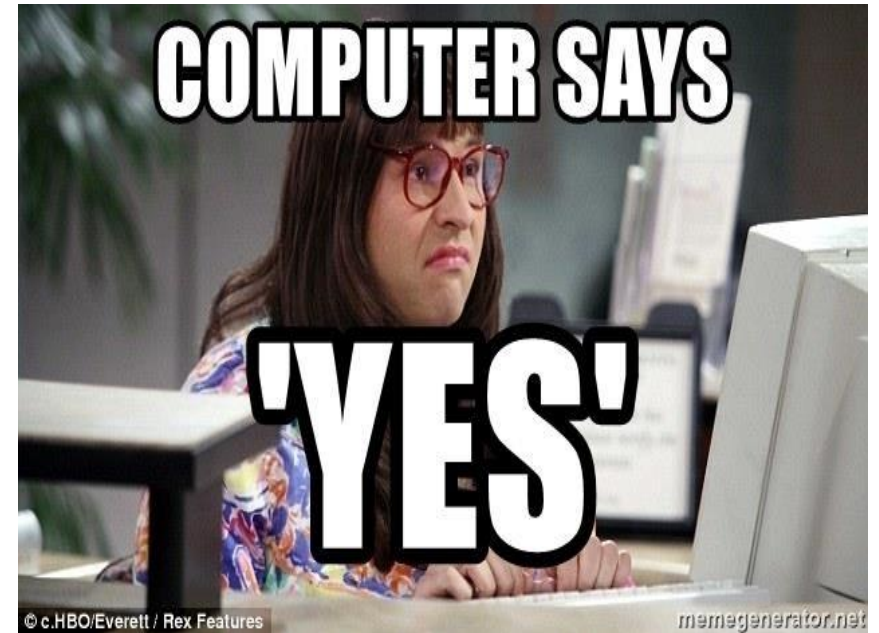
Importance of **appropriate tools**

- PT hubs play a **very important role in the public transport network**
- Influence in the **experience of public transport journeys**
- **Many actors** in a limited space
Pedestrians, cyclists, buses, taxis, shared mobility ...
- Influence in the **neighbouring network(s)**



To plan for:

- **Good operation**
- Safety for all actors
- Adequate/efficient use of space
- Connection with neighbouring network(s)



Translated to projects

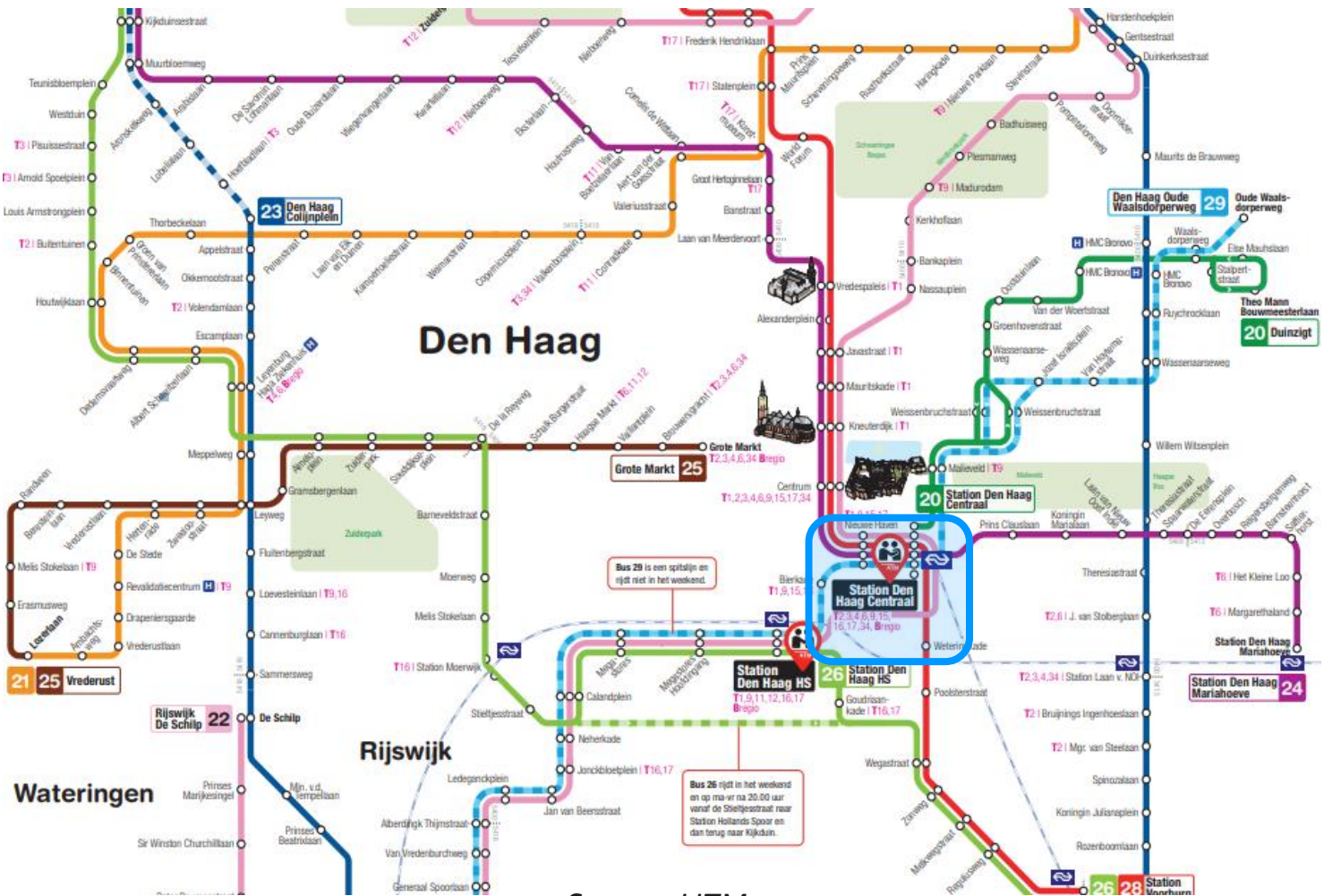
In projects, we **support decision making**, by:

