Utrecht-region: under pressure

mobile design and strategy to keep the Utrecht-region accessible, vital and livable

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P5 final presentation
29-01-2010, 10.00

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1 introduction

2 research

3 design

4 conclusion

1 introduction

2 research

3 design

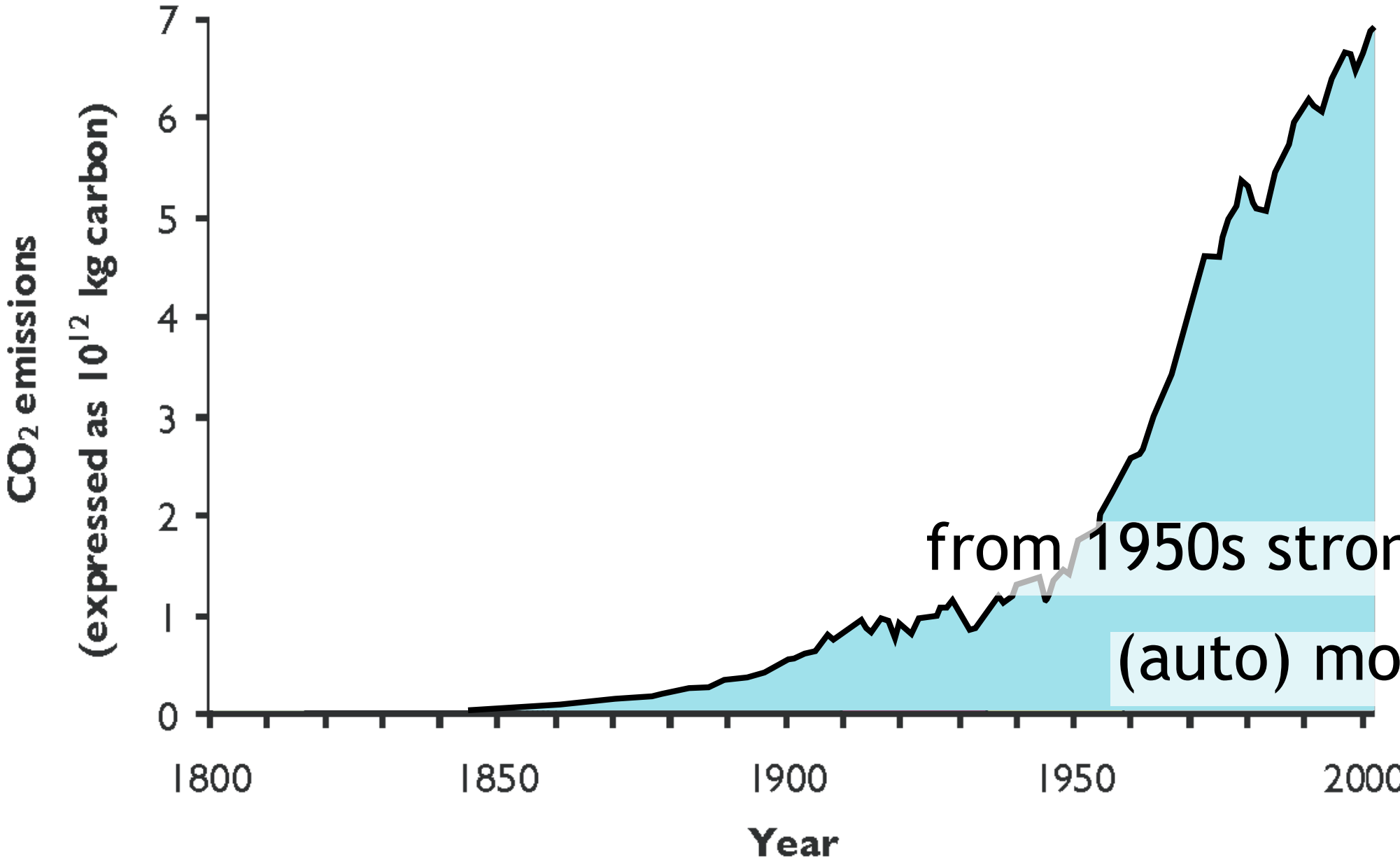
4 conclusion

introduction

1.1 motivation
1.2 potentials and problems
1.3 research question

emissions

CO_2 global



from 1950s strong growth

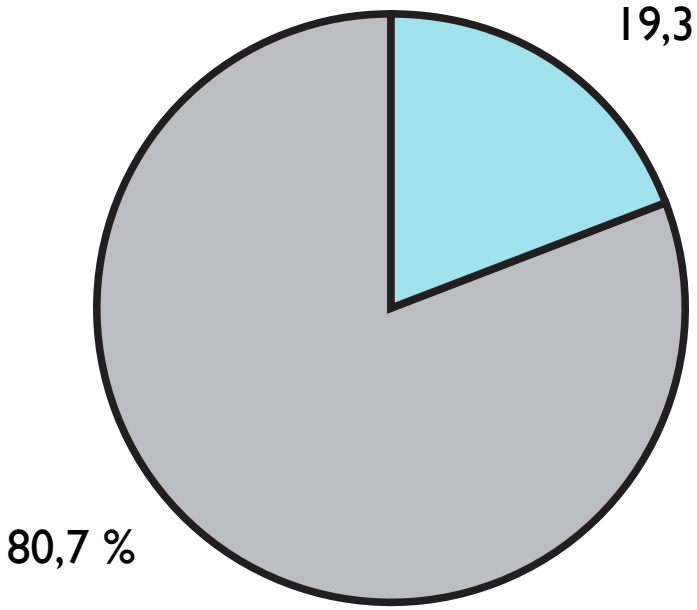
(auto) mobilisation

source: G. Marland, T.A. Boden & R.J. Andres (2005)

emissions

share of transportation in total emission CO_2

1971



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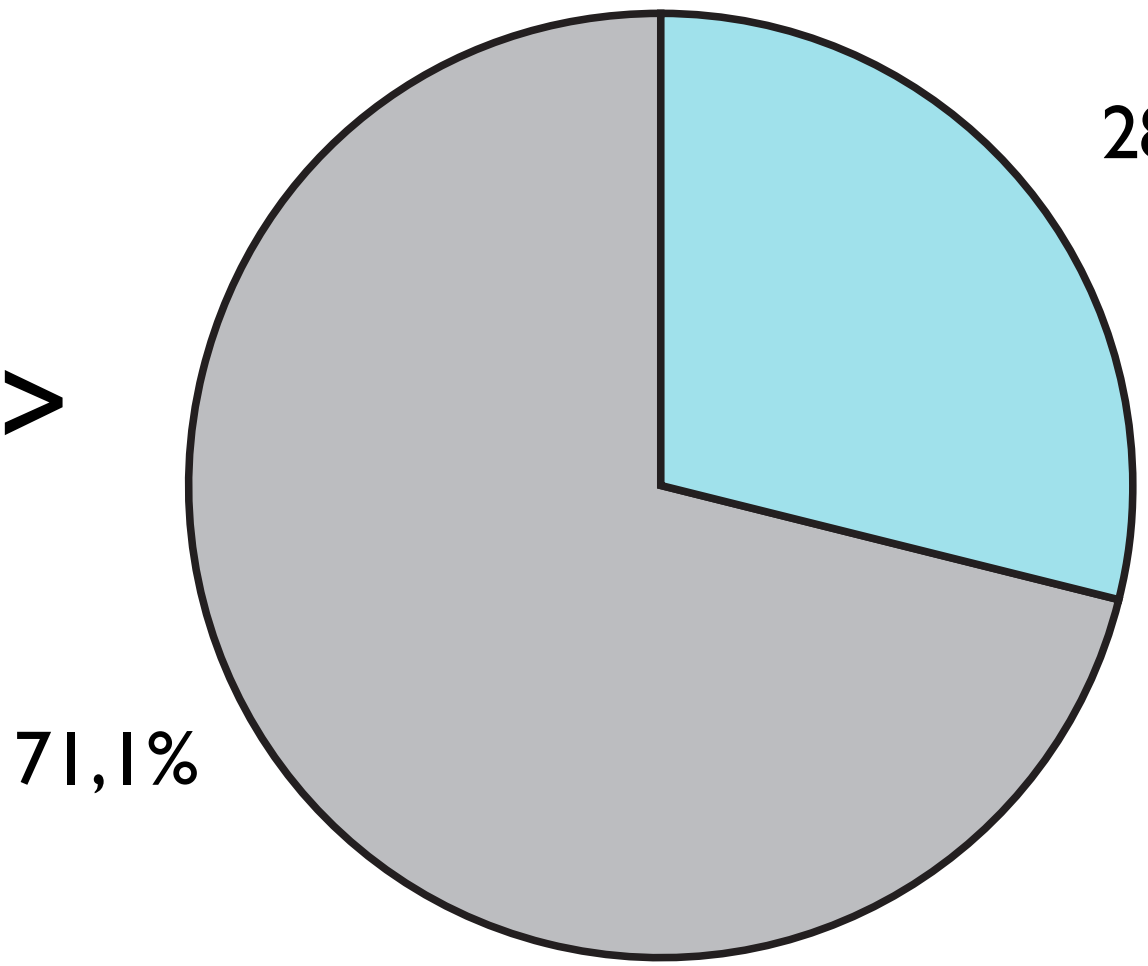
2003

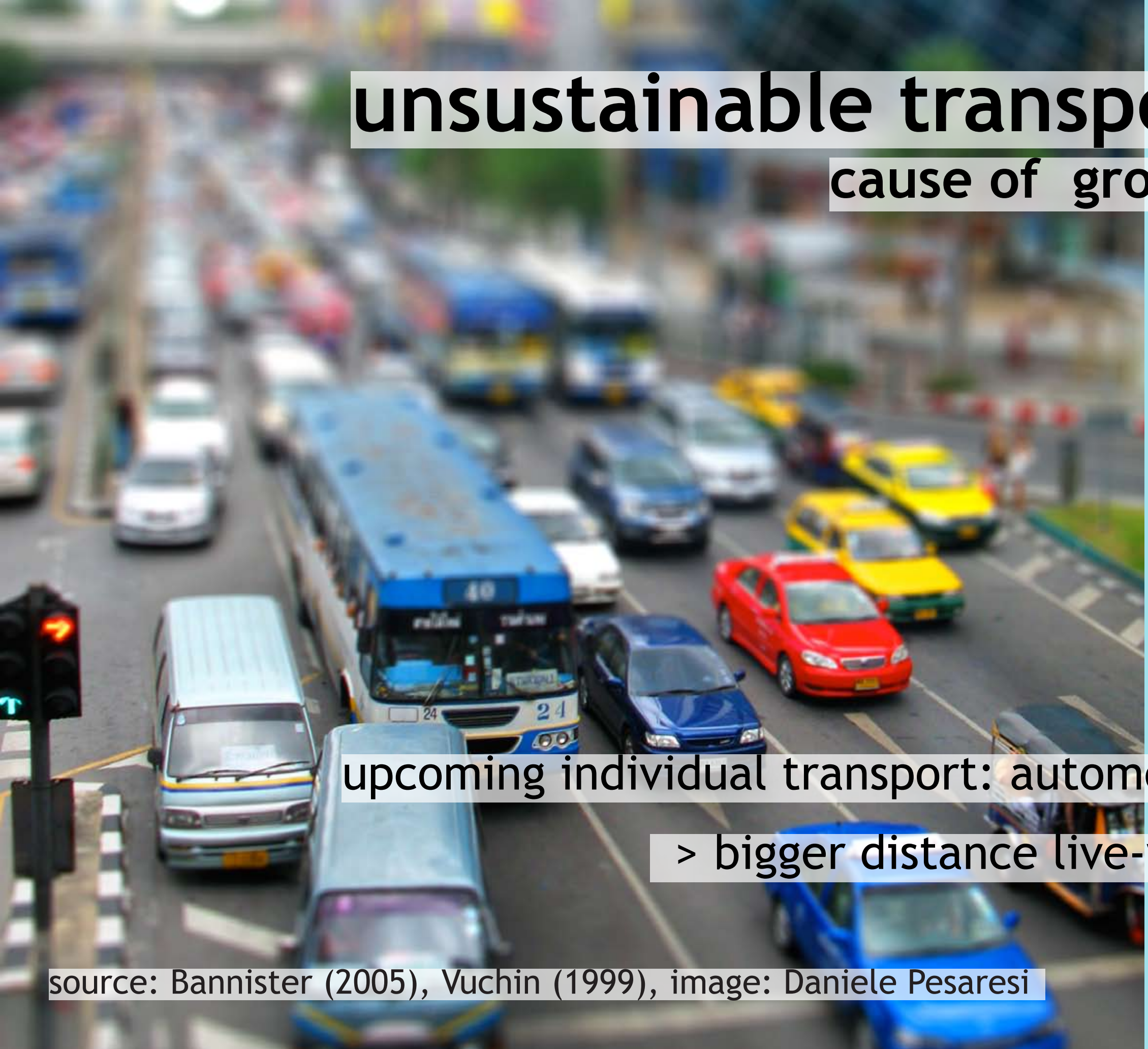


source: Banister (2005)

> absolute and relative growth

unsustainable transport

cause of growth



upcoming individual transport: automobile

> bigger distance live-work

source: Bannister (2005), Vuchin (1999), image: Daniele Pesaresi

spatial consequence

urban sprawl patterns US and western Europe

characteristics:

car based communities

low density > inefficient land use

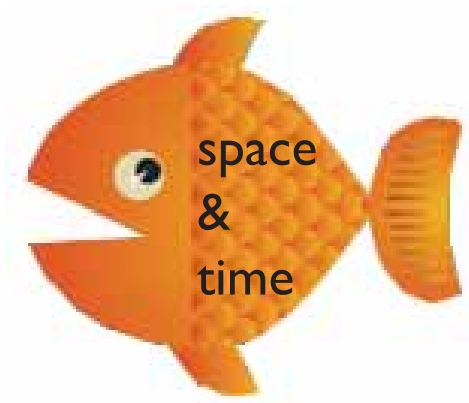
poor access public transport

> high use fossil fuel, air and sound pollution

source: Jason Hawkes (2009), Bannister (2005), image: Johnie K.

automobile

a space & time consumer



spatial problem:

unsustainable planning

> urgency relation mobility and urbanity

source: www.swimatyourownrisk.org (2009), Hall (2002)

measures

different strategies, focus on planning strategy

demand control

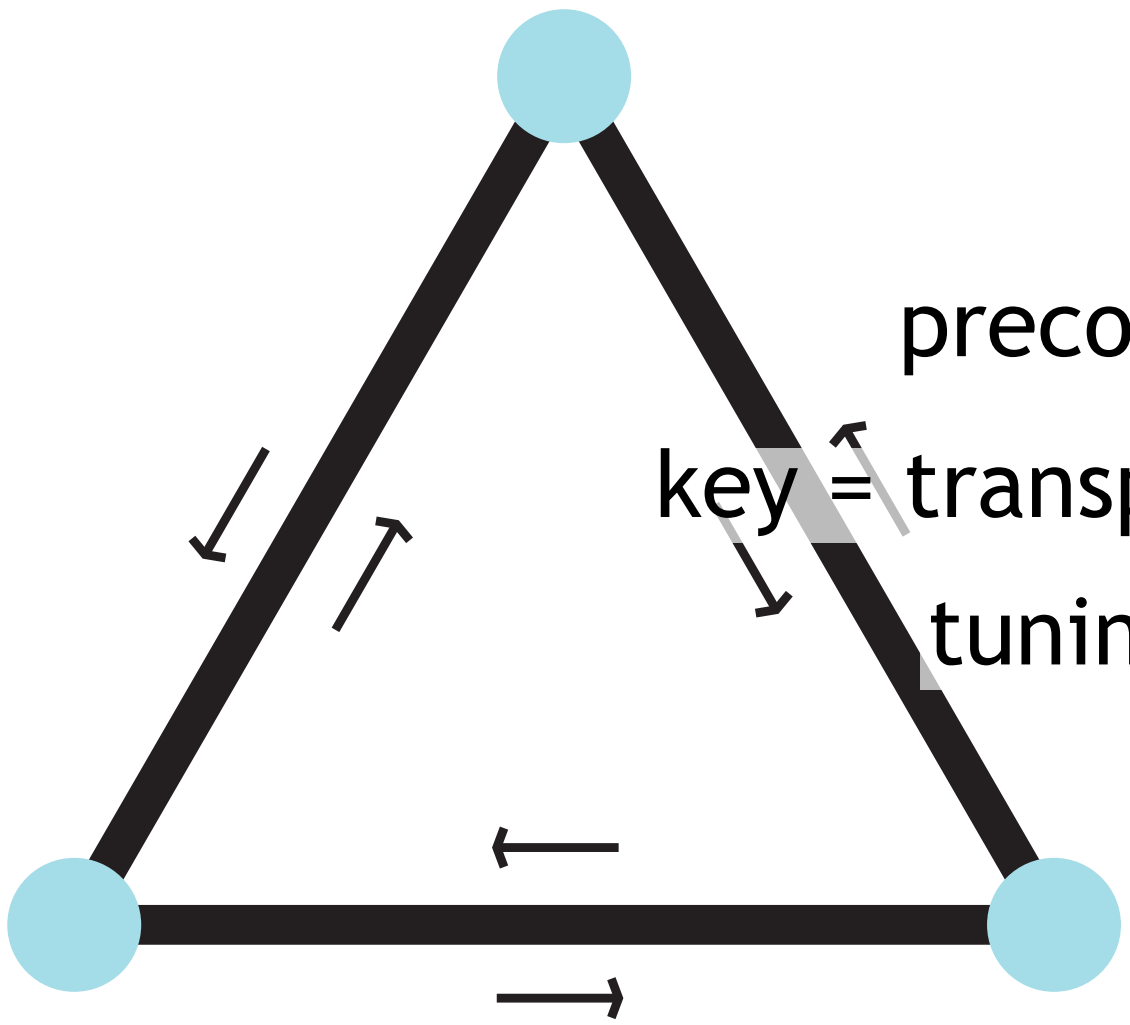
technological developments

supply control

planning strategies

source: Nijkamp (1993)

planning challenge
mobility and urbanity



preconditions sustainable cities

key = transportation (Bannister 2005)

tuning = challenge (Hall, 2002)

> transferable problem

source: Hall (2002)

question
generic question

What is a suitable spatial strategy for the management of a complex unsustainable city-region?

introduction

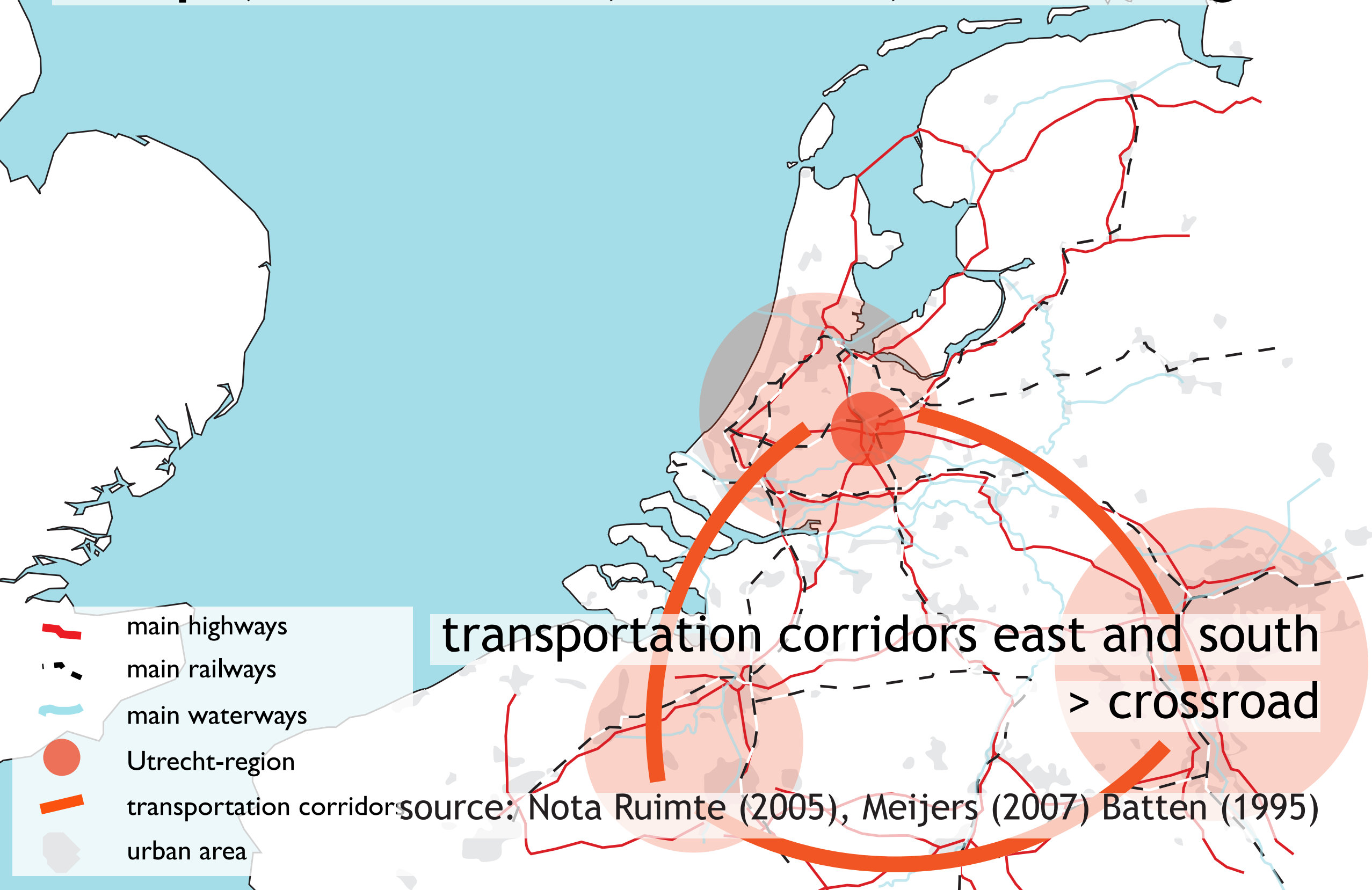
1.1 motivation

1.2 potentials and problems

1.3 research question

case

Europe, Netherlands, Randstad, Utrecht-region



transportation corridors east and south

> crossroad

source: Nota Ruimte (2005), Meijers (2007) Batten (1995)

BRU region

why the Utrecht-region?

