Impacts of automation on urban areas: some results of TU Delft research

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Electric and Automated Transport Research

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Department of Transport & Planning

ShanghaiRanking's Global Ranking of Academic Subjects 2018 - Transportation Science & Technology

2018 ▾

Field: Engineering ▾ Subject: Transportation Science & Technology ▾ Methodology

World Rank	Institution*	Country/Region	Total Score	Score on PUB ▾
1	Beijing Jiaotong University		284.1	88.9
2	Tsinghua University		272.9	80.1
3	Delft University of Technology		266.0	100
4	Southeast University		249.5	78.4
5	University of California, Berkeley		243.0	81.5
6	University of Sydney		235.2	75.4
7	University of Leeds		235.1	72.9
8	University of British Columbia		234.4	66.3
9	Tongji University		231.3	79.7
10	Massachusetts Institute of Technology (MIT)		230.6	71.3

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Modeling

Observing and analyzing the reality

+

Modeling the reality

→

Better transport and spatial planning

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Automated Driving

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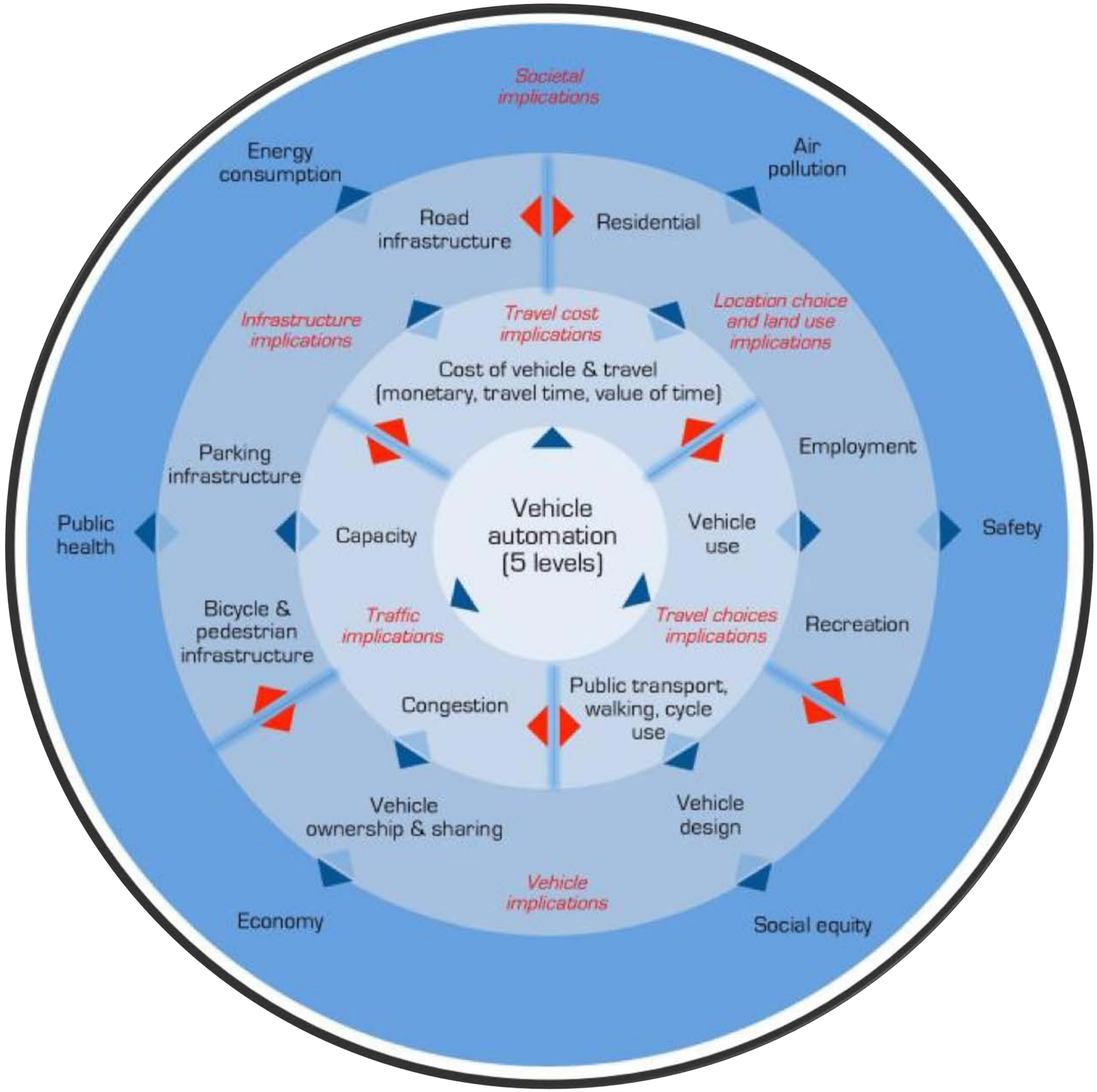
Lots of impacts!



Correia, G., Milakis, D., Arem, B. van, Hoogendoorn, R., 2015. Vehicle automation for improving transport system performance: conceptual analysis, methods and impacts, in: Bliemer, M. (Ed.), Handbook on Transport and Urban Planning in the Developed World.

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Urbanism Next framework

URBANISM NEXT | FRAMEWORK

One of the key challenges to addressing the multi-level impacts of emerging technologies—such as autonomous vehicles, e-commerce, and the sharing economy—on cities is understanding the range of areas affected and how these areas are related. The Urbanism Next Framework organizes impacts based on four key areas—land use, urban design, transportation, and real estate—and relates those to the implications they have on equity, health, the environment, the economy, and governance.

LAND USE

RETAIL/COMMERCIAL/ OFFICE/INDUSTRIAL (EMPLOYMENT USES)
How will the changing nature of travel, employment and shopping impact retail, commercial, and industrial districts?

HOUSING
What are the opportunities to increase housing through infill? Will people choose to locate in cities? Or move farther out in the suburbs?

URBAN DESIGN

METROPOLITAN FOOTPRINT
When proximity to workplaces and goods/ services no longer holds people in cities, what will happen to their already sprawling footprints?

STREET DESIGN
As cities make plans for future expansions, changes to their street network, the inclusion of various modes/complete streets, and overall street design – what should they be considering?

CENTERS AND CORRIDORS

TRANSPORTATION

WALKING
How will we regulate the interactions between pedestrians and vehicles? What happens when pedestrians can stop AVs by simply stepping into the street?

BIKING
Will the mixing of modes be frowned upon because it is such a limitation to AV efficiency? Will some areas ban bikes? How will bikes work around curbside deliveries and dropoff?

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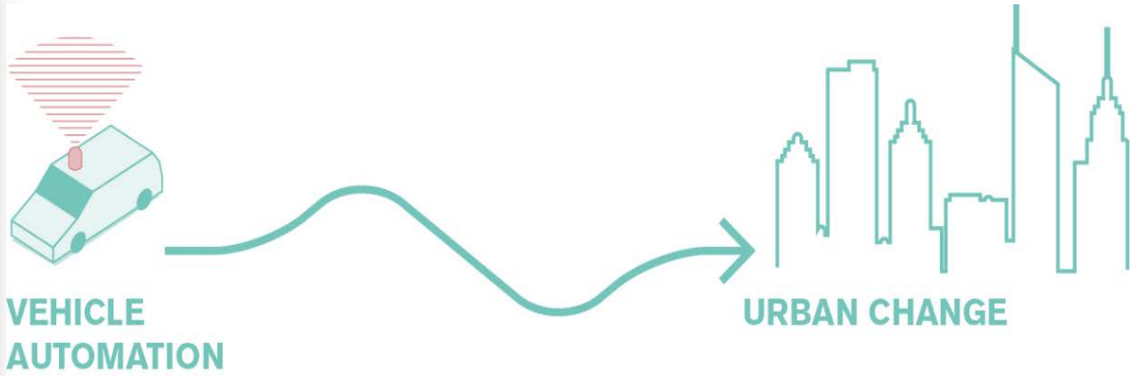
AV and spatial transformation potential



Martijn Hollestelle (master thesis) *AUTOMATED DRIVING: DRIVING URBAN DEVELOPMENT? AN INTEGRATED MODELLING AND RESEARCH-BY-DESIGN APPROACH ON THE SPATIAL IMPACTS OF AUTOMATED DRIVING*

