Mobility

Presentation

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Publication date:
2017-10-06

Permanent link:
https://doi.org/10.3929/ethz-b-000210343

MOBILITY
YALE NUS COURSE 2017

October 6, 2017

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Institute for Transport Planning and Systems

ETH zürich

OUTLINE

Today's lecture

/ Why mobility?
/ Transport planning
/ Disruption

Next week

/ Networks & representation
/ Infrastructure design

WHY TRANSPORT?

http://www.evolo.us/competition/times-squared-3015/

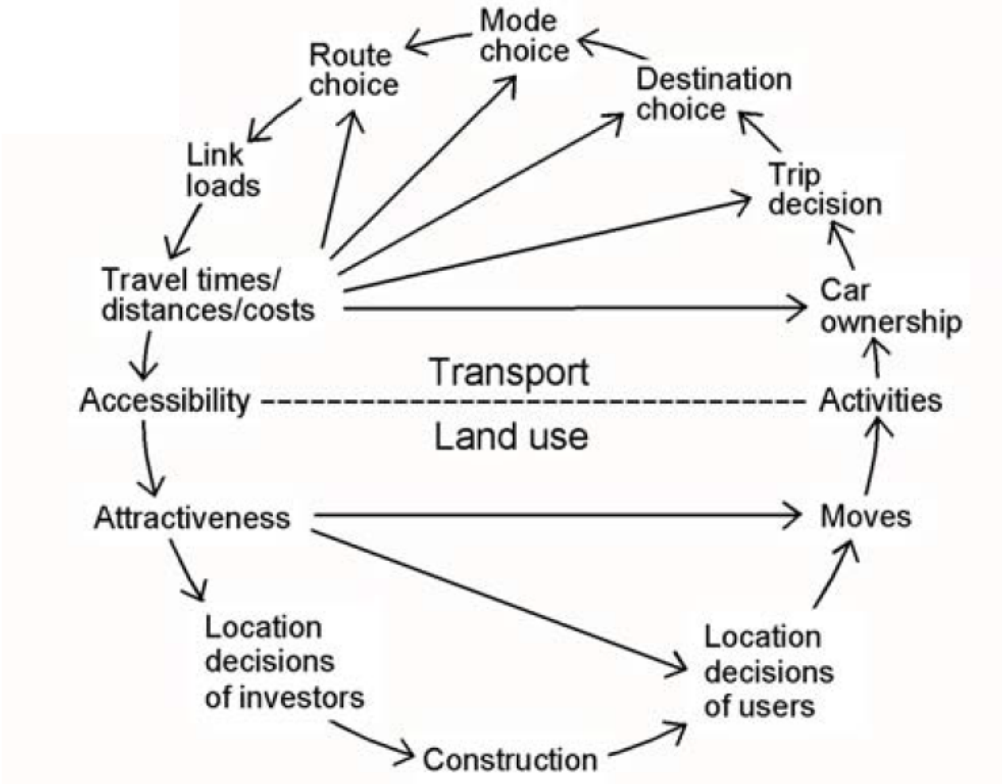
WHY TRANSPORT?
TRANSPORT AND LAND-USE

/ **Transportation system** provides spatial accessibility.

/ **Spatial accessibility** influences location decisions for the land use system.

/ **The land use system** -- residential, industrial or commercial -- affects the locations of human activities such as living, working, shopping, education or leisure.

