25 / 02 / 2020

Smart Urban Mobility

A presentation by
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Research Question

How do cities use data to understand and manage transportation patterns in order to ensure efficient and sustainable urban mobility?

Contents

- Introduction to the Field
  - Relevance
  - Challenges
  - Linkage to Data Science
- Approach
- Presentation of Cases and Results
  - One Subtopic per Person
- Discussion
- Conclusion
- Reflection on Project Work

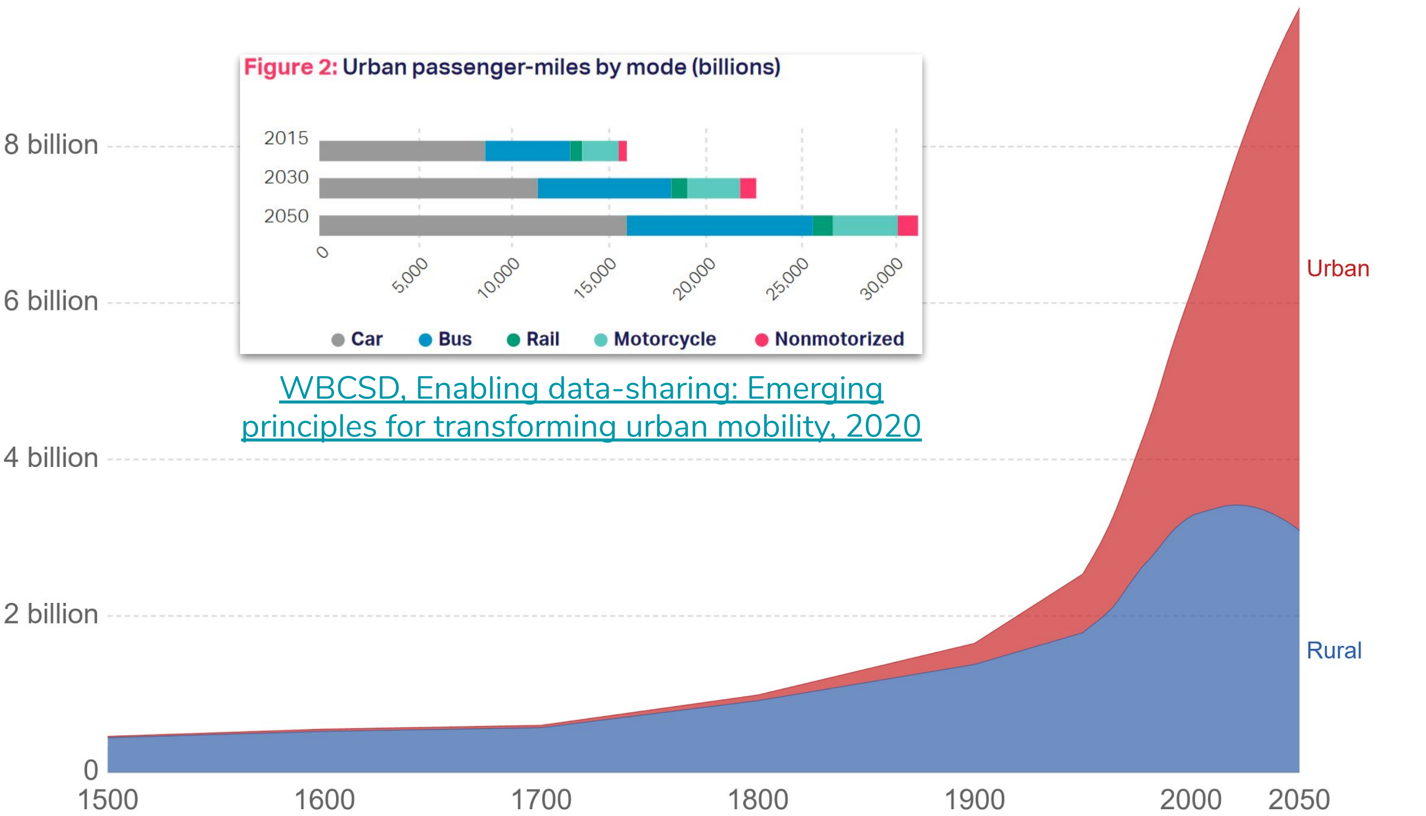
Relevance of the Research

SDG #11.2:

"By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons." United Nations 2015: 26

Urban and rural population projected to 2050, World

Total urban and rural population, given as estimates to 2016, and UN projections to 2050. Projections are based on the UN World Urbanization Prospects and its median fertility scenario.



[WBCSD, Enabling data-sharing: Emerging principles for transforming urban mobility, 2020]

Source: OWID based on UN World Urbanization Prospects 2018 and historical sources (see Sources)

[Our World in Data, Urbanization, 2018]

Challenges in Urban Transport

01 Segregation and Exclusiveness

02 Air and Noise Pollution

03 Road Safety and Accidents

04 Connectedness of Data

05 Traffic Overload

Axel van Trotsenburg (World Bank) @ TRANSFORMING TRANSPORTATION 2020:

3 Major Problems are **exclusiveness, emissions and safety** within Transport

Distinctions:

Transportation in cities vs. inland

Passenger vs. freight transport

Linkage to Data Science

“Traffic data contains hidden values that can improve and support safe and sustainable transportation systems.” Neilson et al. 2019: 1

“It is certain that data will form the […] interconnected mobility ecosystem and unlock an array of opportunities and benefits.” WBCSD 2019: 3

“ML can help decarbonize transportation by providing data, gaining knowledge from data, planning, and automation. Moreover, ML is fundamental to shared mobility, AVs, EVs, and smart public transit […].” Rolnick et al. 2019: 19

Approach

Applying the business model canvas (BMC)?

has been done in public management, especially e-government (Ranerup et al, 2016; Kaplan, 2011; Janssen et. al, 2008)

mainly: derive policy recommendations or understand interactions between the private and the public sector (Magalhaes & Roseira, 2017, Poel et. al., 2007)

different role of revenue streams

relations between sectors

scope public sector’s tasks

different mindsets

Approach

Applying the business model canvas (BMC)?

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2016; Kapl

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the priv

(Magalhaes & Roseira, 2017, Poel et. al., 2007)

different role of revenue streams

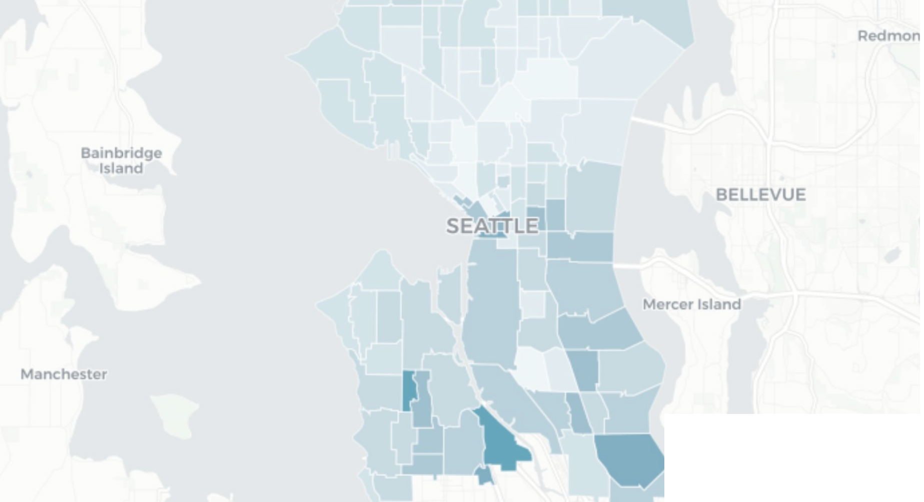
scope public sector’s tasks

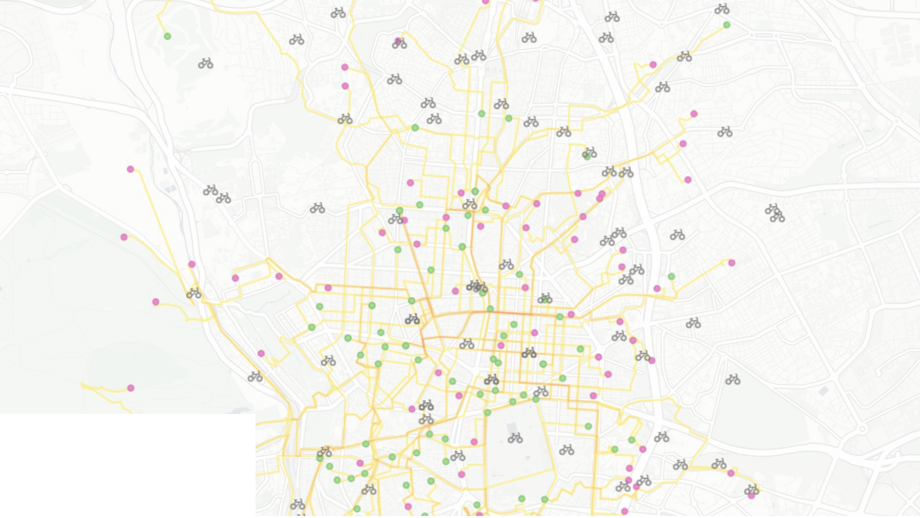
BMC is applicable, but other frameworks can prove more useful

proposed classification (see Tao et al, 2014, p. 90):

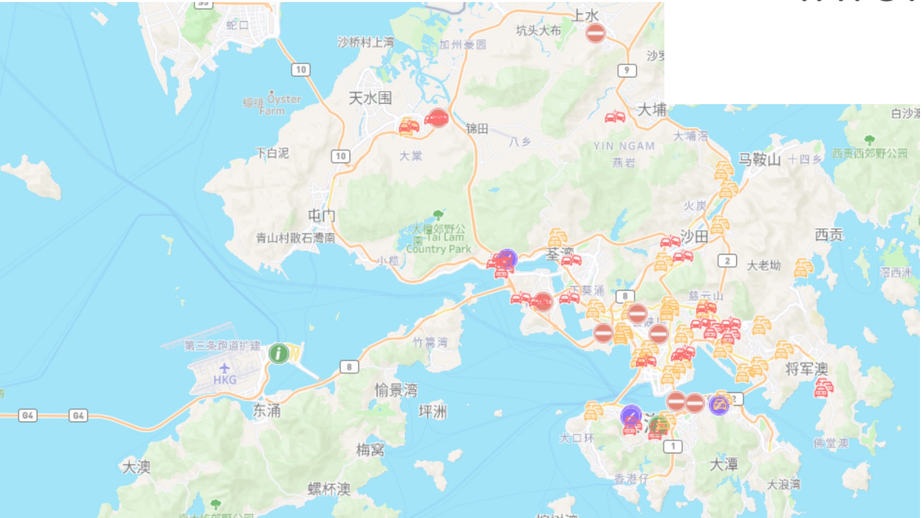

1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8
SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 ON LAND
16 AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