Maarssen

De Bilt

Utrecht

Zeist

IJsselstein

Nieuwegein

Bunnik

Houten

Vianen

BRU: cooperation 9 municipalities

relation mobility urbanity:

specific and urgent

source: Topografische dienst (2007)

potentials

vs

problems

potentials

+

position in the Netherlands

public transport system

main hub of the Netherlands

connector Randstad to hinterland, Meijers (2007)

source: www.ns.nl (2009)

position in Randstad

economic clusters Randstad

national operating companies

> knowledge and service sector city

€ economic clusters

rail lines

urban area

source: Randstad 2040 (2007), Meijers (2007), Lambregts (2001)

knowledge city
university

knowledge & service sector city

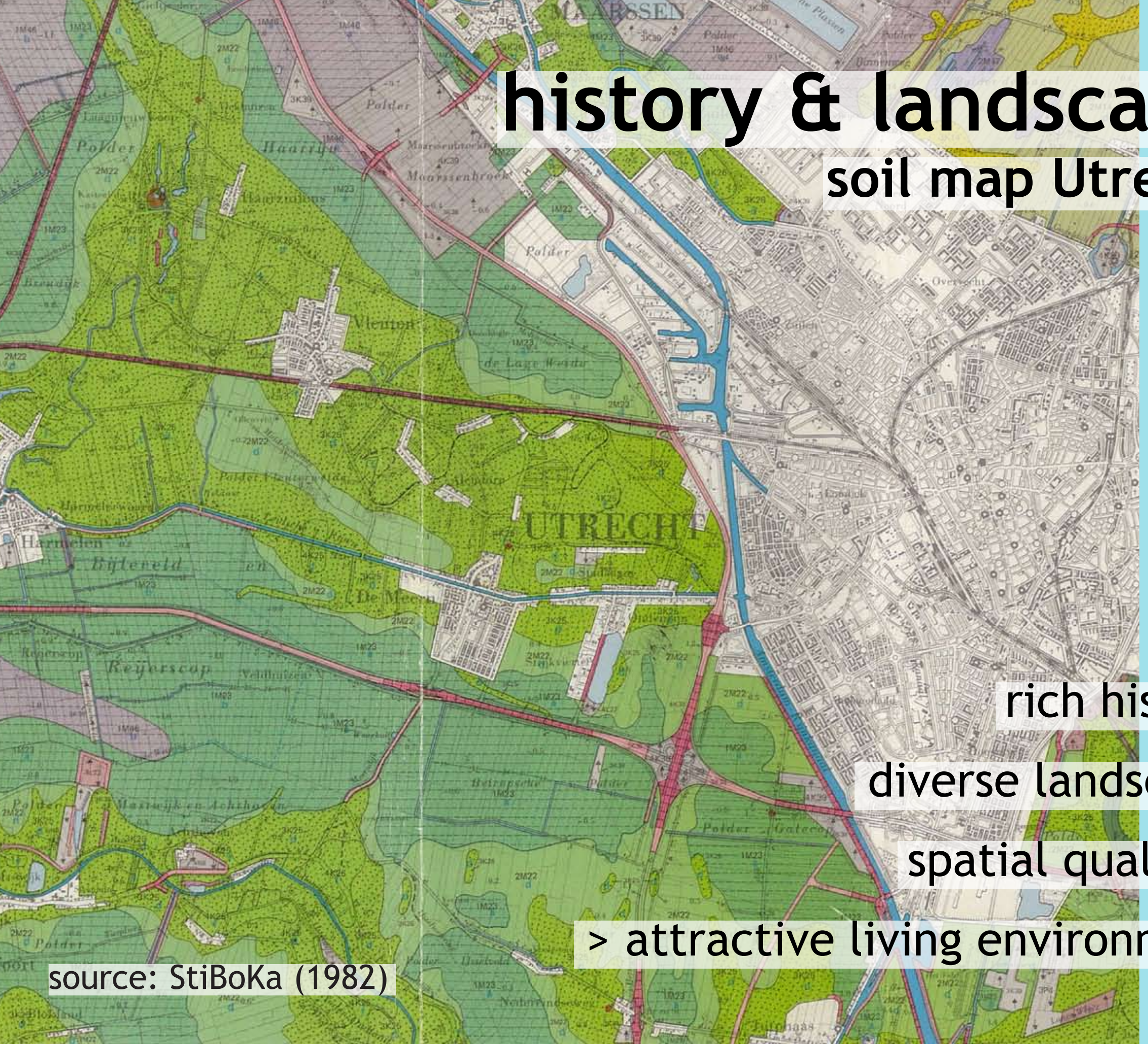
top university Netherlands

> 60.000 students & large amount knowledge workers

source: www.arwu.org - Sjanghai Jiao Tong University (2008)

history & landscape

soil map Utrecht



rich history

diverse landscape

spatial qualities

> attractive living environment

source: StiBoKa (1982)

[redacted]

problems

public transportation

poor city-regional system

capacity shortages

lacking quality and reliability

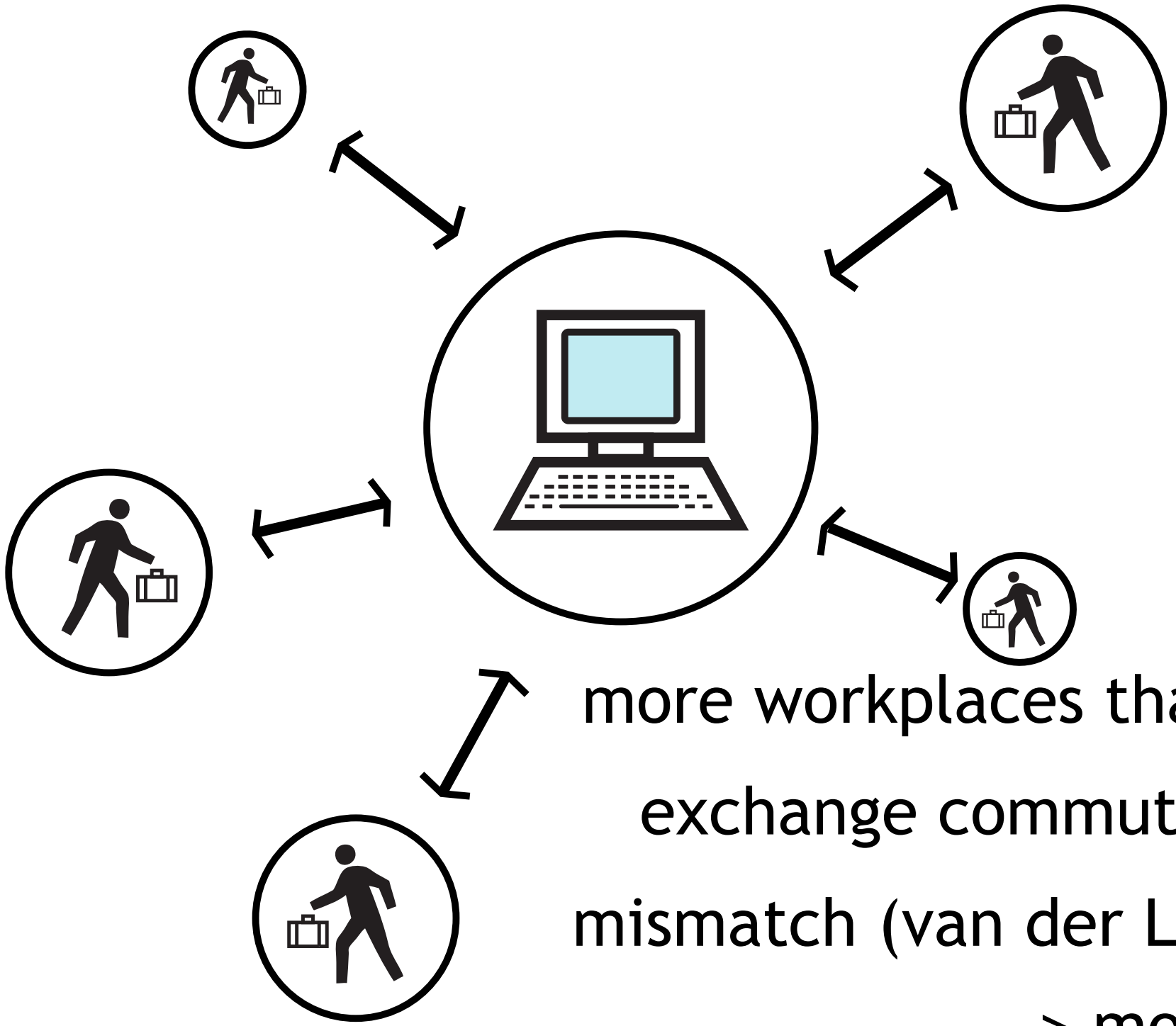
poor inter connectivity layers and modes

> two systems: city- and regional scale not, integrated

source: BRU (2004), GVU (2009), Gent et al. (1998), Priemus et al. (1999), Schoemaker (2002)

spatial mismatch

workplaces and dwellings



more workplaces than workers

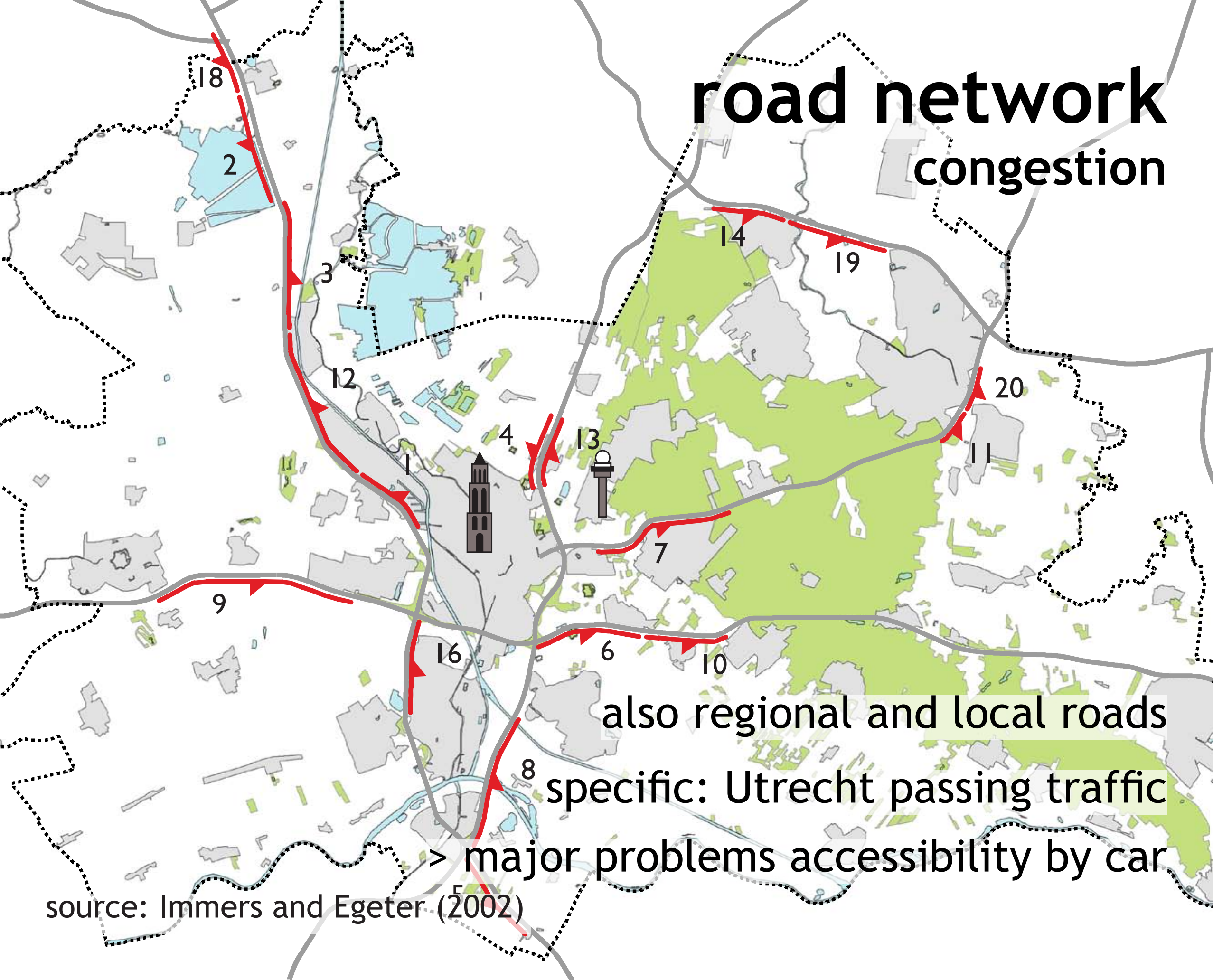
exchange commuting system

mismatch (van der Laan, 1996)

> mobility rises

source: van der Laan (1996)

road network
congestion



also regional and local roads

specific: Utrecht passing traffic

> major problems accessibility by car

source: Immers and Egeter (2002)

sound- and air pollution

sustainability?

60 % of movements done by car

> air pollution, exceeding limits

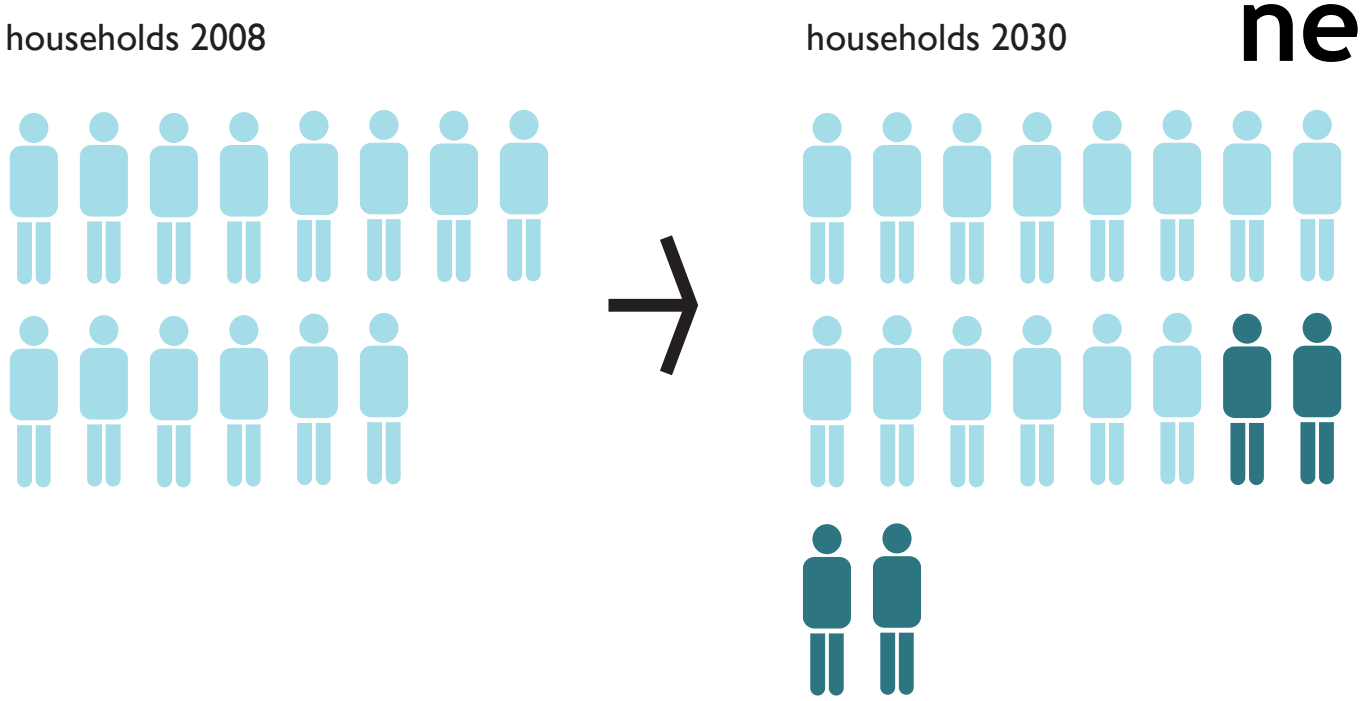
exceeds 50 µg/m3

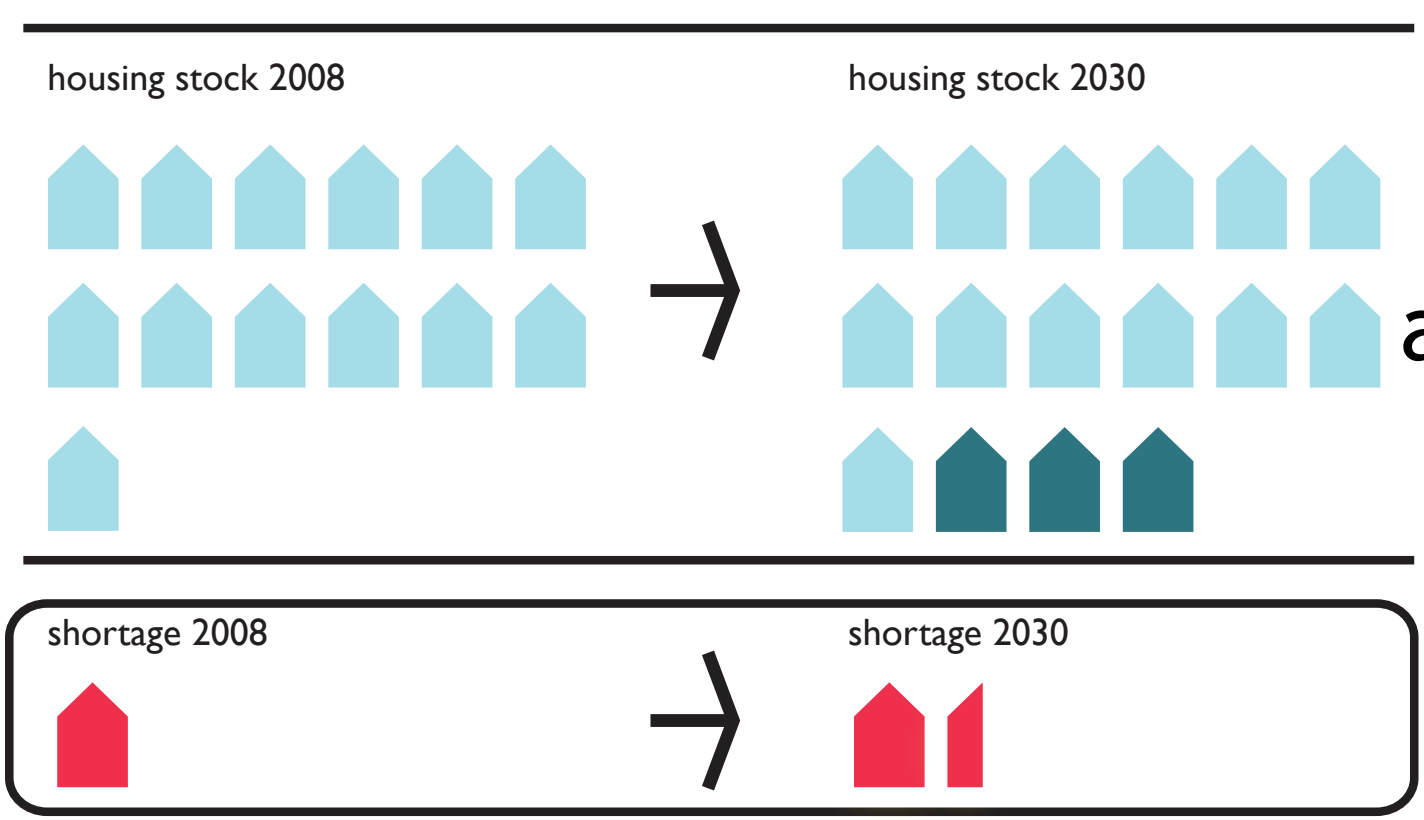
exceeds 40 µg/m3

source: Immers & Egeter (2006)

housing

need for new dwellings





already housing shortage

> increasing in future

= +/- 20.000 dwellings

= +/- 20.000 households

source: BRU (2008), ABF research (2008)

national landscapes

extension possibilities

protected landscapes

> restricted possibilities for extension

source: LNV & VROM (2009)

summary
consider the facts...