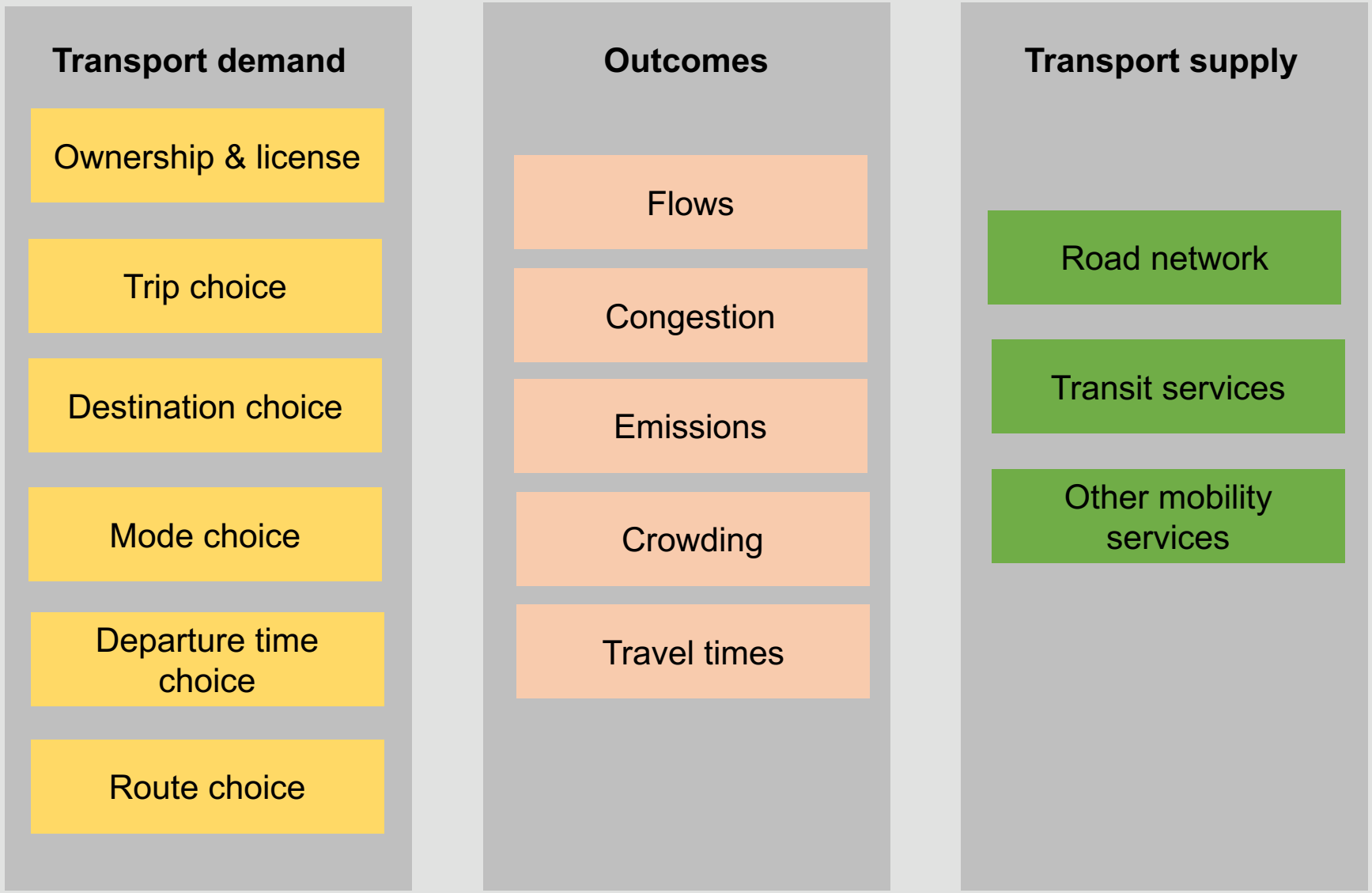
/ These **human activities** form trip patterns in the transportation system.



Source: Wegener and Fuerst (2004)

TRANSPORT PLANNING

Cities are the subsequent result of a series of cumulative decisions of many agencies and persons (Lynch, 1984)



EVALUATION

/ Vehicle travel
Refers to vehicle movement and speed are beneficial; congestion or inadequate roads are seen as the problem

/ Measure
Vehicle miles

/ Indicators
Vehicle traffic volumes and speeds, roadway Level of Service, costs per vehicle-mile, parking convenience

/ Mobility
Refers to the movement of people and goods

/ Measure
Person-miles and ton-miles

/ Indicators
Travel distance and speeds, road and transit Level of Service, cost per person-mile, travel convenience

/ Accessibility
Refers to the ease of reaching goods, services, activities and destinations (opportunities)