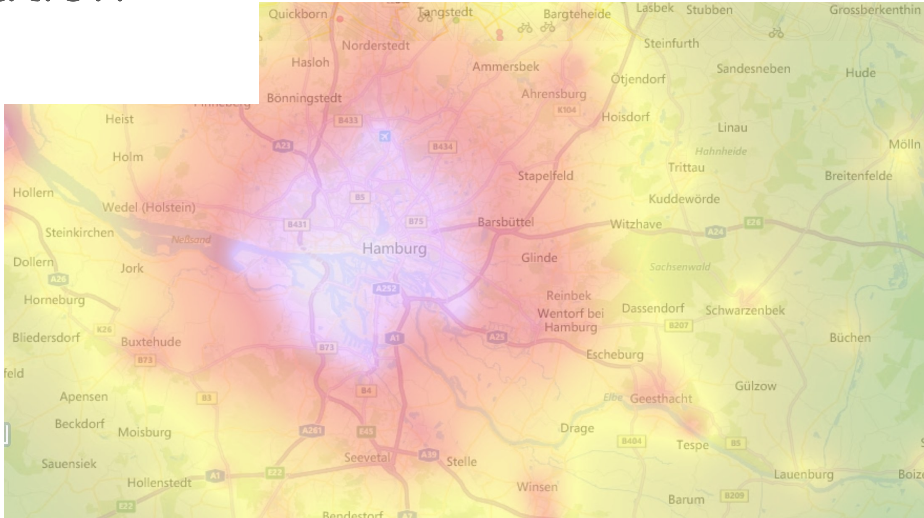
objective

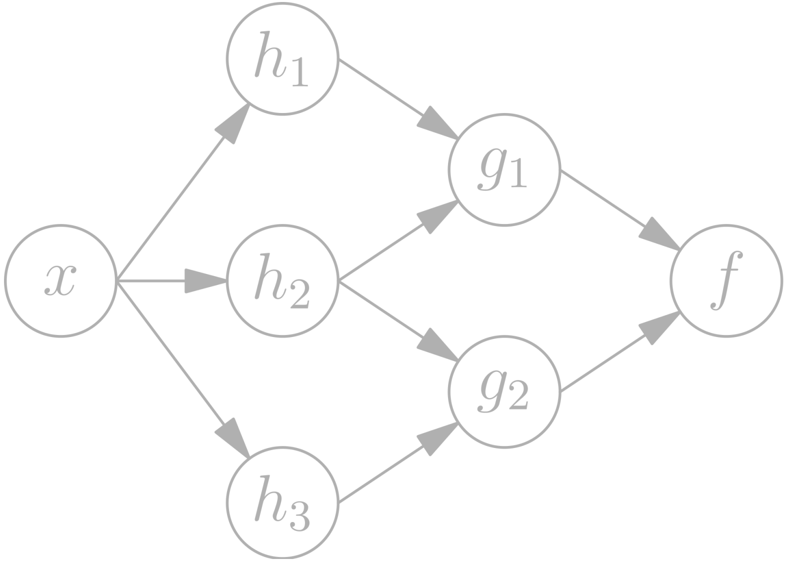


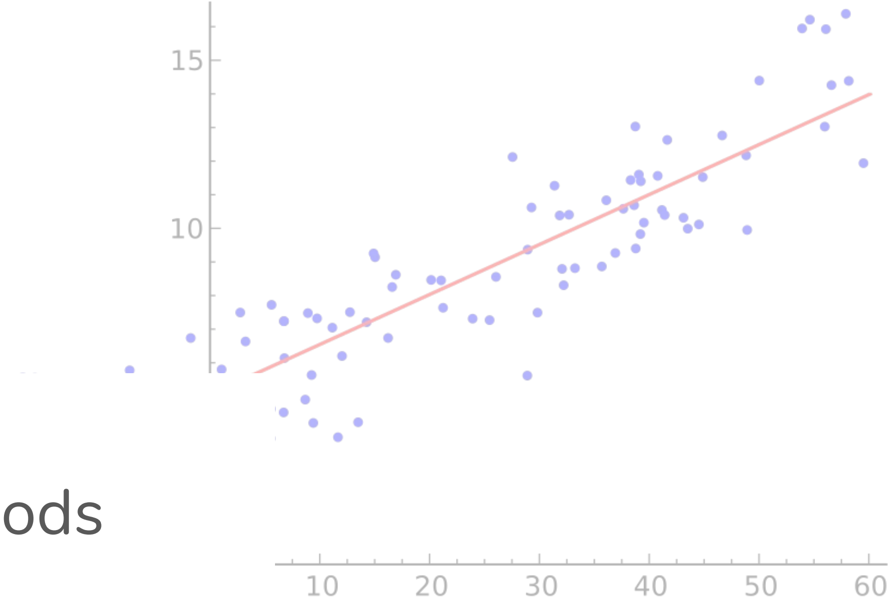


information

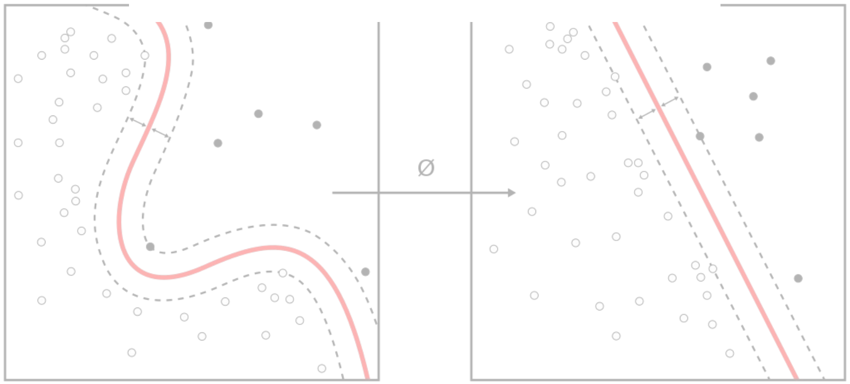




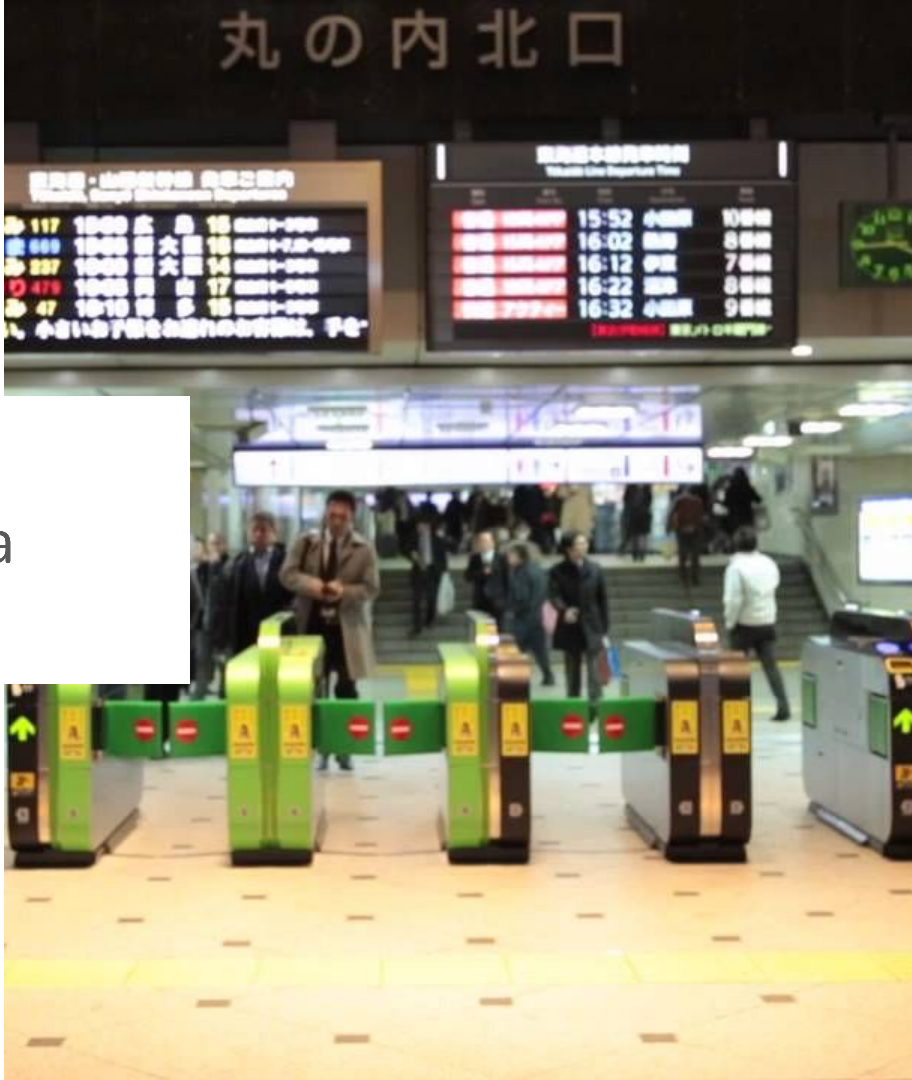


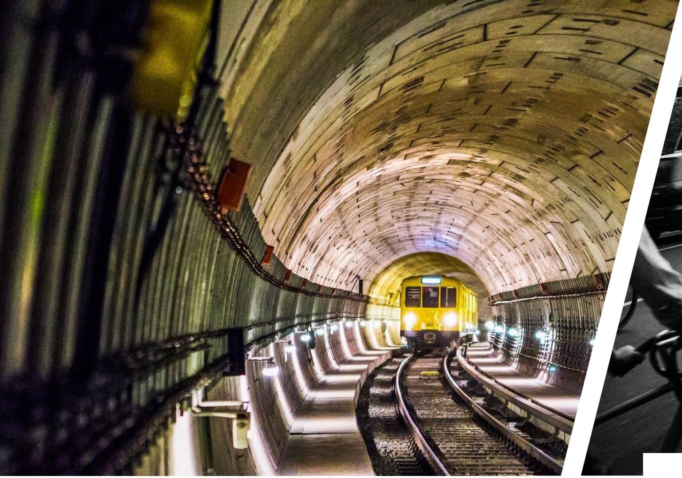


methods



data





transport mode

Approach

01 Objective

02 Information

03 Method

04 Data Type

05 Transport Mode

problem solving focus: how can cities tackle problems?