+ strategic location in the Netherlands

- accessibility under pressure

+ strong (growing) region in Randstad

- limited extension possibilities

introduction

1.1 motivation
1.2 potentials and problems
1.3 research question

research question

main research question

In what way can transit-oriented development (TOD) manage a complex city-region in developed countries?

How can this spatial strategy respond to the need for housing and ensure the accessibility of a city-region?

goal

case: Utrecht-region

The goal is boost the region’s comparative advantages, its spatial qualities and strengthen the position of the Utrecht-region in the Randstad

1 introduction

2 research

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research

2.1 theoretical framework
2.2 research & design process
2.3 practice based research

2

theoretical framework

types of theoretical research

applied theory:

transit-oriented development and node-place-model

context theory:

daily urban system

> direction and focus for research

transit-oriented development

planning concept

applied theory:

integration public transport & spatial developments

> positive effects (sustainable, economical, social)

source: Calthorpe (1993), Cervero (1998), image: Greg Keene

transit-oriented development

goals on two scales

regional goals

integrate regional transit system

define edge metropolitan area

provide alternatives car

keep qualities landscape

support public transport

local goals

mixed-use

walkable environment

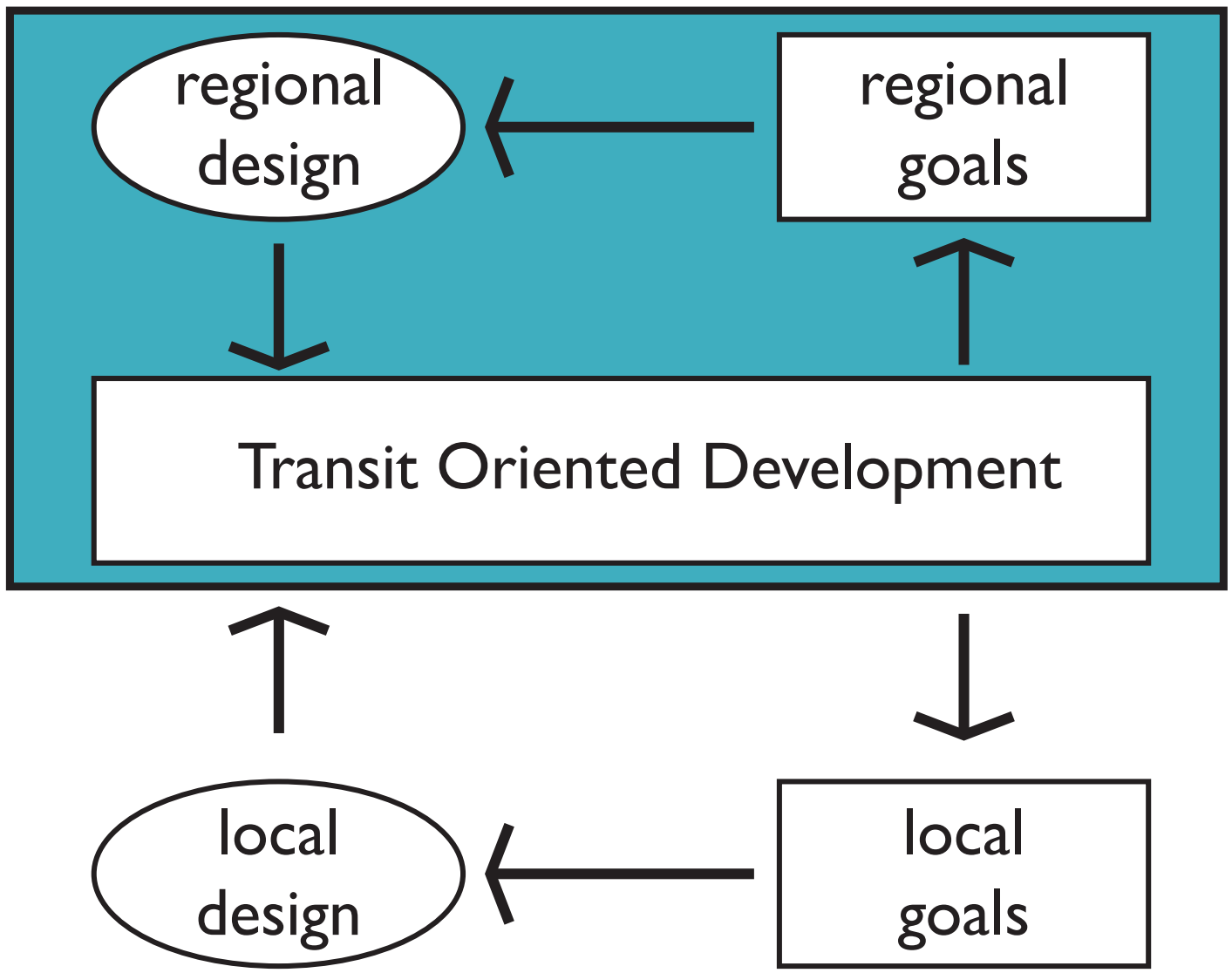
mixed housing types

2.000 foot (600m) walking transit stop

source: Calthorpe (1993), image: Doomster

transit-oriented development

why focus on regional goals & design



most interactions take place on city-regional scale

> research and design on this scale necessary

source: Musterd and van Zelm (2001), RPB (2006)

node-place-model

complexity station areas

applied theory:

node of social-economic ***interactions*** (Jacobs, 2000)

ambivalent: node transportation systems (transit stop)

and a place with varied urban activities (station area)

> analytical model to relate these two dimensions

source: Bertolini (1999), image: Isaac Vallée

node-place-model

place value

determined by:

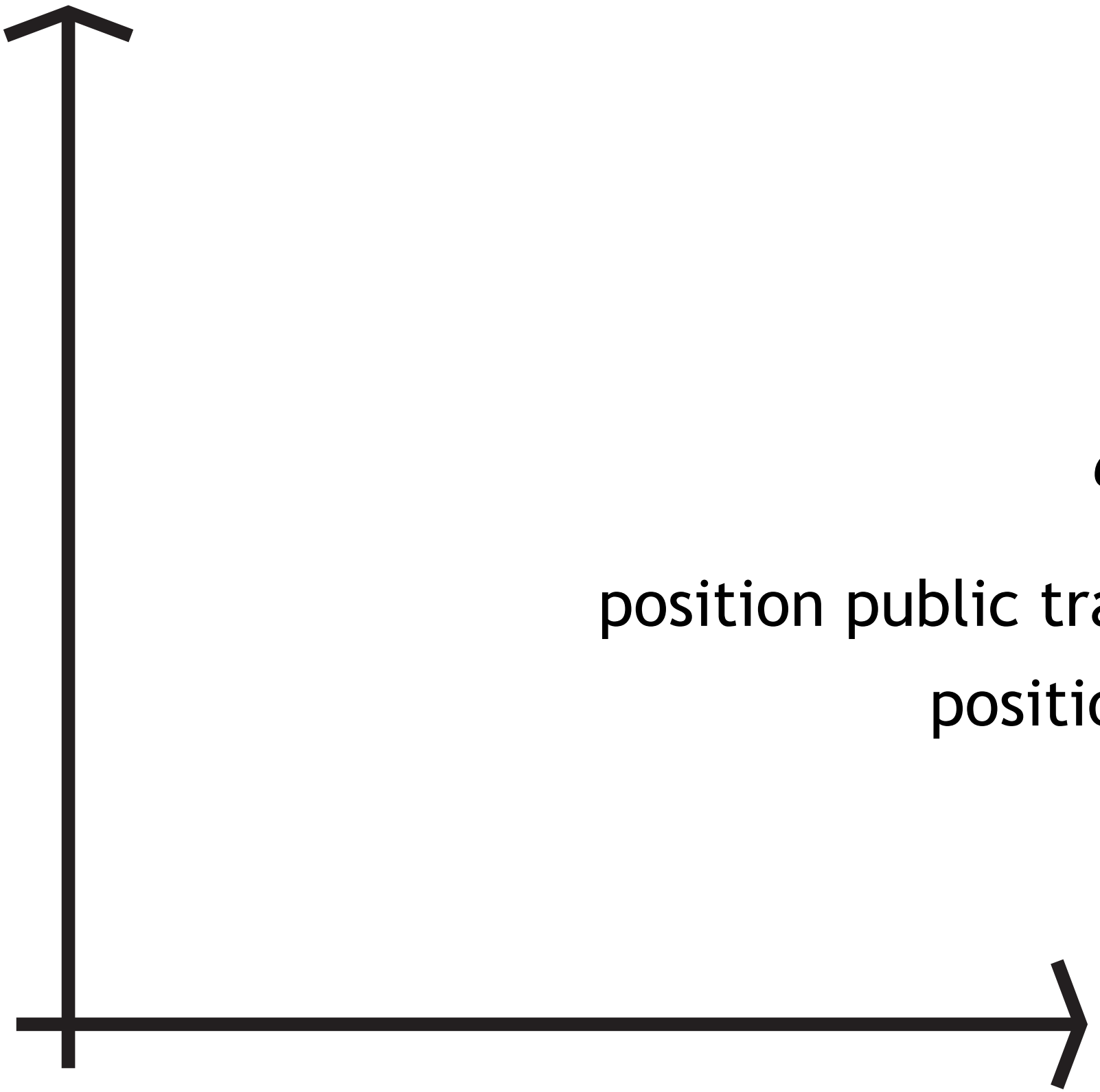
workers- and inhabitants density

degree of functional mix

place value

x-axis

node value
y-axis



node-place-model

node value

determined by:

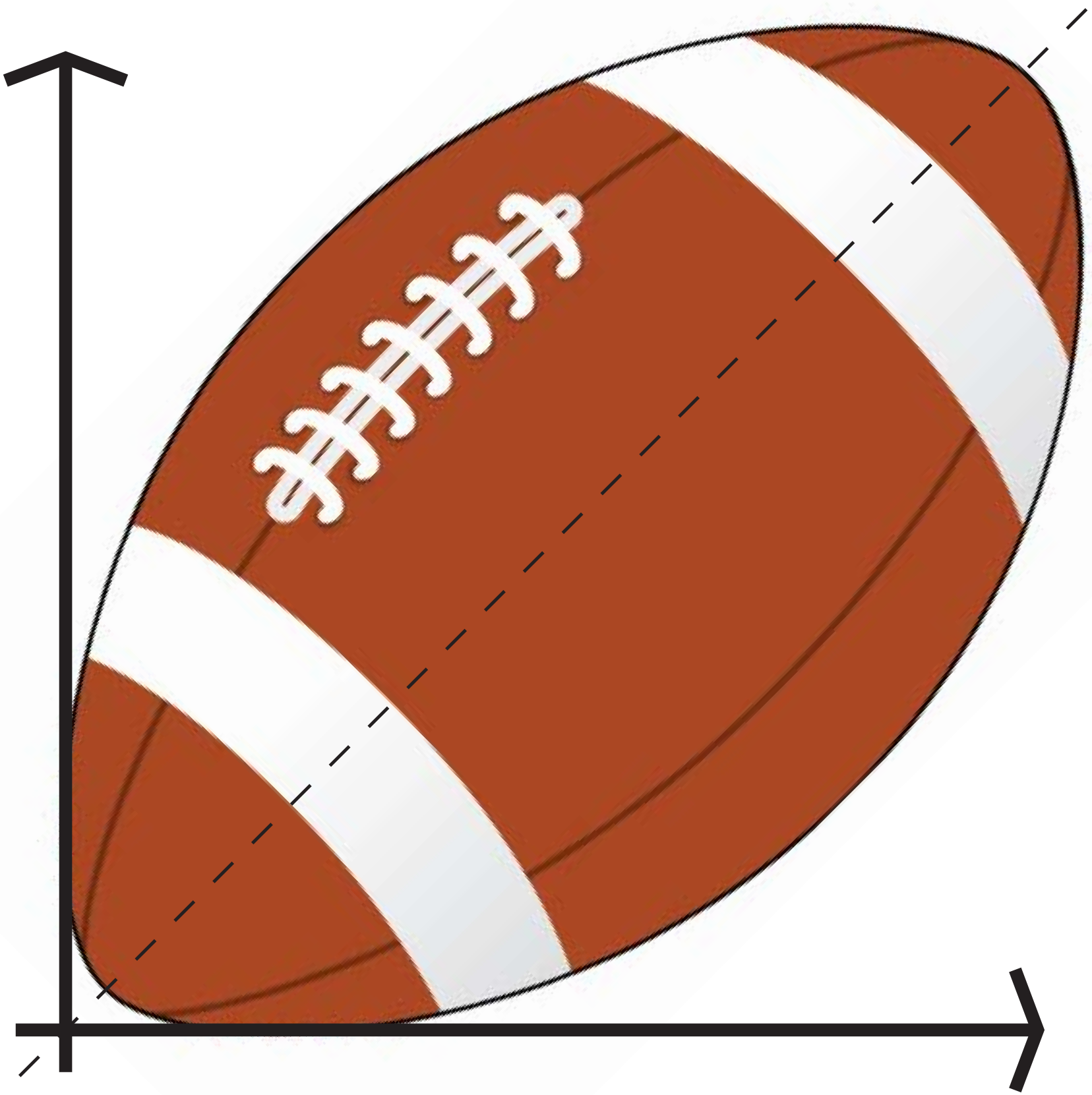
position public transport network

position road network

place value
x-axis

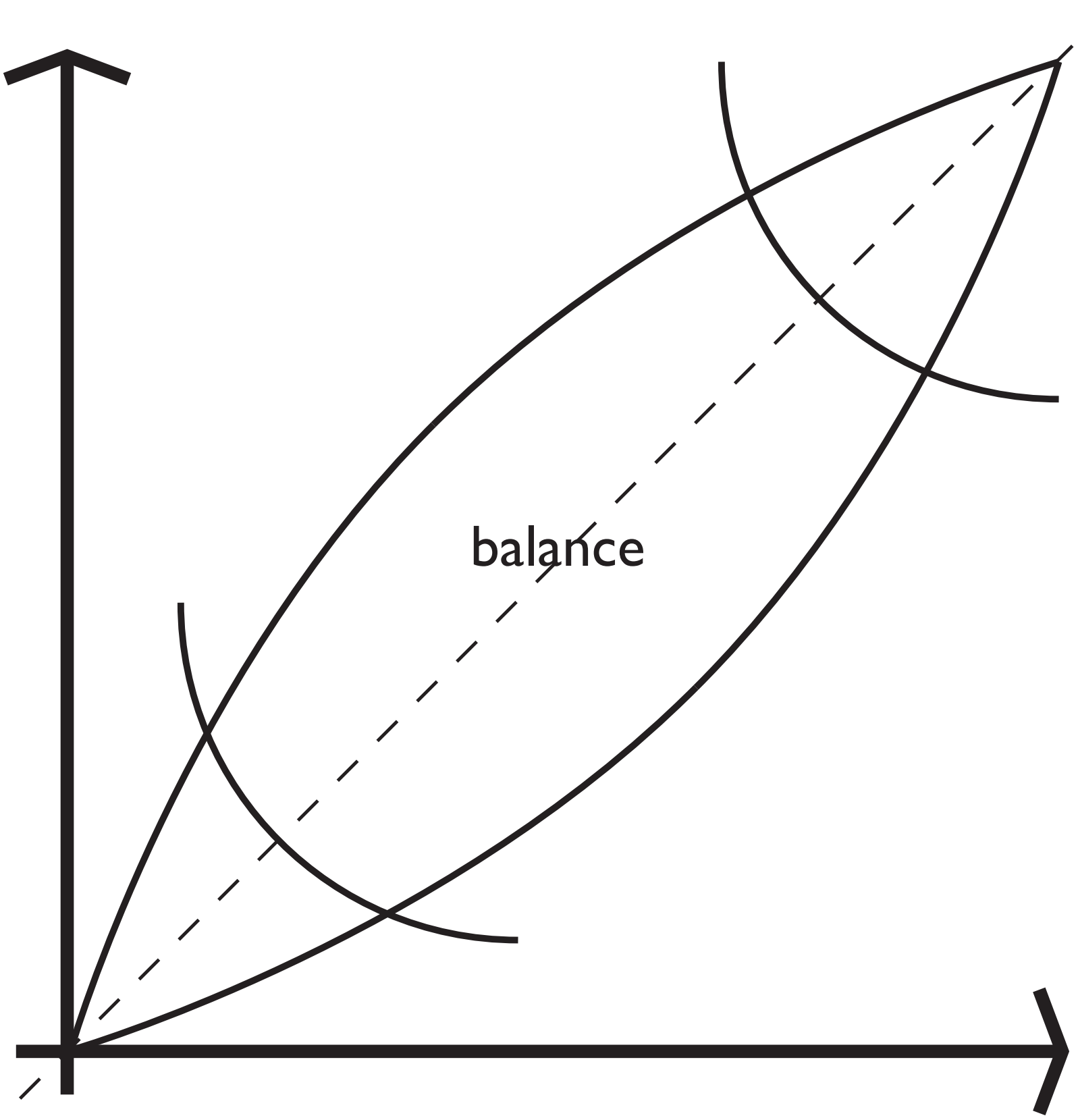
node-place-model

rugby ball



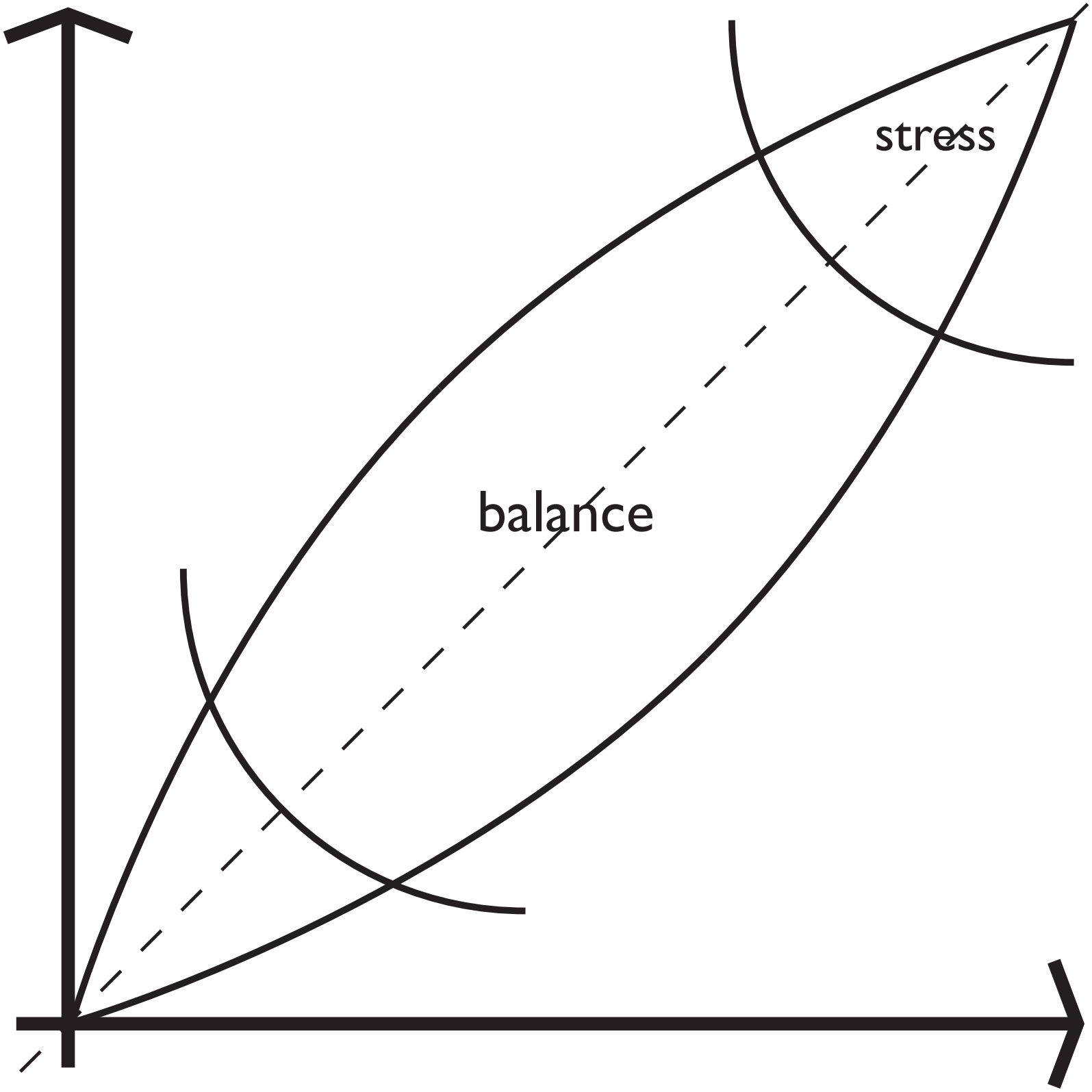
node-place-model

balance



node-place-model

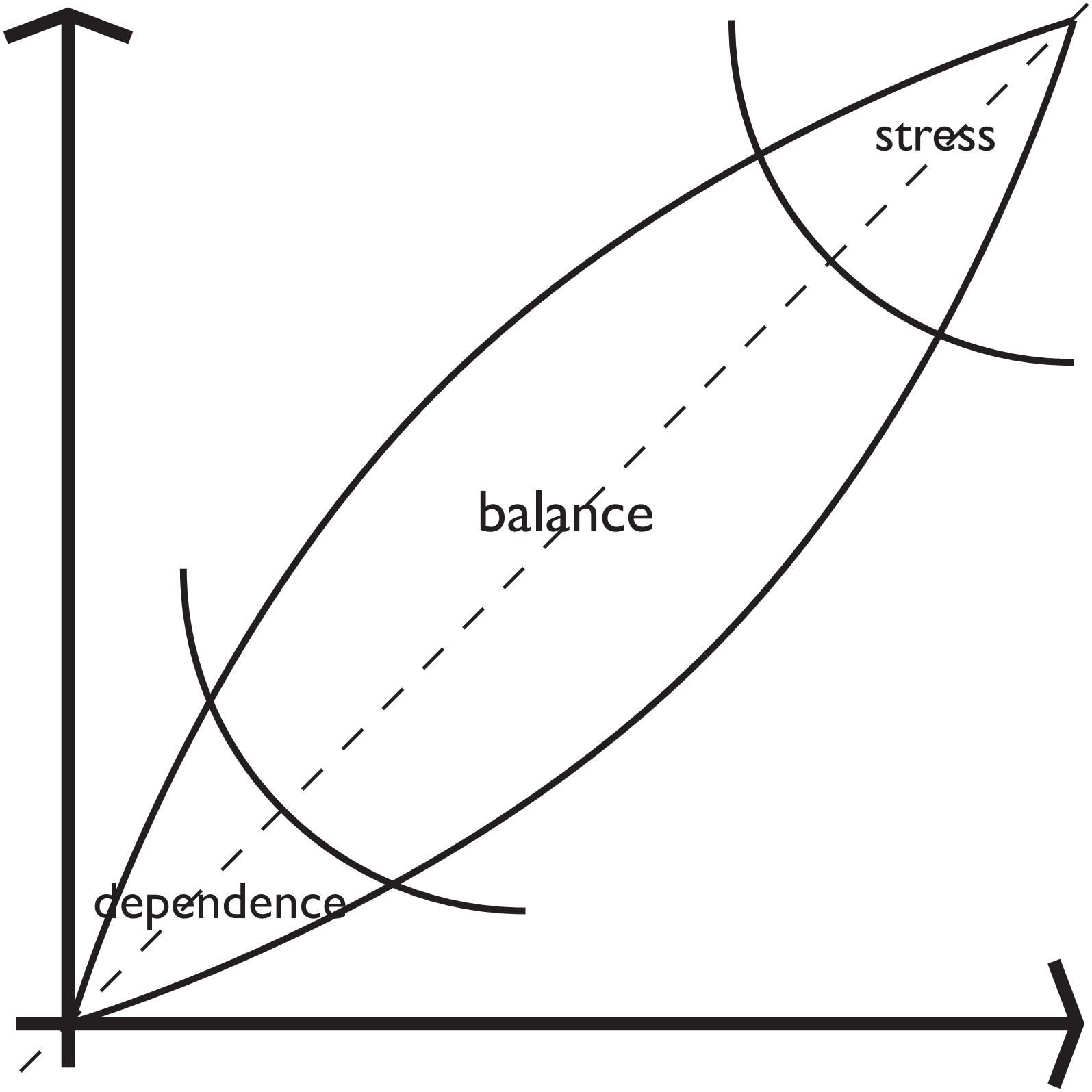
node value
y-axis



stress

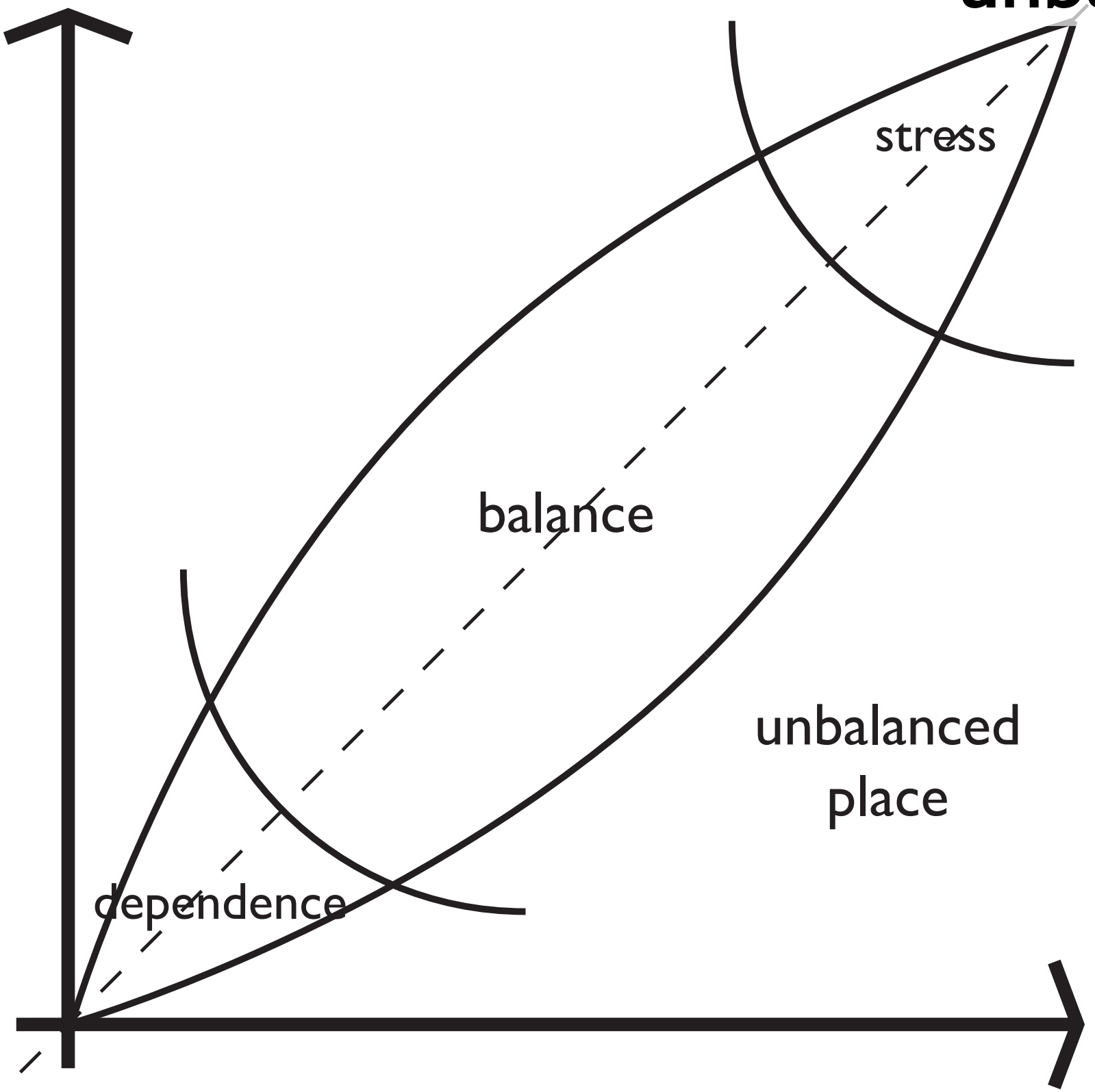
place value
x-axis

node-place-model

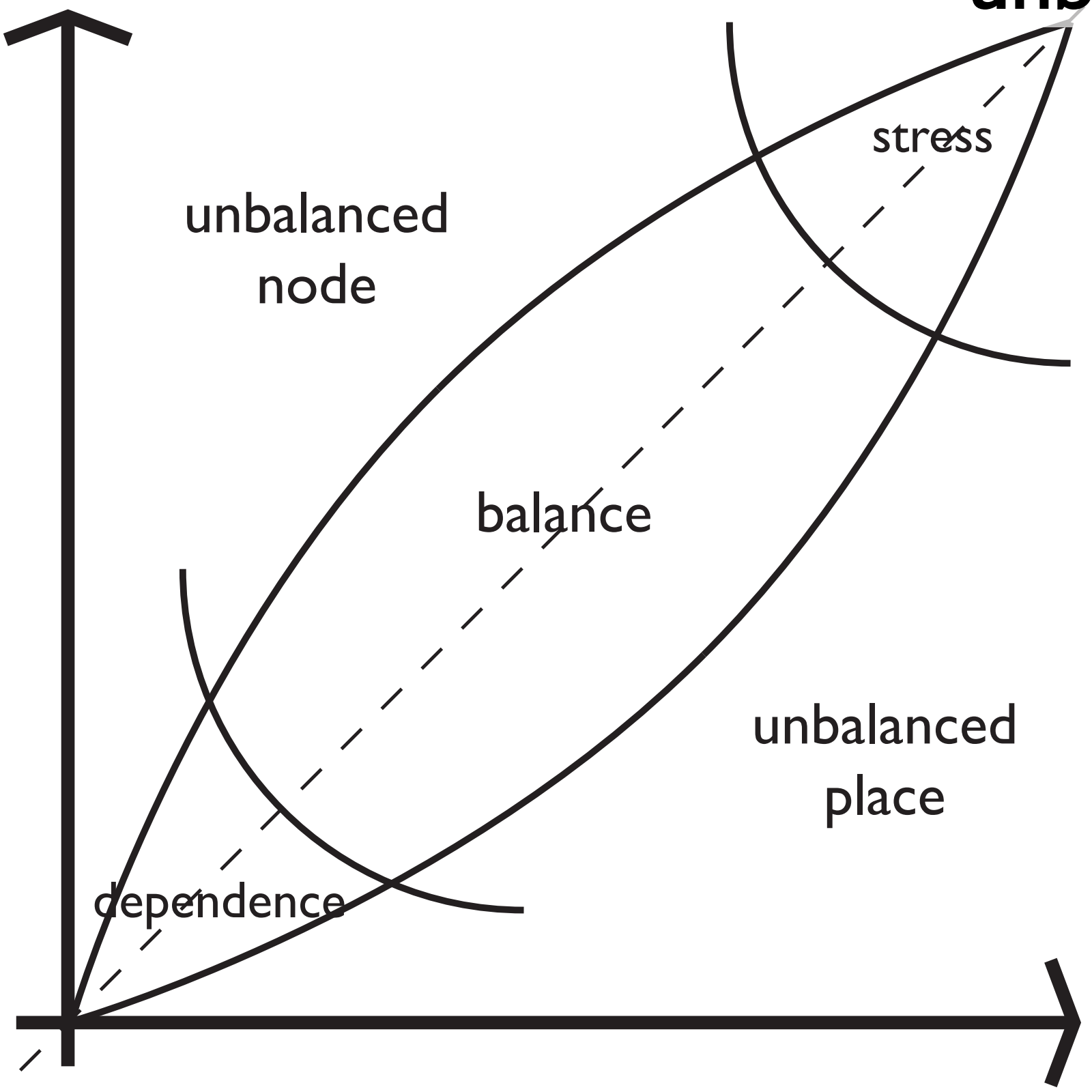


node-place-model

unbalanced place



node-place-model



2010

node value
y-axis

1,0
0,8
0,6
0,4
0,2
0,0

0,0 0,2 0,4 0,6 0,8 1,0

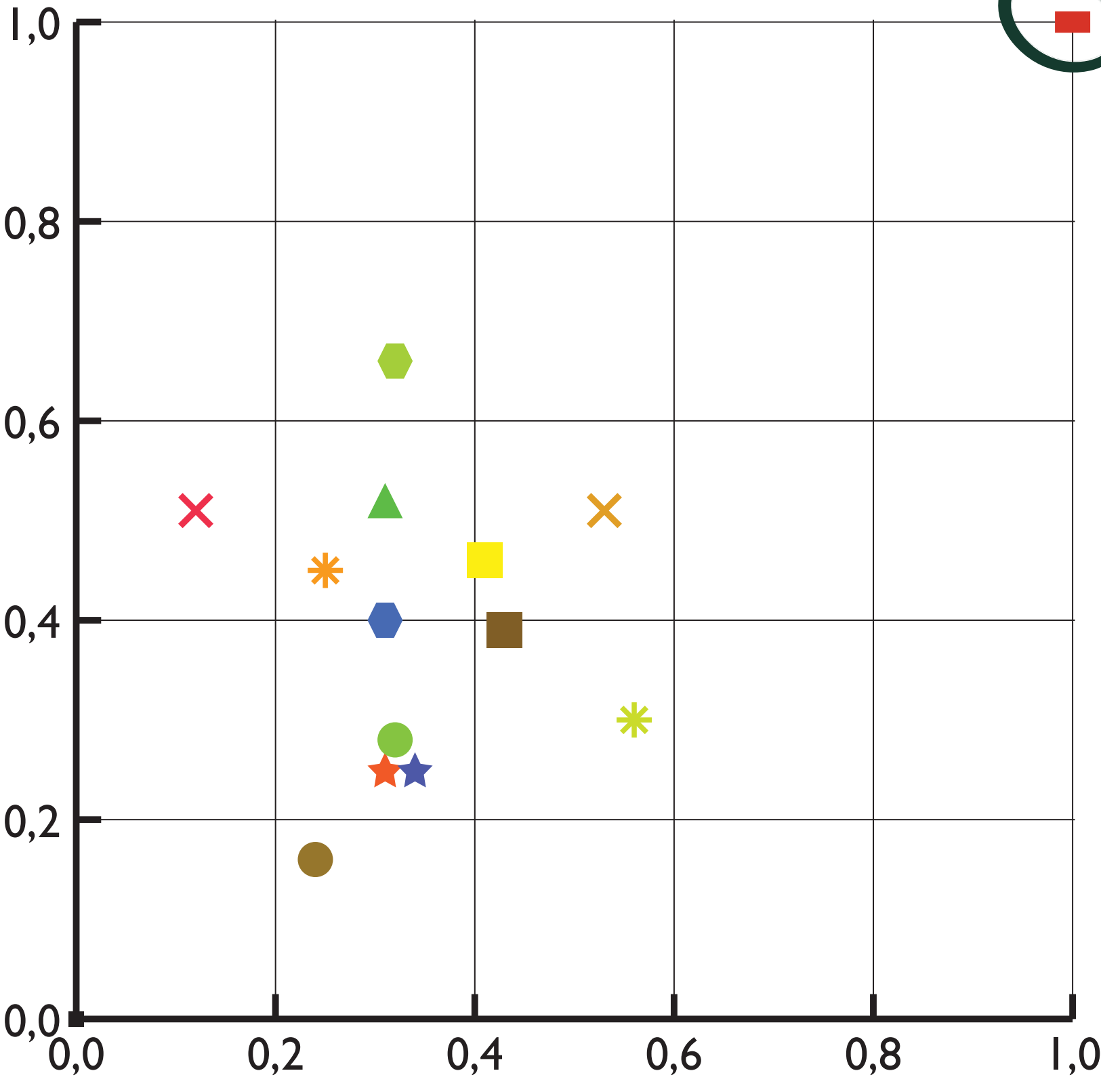
Bilthoven
Bunnik
Den Dolder
Driebergen-Zeist
Hollandsche Rading
Houten
Houten Castellum
Maarrssen
Utrecht Centraal
Utrecht Lunetten
Utrecht Overvecht
Utrecht Terwijde
Utrecht Zuilen
Vleuten
Utrecht Vaartsche Rijn
Utrecht Leidsche Rijn Centrum
Utrecht Majella
Utrecht Lage Weide
Vianen
Houten West
Utrecht Lunetten Beatrixpark
Maartensdijk

place value
x-axis

node value
y-axis

2010

Utrecht Centraal



- Bilthoven
- Bunnik
- Den Dolder
- Driebergen-Zeist
- Hollandsche Rading
- Houten
- Houten Castellum
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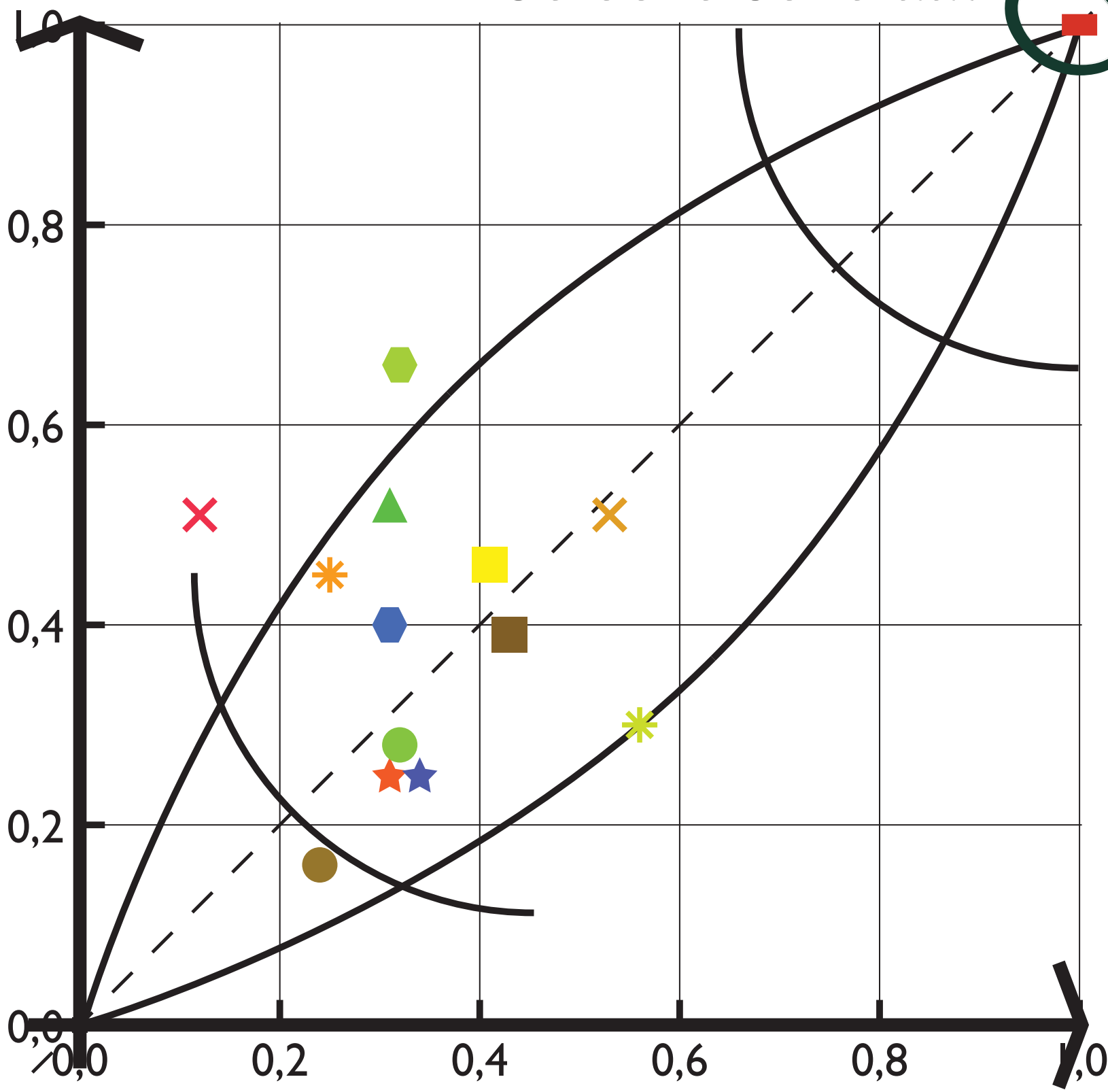
place value
x-axis