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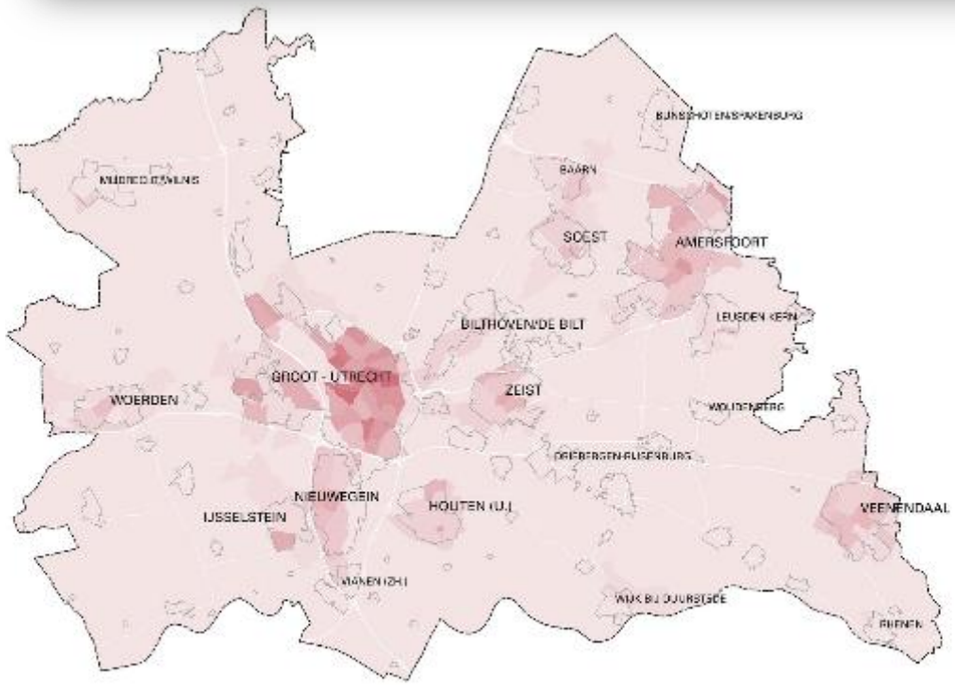
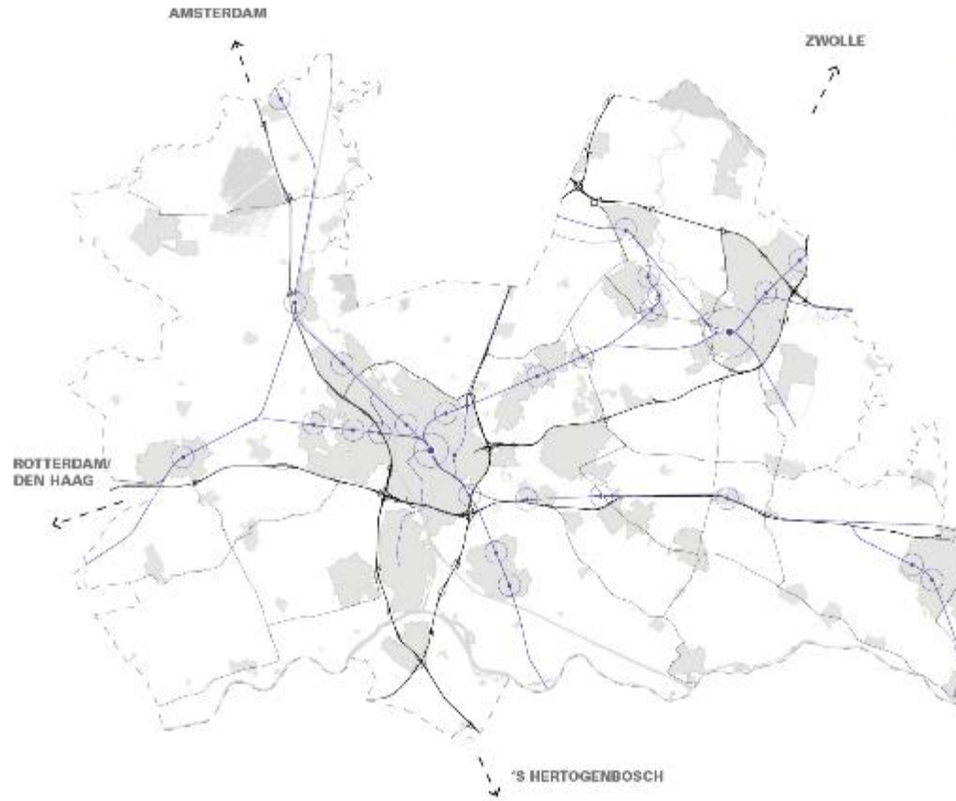
Case-study: Utrecht





Scenarios

Scenario 1: <u>Transformation</u> of the mobility system

Only shared automated vehicles (taxi-bots) on the roads (Level 5). High capacity gains in regional and urban road networks. It's so convenient that all conventional PT disappears. Good travel comfort and experience. Value of Travel Rime (VOTT) decreasing.

Scenario 2: <u>Growth</u> on private AVs with great experience

Automated driving develops to full automation everywhere but only as a private mode of transport (Level 5). Technology allows vehicles to drive empty to park at specific outside parking areas. Traveling in a private AV is a great experience. Public transport is the same as today's. VOTT in cars decreases

Scenario 3: <u>Constrained</u> usage of private AVs

Automated driving is level 4 so only full automation in regional networks (no city centers). Capacity only increases on that part of the network. It does not deliver the comfort that was expected at the outset. Parking is the same as today. VOTT decreases but not as much.

Scenario 4: <u>Decline</u> of the mobility system

Automated driving becomes Level 5 but it does not lead to capacity increases. No real effect on the comfort. No public transport any more. Everyone using private AVs. VOTT the same as today.

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Parameters for the scenarios

Category		Scenario			
		Transformation	Growth	Constraint	Decline
Induced travel	For road travel by new user groups	All public transport transferred to cars on the road network	+10%	N/A	All public transport transferred to cars on the road network
	By empty ride allocation to pick-up other passengers	+20%	+10%	No possibility to pick up other people since it's level 4	+10%
	By empty ride allocation to designated parking zones	N/A	All arrivals in zones with parking restriction policies are directed to designated external parking zones	N/A	N/A
Traffic efficiency	Outer-urban roads	+ 100%	+40%	+40%	-20%
	Inner-urban roads	+ 50%	+20%	+0%	+0%
	Intersection delay factor	All 0.1	All 0.25	+0%	+0%
Travel cost factors	Value of time (all purposes)	-35%	-50%	-15%	+0%

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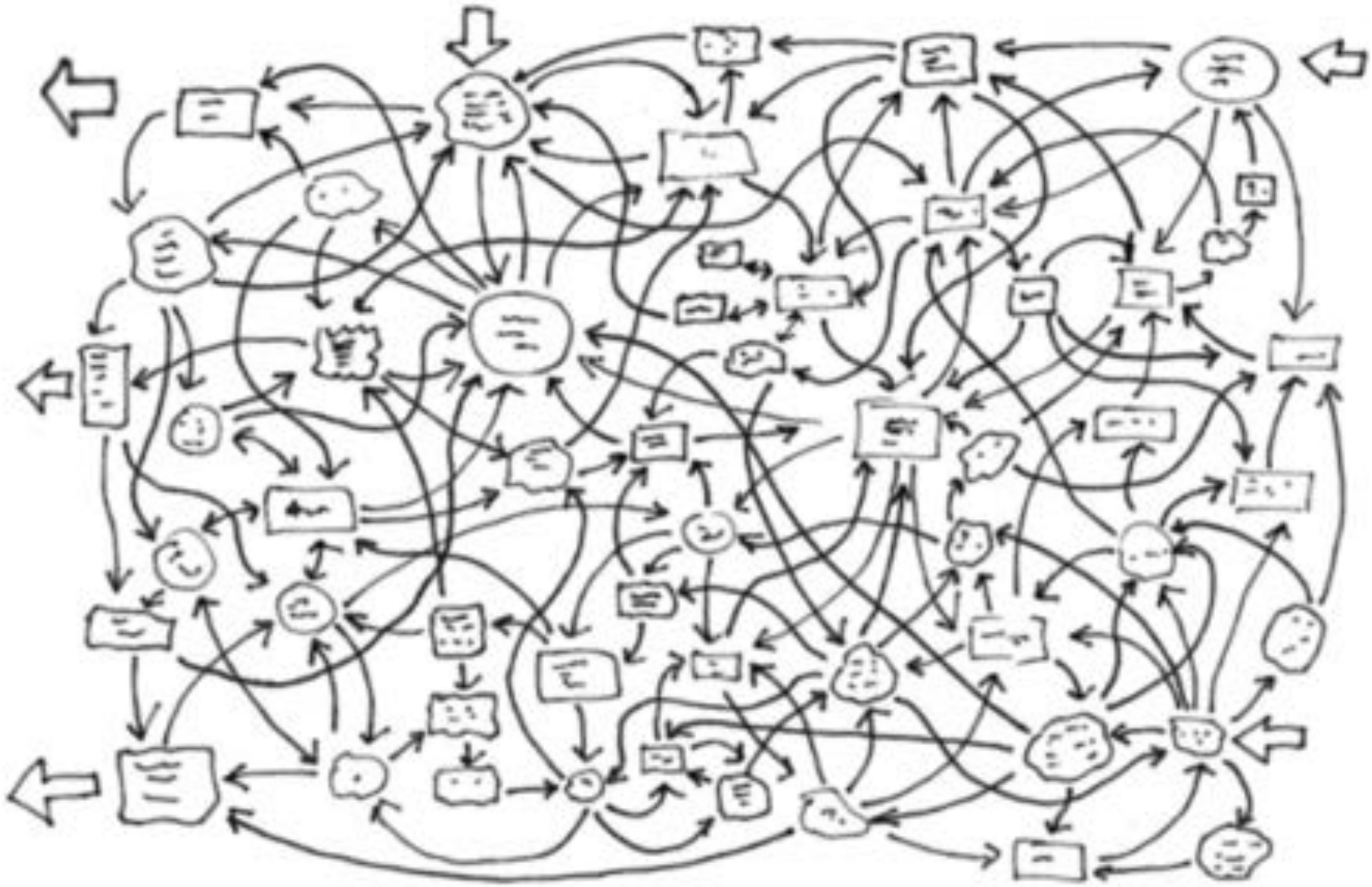
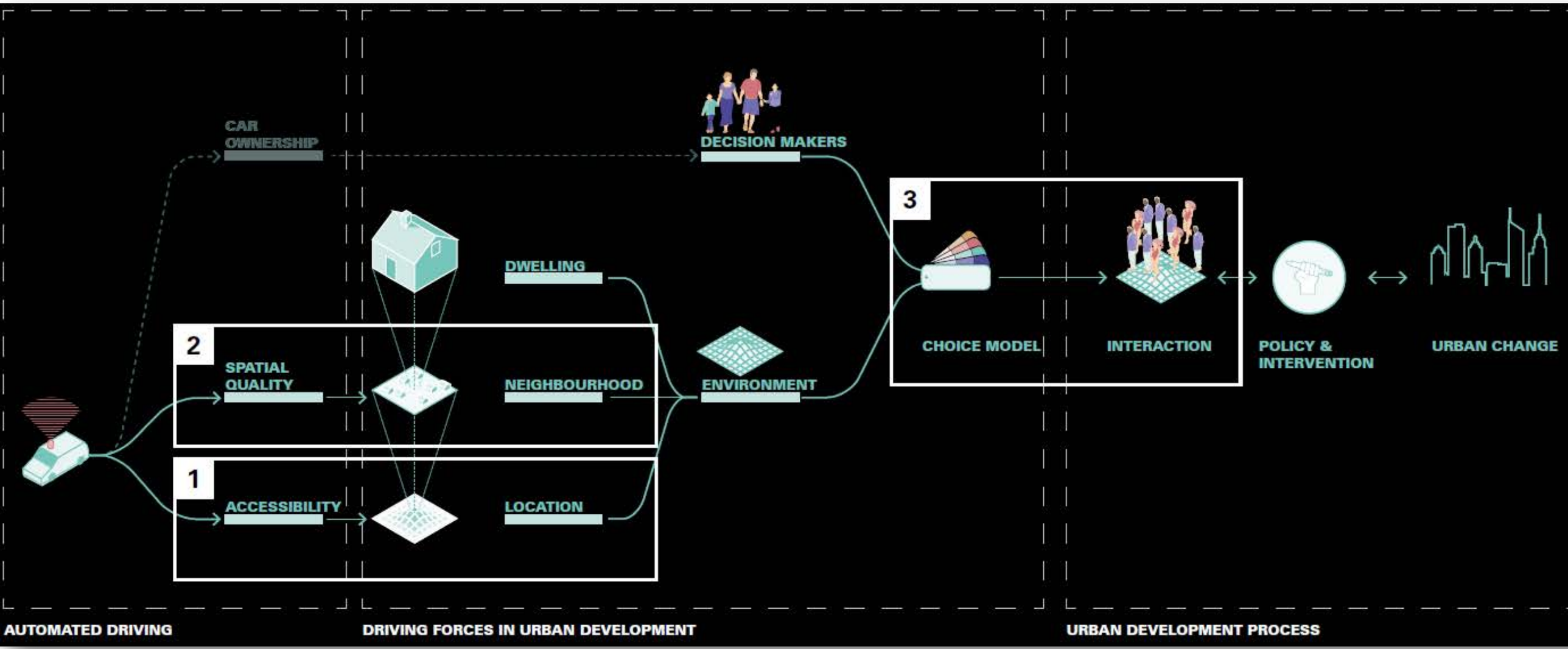
So what kind of model to estimate the impacts of these scenarios?