Segregation and Exclusiveness

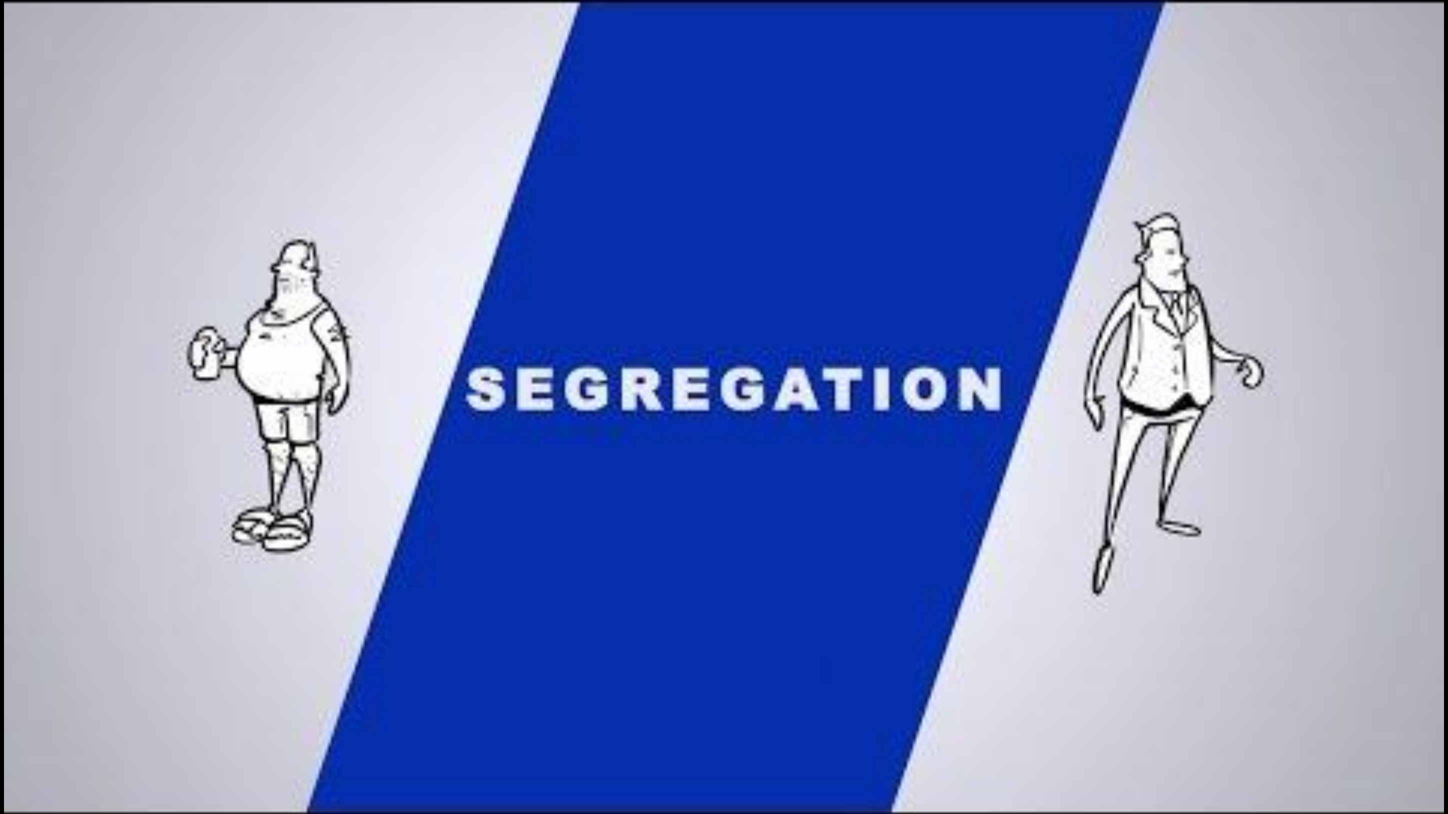
Segregation, social exclusion and lack of participation through an unequal access to the public transport systems are issues which cities of today are facing

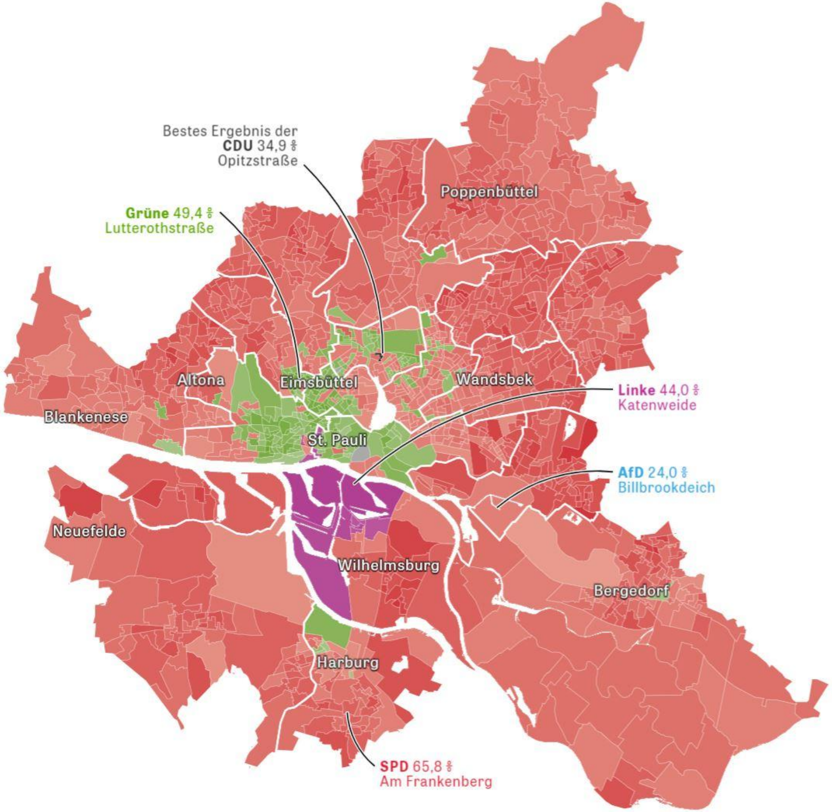
How can data science methods address and/or analyze these problems?

“Repeated experience of spatial distance affirms social distance” (Bourdieu 1999: 126)

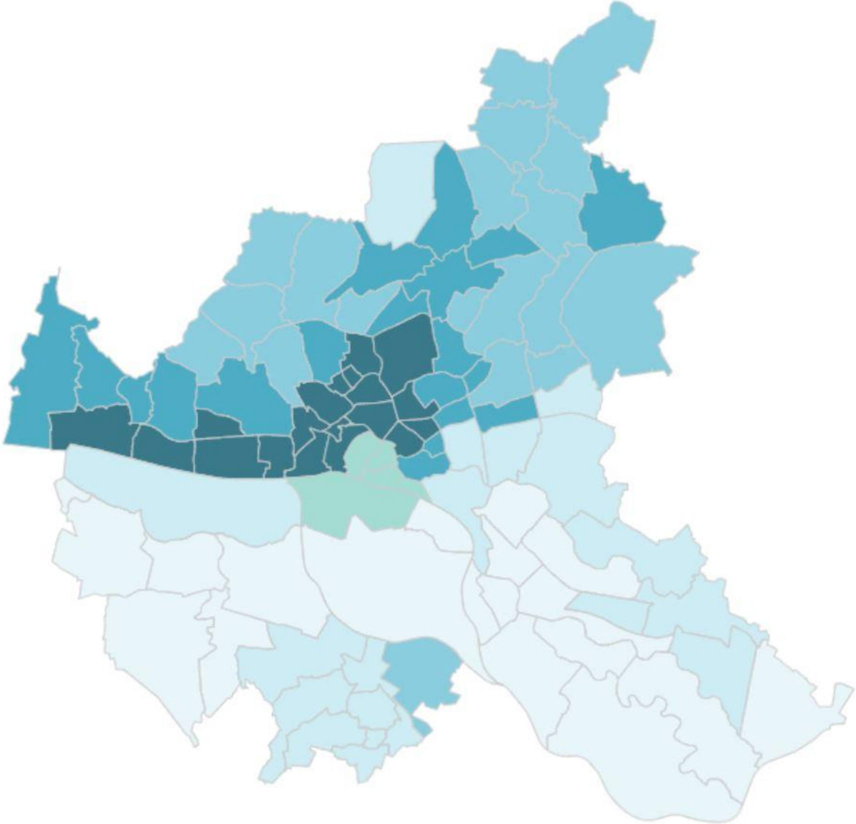
But first:

What is segregation and why is it bad?


SEGREGATION



[Zeit, Bürgerschaftswahl in Hamburg, 24.02.2020]()



[Statistisches Amt für Hamburg und Schleswig-Holstein, Hamburger Stadtteilprofile 2018]()

Segregation as an ambivalent phenomenon

- Segregation is an ambivalent, contradictory and a highly complex phenomenon.
- it can be seen as functional/voluntary segregation and also as structural segregation caused by social dynamics of inequalities.
- There are benefits and downsides of segregation developments in cities.