- Testing **variants**: *design, timetable, platform assignment, etc*
- Understanding **current operation** of stations
- Investigating the effects of **potential optimizations**
- **Testing feasibility** of technological/political changes

...



The challenge

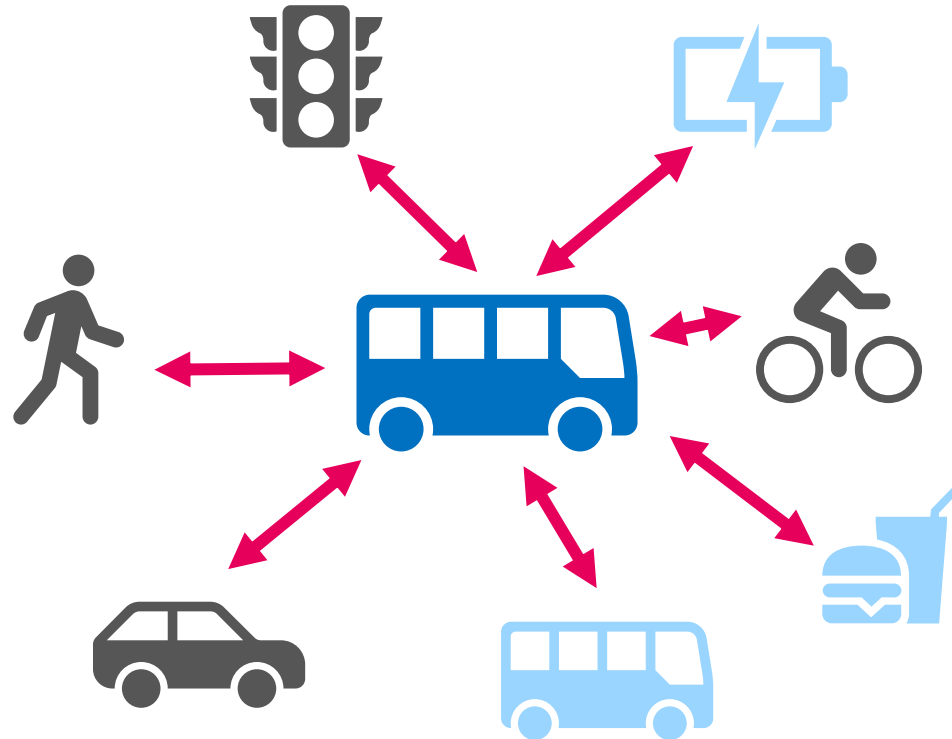


Source: HTM

- A station is part of a larger system, which influences how well vehicles (*buses, trams*) adhere to their planned timetable.



The challenge



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- Many interactions take place within the station.

The challenge



- A station is part of a larger system, which influences how well vehicles (*buses, trams*) adhere to their planned timetable.
- Many interactions take place within the station.
- Unlike other transit modes, buses have much more freedom of movement. Drivers can make multiple choices at any given moment, all of which affect the operation of the station.