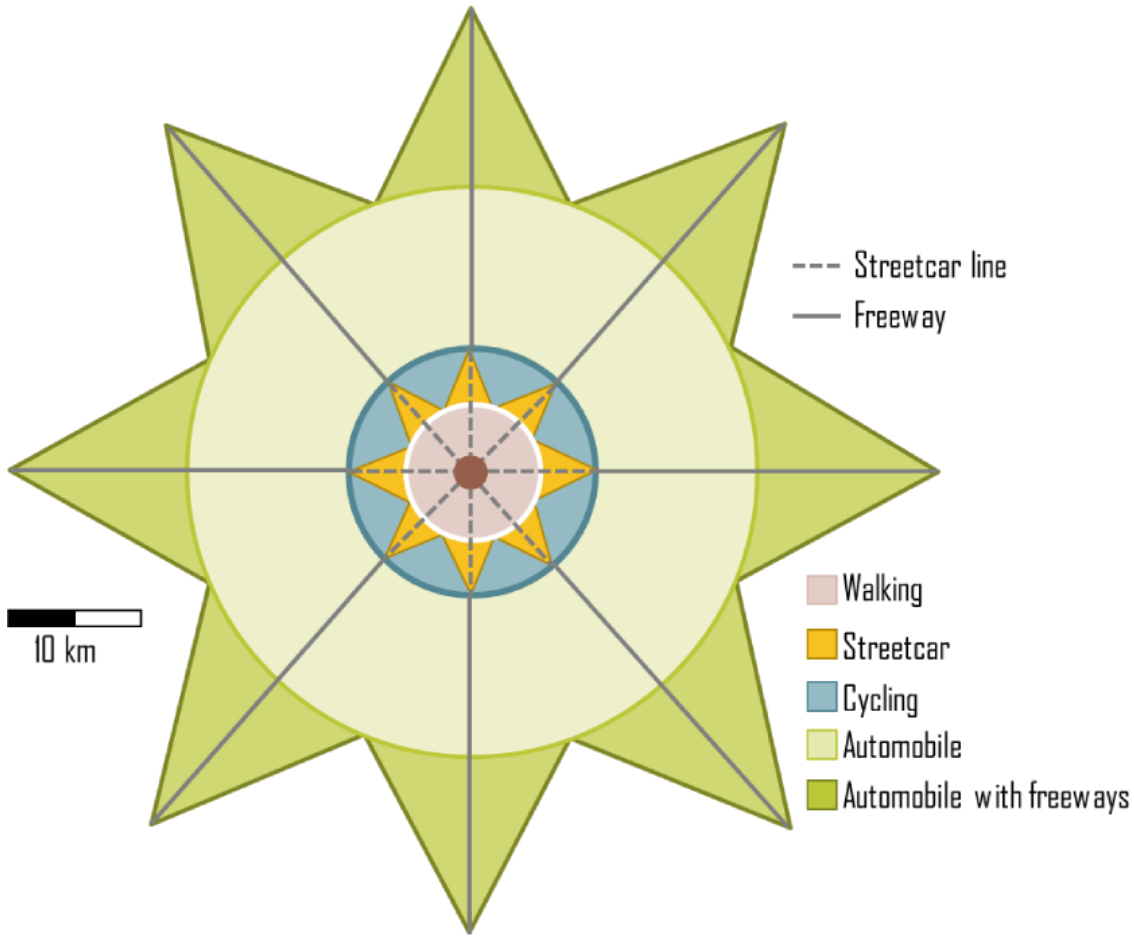
/ Measure
Trips, generalized costs

/ Indicators
Quality of available transportation choices. Distribution of destinations. Cost per trip

Littman, Todd (2017) Evaluating Accessibility for Transport Planning Measuring People's Ability to Reach Desired Goods and Activities, available here