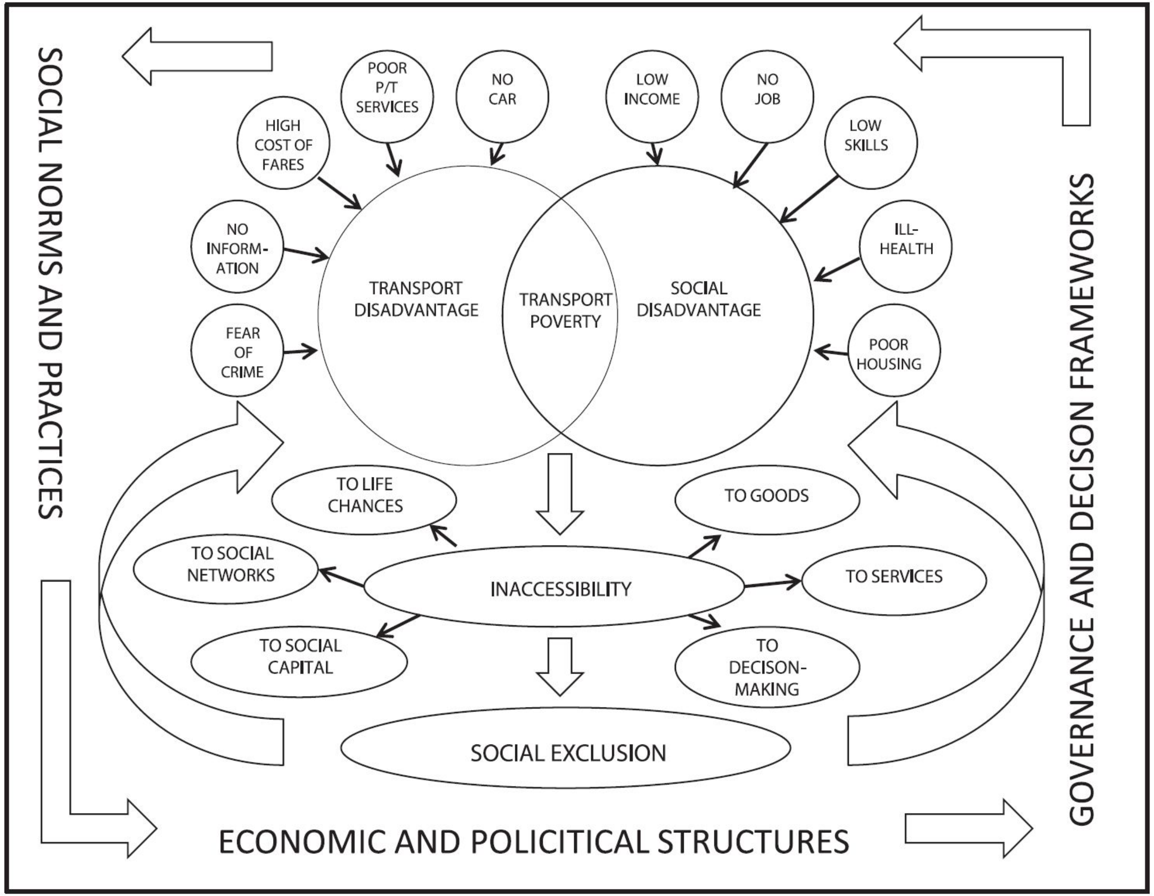
→ balancing act for politicians and city planners

- functional condition for the successful integration of migrants (e.g. Little Italy and China Town in New York) but also development of gated communities
- inequalities as structural drivers (housing, education, political representation)

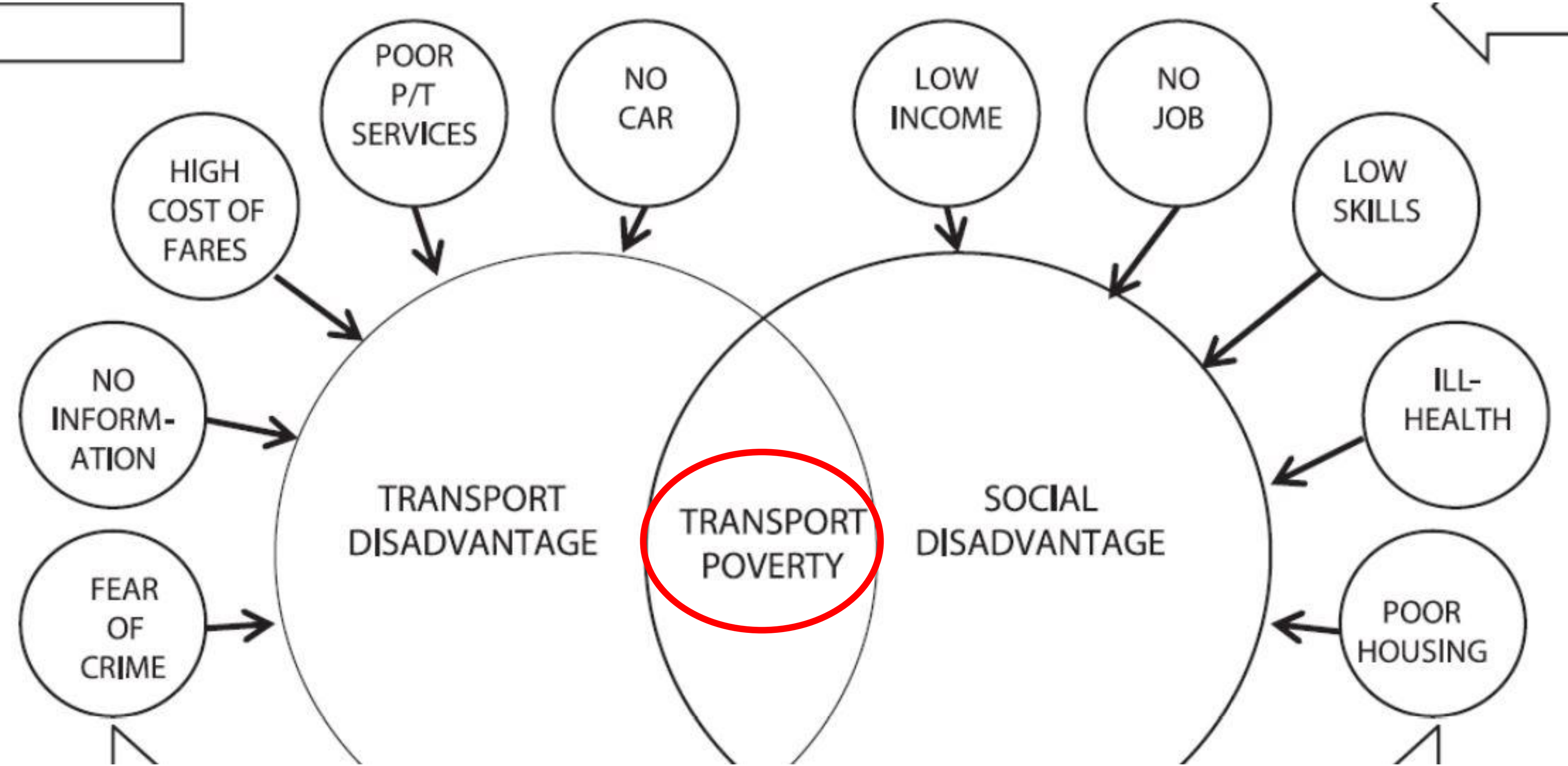
How is segregation linked to urban transportation

- Inequalities as structural drivers (education, political representation, wealth…)
- Segregation is "the projection of a social structure onto space" (Cassiers/Kesteloot 2012: 1912)
- An accessible transport system is an essential condition for the integration of people in the networks of civic life
- If citizens are constrained in their possibilities of traveling around, the danger of social exclusion arises

Segregation and the link to social exclusion or: the necessity of accessibility



Lucas 2012: 107



HIGH COST OF FARES
POOR P/T SERVICES
NO CAR
LOW INCOME
NO JOB
LOW SKILLS
NO INFORM-ATION
ILL-HEALTH
FEAR OF CRIME
POOR HOUSING
TRANSPORT DISADVANTAGE
TRANSPORT POVERTY
SOCIAL DISADVANTAGE

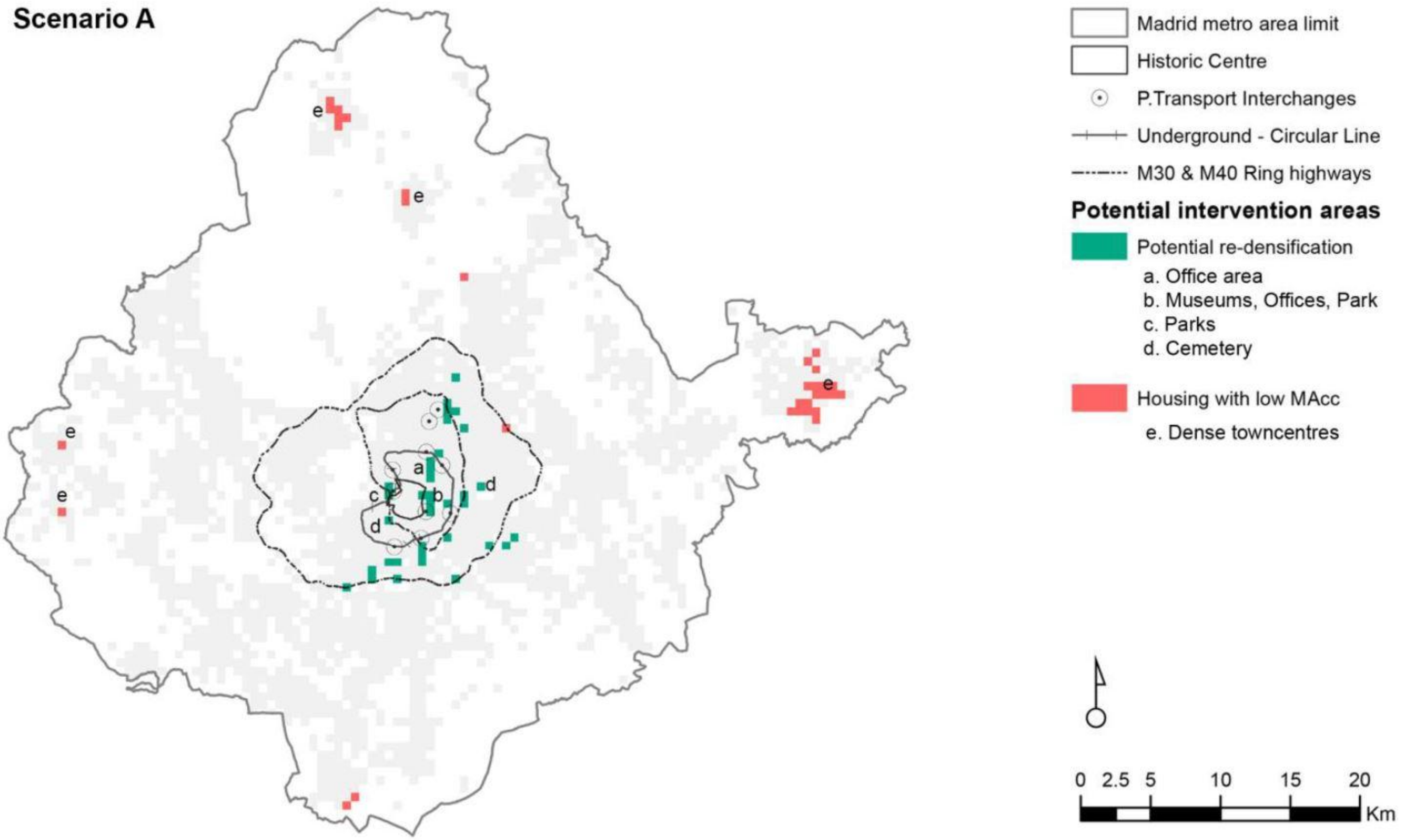
Madrid ranked most segregated city in Europe between rich and poor

thelocal.es, Madrid ranked most segregated city in Europe between rich and poor, 29.10.2019