Our solution

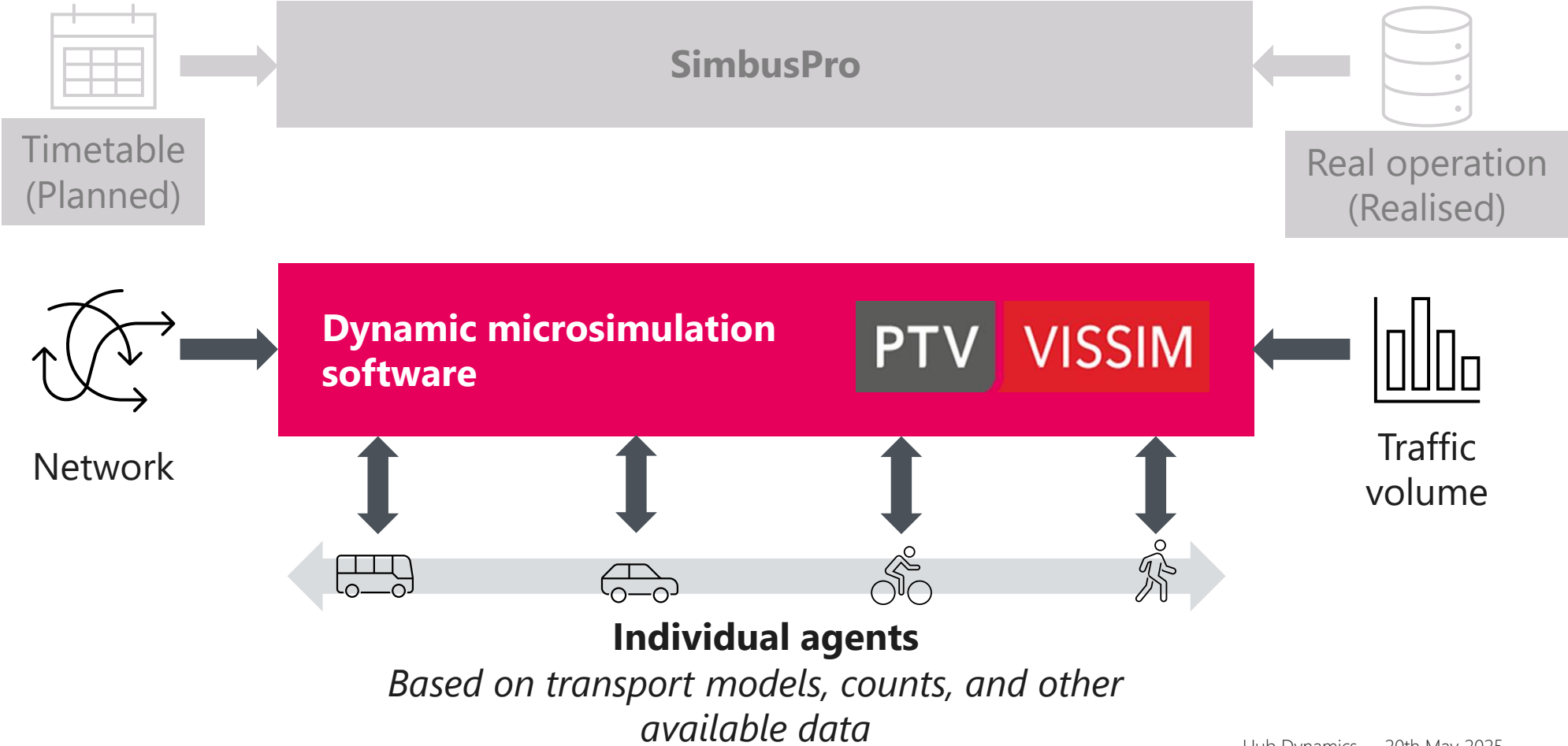
HubDynamics



Dynamic microsimulation model

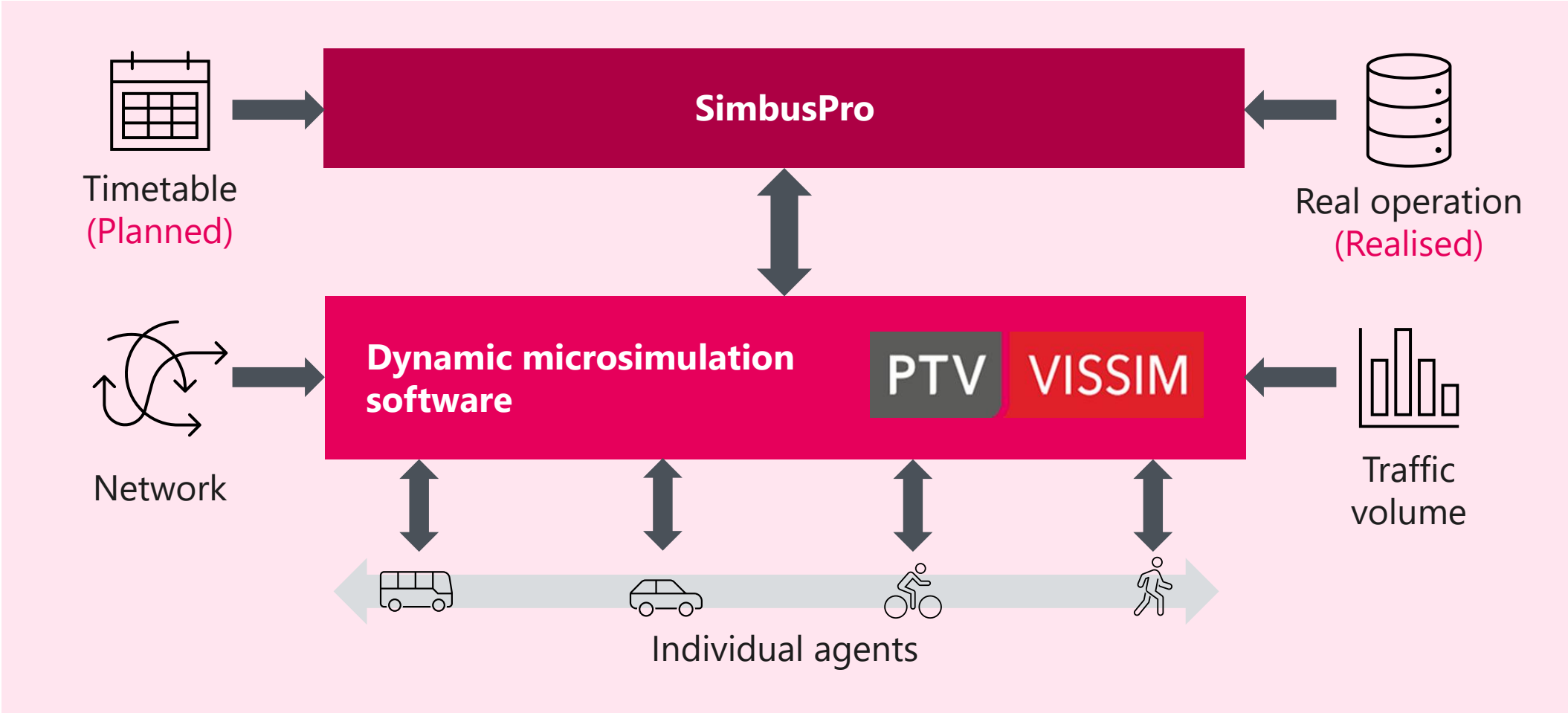


Dynamic microsimulation model

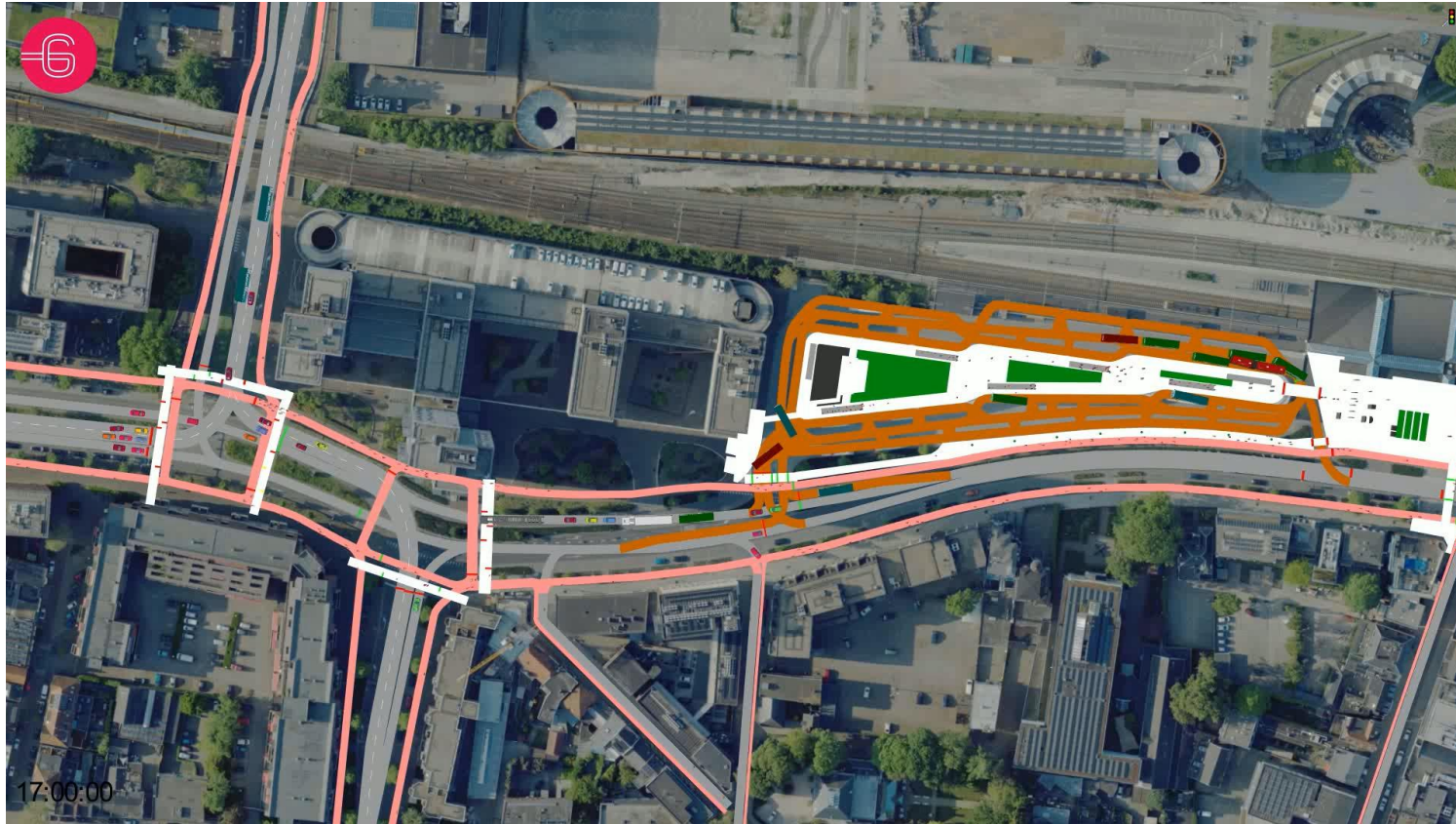


Dynamic microsimulation model

HubDynamics



Behaviour of buses



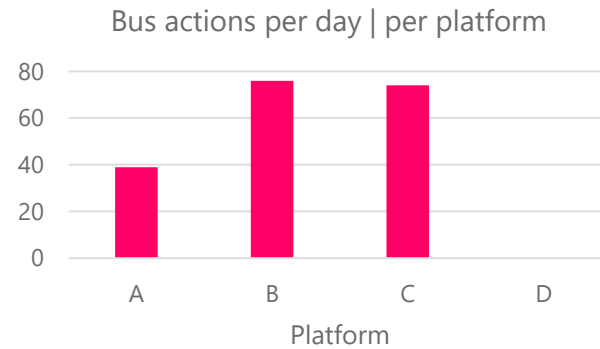
Interactions

- Between buses
- Between buses and the station
- Between buses pedestrians
- Between buses and the external network
 - Traffic lights
 - Pedestrians
 - Cyclists