node value
y-axis

2010

Utrecht Centraal



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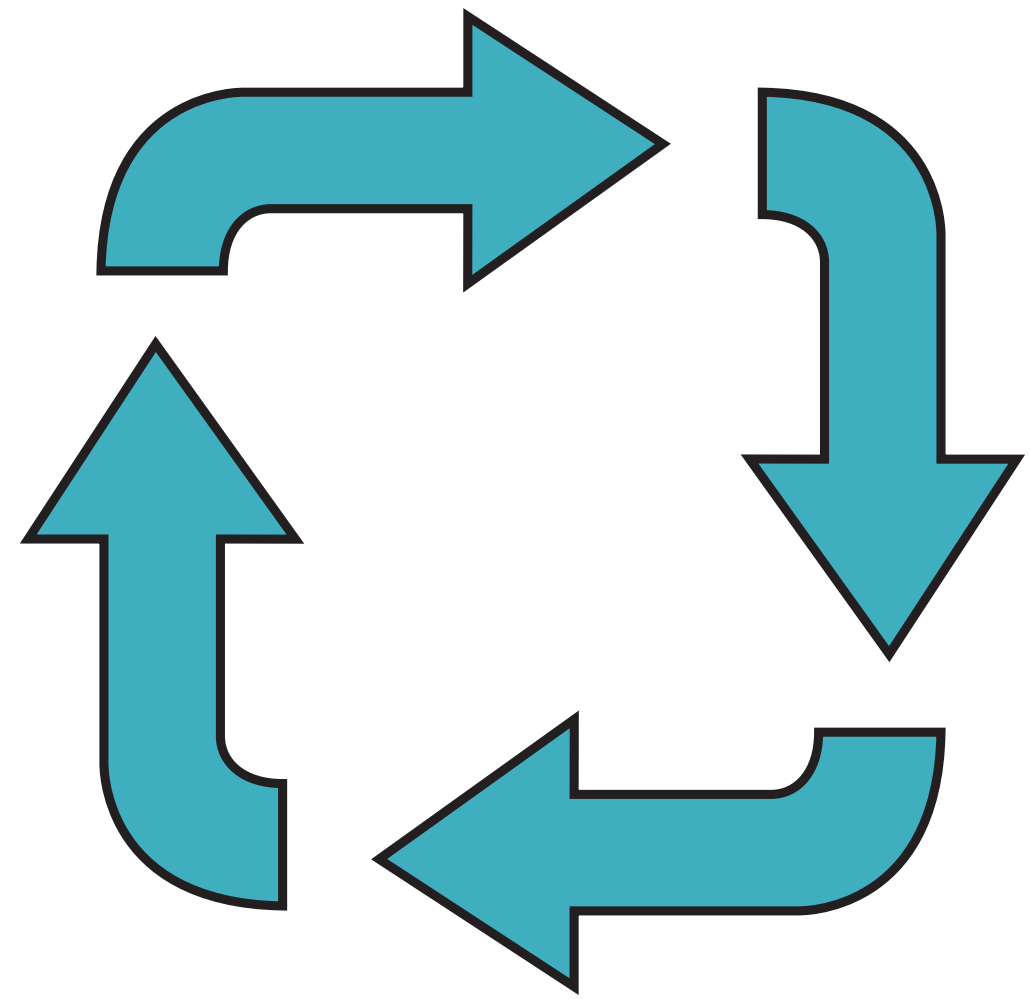
place value
x-axis

node-place-model
mechanism

node value ++

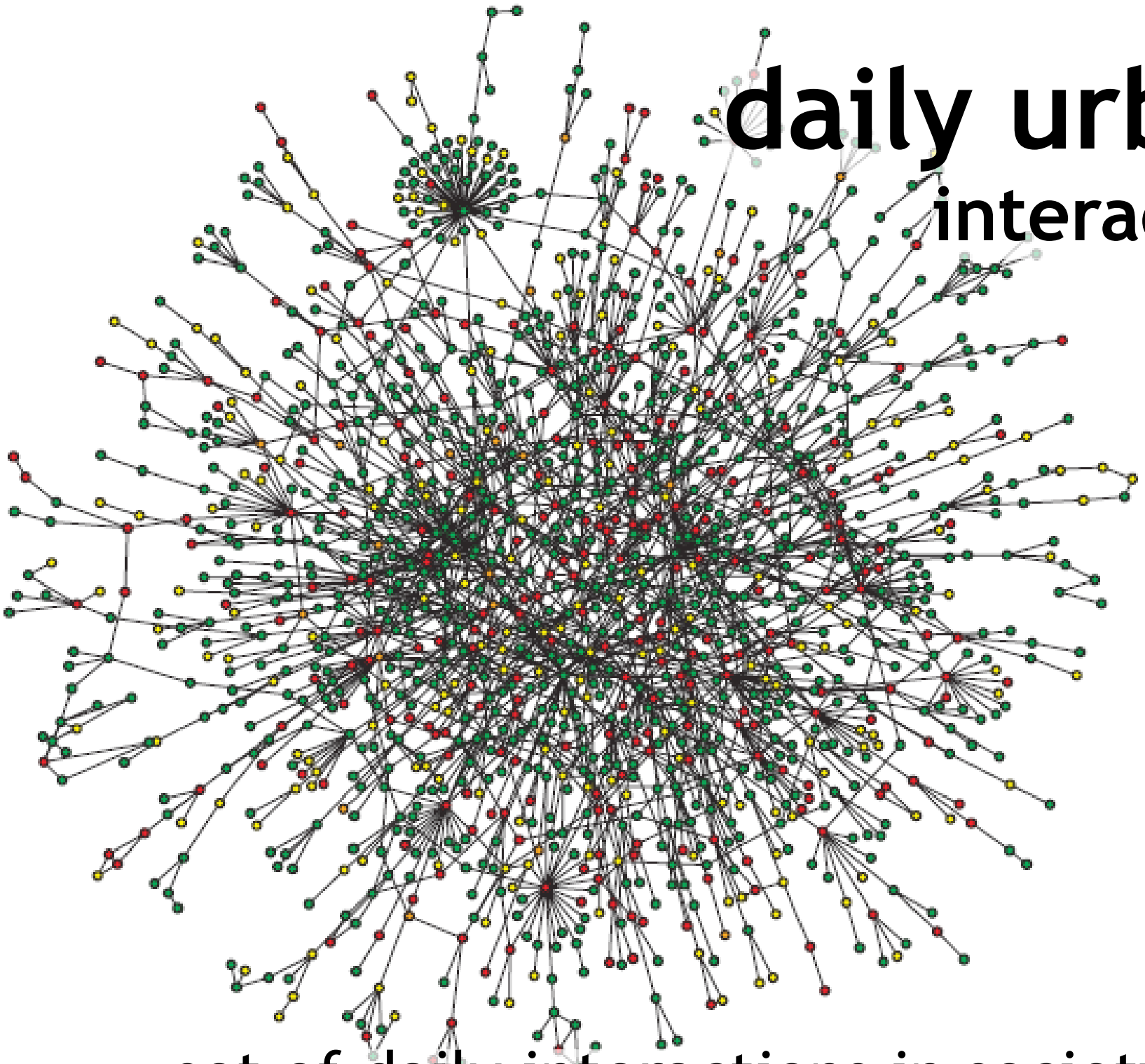
new
infrastructure



intensification
diversification
urban activities

place value ++

source: Bertolini (2008)



daily urban system

interactions in society

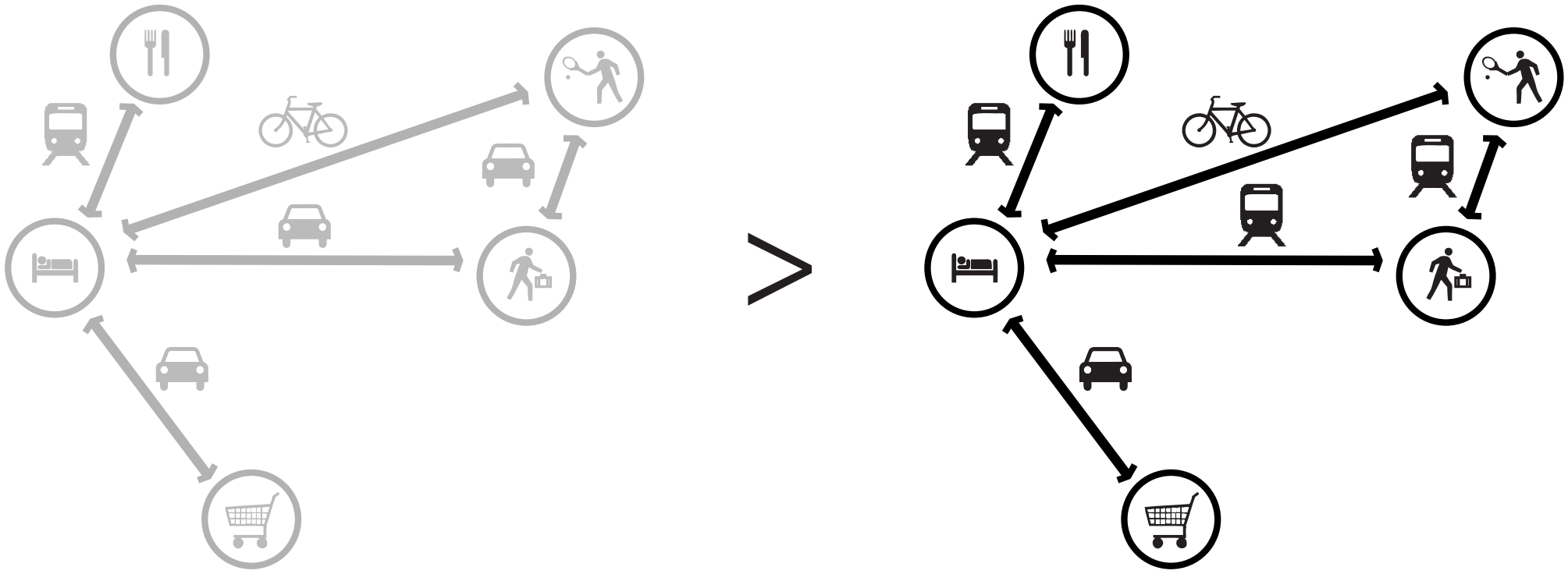
context theory:

set of daily interactions in society: commuter flows, daily shopping, flows of services and goods between companies

source: Tordoir (2005), Schwanen et al. (2001)

summary

why applying these theories?



focus: daily interactions; daily urban system

TOD: intervene in this system: integration

station areas: crucial as nodes of daily interactions

node-place model: identify potentials of station areas

>regional design decisions: in a transit-oriented way

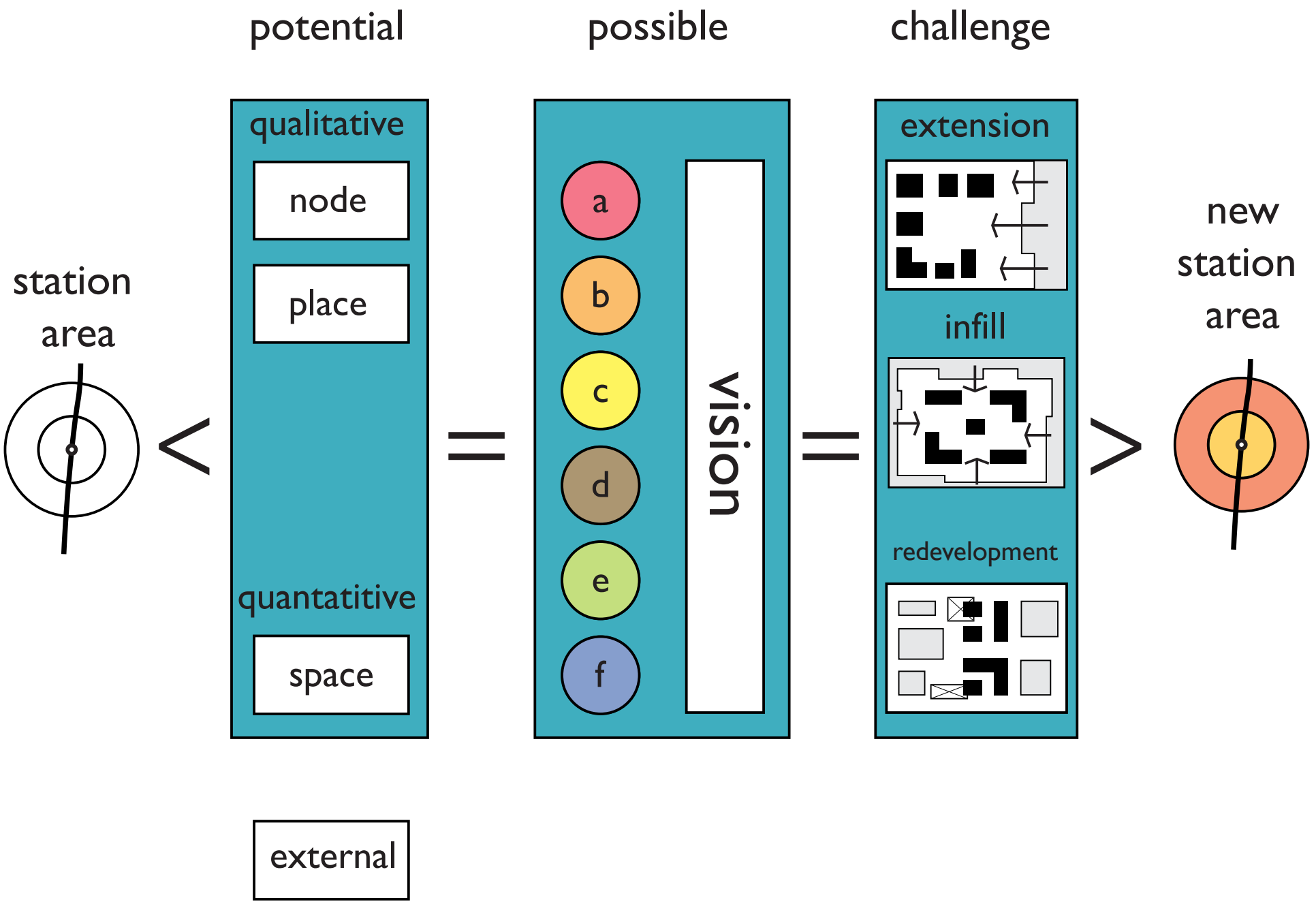
research

2.1 theoretical framework
2.2 research & design process
2.3 practice based research

2

process station areas

development of the station areas



research station areas

example

Driebergen-Zeist

catchment area

rail station

rail line

light-rail line

urban area

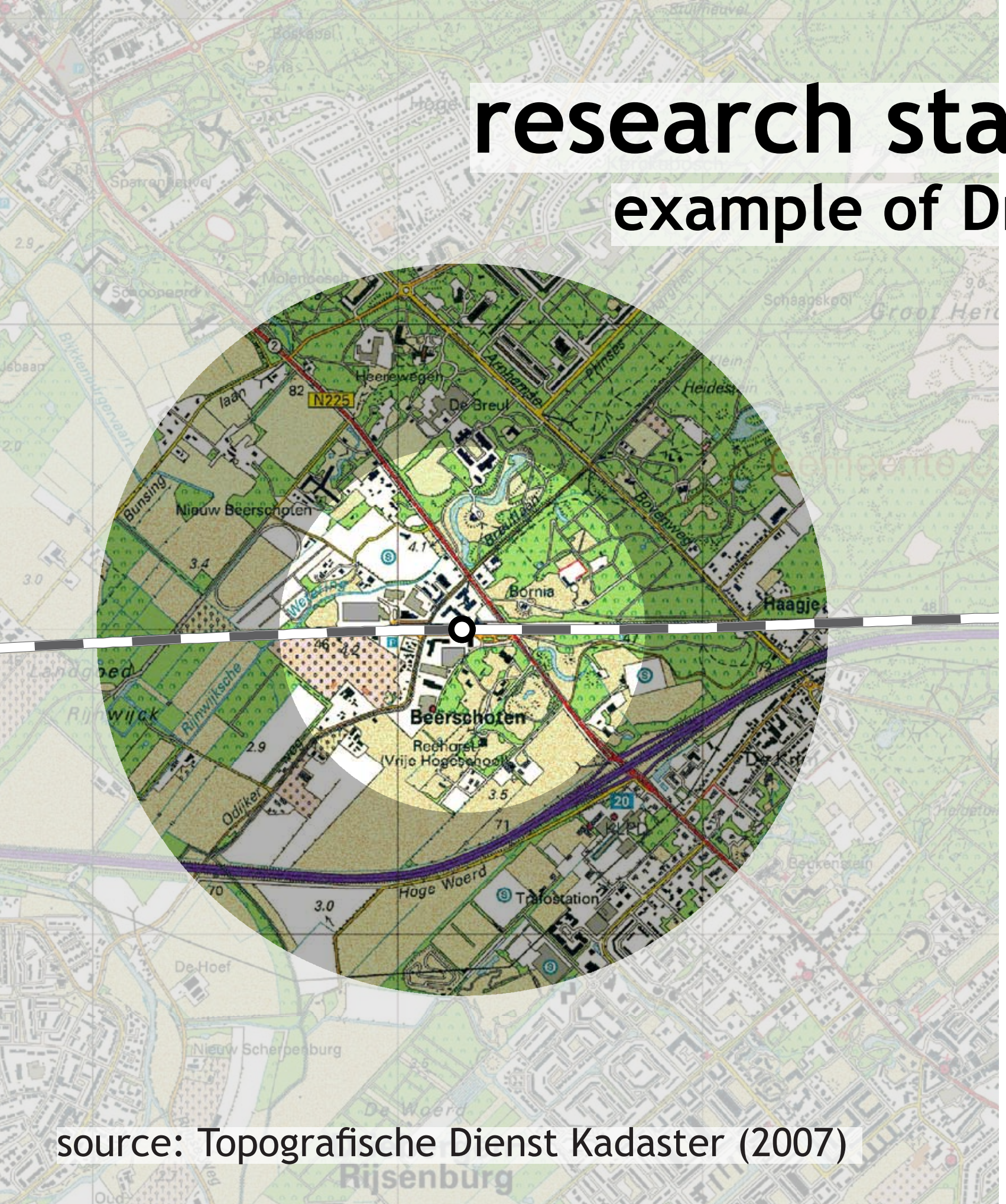
10 km

research station areas

example of Driebergen-Zeist

research station areas

example of Driebergen-Zeist



source: Topografische Dienst Kadaster (2007)

Node value

Position road network

85%

Position transit network

32%

Place value

Workers/inhabitants density

8%

Degree of functional mix

26%

Space value

Agriculture

3%

Built

3%

Open space

35%

Nature

41%

Water

2%

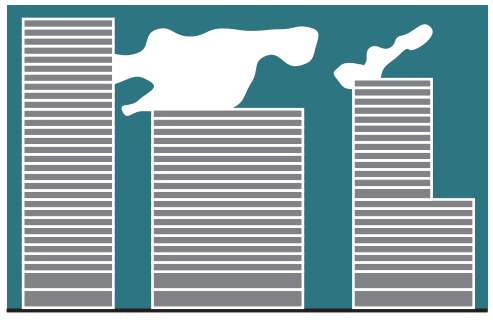
Other

16%

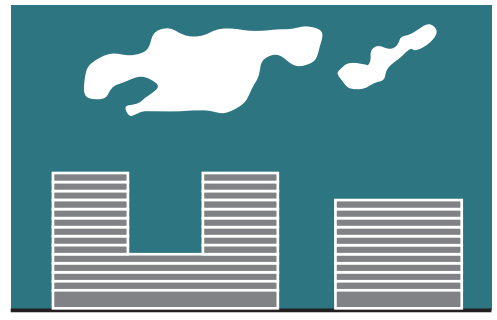
station categories

six types

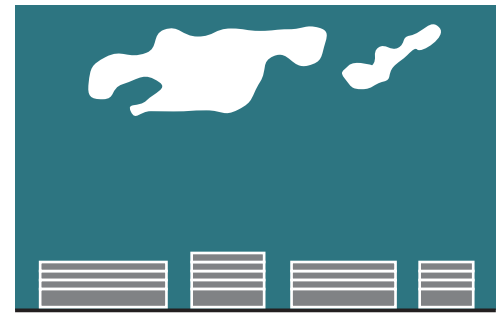
downtown centre



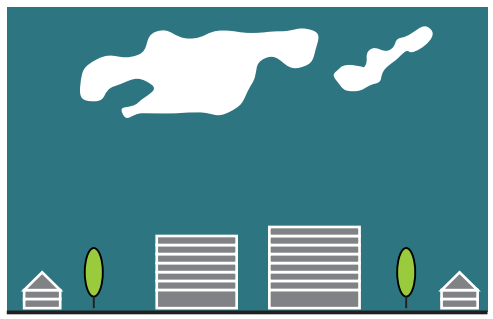
urban centre



urban neighbourhood

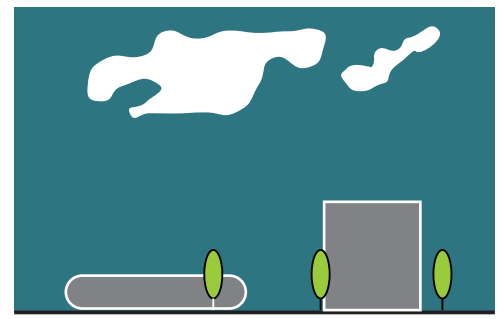


town centre



transit zone

special zone



urban centre

3 - 15 stories

60 dwellings p/ha
multi-family, mansions, attics, appartment

800 workers p/ha

office, retail, residential

85 % site coverage

interregional

research

2.1 theoretical framework
2.2 research & design process
2.3 practice based research