Social Exclusion and the accessibility of transport

Case Study: Madrid (2019)

01	Objective	Increase social cohesion through informed transport and land use policies
02	Information	Potential encounter of difference in city spaces opened up by multimodal transport infrastructures
03	Method	Spatial network analysis, model of mobility flows, development of a multi-accessibility value
04	Data Type	Data from transit and street network, real journey time data for the automobile network
05	Transport Mode	Public Transit, Automobile, Walking



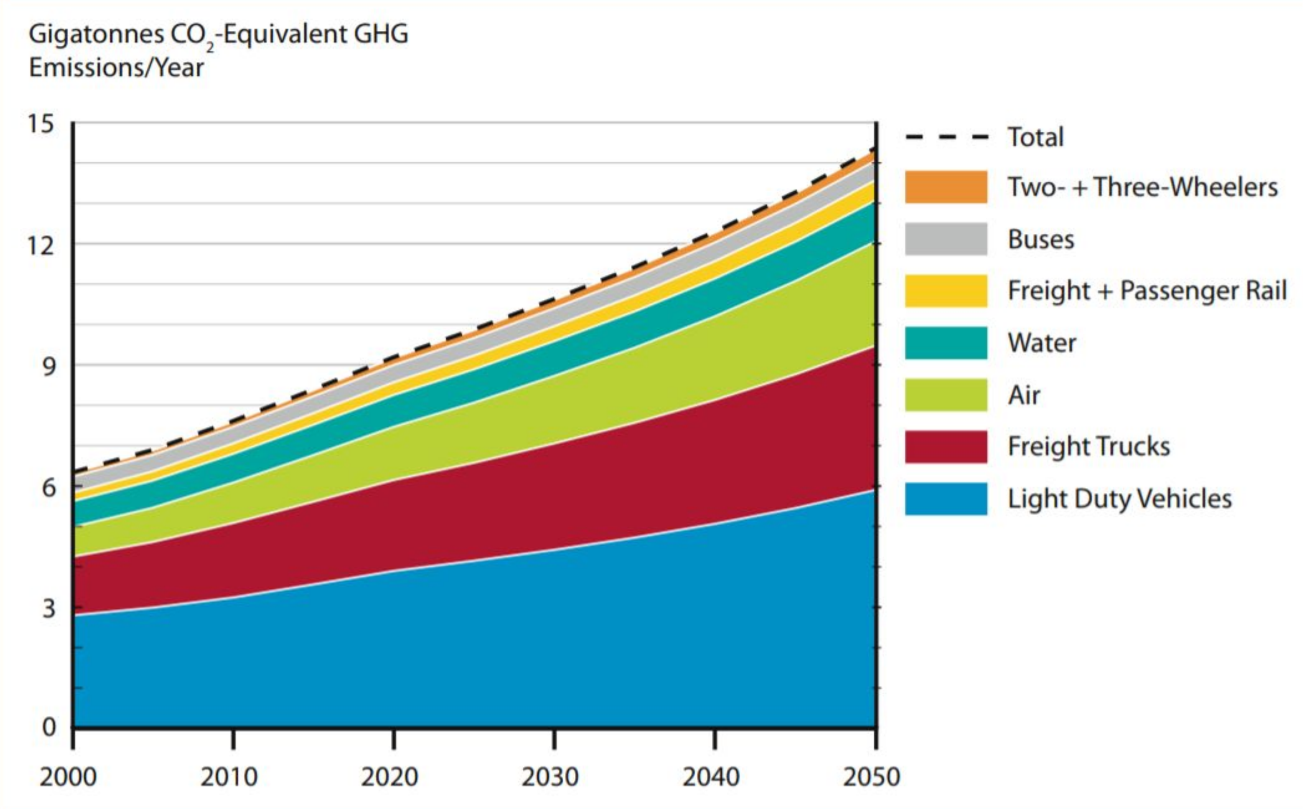
Carpio-Pinedo 2019: 22

Air and Noise Pollution

(DW Akademie, Stuttgart: Germany's 'Beijing' for air pollution?, 2016)

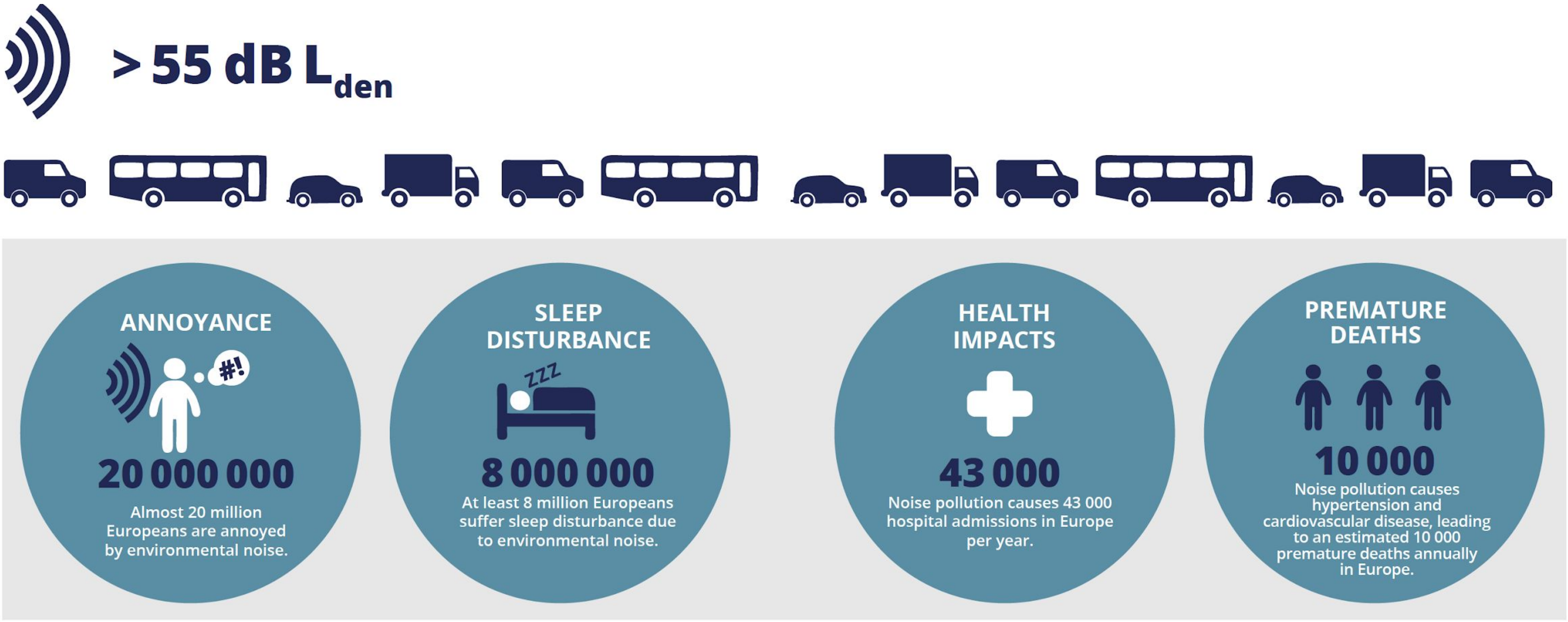
(Euractiv, Study says EU moving too slowly on noise pollution, 12.04.2012)

Air Pollution



(WHO, Sustainable Transport - A Sourcebook for Policy-makers in Developing Cities, pg. 10, 2011)

Noise Pollution

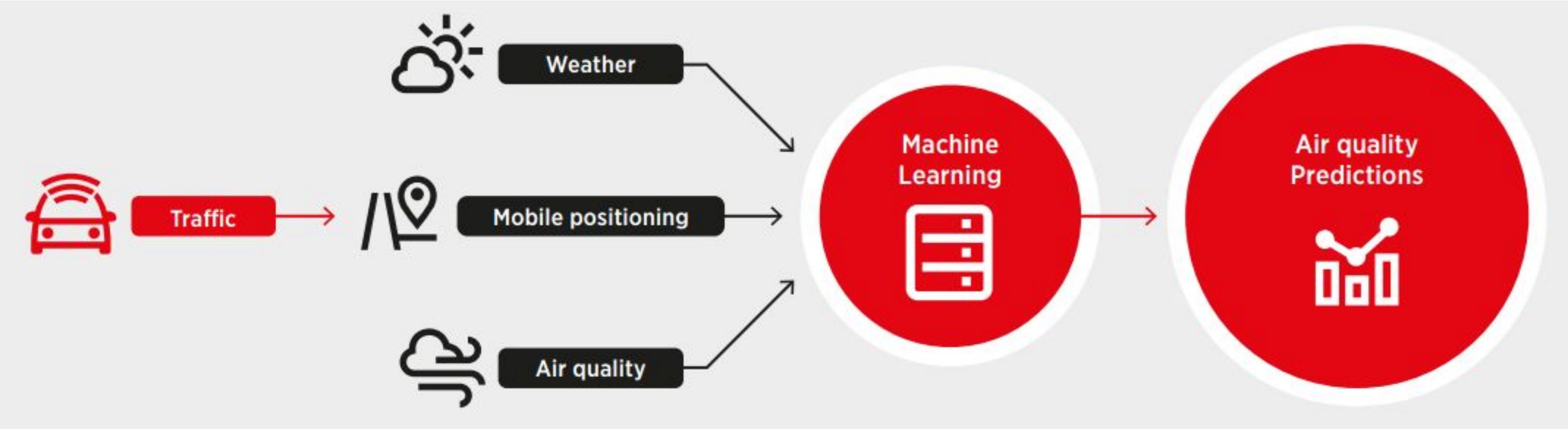


(eea.europa.eu, EEA Report No 10/2014)