Output

The output includes:

- Nice visualizations
 - Pictures
 - Video
- Detailed information of each bus passage
- Overall statistics
 - Number of actions in the station
 - Platform occupancy
 - Type of procedures
- **Annoyance to vehicles**
 - **At the platform**
 - **At other locations**

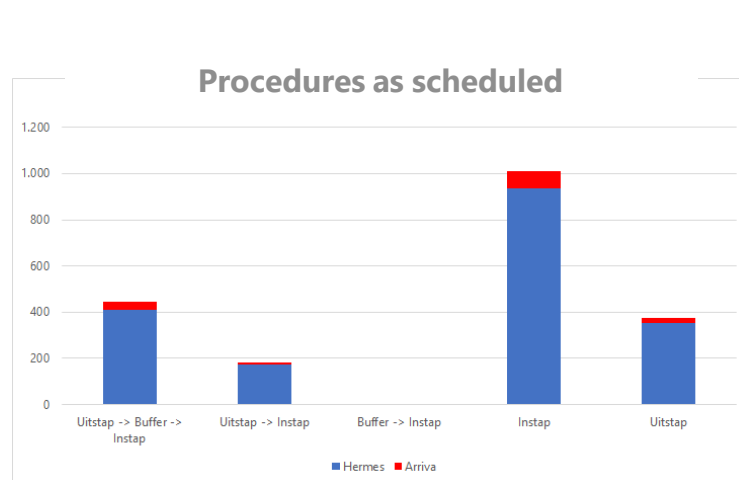
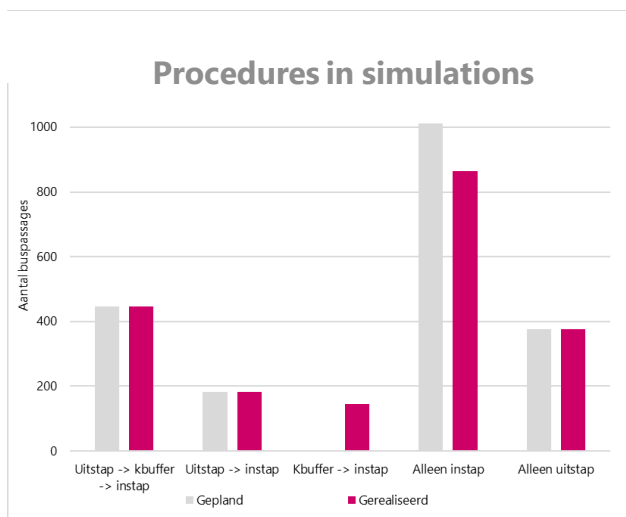


Wachttijd – Ambitie variant 2 (OS)					
Scenario	Aantal ritten	Aantal ritten met verstoringen	Aandeel van de ritten met verstoringen (%)	Gemiddelde (seconden)	Maximale (seconden)
Ambitievariant 2	288	57	20%	38	407
Ambitievariant 1	318	118	37%	44	1019
Spoorlaan variant	227	22	10%	15	323
Huidige situatie	227	24	11%	16	208