Methodology



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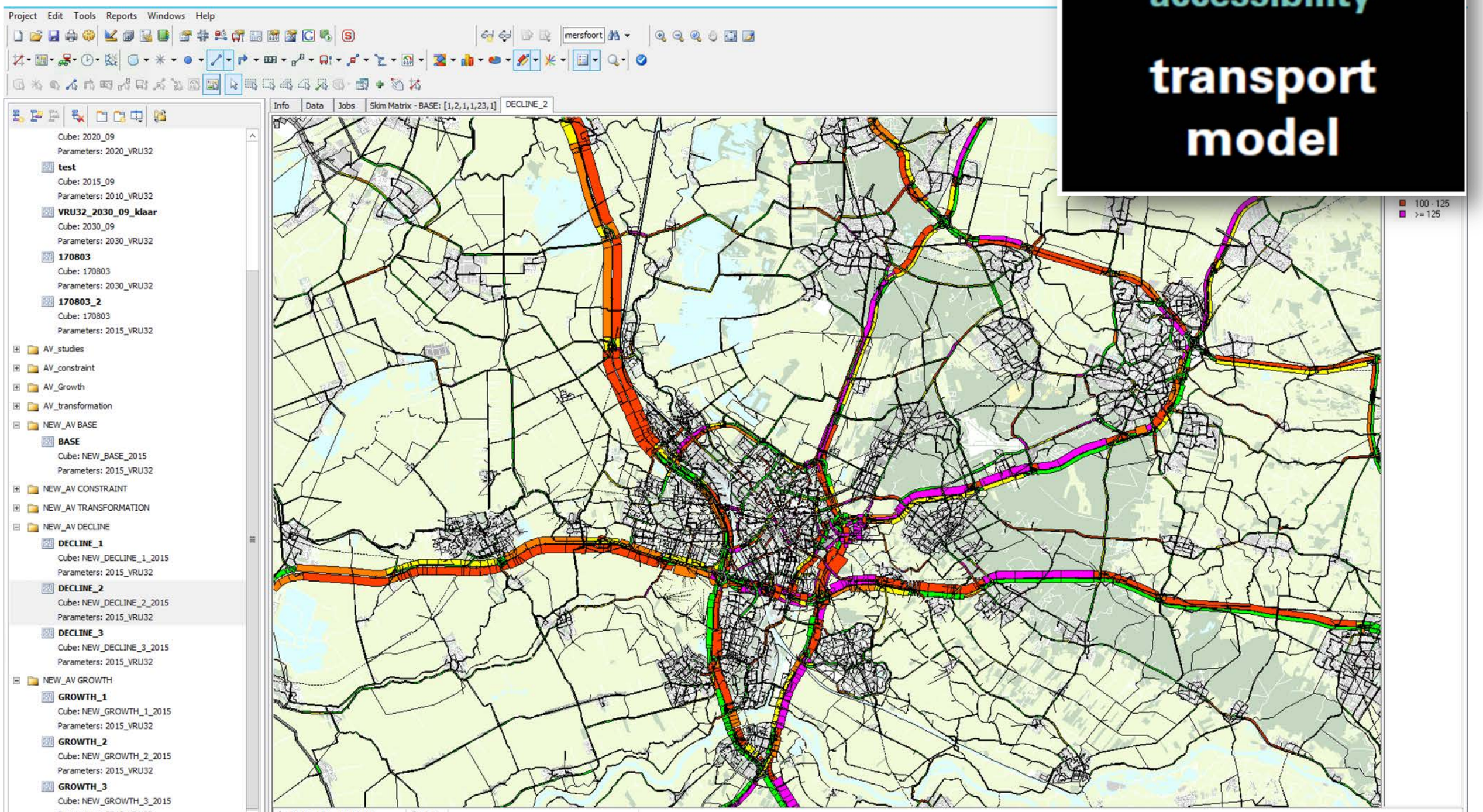
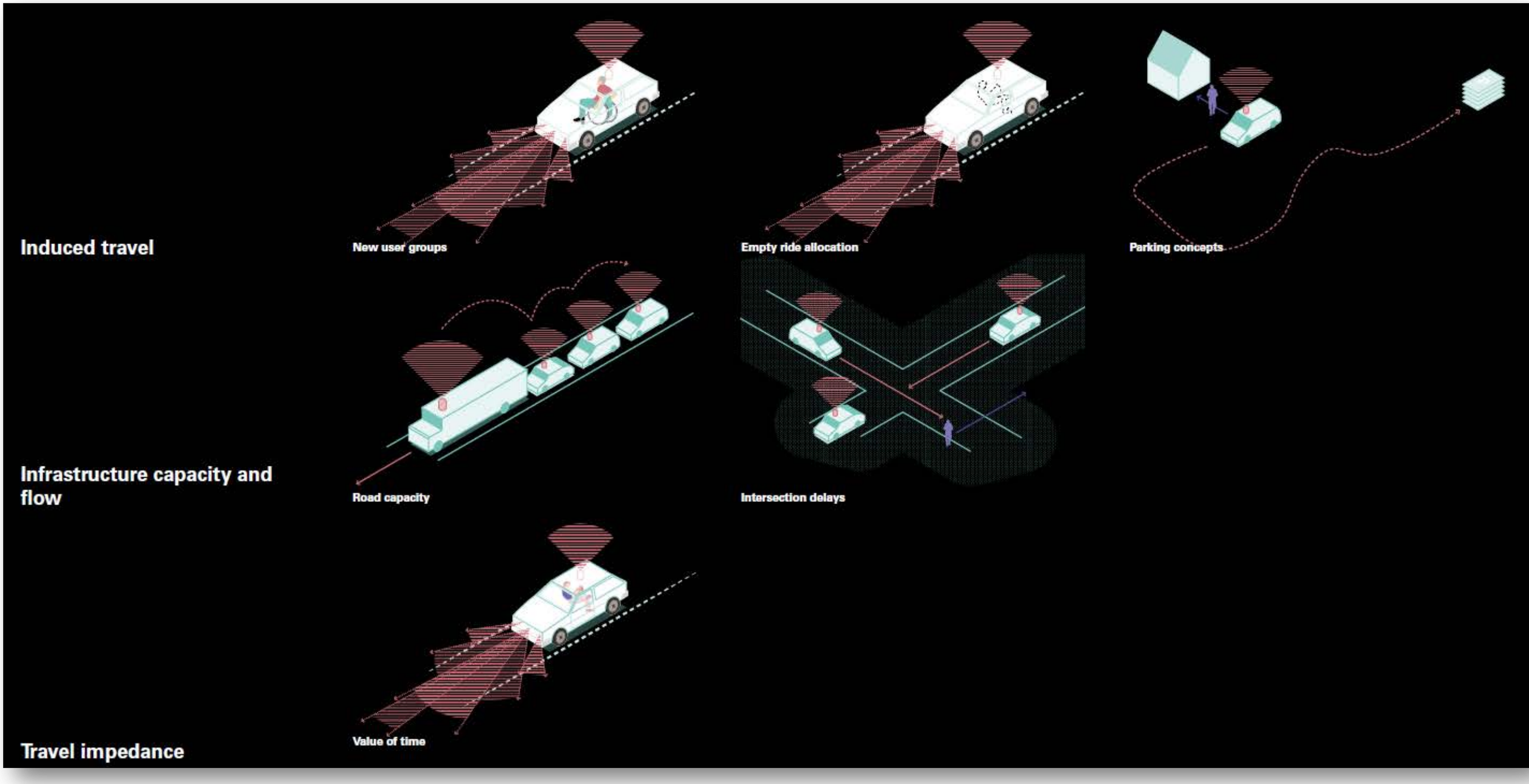
Transport model