ACCESSIBILITY

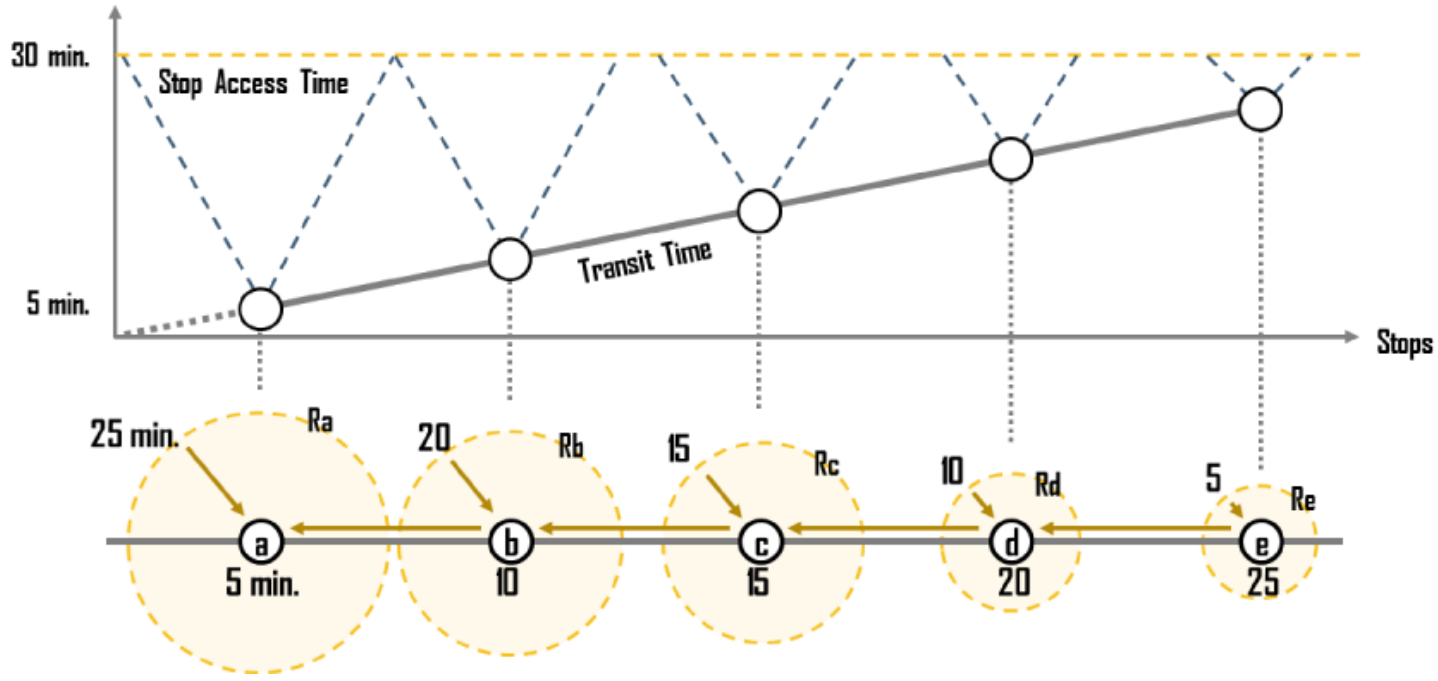
Different catchment areas: 1 hour commute by different modes



The geography of transport systems,
https://people.hofstra.edu/geotrans/eng/ch6en/conc6en/ch6c3en.html

ACCESSIBILITY | MULTI-MODAL

30 minute commute by public transport and walking



The geography of transport systems,
https://people.hofstra.edu/geotrans/eng/ch6en/conc6en/ch6c3en.html