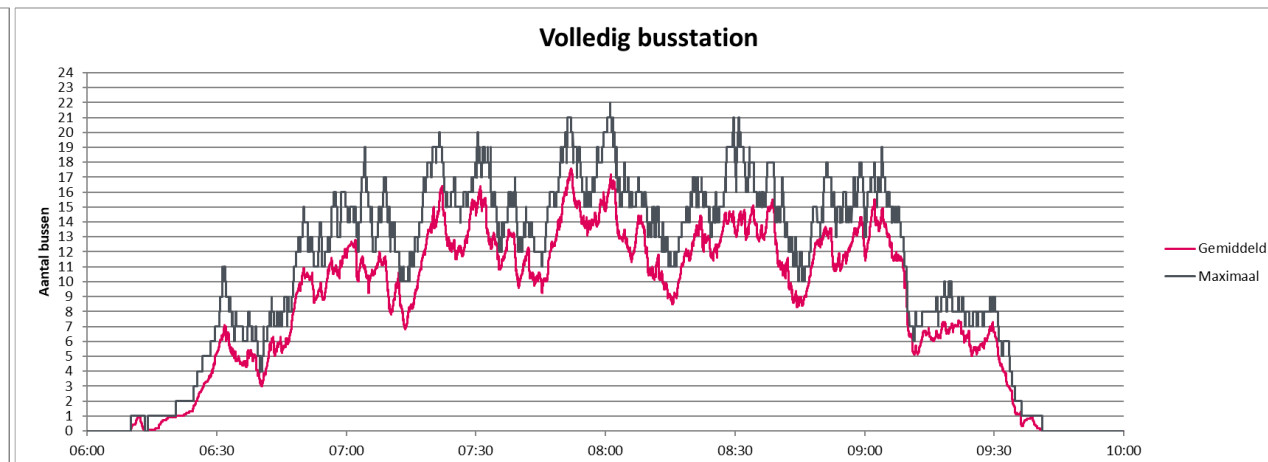
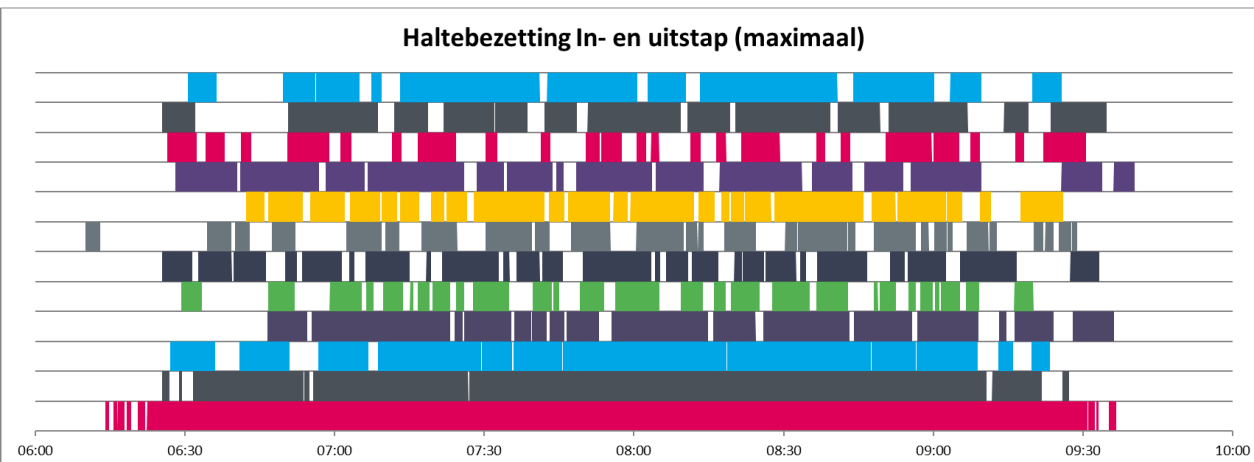
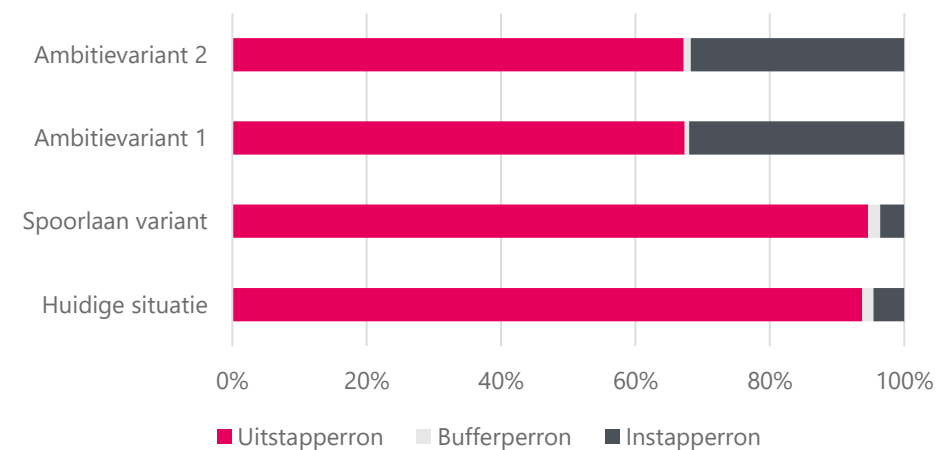
Hindertijd – Ambitievariant 2 (OS)					
Scenario	Aantal ritten	Aantal ritten met verstoringen	Aandeel van de ritten met verstoringen (%)	Gemiddelde (seconden)	Maximale (seconden)
Ambitievariant 2	288	153	53%	53	667
Ambitievariant 1	318	238	75%	110	959
Spoorlaan variant	227	116	51%	40	382
Huidige situatie	227	122	54%	39	414