What’s modelled there



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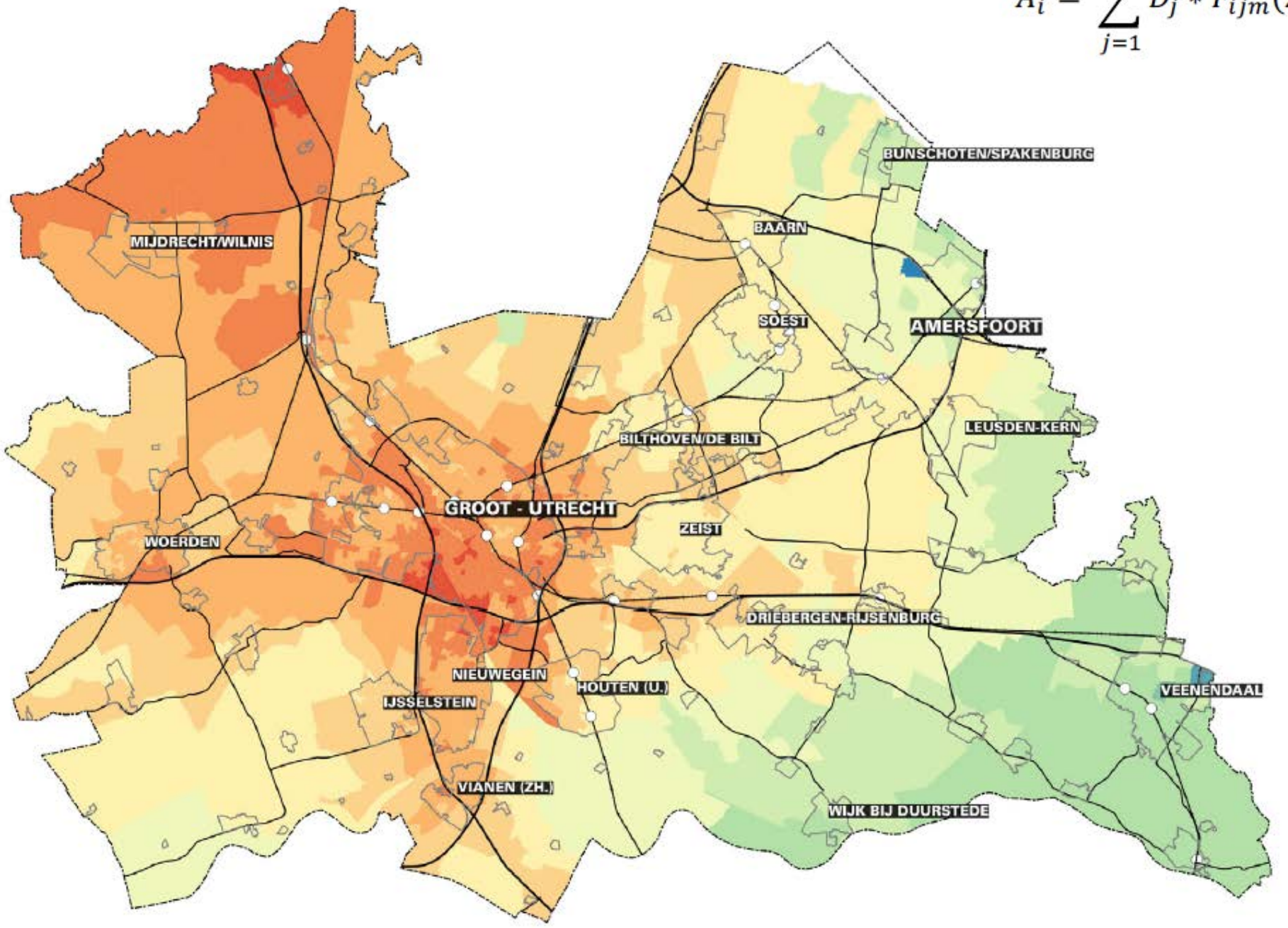
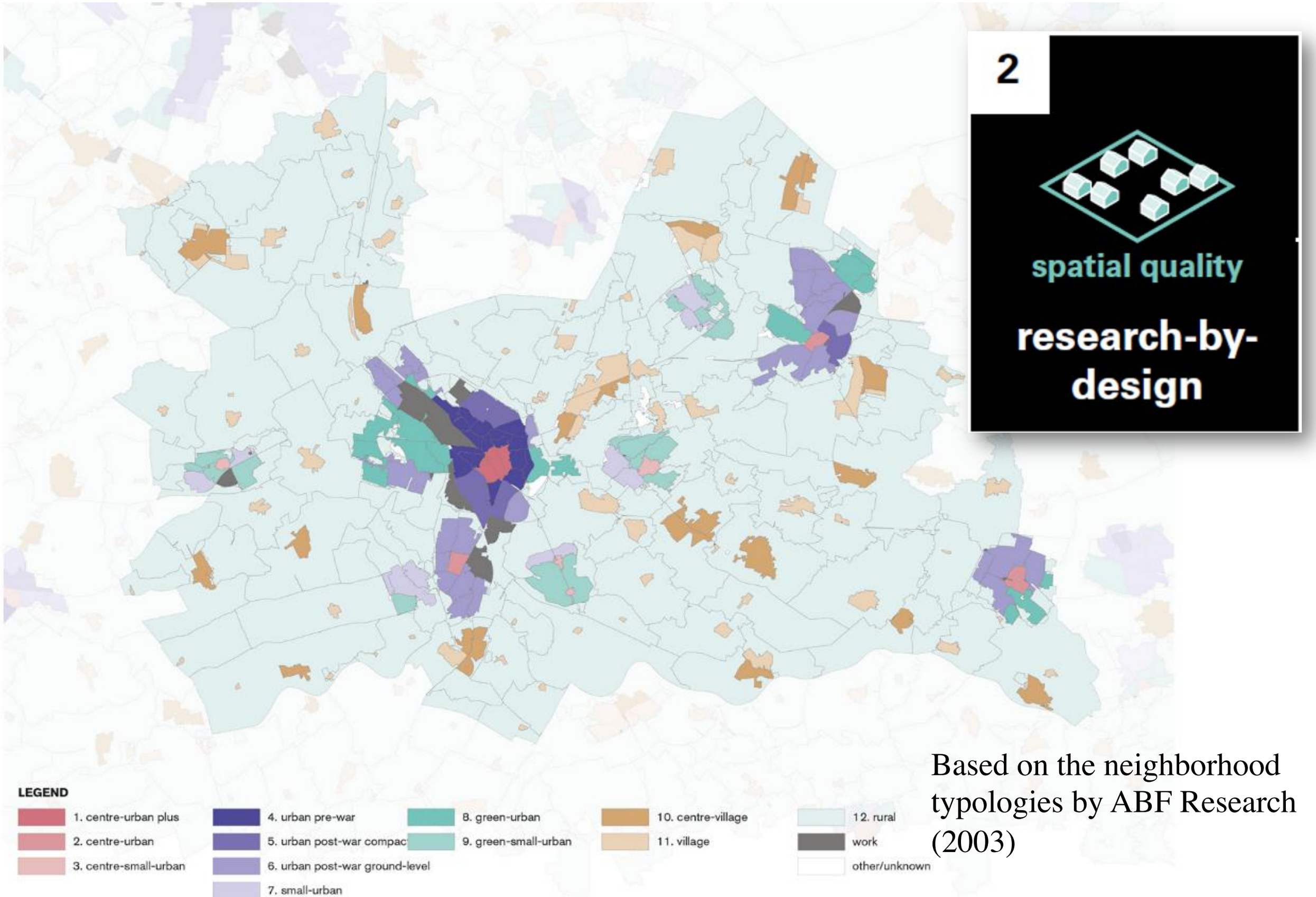
Accessibility to jobs by car

$$A_i = \sum_{j=1}^{n} D_j * F_{ijm}(Z_{ijm})$$



Spatial classification in neighborhood types



Based on the neighborhood typologies by ABF Research (2003)