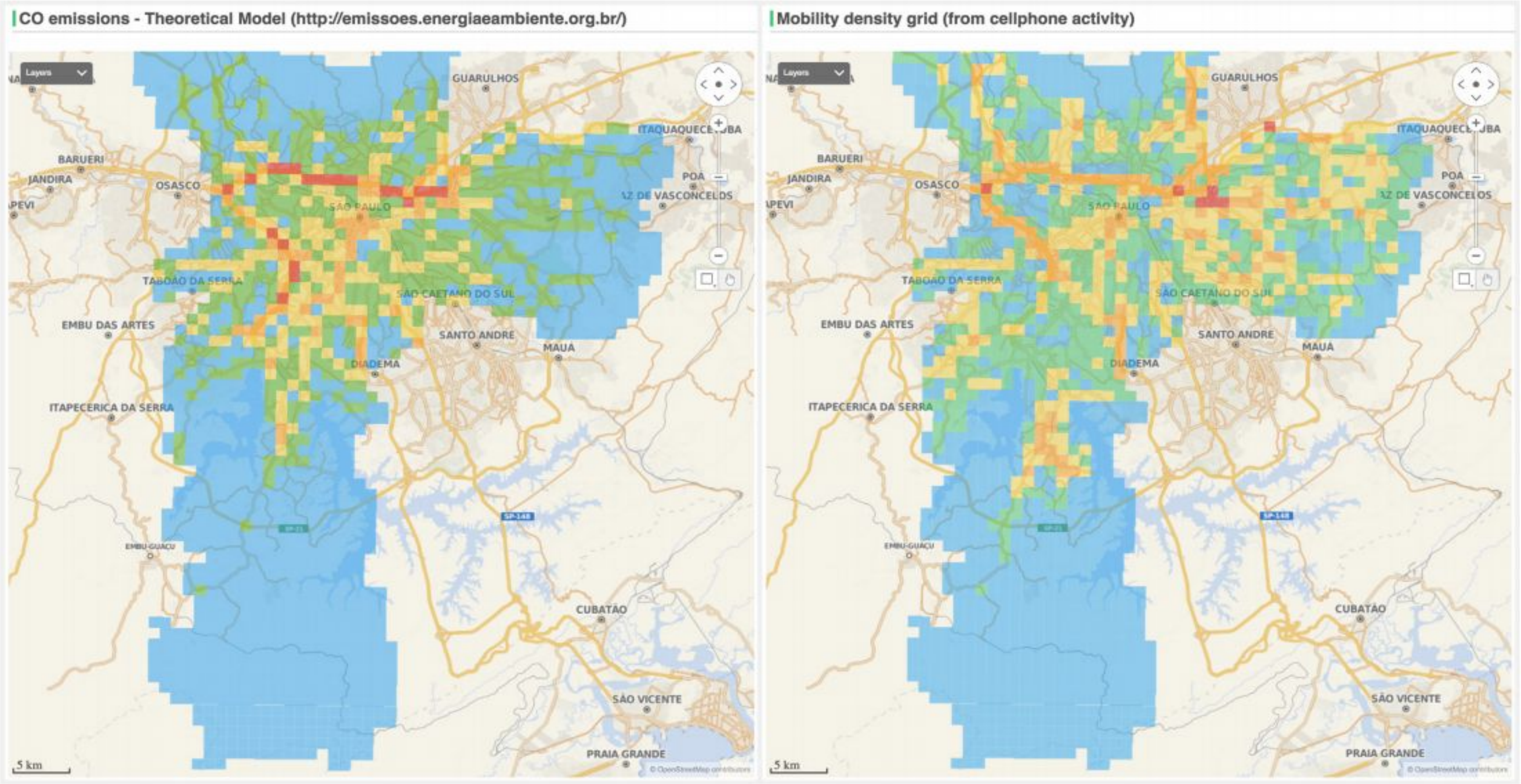
Air and Noise Pollution

Case Study: Telefónica, São Paulo, Brazil (2018)

01	Objective	Efficient collection of air pollution data and providing policy support
02	Information	To model and predict air quality by using mobile network network data
03	Method	Machine Learning and Predictive analytics
04	Data Type	Data generated by mobile networks, coupled with sensor data for pollution and weather
05	Transport Mode	All modes of road transport



(GSM Association, Case Study: Telefónica Brazil, 2018)



(GSM Association, Case Study: Telefónica Brazil, 2018)

[WHO, Road safety: 1 person killed every 24 seconds, 10.12.2018]


Global status report on road safety 2018
Through the Sustainable Development Goals,
governments are committed to reducing
.

Road Safety and Accidents

> By 2020, halve the number of global deaths and injuries from road traffic accidents.

[United Nations - 2030 Agenda for Sustainable Development: 20](#)

Road Safety and Accidents

“

Every ___24 seconds___ a person dies on the road. (WHO Road Safety Report 2018)

[WHO, Death on the roads, 2018]

Vision Zero as a Strategy

Started in Sweden in 1997

"

Vision Zero is a strategy to eliminate all traffic fatalities and severe injuries, while increasing safe, healthy, equitable mobility for all.

[Vision Zero Network, what is Vision Zero]

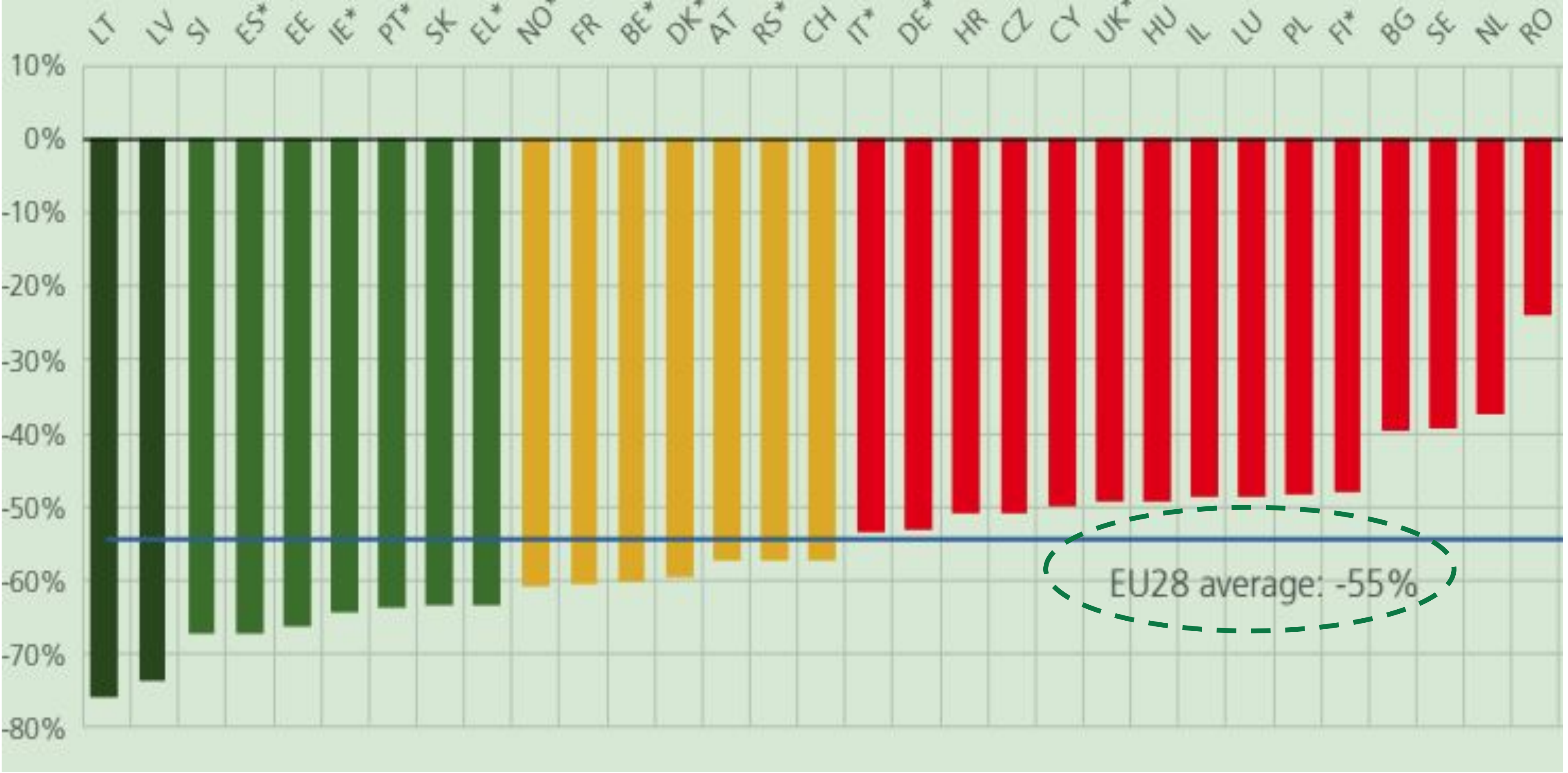
Vision Zero
is a Data-driven Approach

VISION ZERO
CORE ELEMENTS

DATA-DRIVEN

City stakeholders commit to gather, analyze, utilize, and share reliable data to understand traffic safety issues and prioritize resources based on evidence of the greatest needs and impact.