2

practice-based research

crucial analysis

earlier research: Atlas of the Utrecht-region

application of the node-place-model

workers-inhabitants analysis

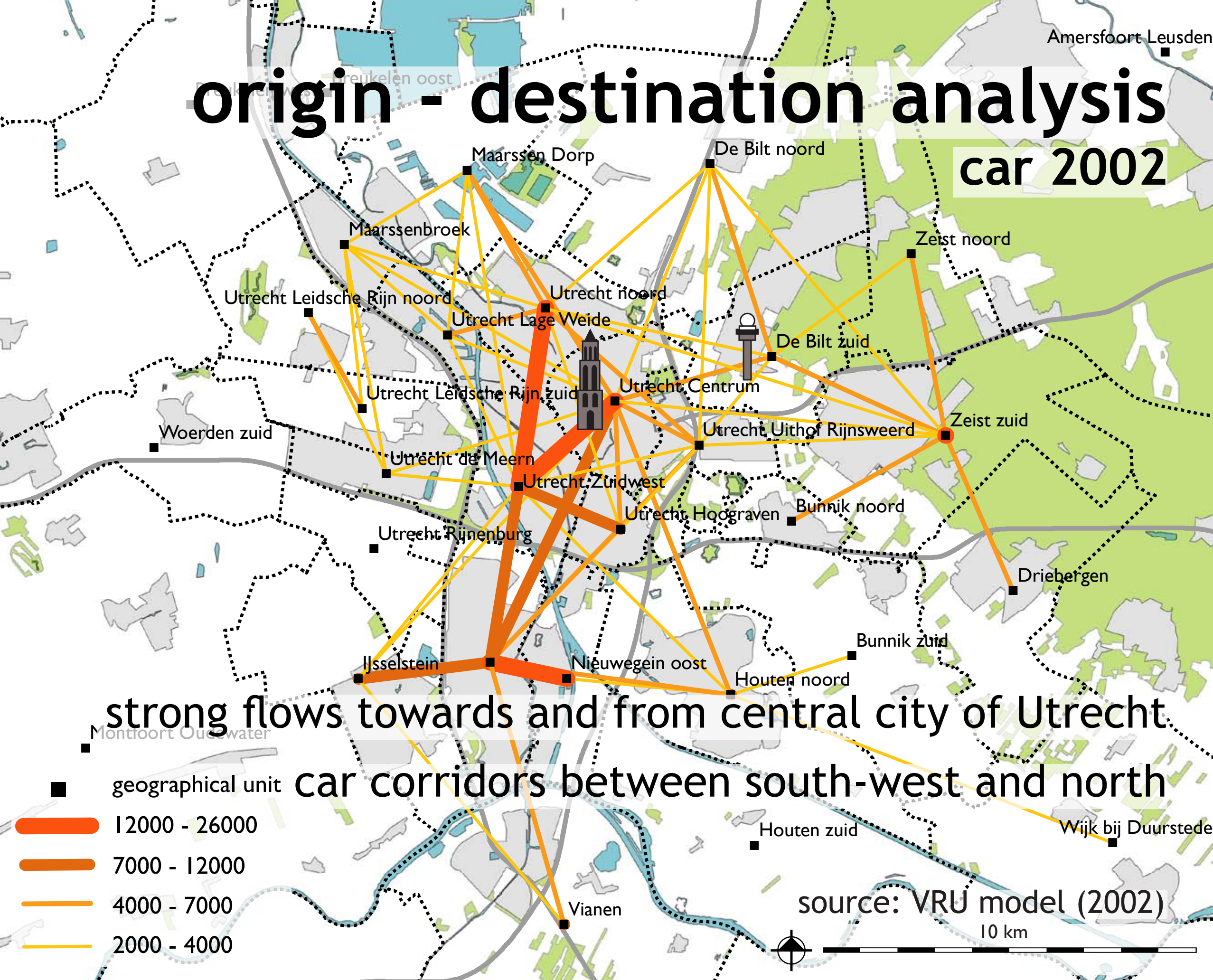
> origin-destination analysis: movements and interactions

origin - destination analysis

car 2002

strong flows towards and from central city of Utrecht

car corridors between south-west and north



origin - destination analysis

car 2020

Maarssen Dorp
De Bilt noord
Amersfoort Leusden
Maarssenbroek
Zeist noord
Utrecht Leidsche Rijn noord
Utrecht noord
Utrecht Lage Weide
De Bilt zuid
Utrecht Leidsche Rijn zuid
Utrecht Centrum
Woerden zuid
Zeist zuid
Utrecht Uithof Rijnsweerd
Utrecht de Meern
Utrecht-Zuidwest
Bunnik noord
Utrecht Hoograven
Utrecht Rijnenburg
Driebergen
IJsselstein
Nieuwegein oost
Houten noord
Montfoort Oudewater
Houten zuid
Wijk bij Duurstede
Vianen

increase car movements

Leidsche Rijn finished, generator car movements

tangential connections: Houten-Nieuwegein

geographical unit

12000 - 26000

7000 - 12000

4000 - 7000

2000 - 4000

source: VRU model (2002)

10 km

origin - destination analysis
public transport 2002

Utrecht centraal, dominant position

important anchors: Lage Weide, Zuidwest, Uithof

Amersfoort Leusden
Maarssen Dorp
De Bilt noord
Maarssenbroek
Zeist noord
Utrecht Leidsche Rijn noord
Utrecht noord
Utrecht Lage Weide
De Bilt zuid
Utrecht Leidsche Rijn zuid
Utrecht Centrum
Zeist zuid
Woerden zuid
Utrecht Uithof Rijnsweerd
Utrecht de Meern
Utrecht Zuidwest
Utrecht Hoograven
Bunnik noord
Utrecht Rijnenburg
Driebergen
IJsselstein
Houten noord
Montfoort Oudewater
Houten zuid
Wijk bij Duurstede
Vianen

geographical unit
3000 - 6500
1500 - 3000
500 - 1500
250 - 500

source: VRU model (2002)

10 km

origin - destination analysis
public transport 2020

Maarssen Dorp
Maarssenbroek
Utrecht Leidsche Rijn noord
Utrecht noord
Utrecht Lage Weide
Utrecht Leidsche Rijn zuid
Utrecht Centrum
De Bilt zuid
Zeist noord
Zeist zuid
Woerden zuid
Utrecht Uithof Rijnsweerd
Utrecht de Meern
Utrecht Zuidwest
Utrecht Hoograven
Bunnik noord
Utrecht Rijnenburg
Driebergen
IJsselstein
Houten noord
Montfoort Oudewater
Houten zuid
Vianen
Amersfoort Leusden

increase tangential movements
> more movements, more interactions

no public transport facility, no possibility relation
> increase supply

source: VRU model (2002)

geographical unit
3000 - 6500
1500 - 3000
500 - 1500
250 - 500

10 km

1 introduction

2 research

3 design

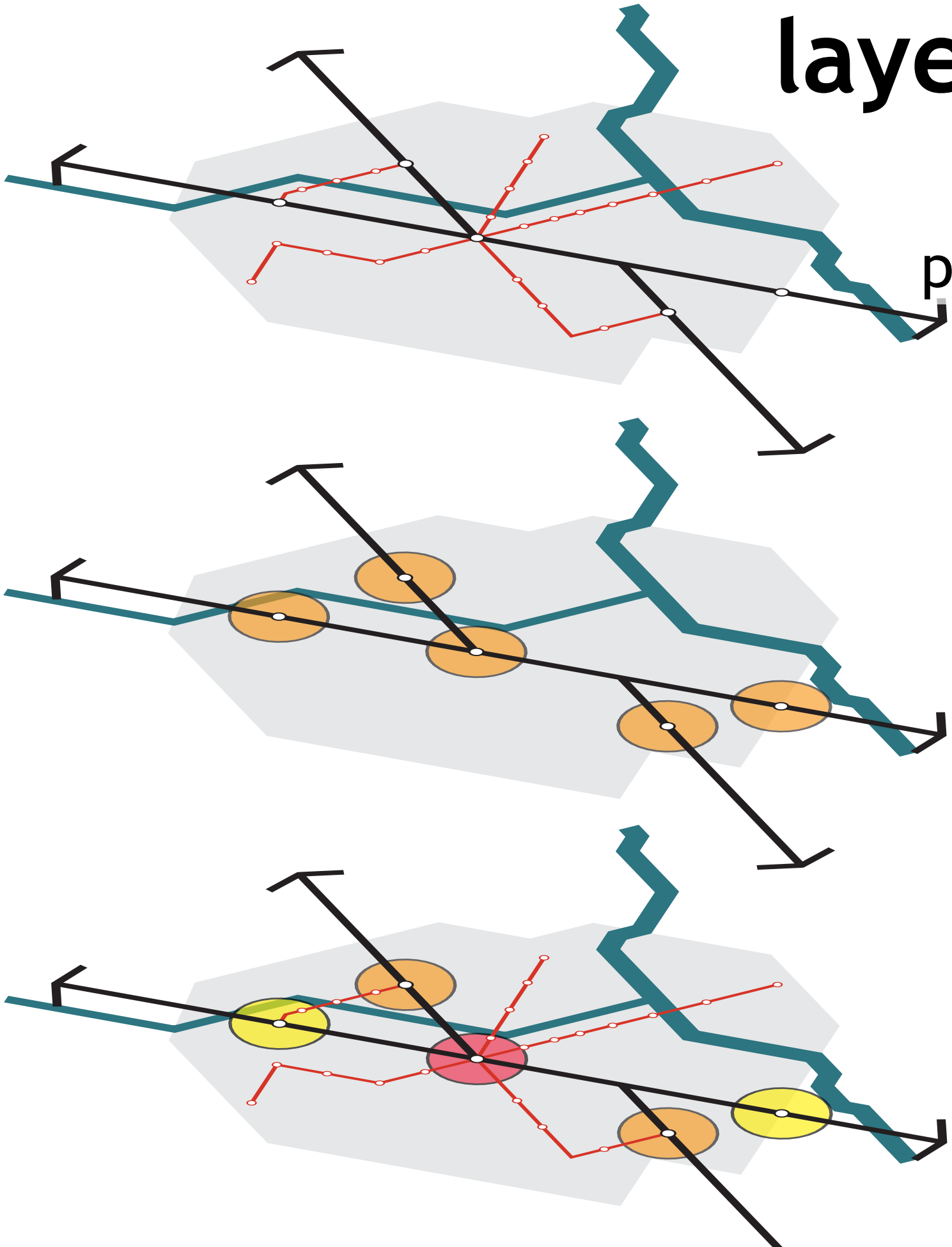
4 conclusion

design

3.1 proposal public transport

3.2 proposal spatial developments

3



layers of design

two challenges

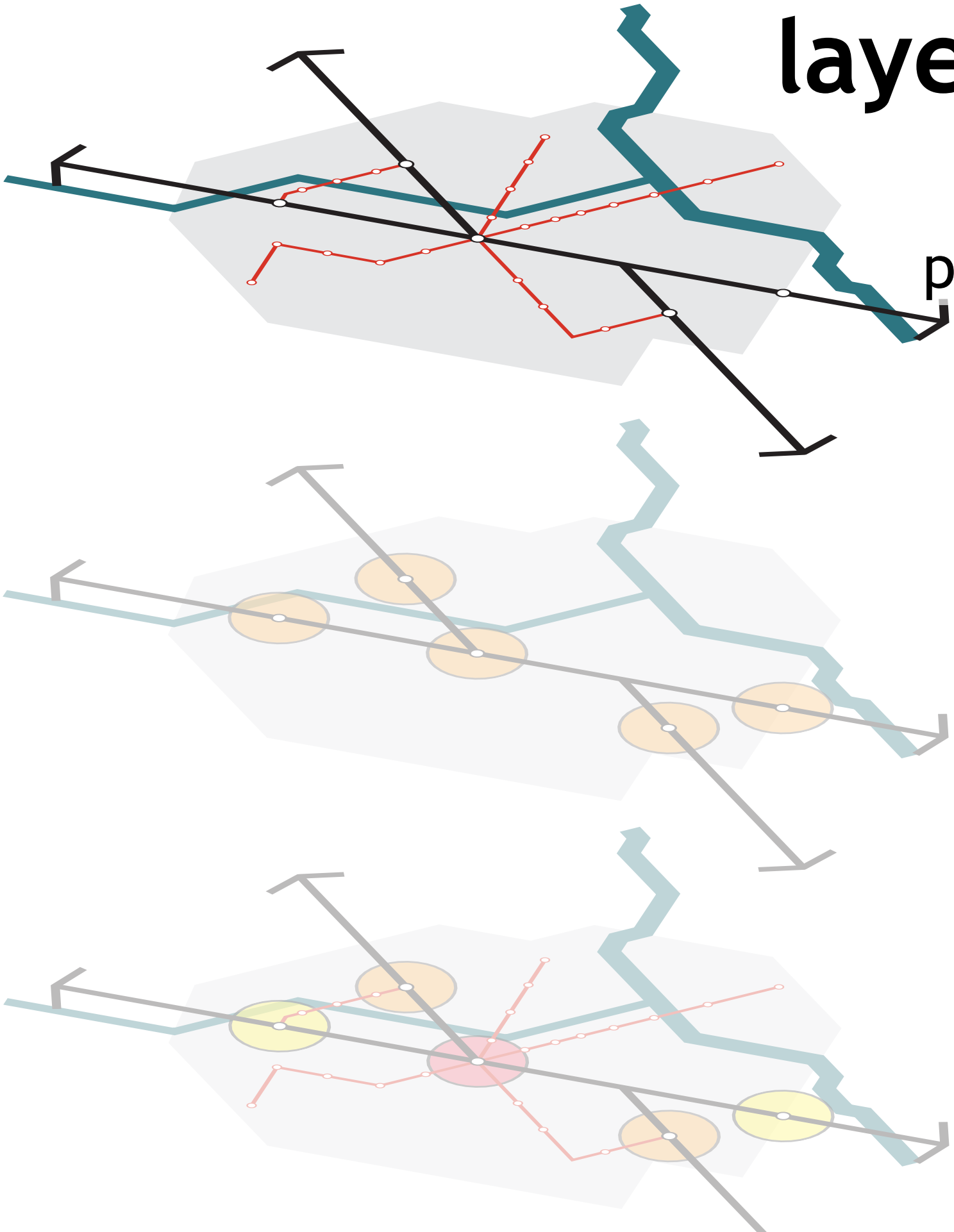
public transport system

+

station areas

=

regional design



layers of design

two challenges

public transport system

+

station areas

=

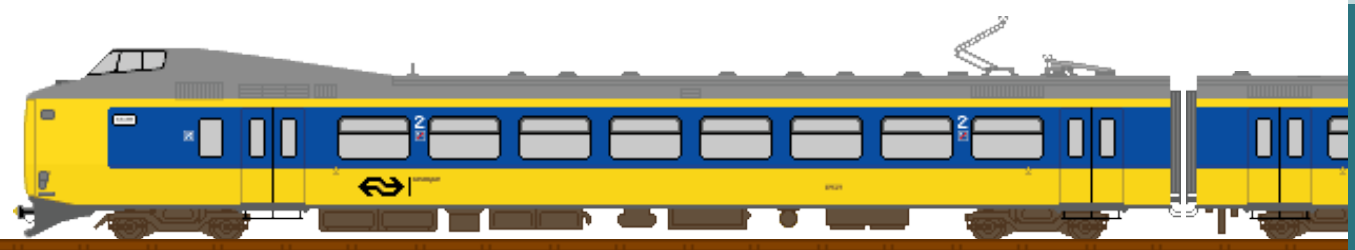
regional design

public transport system

hierarchy and modalities

international

national



inter-regional

regional

agglomerative

new layers: interregional and agglomerative

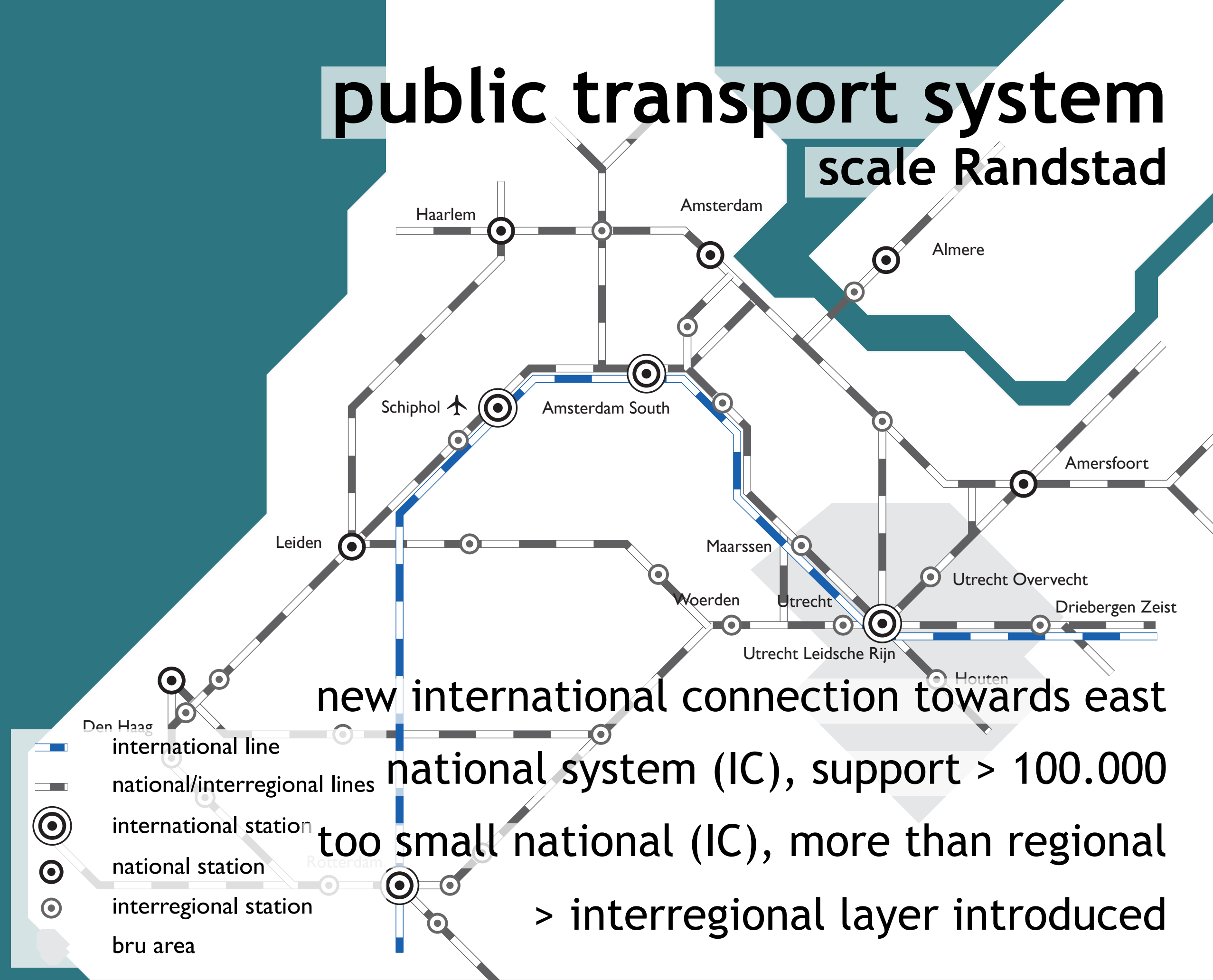
> inter-connectivity

local

source: priemus et al. (1999), Schoenmaker (2002)

public transport system

scale Randstad



new international connection towards east

national system (IC), support > 100.000

too small national (IC), more than regional

> interregional layer introduced

public transport system

scale Utrecht-region

Breukelen
Soest Zuid
Maartensdijk
Den Dolder
Maarssen
Lage Weide
Bilthoven
Utrecht Leidsche Rijn Centrum
Utrecht Overvecht
Utrecht Zuilen
Vleuten
Utrecht Terwijde
Utrecht Majella
Utrecht
Utrecht Vaartsche Rijn
Utrecht Lunetten
Bunnik
Driebergen Zeist
Houten West
Houten
Houten Castellum
Vianen
Culemborg

- international line
- national/interregional lines
- agglomerative lines
- international station
- national station
- interregional station
- regional station
- bru area

new agglomerative public transport system:

city-regional light-rail

public transport system

system map

Maarssen 5 4

Ruimteweg

Proostwetering

Haarrijnse Rading

De Wetering

Rijpwetering

Station Leidsche Rijn Centrum

Vleuten 3

Europaweg

Vleuterweide

Veldhuizen

De Meern C.