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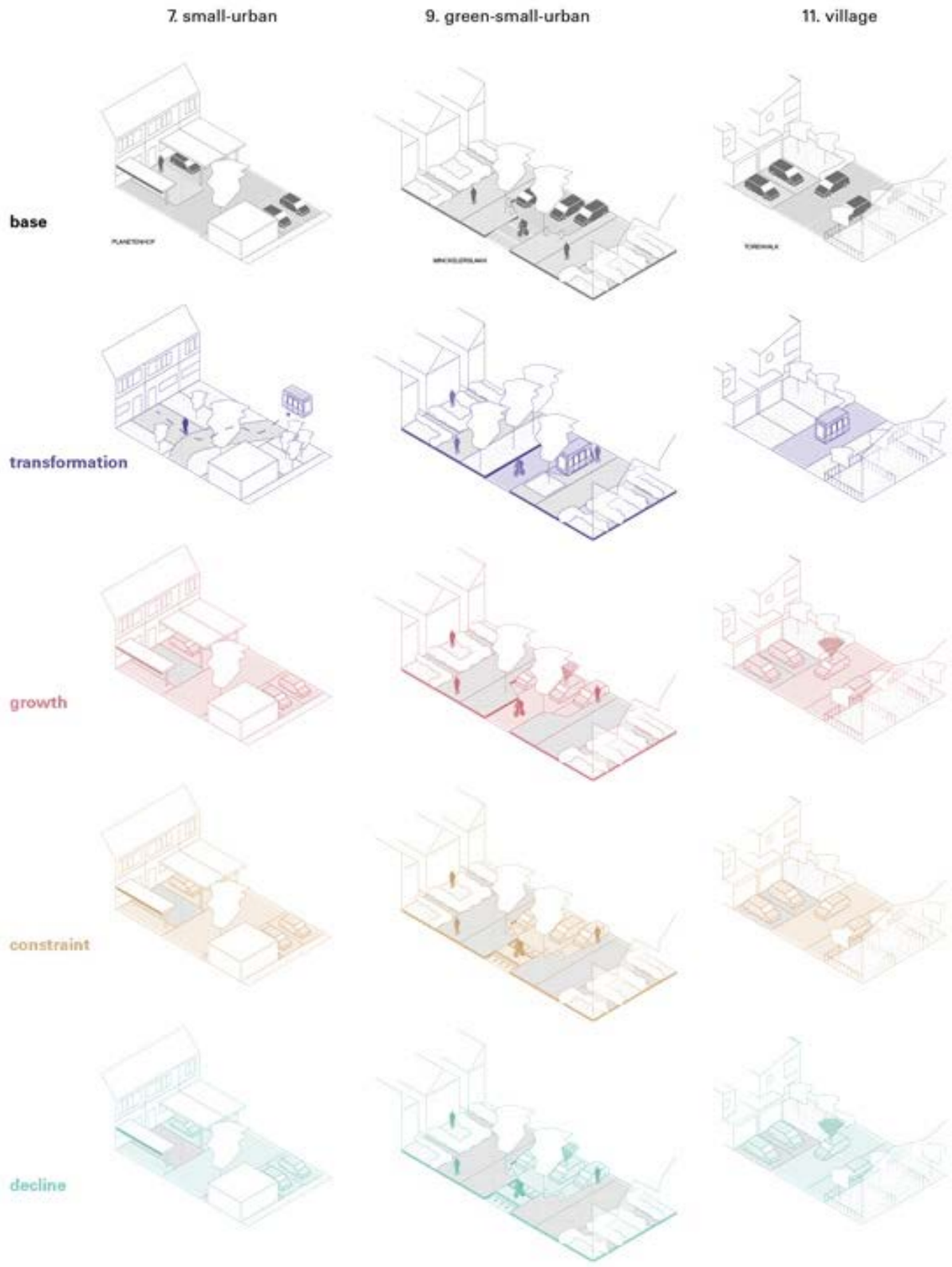
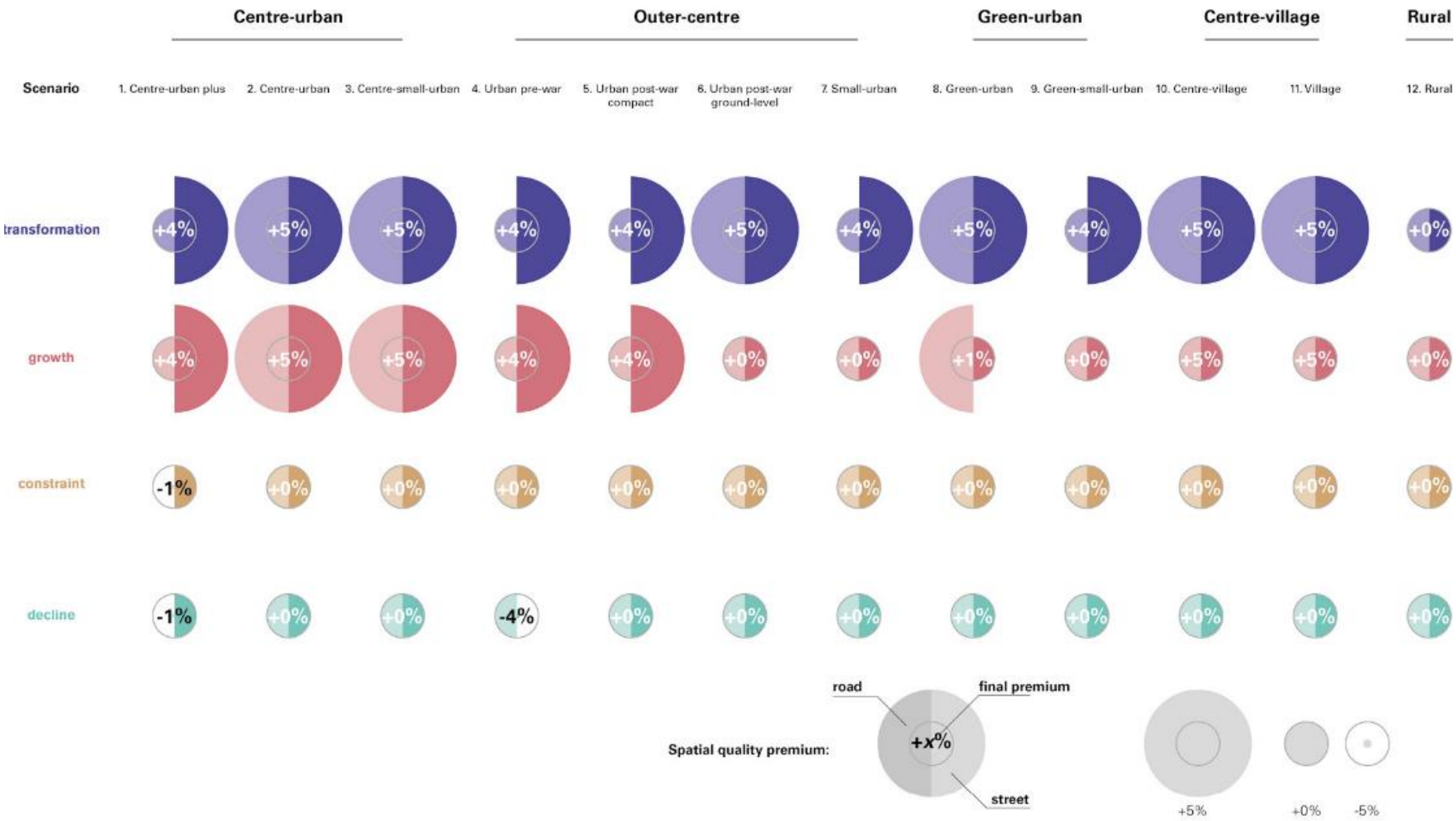
Detailed design transformation potential