Vision Zero Network, 9 Components of a Strong Vision Zero Commitment

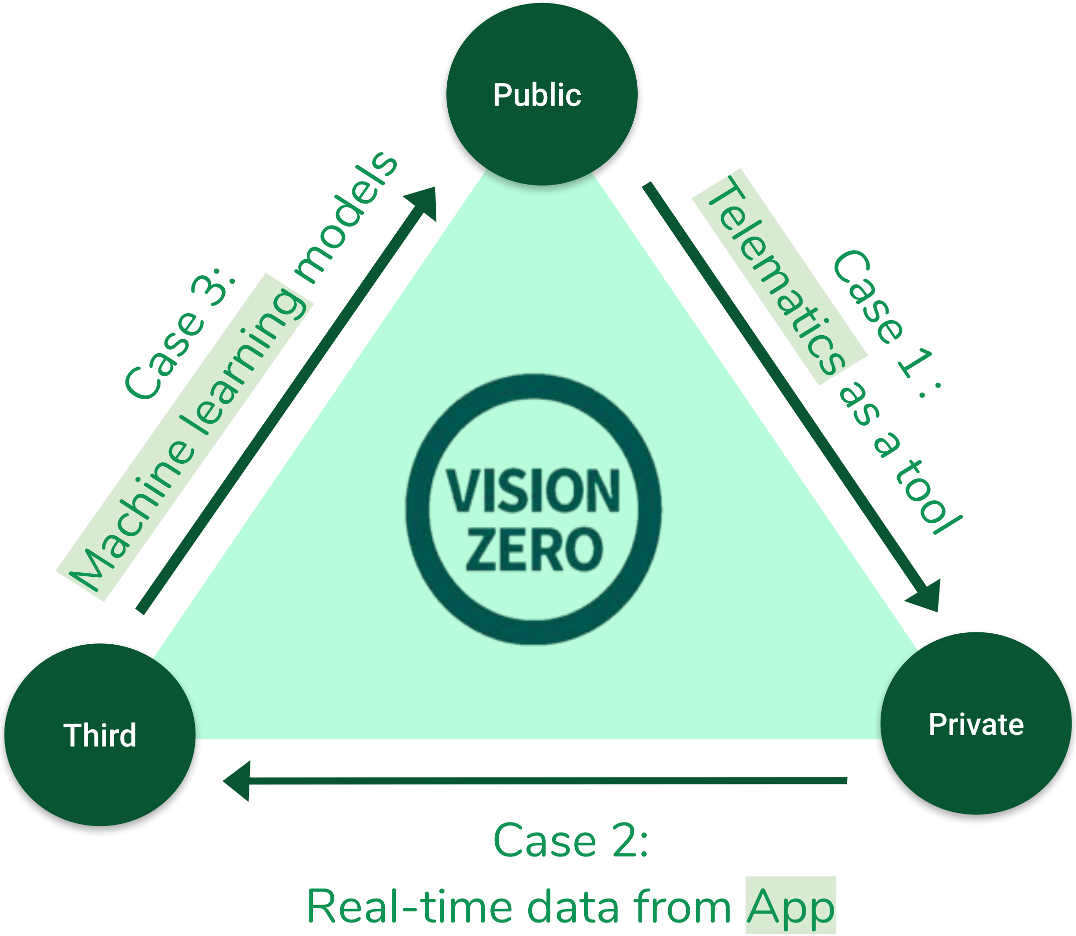


[European Transport Safety Council, 13th Road Safety Performance Index Report: 20, 2019]()

How do the 10 focus cities in the US apply data to achieve vision zero?

does New York City

vision zero network, 10 Cities Lead National Effort to Eliminate Traffic Fatalities. 2016


Public
Private
Third
VISION ZERO
Case 1: Telematics as a tool
Case 2:
Real-time data from App
Case 3: Machine learning models

Road Safety and Accidents

Case Study: Telematics as a tool, New York City (2018)

01	Objective	Vision Zero : improve road safety, reduce fatality
02	Information	Fleets driving behaviors (ex: braking, acceleration) Safety factors (ex: road status)
03	Method	Machine learning ; data system → visualization
04	Data Type	Real-time data from telematics device 
05	Transport Mode	All modes : city fleets → all road users

Between cases, regardless of the differences (sectors involved / methods used / source of data etc...)

they all aim to improve safety for all road users(cyclists, pedestrians, automobiles) , aiming for vision zero.

Connectedness of Data

classic modes of transport

innovations

Connectedness of Data

different modes of transport
“cannibalising” each other

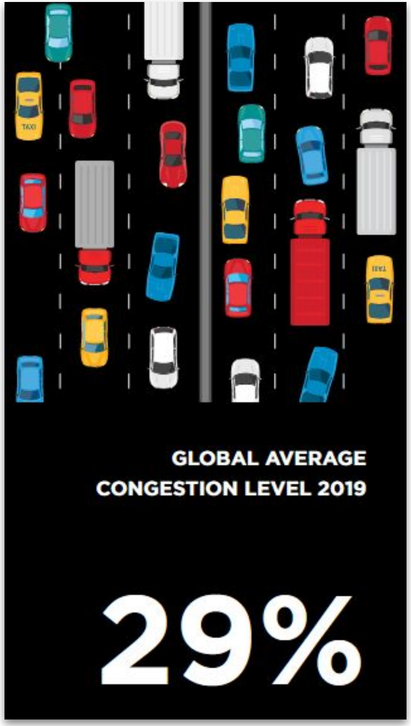
increase in overall traffic
(Suatmadi et al., 2019)
aggravate inequity
(Golub et al., 2019)

Connectedness of Data

Mobility Data Specification, Los Angeles

01	Objective	manage dockless scooters and bikes
02	Information	real time data about vehicles
03	Method	API to connect providers and city (MDS: Mobility Data Specification): provide data, enable regulation
04	Data Type	sensor data (GPS, vehicle status), provider’s database (prices)
05	Transport Mode	e-scooters (currently); “shared” vehicles, autonomous vehicles (scalable)

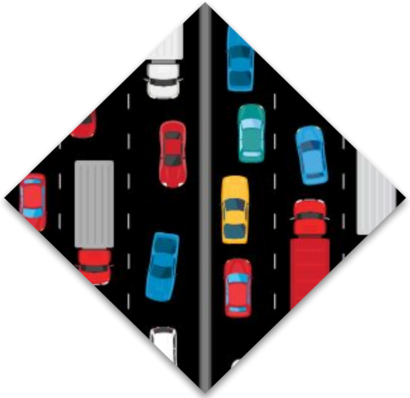
Traffic Overload



World rank	City	Country	Congestion level
1	**Bengaluru**	India	**71%**
2	**Manila**	Philippines	**71%**
3	**Bogota**	Colombia	**68%**

TomTom, Traffic Index, 2020

Traffic Overload



SOCIAL

ECONOMIC

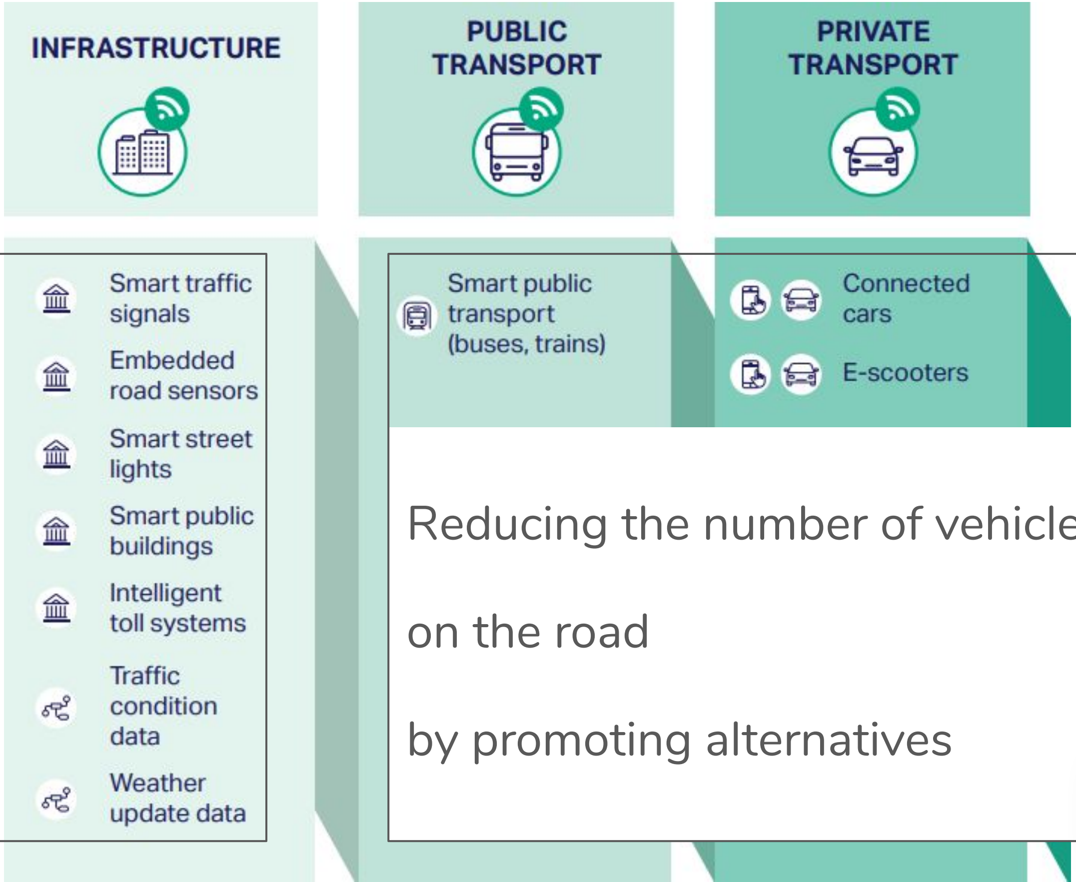
ENVIRONMENTAL

Traffic category		CO	HC	NO_x	CO_2	PM_{10}
1aa	Stop-and-go' traffic, speed below 10 km/h	5.51	0.93	0.63	370	0.06
1a	Stop-and-go' traffic, speed between 0 en 25 km/h	2.84	0.60	0.50	239	0.05
1b	Congested traffic, speed between 25 and 40 km/h	1.71	0.43	0.48	178	0.04
1c	Congested traffic, speed between 40 and 75 km/h	1.15	0.23	0.47	153	0.04
2a	Speed 75-120 km/h, traffic volume over 1000 vehicles per lane per hour, speed limit = 100 km/h	1.13	0.14	0.49	146	0.03
2b	Speed 75-120 km/h, traffic volume over 1000 vehicles per lane per hour, speed limit = 120 km/h	1.20	0.14	0.57	157	0.04
2c	Speed 75-120 km/h, traffic volume below 1000 vehicles per lane per hour, speed limit = 100 km/h	0.90	0.11	0.47	146	0.03
2d	Speed 75-120 km/h, traffic volume below 1000 vehicles per lane per hour, speed limit	1.17	0.12	0.66	173	0.04
2e	Speed over 120 km/h, independent of traffic volume	3.42	0.16	0.98	208	0.18
3	Shortcut/back road	2.42	0.19	0.49	177	0.12