Rijnenburg Centrum

De Meern

Strijkviertel

Papendorp

Parkwijk

Langerak

Beneluxlaan

Utrecht CS

centre

Jaarbeurs

Vaartsche-Rijn

Transwijk

Kanaleneiland Z.

Westraven

Station Lunetten

4 Voordorp

Stadion de Galgenwaard

Weg tot de Wetenschap

Heidelberglaan

De Uithof 1 2

Kromme-Rijnlaan

Laan van V.

De Dreef

Berglaan

Zeist Centrum

Molenweg

Station Driebergen-Zeist

Hoofdstraat

Driebergen 3

Rijnenburg

St. Antonius Ziekenhuis

A12-zone

Doorslag

Galecop

Clinckhoef

Achterveld

Binnenstad

Zuilenstein

Batau Noord

Wijkersloot

Stadscentrum

Fokkesteeg

Rhijnhuysen

De Liesbosch

Station Houten West

De Wulven

Den Oord

6 Houten

IJsselstein 2

1 6 Nieuwegein

streetcar and light-rail

regional public transport

why light-rail?

increase: capacity and reliability

sustainability: decrease sound and air pollution

integration: city and region

synergy: public transport and spatial developments

> create alternative for car

source: priemus et al. (1999), Vuchic (1999), Bach et al. (2002)

image: Johnie K.

light-rail
feasibility

rank-size-rule: 400.000+ inhabitants

Utrecht-region: 618.000 inhabitants, 2030: 721.000

high quality public transport increase asset value (OZB)

increases turnover of retail near the line (Grenoble)

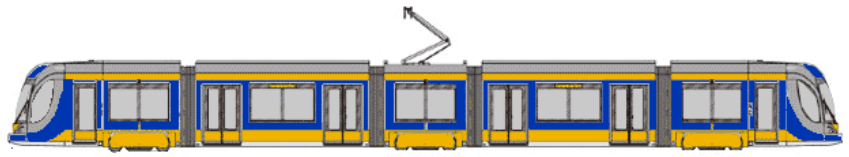
source: Bach et al. (2002), image: Johnie K.

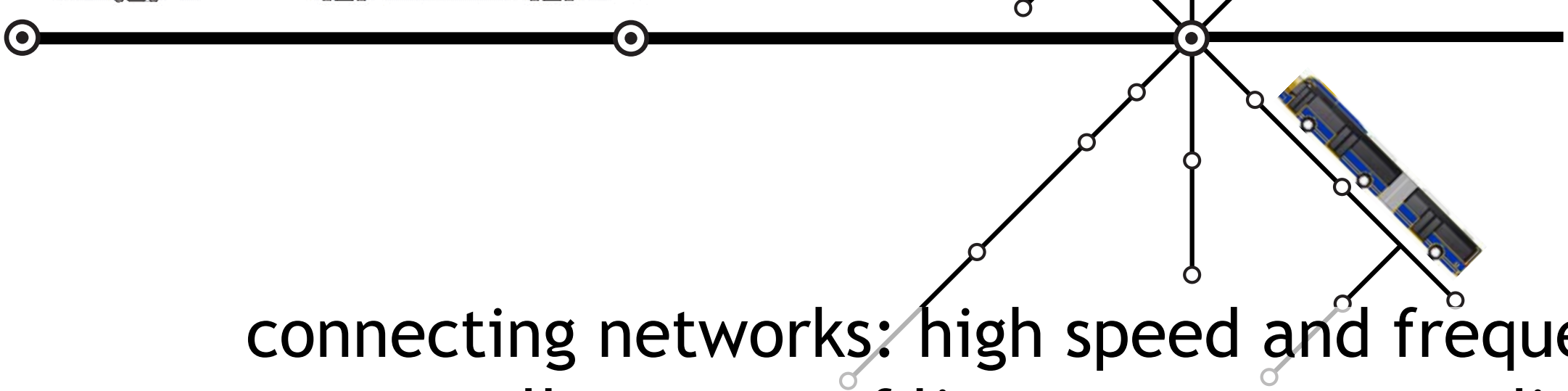
principle public transport

connecting and unfolding systems

unfolding

connecting



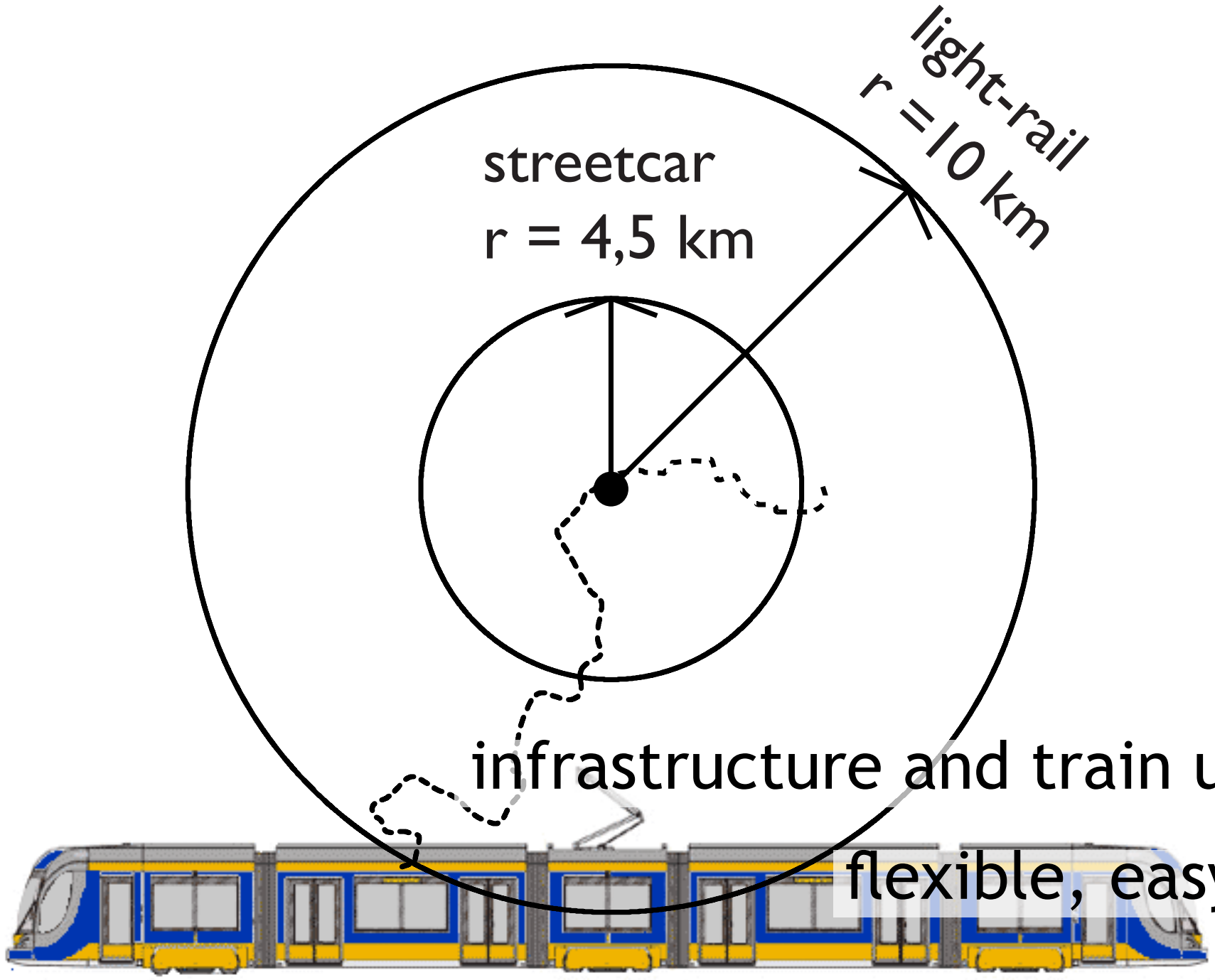


connecting networks: high speed and frequencies, small amount of lines, greater stop distances

unfolding networks: low speed, big amount of lines, smaller stop distance

source: Van den Heuvel and Promotor Van Witsen (1997)

principle light-rail
one technique two modalities



infrastructure and train units similar

flexible, easy adaptable

source: ministerie van V&W (1997)

biltstraat

towards city centre

biltstraat

towards city centre

nobelstraat

towards city centre

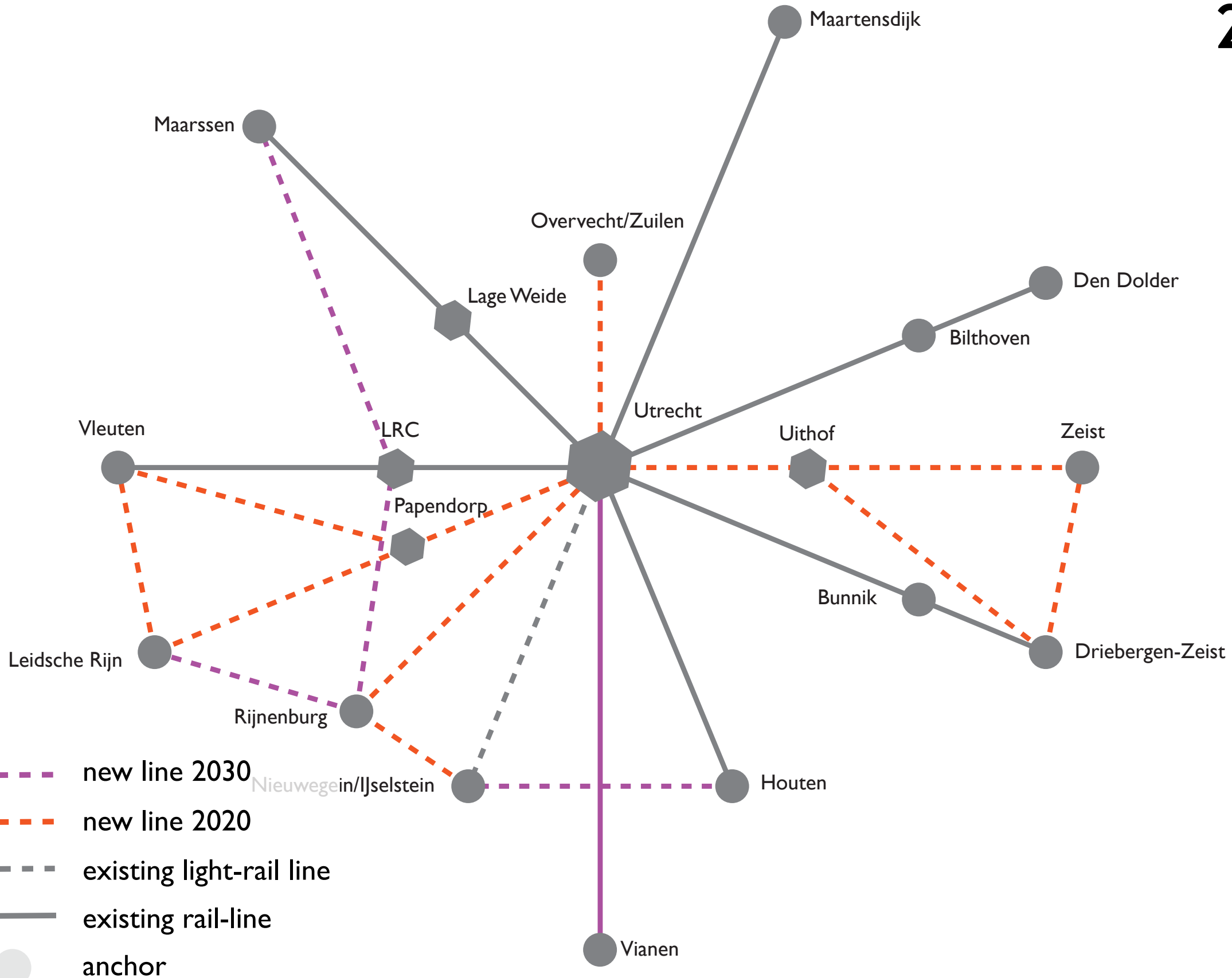
nobelstraat

towards city centre

development pt system
2010

development pt system 2020

development pt system
2030



2010

catchment area

rail station

rail line

light-rail line

urban area

10 km

2020

new catchment area

new rail station

new rail line

rail line

new light-rail line

light-rail line

new urban area

10 km

2030

new catchment area

new rail station

new rail line

rail line

new light-rail line

light-rail line

new urban area

10 km

regional public transport

justification design decisions

1 2 3 4 5

connecting anchor points in the Utrecht-region (1)

support of workers and inhabitants (VRU model) (2)

flows in the Utrecht-region (VRU model) (3)

calculations of BRU (transportation value) (4)

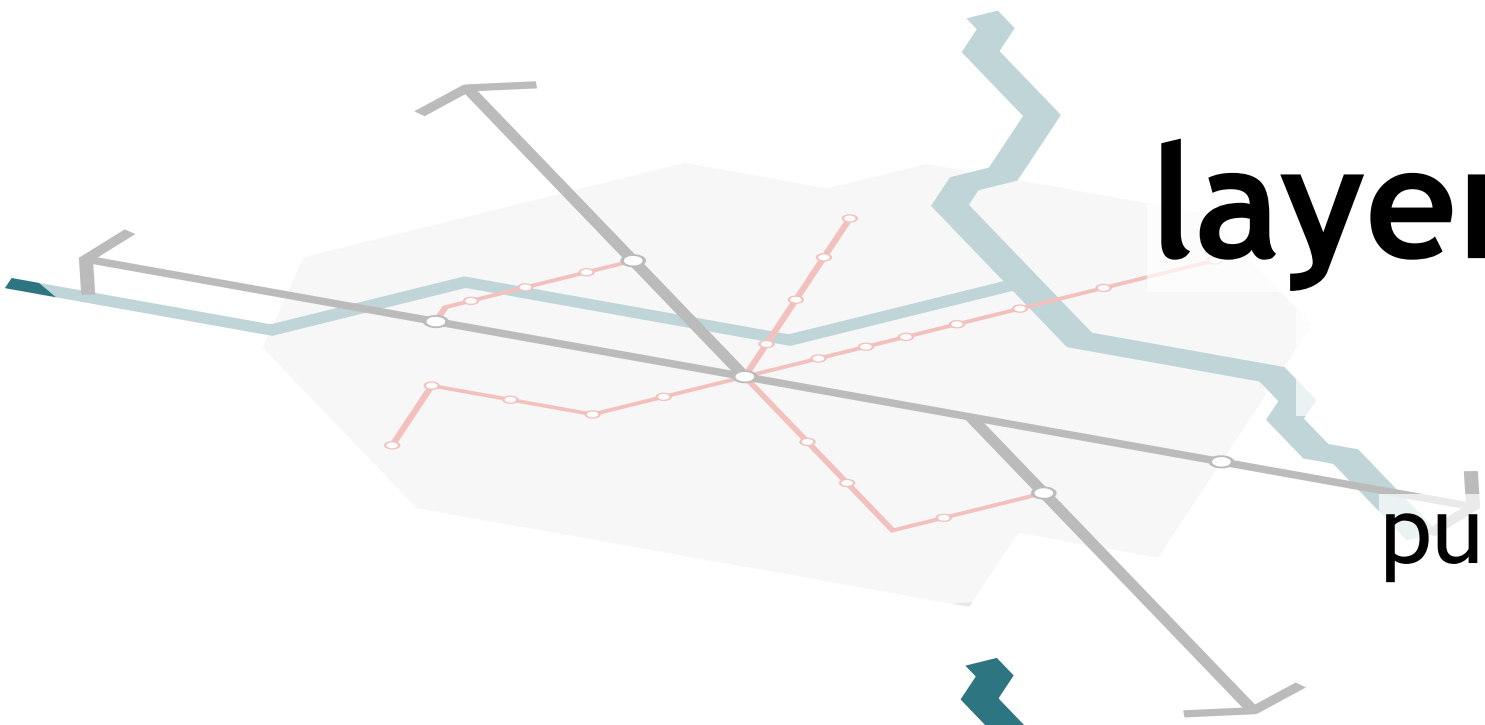
geographical fitting (5)