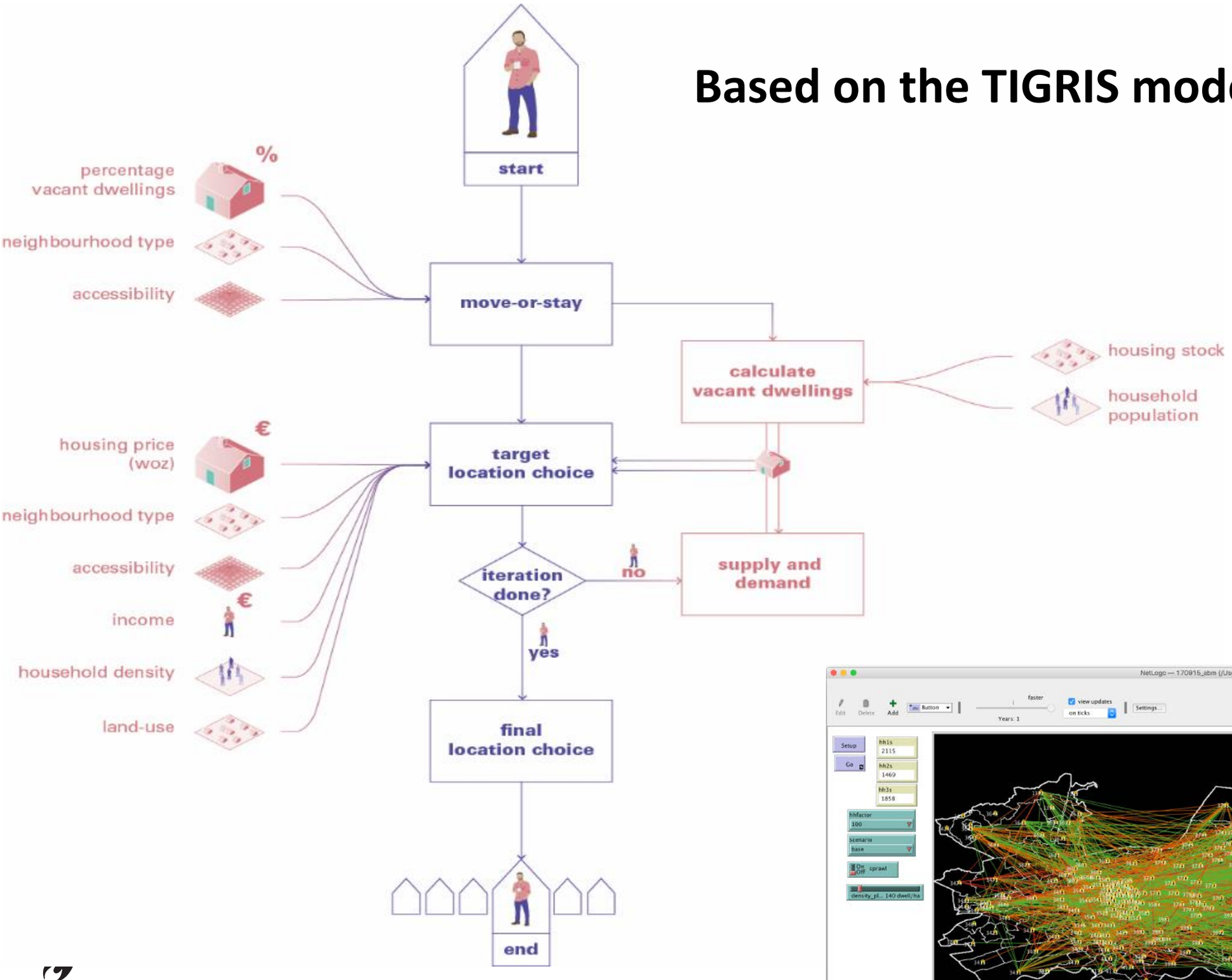
Summary on spatial quality premium

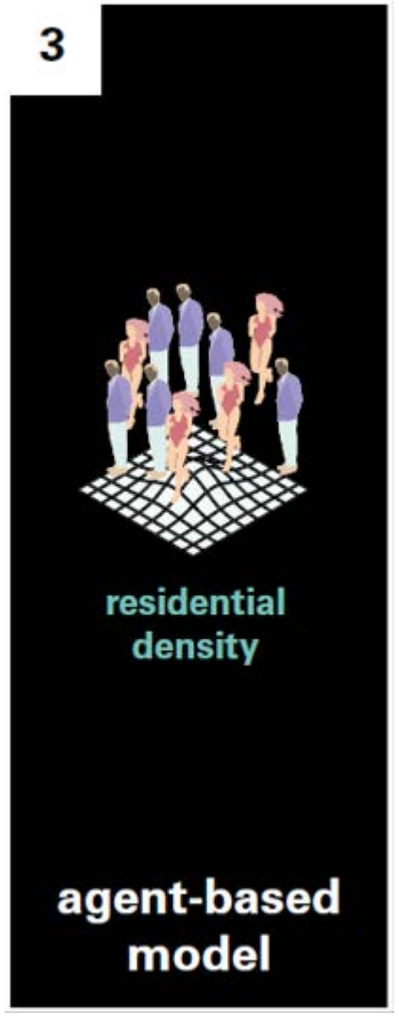


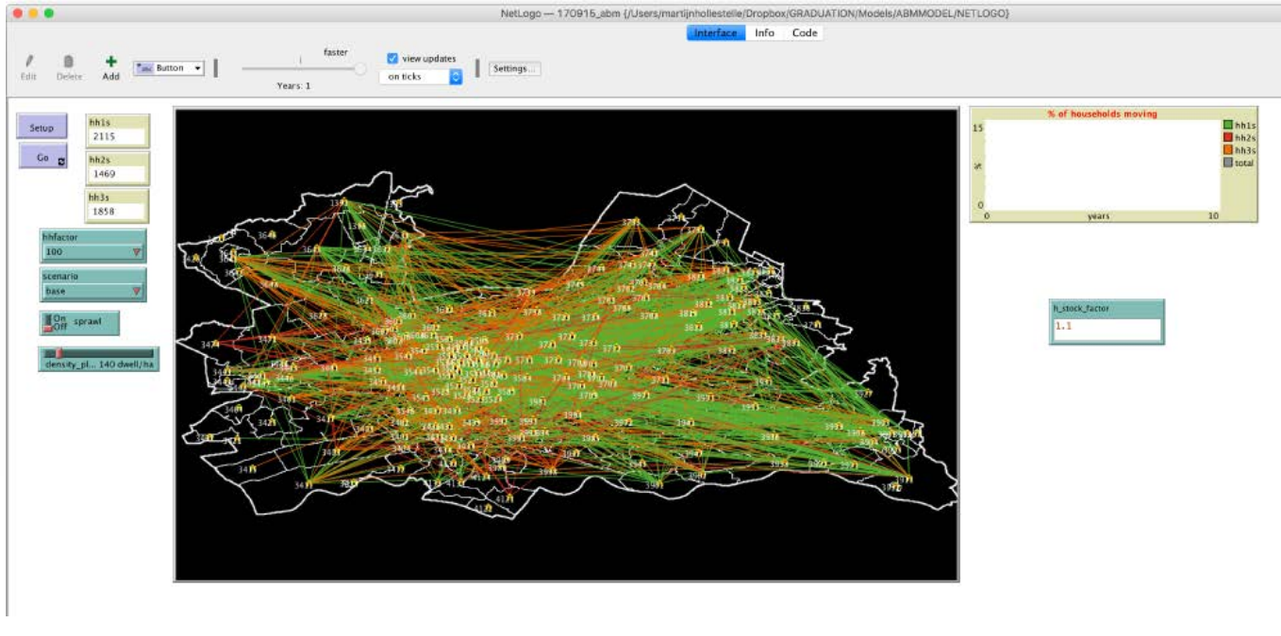
Spatial quality premium house price, based on research by design at (residential) street (0,2) and (arterial) road level (0,8); +5% if street can be made greener, -5% if demand increases too much;

House choice model: agent-based model

Based on the TIGRIS model







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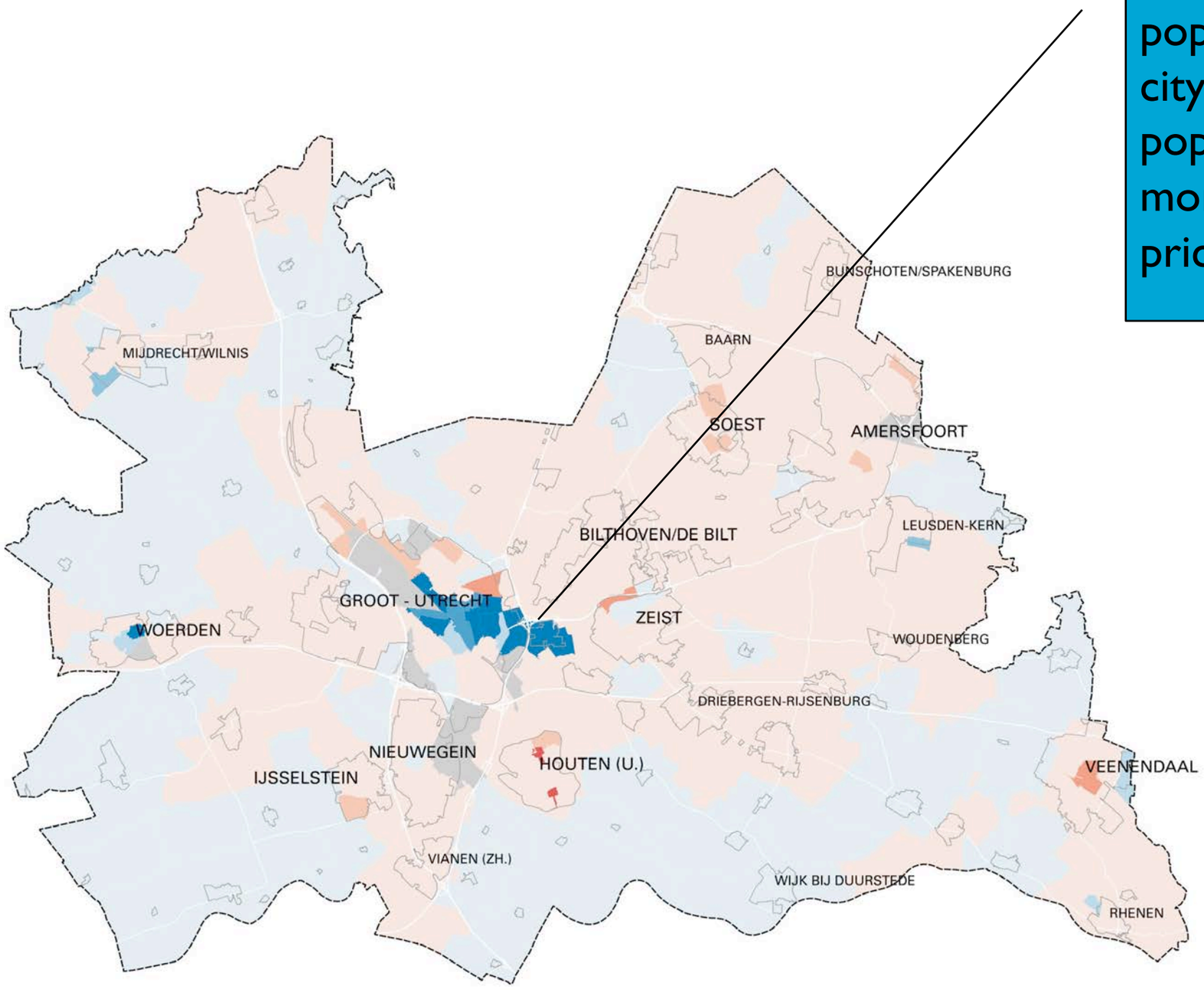
Model is run for 10 years: do-nothing scenario



Trend of losing population in the main city center as the population searches for more space and lower prices.