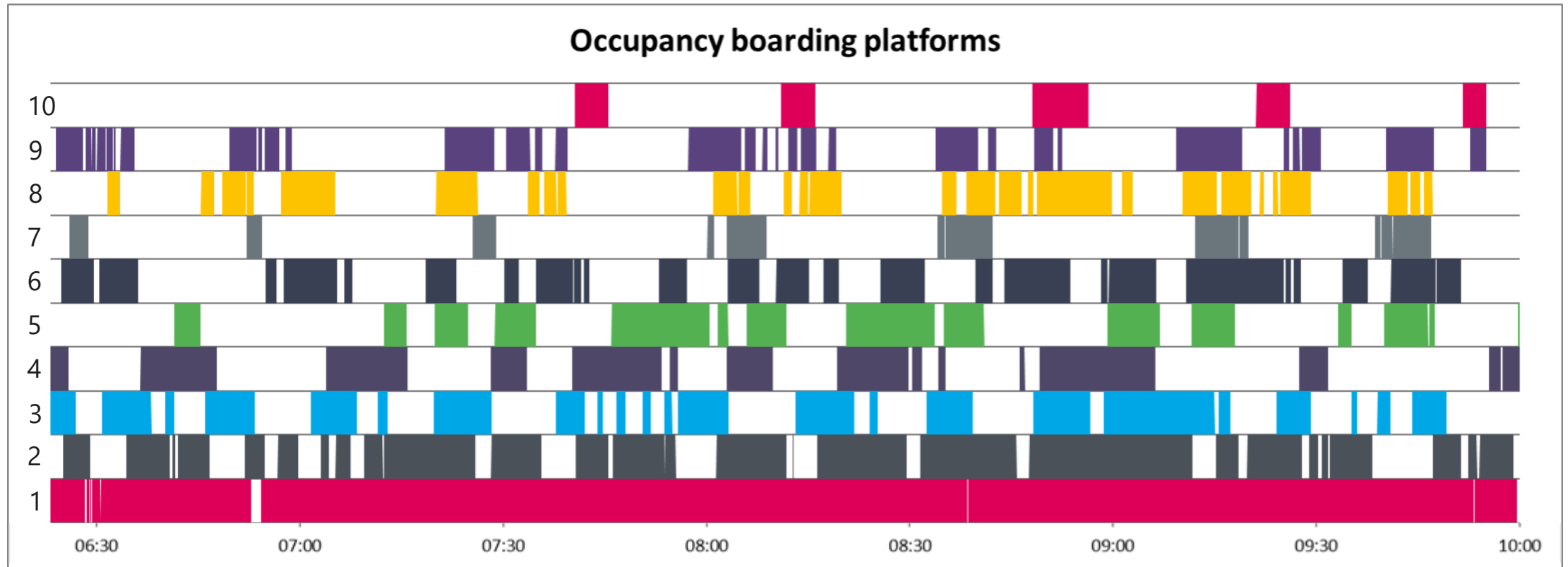
Output



% ritten met wachttijd



Output

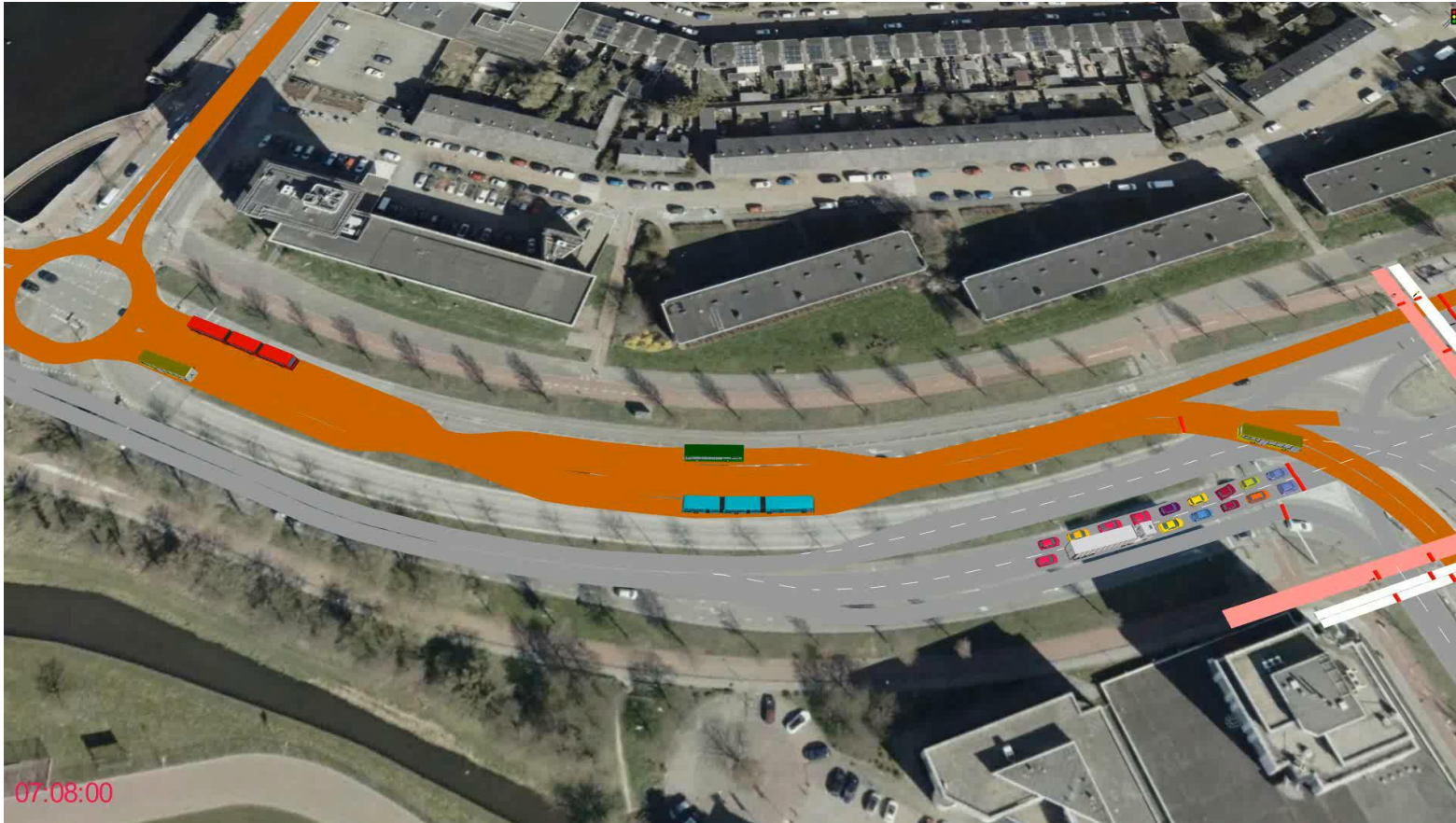


Theory put into practice

Some examples



Haarlem



New mobility hub

- Simulation of different design options for the bus station
- Evaluation of required design under two different timetable (concepts)
- External network, including bridge that opens to let long ships pass