Veurman et al. 2002

[WBCSD, Enabling data-sharing: Emerging principles for transforming urban mobility, 2020]

Traffic Overload



01

Redesigning

current infrastructure

to address

road bottlenecks

Reducing the number of vehicles

on the road

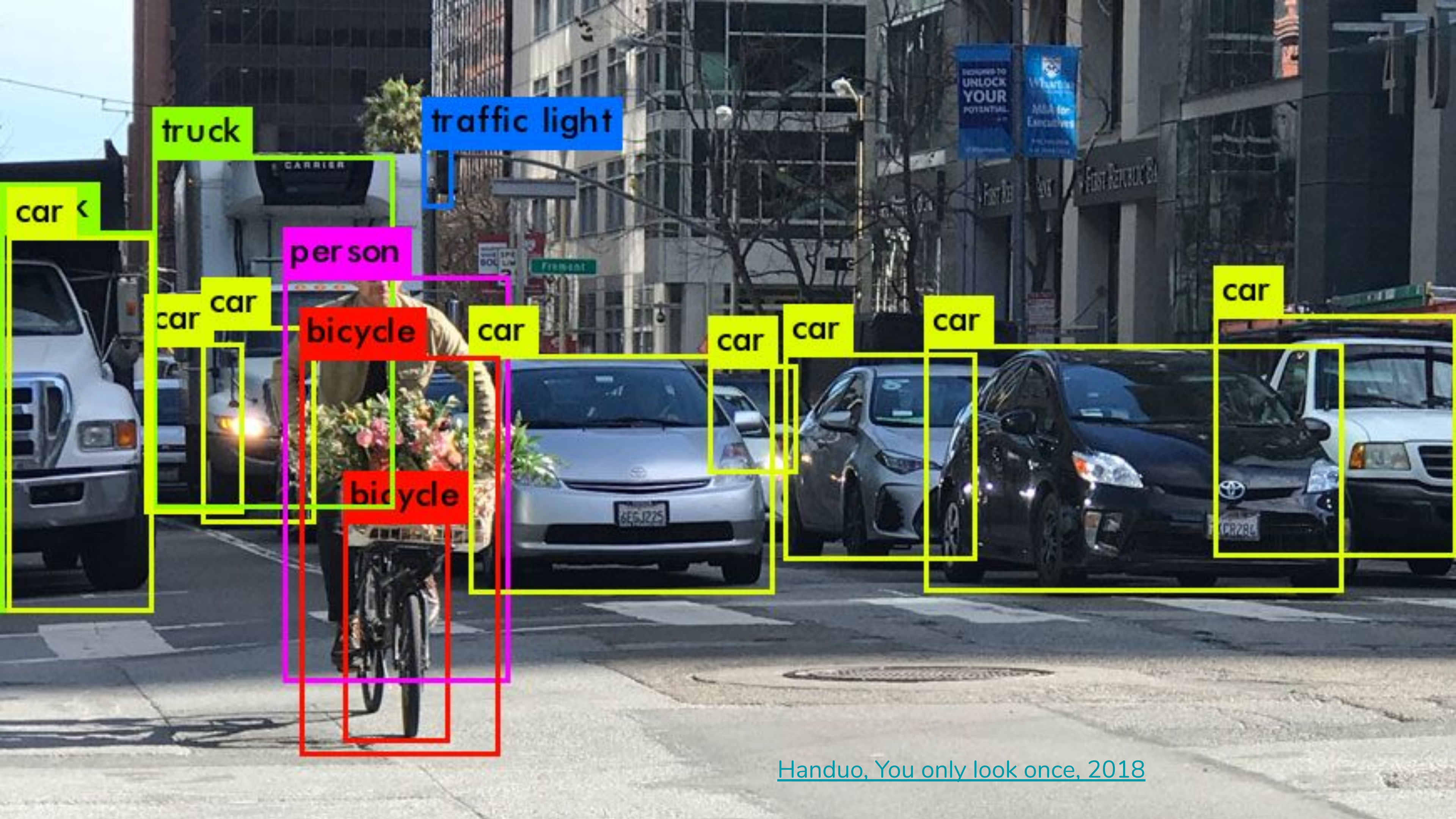
by promoting alternatives

02

Traffic Overload

Morten Kabell, Copenhagen City (2017)

01	Objective	Carbon-neutral city by 2025 ⟶ less cars
02	Information	Recognize moving objects ⟶ traffic light control
03	Method	Image recognition and classification
04	Data Type	Collected sensor data through cameras
05	Transport Mode	Interplay of all modes



[Handuo, You only look once, 2018]()

Discussion

objective:	sustainability, increase health and safety, **optimization**
information:	deeper understanding of mobility and transport systems, **detecting patterns**
method	various methods (Big Data storage, analysis, prediction, regression, spatial modeling etc.)
data type:	Traffic data from different sensors, real time data/streaming data, geospatial, demographic data, **bringing together different data types**
transport modes:	Multimodality, focus on public transport and green transport

Discussion

The topics we selected were of different angles, but shared a similar vision

→ Vision of a smart, sustainable, safe and connected city

Issues of optimization, pattern detection and bringing together different data types

→ perfectly suitable issues for data science methods

Discussion

4 main points emerged:

- The issue of privacy, anonymity and transparency
- The use of open or shared data and the cooperation between sectors and institutions
- Using the results of one case to problems of other cases
- Visualization and communication of results is important (Shiny web apps/interactive maps)

Discussion

→ vision of a smart, sustainable, safe and connected city

→ issues of optimization, pattern detection and bringing together different data types

→ perfectly suitable issues for data science methods

Discussion

privacy, anonymity and transparency

use of open / shared data, cooperation between sectors / institutions

transfer results of one case to problems of other cases

visualization and communication (Shiny web apps/interactive maps)

Conclusion

Assessing the impact on urban mobility using the 4 V’s of Big Data:

- **Velocity** - enabling real time decision making
- **Volume** - provides for a comprehensive analysis
- **Veracity** - lower risk of human error and bias in sensor data, studies towards improved sensor calibration
- **Variety** - challenge to combine data from multiple sources. Eg. private service providers, public databases, etc.

Conclusion

- rising trend towards Open Data
- Emergence of relationships between the Public and Private sectors, structured around Big Data
- Benefits from specialisation of activities
- A common and growing problem - data privacy and anonymisation of records

Reflection on Project Work

Exploration | Development | Implementation | Presentation

❶ Scope-narrowing

green urban planning

⬇️

urban transportation

⬇️

Smart urban mobility

❷ Sub-topics

Obvious problems

Interests

Board coverage

❸ Framework(FW)

⇅

❹ Cases Selection

❺ Cases Analysis

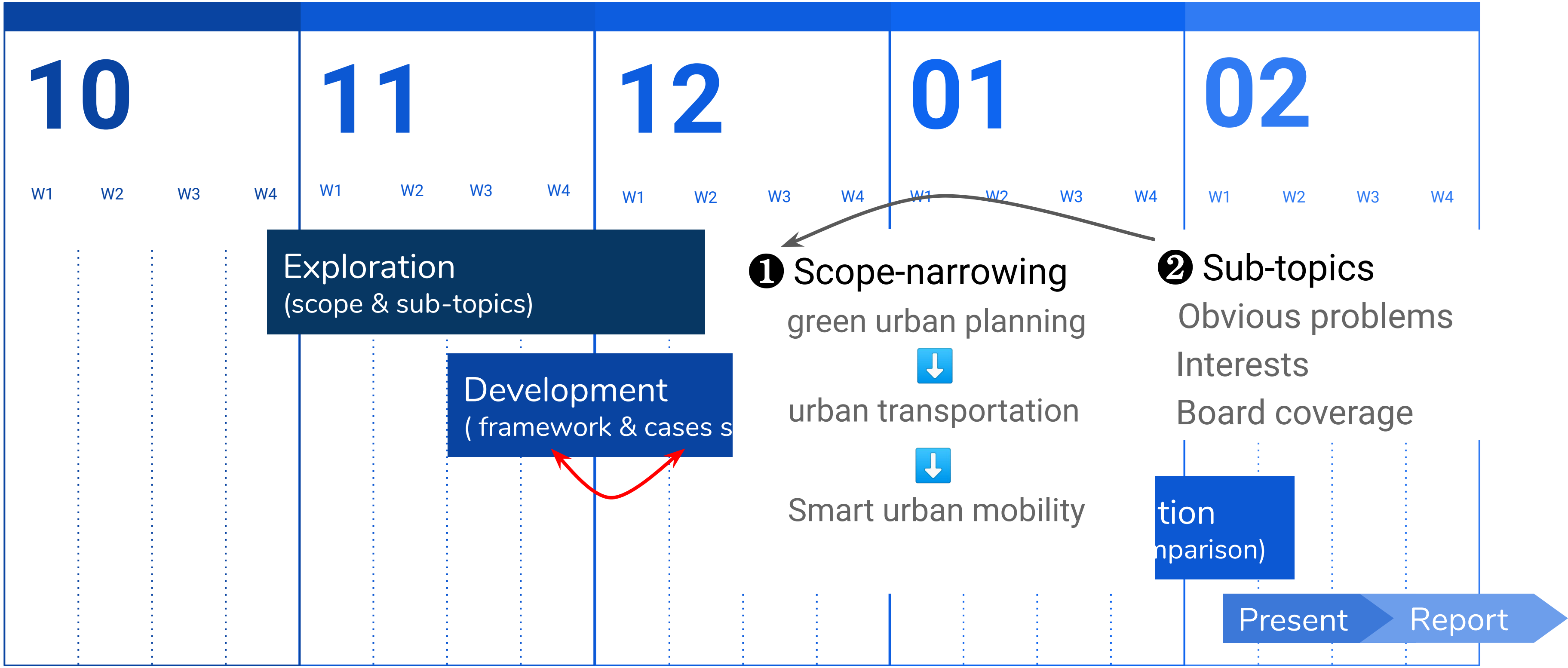
filter information
according to the FW
→ effective and efficient

❻ Cross Comparison

similarities
differences
insights

❼ 30 minutes challenge

Reflection on Project Work



Thank you

Q&A

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