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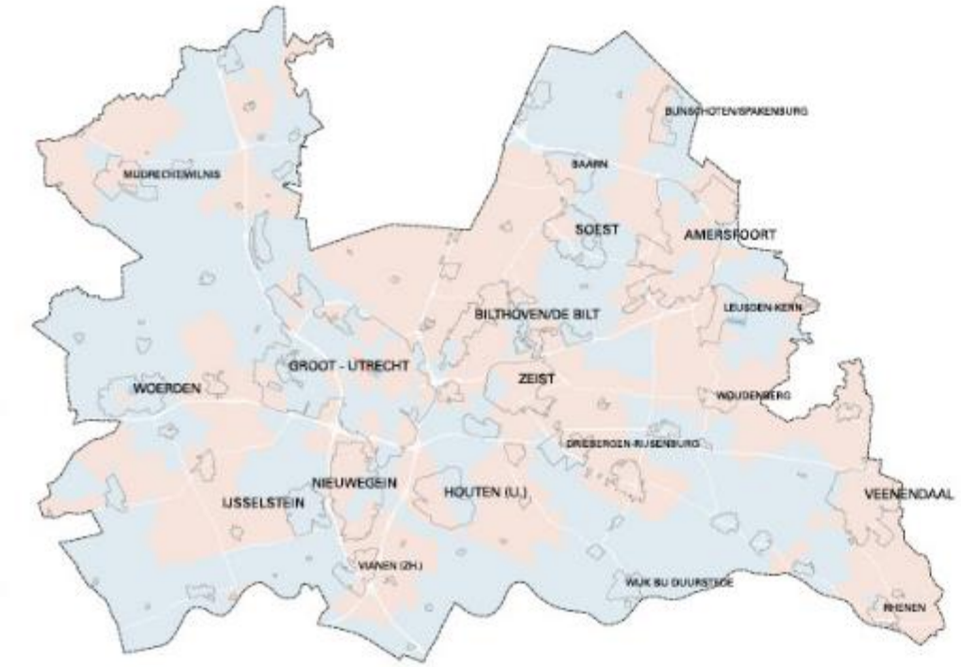
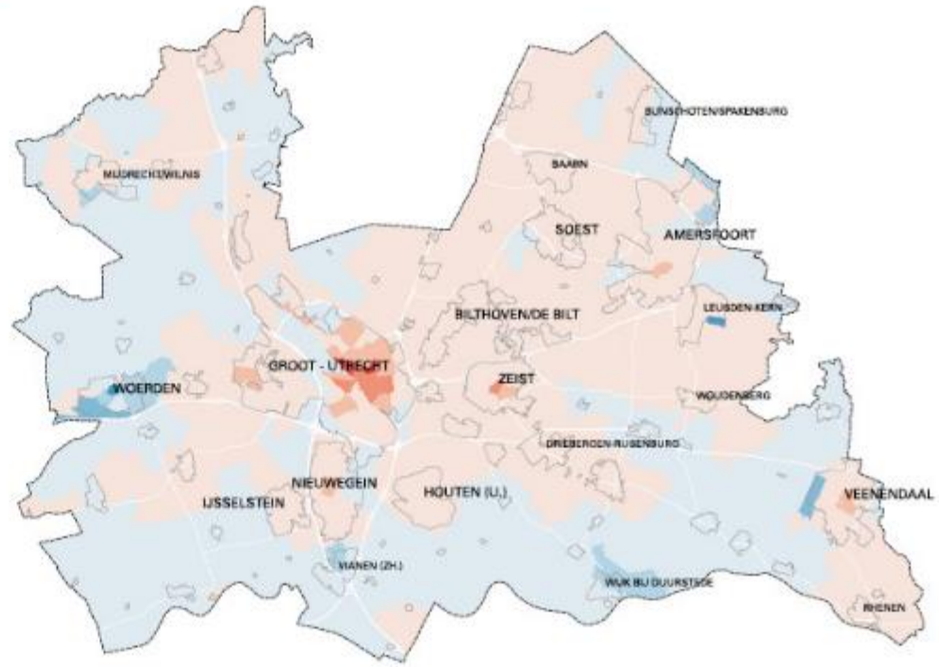
Results: mapping density changes