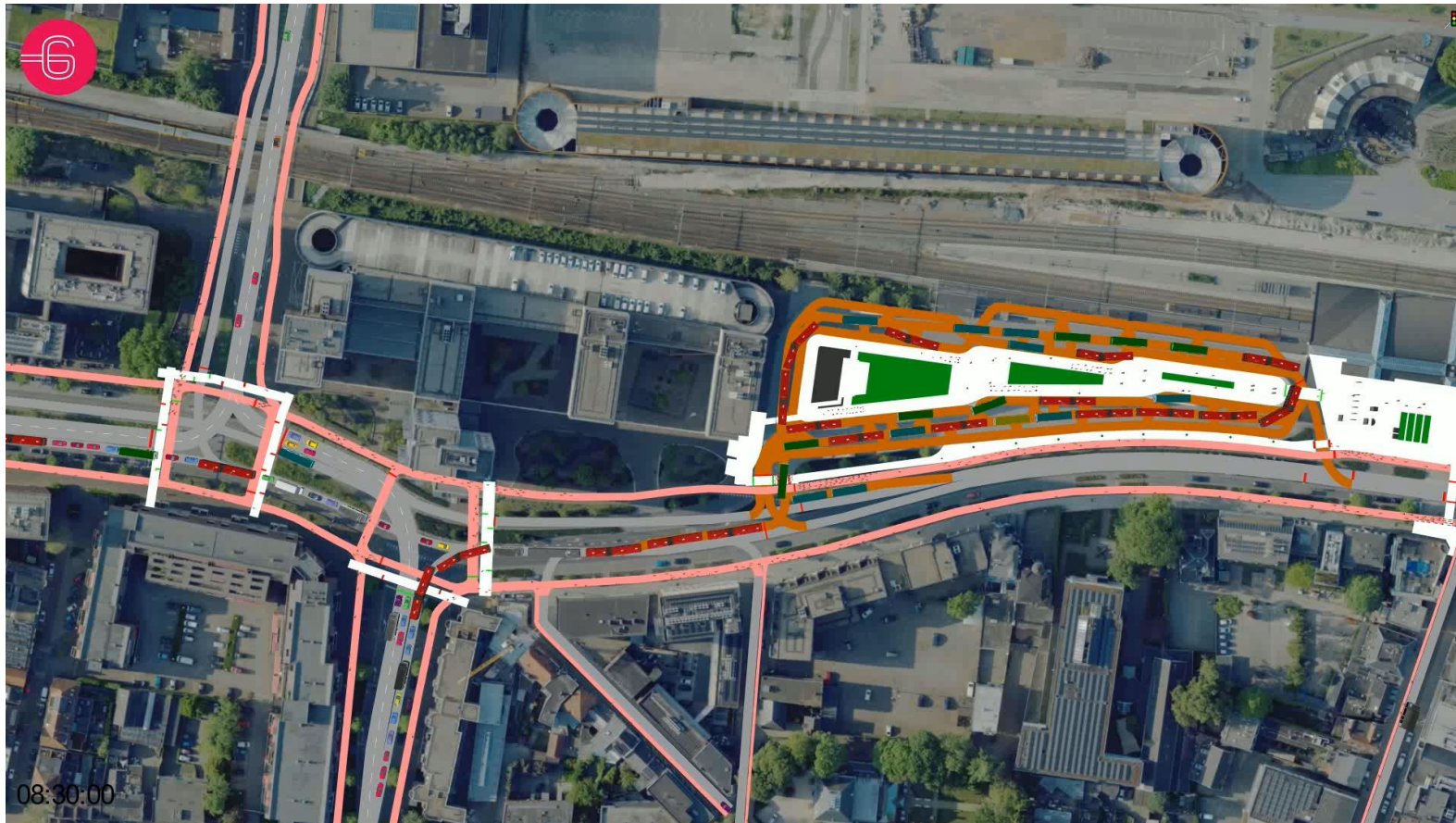
Schiphol Airport



(New) station design for Schiphol

- Simulation of different design options
- Diverse modes of transport included: bus, car, taxi, pedestrians
- Analysis of the effects of zebra-crossings

Tilburg



Is the station future-proof?

- Simulation of the station under different scenarios
- Two potential timetables for 2040
- Changes in the car network, and as a result, also in the station
- Diverse modes of transport included: bus, car, cyclists, pedestrians

's-Hertogenbosch



Is the station future-proof?

- Simulation of the station under different scenario's
- Concept timetables for 2030 and 2040
- Diverse modes of transport included: bus, car, cyclists, pedestrians

's-Hertogenbosch



Is the station future-proof?

- Simulation of the station under different scenario's
- Concept timetables for 2030 and 2040
- Diverse modes of transport included: bus, car, cyclists, pedestrians
- **Potential future design**

Questions?

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Want to know more?

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