design

3.1 proposal public transport

3.2 proposal spatial developments

3

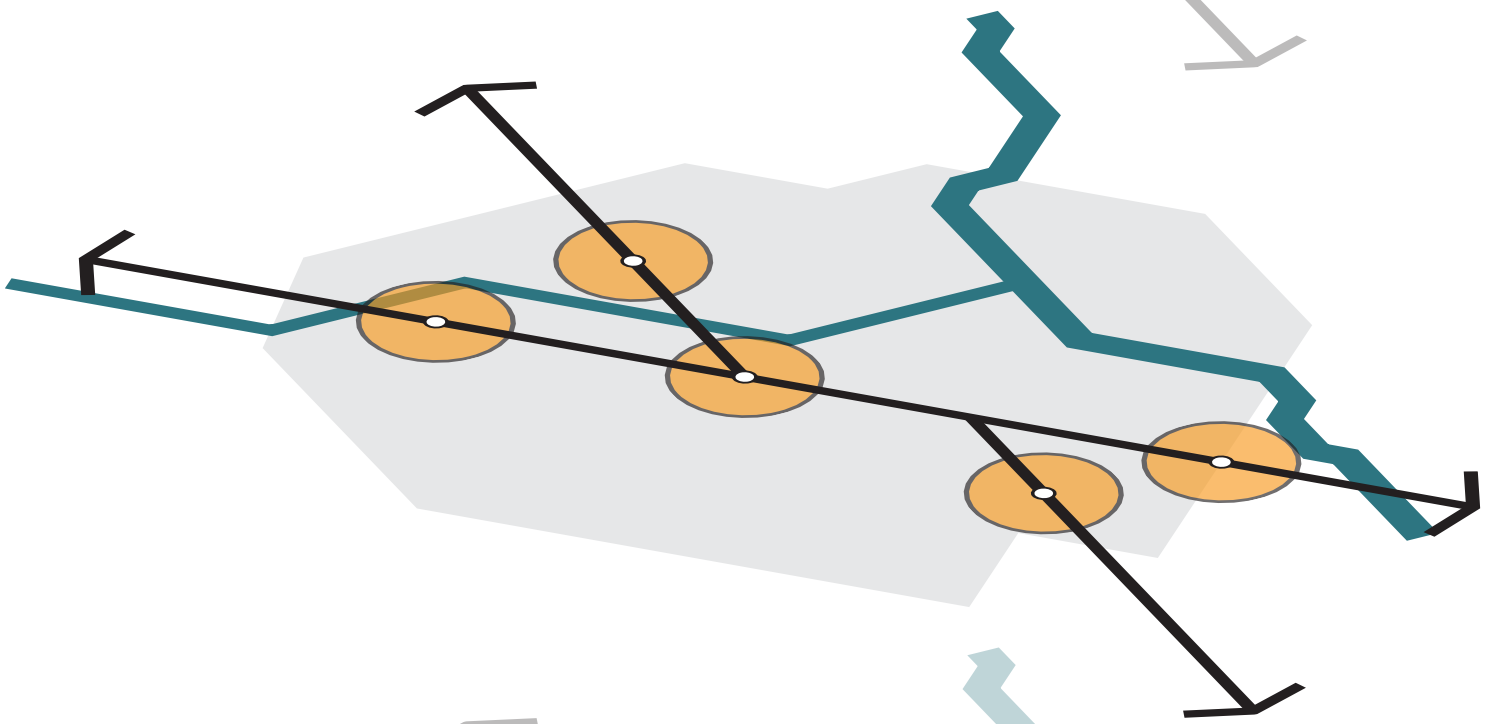


layers of design

two challenges

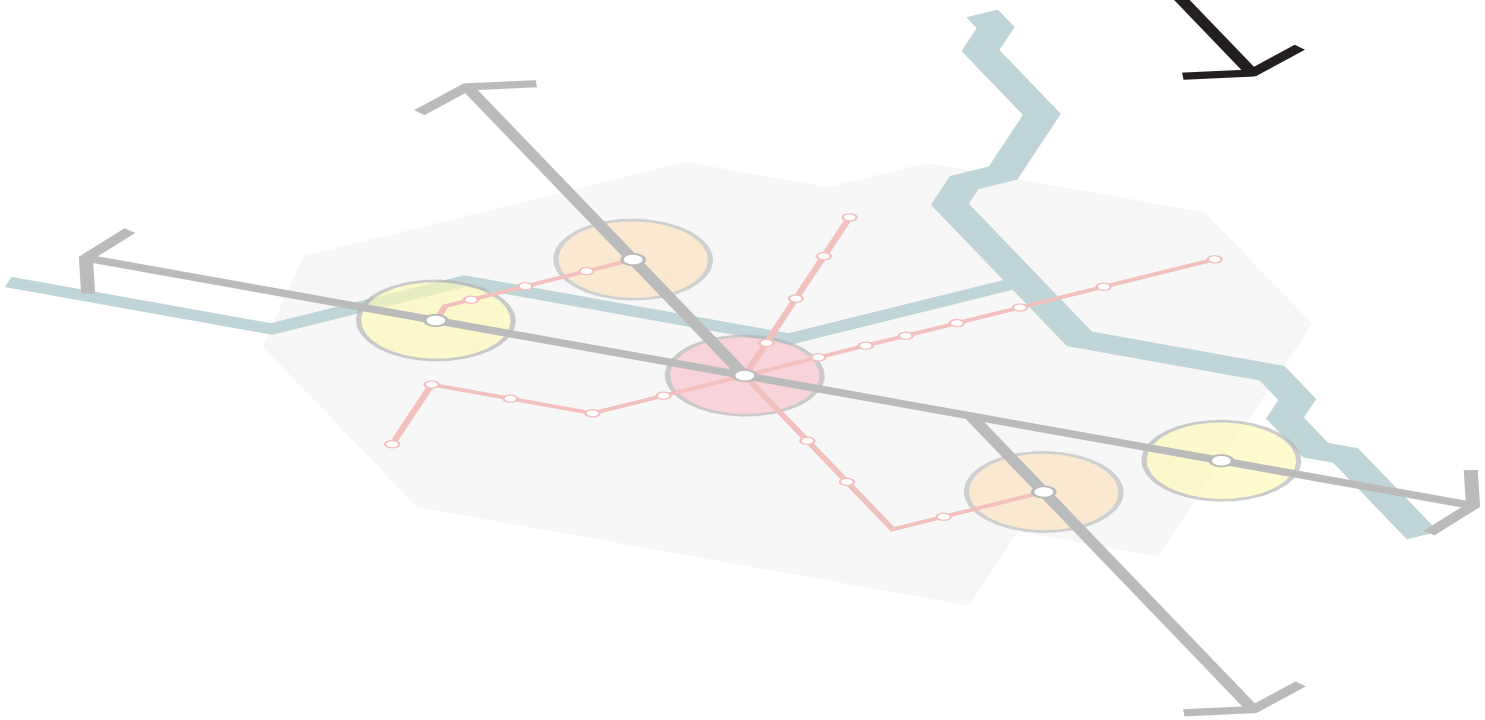
public transport system

+



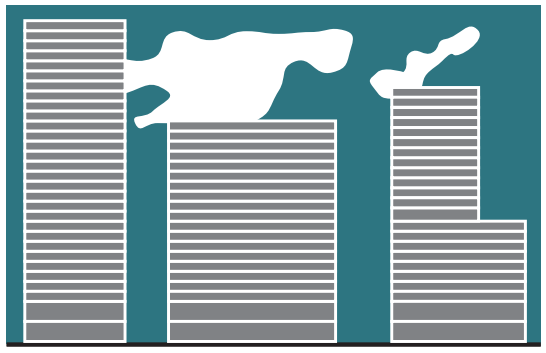
station areas

=

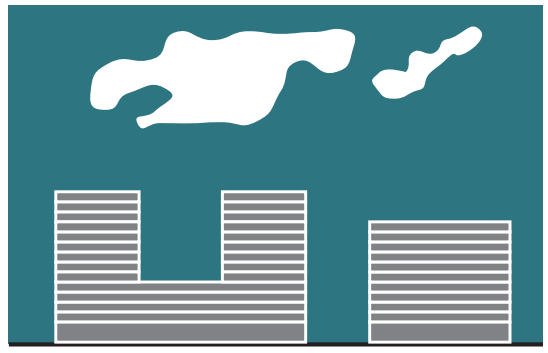


regional design

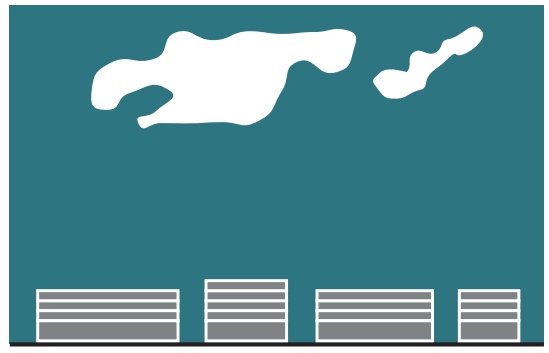
downtown centre



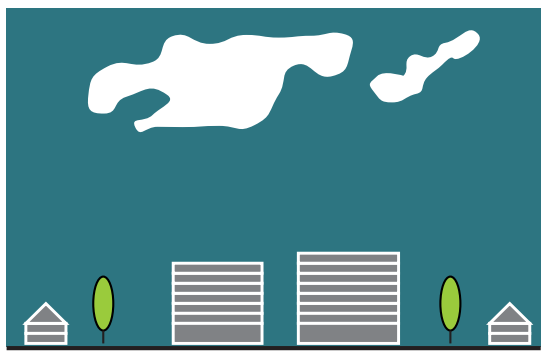
urban centre



urban neighbourhood

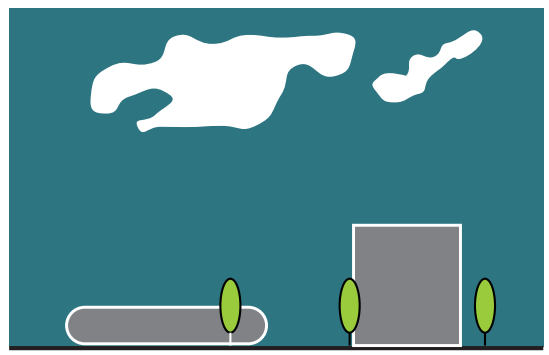


town centre



transit zone

special zone



station categories

station categories

node-place model: Utrecht Centraal under stress

>introduction urban centres, release pressure

downtown centre

urban centre

urban neighbourhood

town centre

10 km

2020

catchment area

rail station

spatial developments

new urban area

urban area

10 km

2030

catchment area

rail station

spatial developments

new urban area

urban area

10 km

challenges

extension, infill and redevelopment

extension

infill

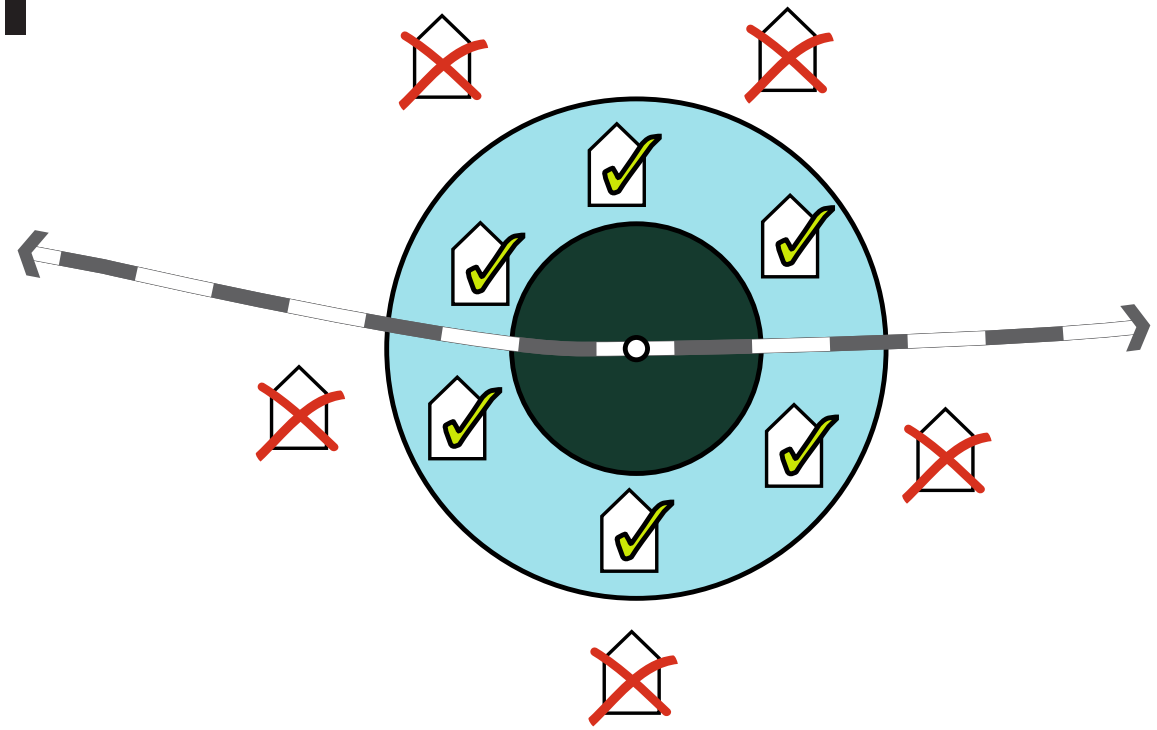
redevelopment

10 km

rules for spatial development

from extension to densification

1



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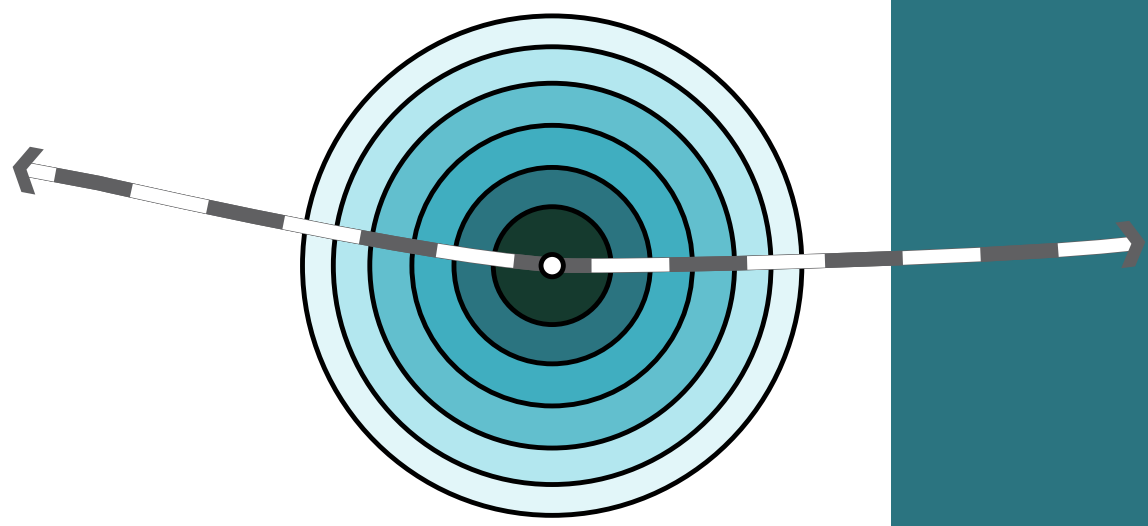


development within catchment station r=600m (1)

near transit stop: high density and functional mix (2)

near transit: destination functions, further away origin

proposal spatial development

why spatial developments around transit?

station area: node of social-economic interaction

create support for public tranport

make high quality public transport feasible

> bundle activities and movements

source: Kusumo (2007)

1 introduction

2 research

3 design

4 conclusion

conclusion

4.1 testing the design

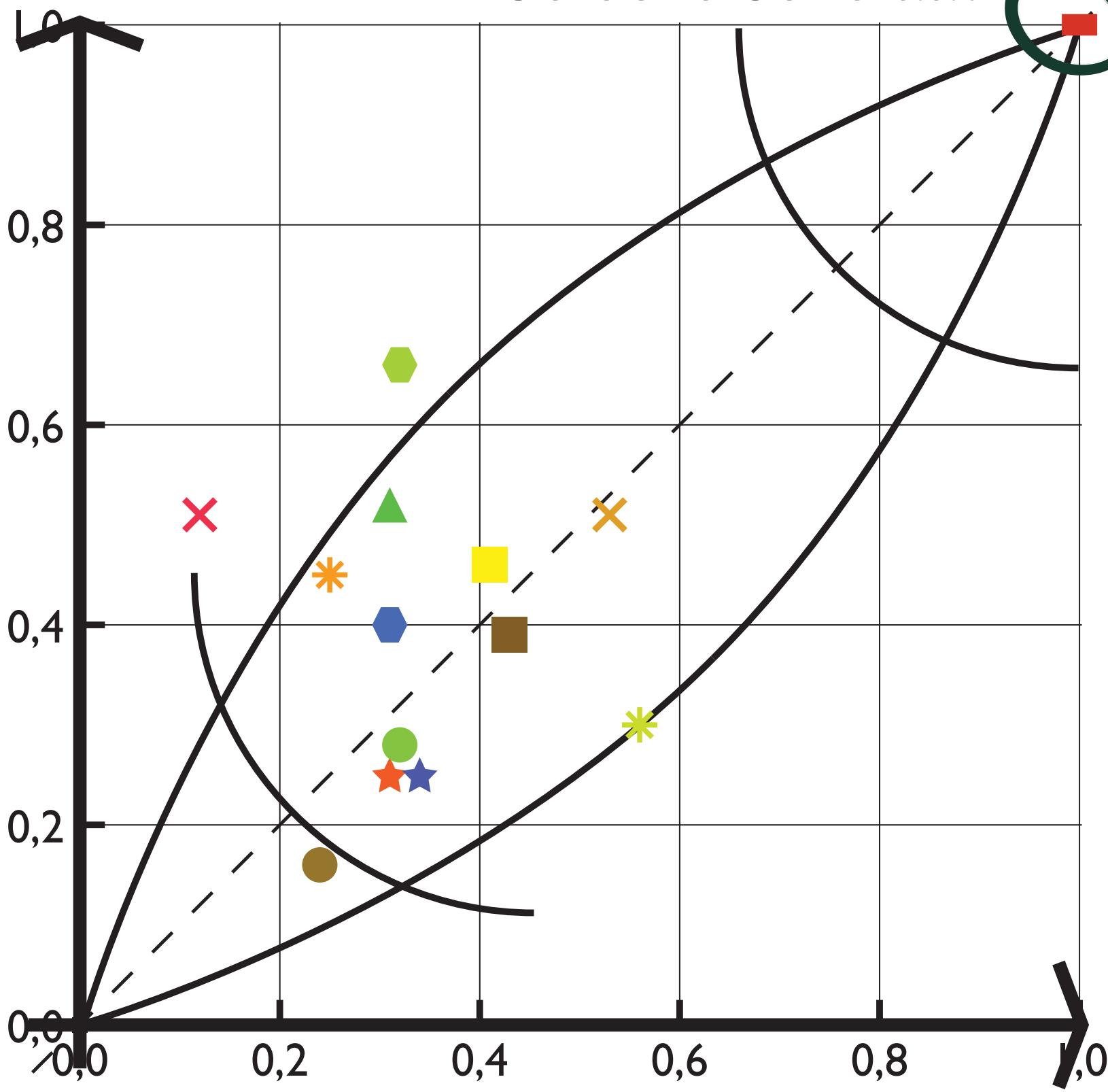
4.2 figures

4

node value
y-axis

2010

Utrecht Centraal



- Bilthoven
- Bunnik
- Den Dolder
- Driebergen-Zeist
- Hollandsche Rading
- Houten
- Houten Castellum
- Maarrssen
- Utrecht Centraal
- Utrecht Lunetten
- Utrecht Overvecht
- Utrecht Terwijde
- Utrecht Zuilen
- Vleuten
- Utrecht Vaartsche Rijn
- Utrecht Leidsche Rijn Centrum
- Utrecht Majella
- Utrecht Lage Weide
- Vianen
- Houten West
- Utrecht Lunetten Beatrixpark
- Maartensdijk

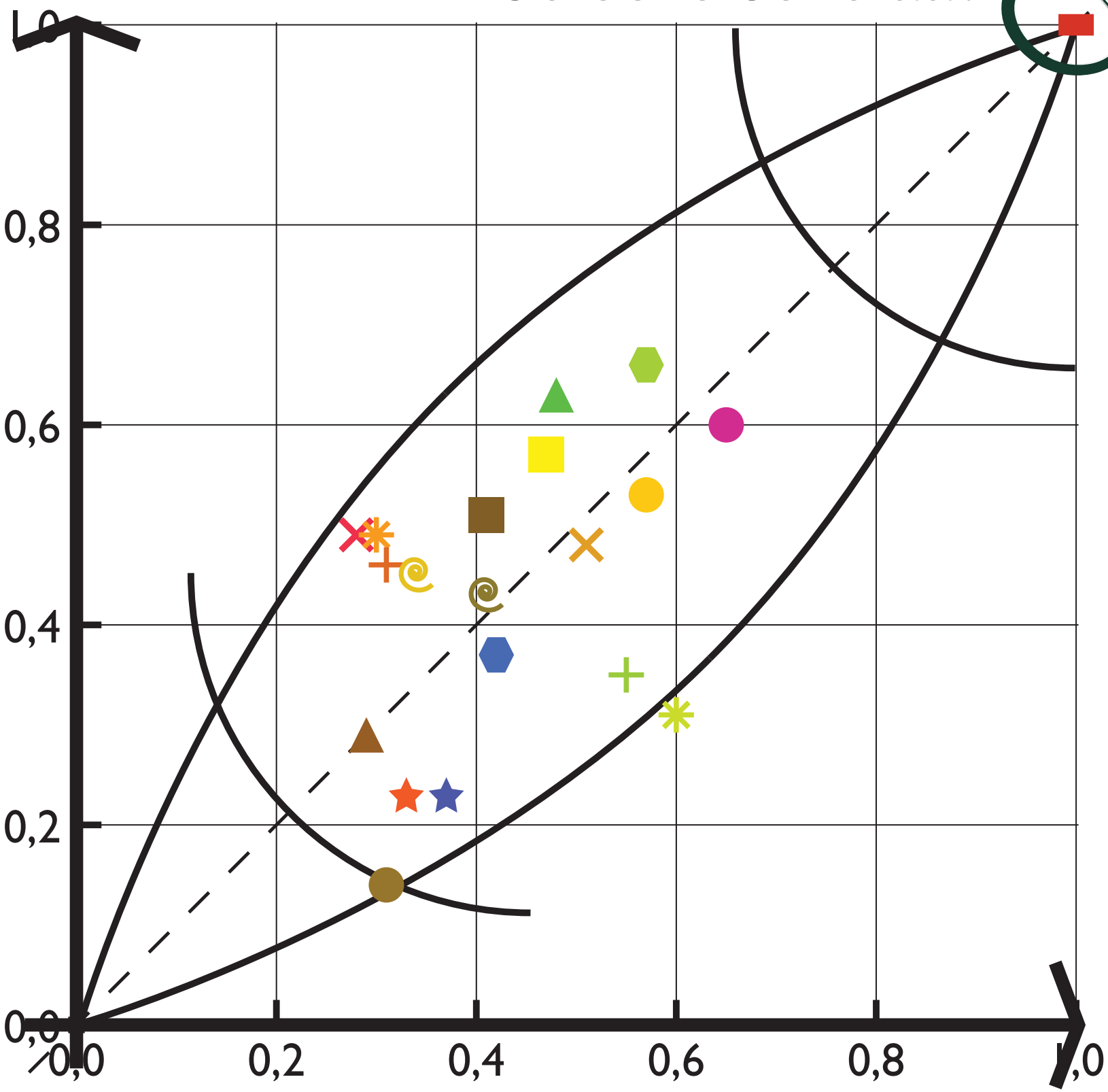
place value
x-axis

2030

Utrecht Centraal

node value
y-axis

place value
x-axis



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- Utrecht Lage Weide
- Vianen
- Houten West
- Utrecht Lunetten Beatrixpark
- Maartensdijk

4

conclusion

4.1 testing the design

4.2 figures

facts sheet

receipt

total planned until 2030:	76.000
built until 2020:	49.000 -
planned without physical place 2030:	27.000
shortage 2030:	32.000 +
total shortage:	59.000
regional design:	37.000 -
modification Rijnenburg	13.000 -
remaining shortage:	***9.000***

source: BRU (2009), De Nieuwe Kaart (2009)

municipal plans
development until 2020

developments not in vicinity traditional rail

> not in a transit-oriented way

catchment area

rail station

planned developments

urban area

source: De Nieuwe Kaart (2009)

10 km

total regional design proposal

Utrecht-region in 2030

Amsterdam

Almere

Amersfoort

Arnhem

Den Haag / Rotterdam

Breda

Eindhoven

downtown centre

urban centre

urban neighbourhood

town centre

catchment area

new rail station

new rail line

rail line

new light-rail line

light-rail line

new developments

10 km

design station areas

example

Driebergen-Zeist

catchment area

rail station

rail line

light-rail line

urban area

10 km

Driebergen-Zeist

present situation

Driebergen-Zeist

new situation

Driebergen-Zeist

station park

Driebergen-Zeist

station park

ZEIST

next steps

life of an engineer