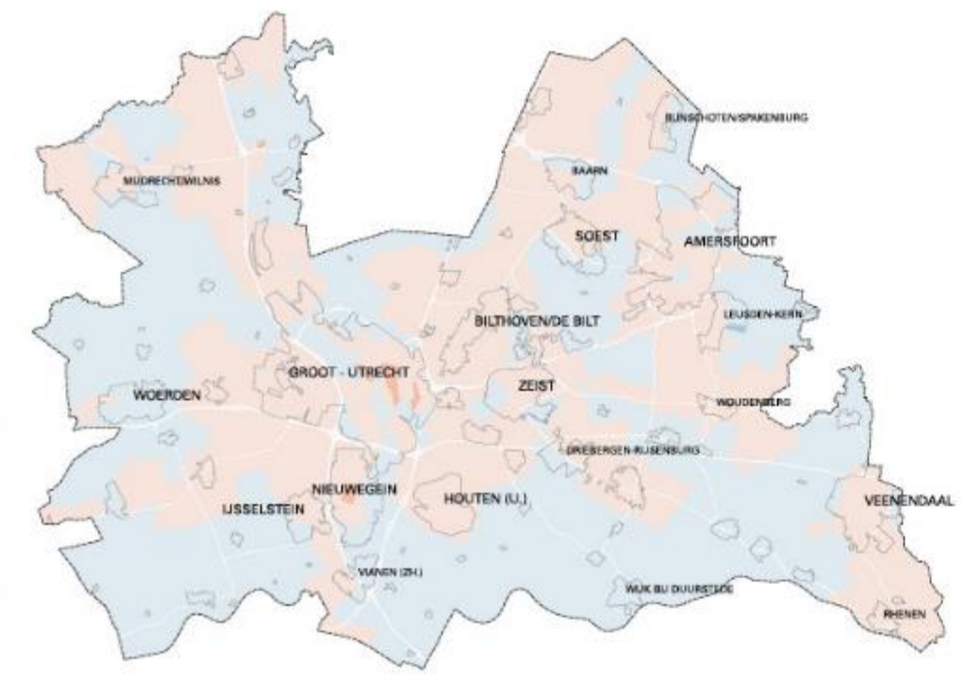
transformation



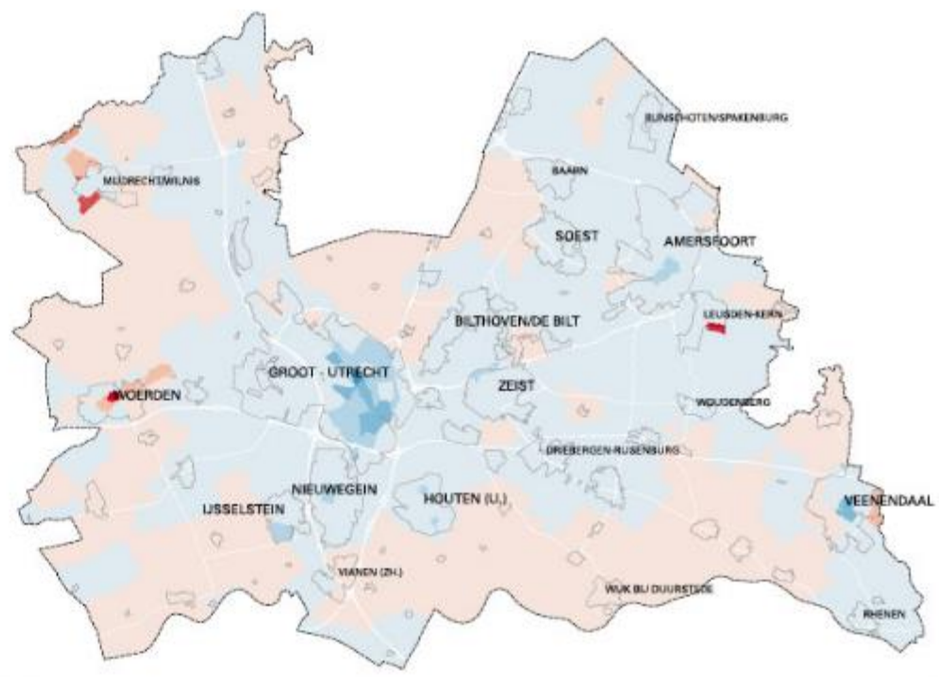
growth

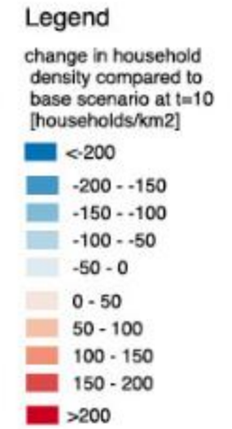


constraint



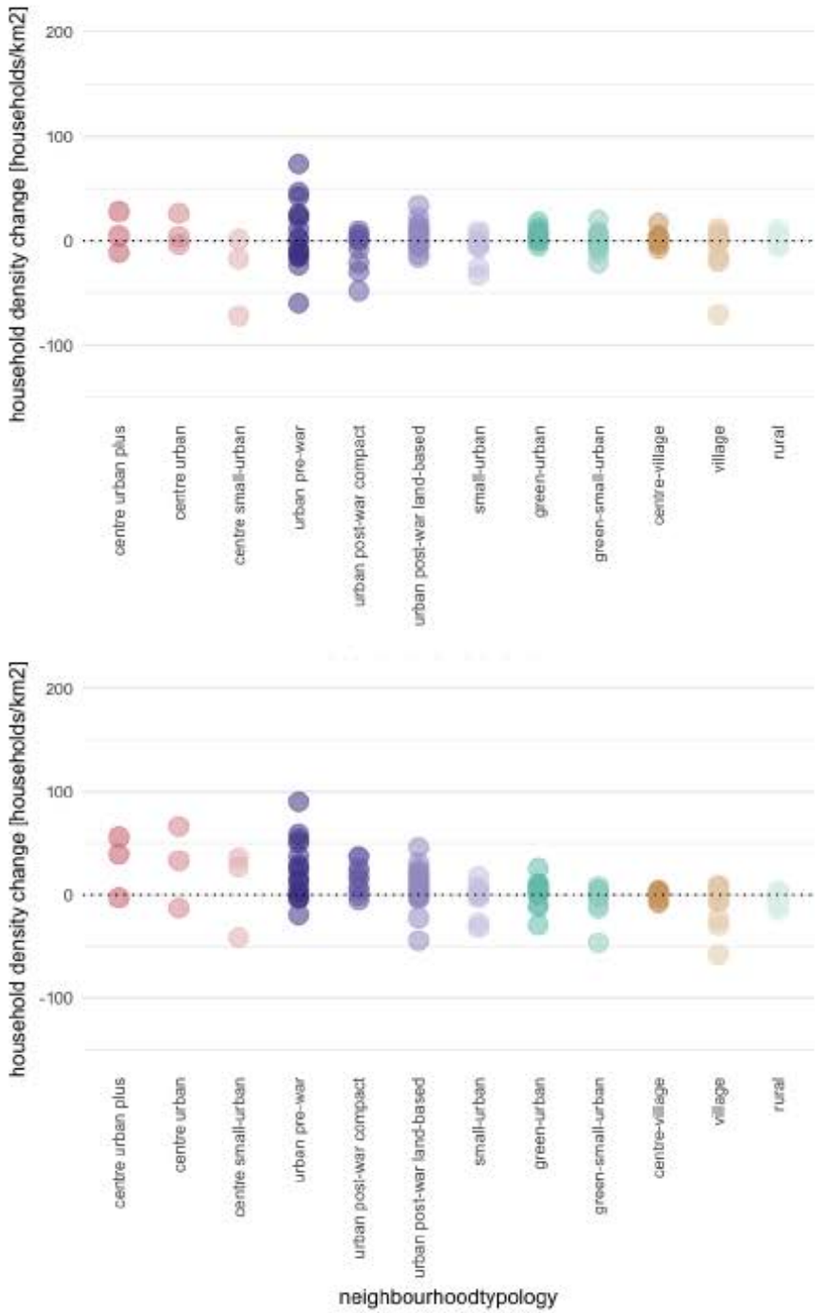
decline



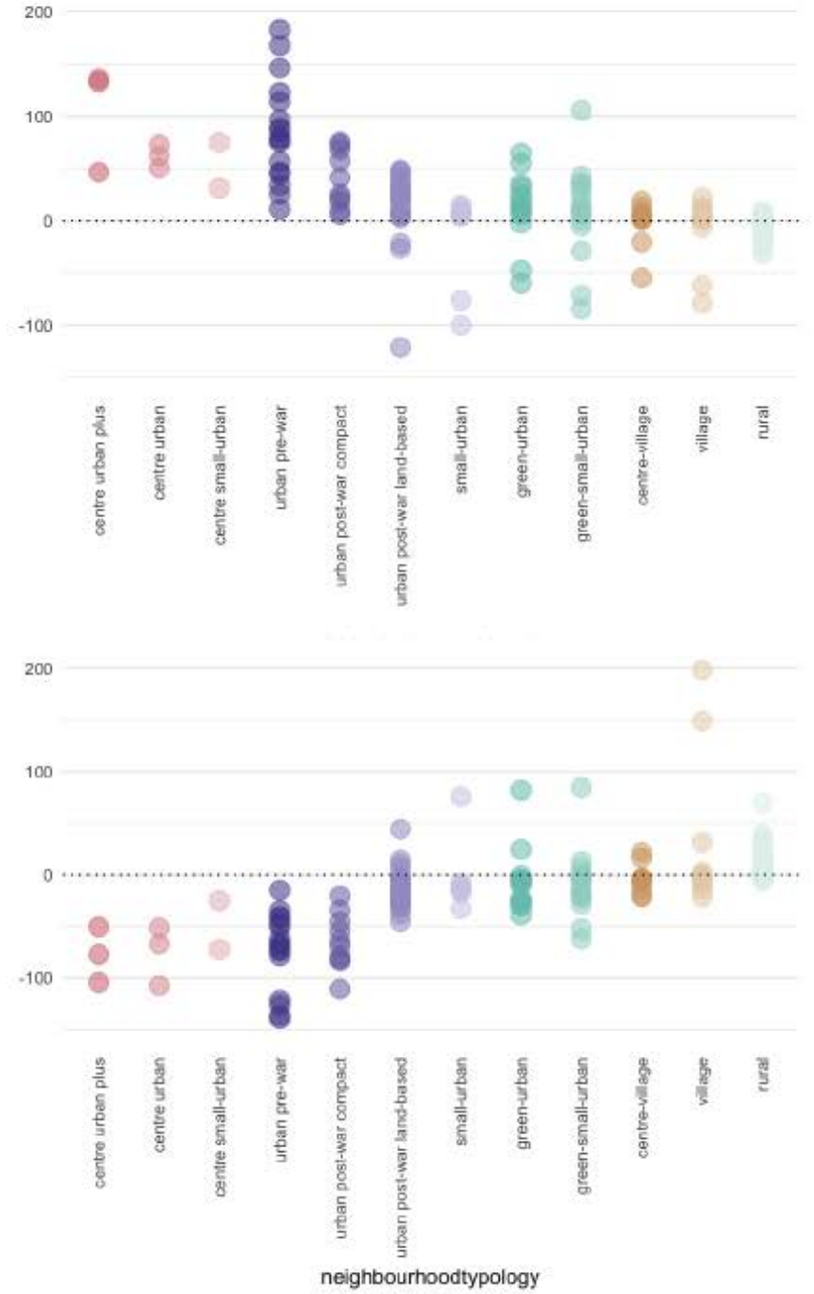


Results: Running the scenarios

transformation



growth



constraint

decline

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Summarizing

- **Scenario 1 transformation:** spatial quality effects are balanced over all neighborhood typologies. Average travel times increase but not dramatically. Main urban center of Utrecht does not gain but it does not lose population in relation to the base year. Improvement of city center quality seems to be keeping people in the main center.

- **Scenario 2 Growth:** most spatial quality benefits are found in the larger urban centres such as Utrech. This scenario also shows an increase in population in these areas, who seem to be drawn by the improved quality and by the fact that travel time has increased significantly with the private AVs usage which does not make it easy to commute.

- **Scenario 3 Constraint:** Spatial quality has been maintained in most of the areas. Travel times are similar to today's. Though it seems that population loss from the city center of Utrecht has been achieved.

- **Scenario 4 Decline:** The spatial quality effects of automated driving do not occur in this scenario and accessibility decreases in most areas. With the increase of travel time the exodus of the city center is not as expressive as in the do-nothing scenario since commuting is not as easy.

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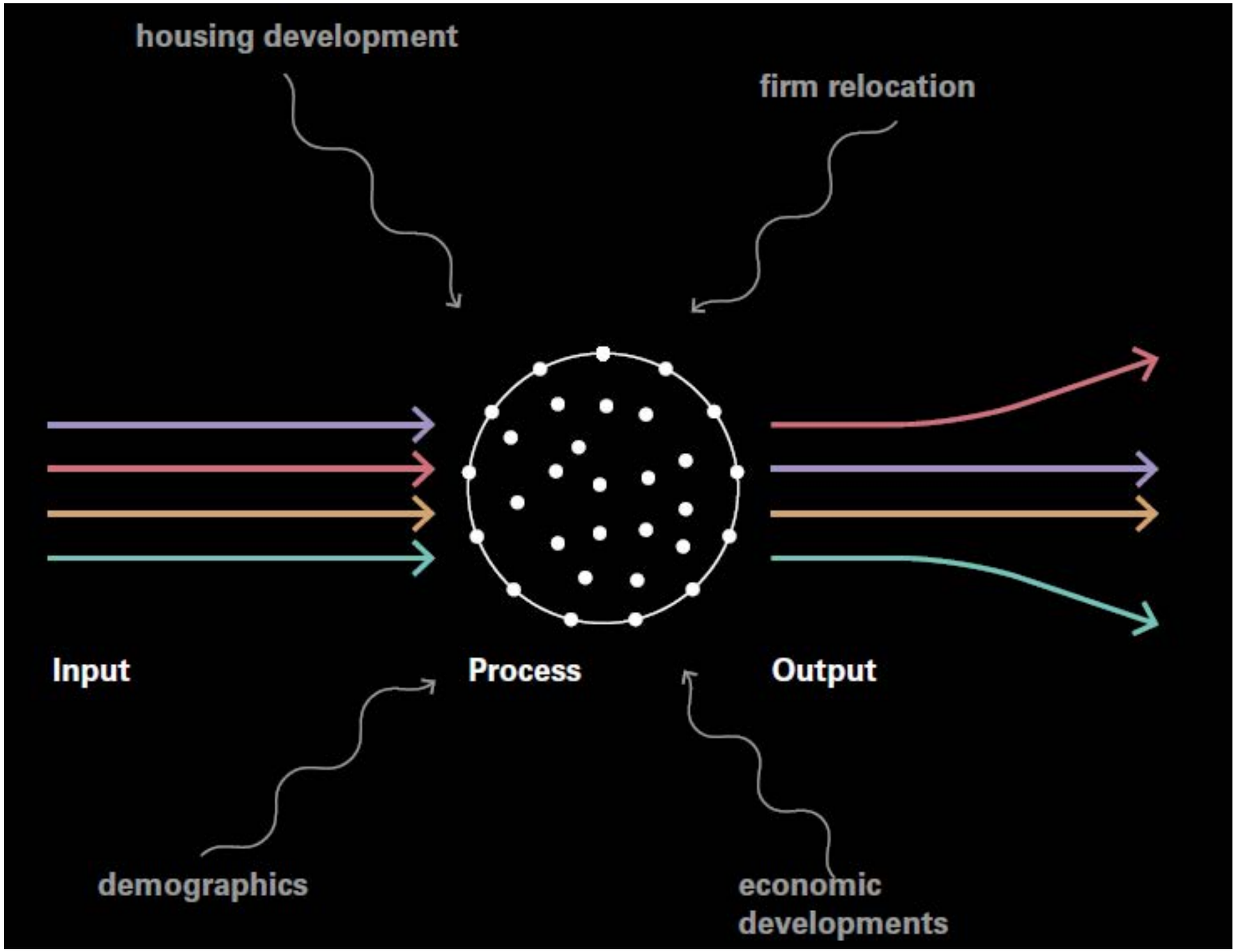
Disclaimer: things missing …



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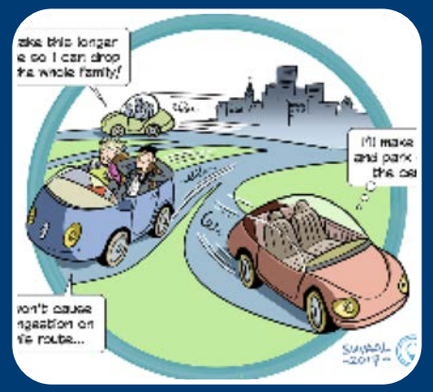
More research topics …



AVs routing

- Private AVs can satisfy more trips of your household
- Public shared AVs can be smartly routed to minimize impacts

First/last mile

- How many vehicles?
- How do they charge if they are electric?
- What is their potential?
- Who will use them?
- What costs?

Value of Travel Time

- What if you can work and have leisure in a car?
- What is the experience and comfort?

A lot of contributors for AVs research at TU Delft

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