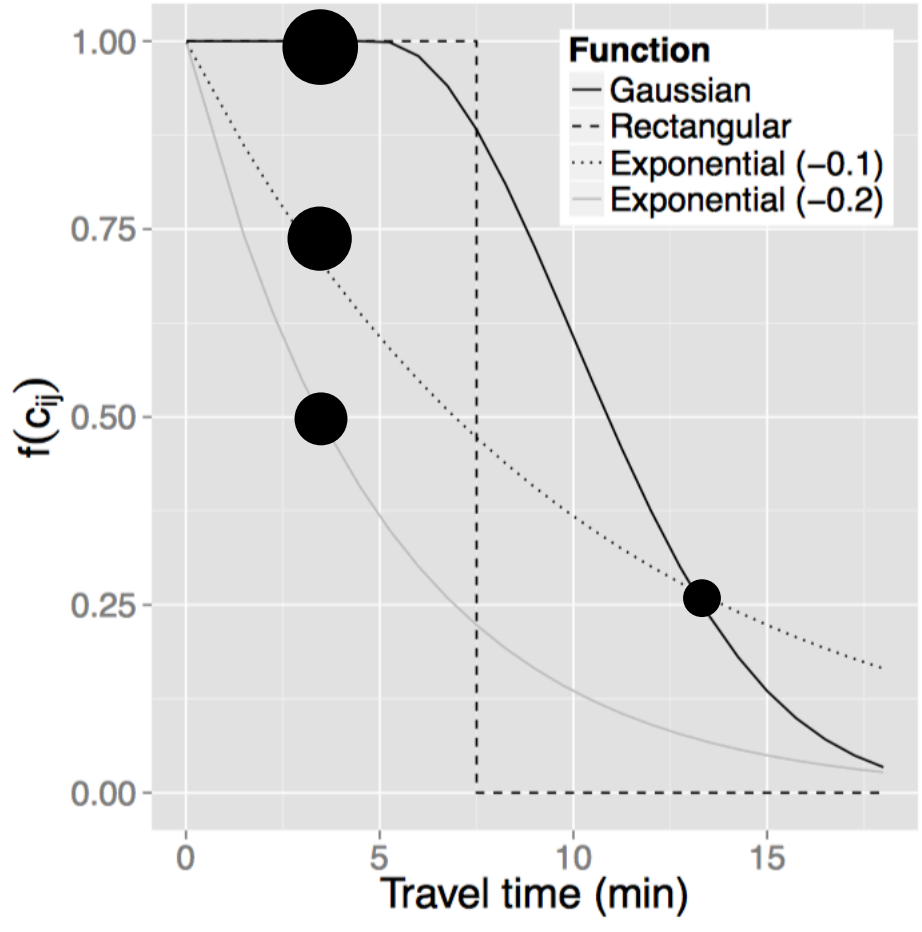
ACCESSIBILITY

First Law of Geography, "everything is related to everything else, but near things are more related than distant things." (Waldo Tobler, 1970)

Decay functions

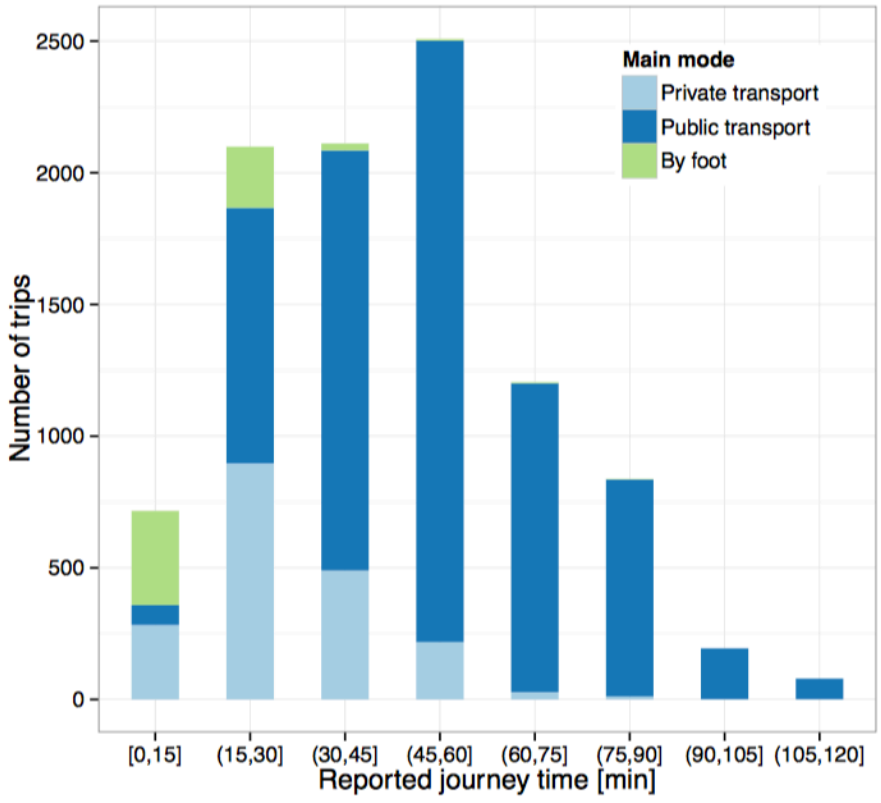
Function	Form
Rectangular	$f(c_{ij}) = \begin{cases} 1 & \text{if } c_{ij} \leq C \\ 0 & \text{if } c_{ij} > C \end{cases}$
Exponential	$f(c_{ij}) = \exp(-\beta c_{ij})$
Power	$f(c_{ij}) = {c_{ij}}^{-n}$
Gaussian	$f(c_{ij}) = \exp\left(\frac{c_{ij}}{v}\right)$
Cumulative Gaussian	$f(c_{ij}) = \begin{cases} 1, & \text{if } c_{ij} \leq C \\ \exp\left(\frac{c_{ij}-C}{v}\right), & \text{if } c_{ij} > C \end{cases}$
Logistic	$f(c_{ij}) = \frac{1}{s}\exp\frac{c_{ij}-m}{s}(1+\exp\frac{c_{ij}-m}{s})^{-2}$
Log-normal	$f(c_{ij}) = \frac{1}{c_{ij}\sigma\sqrt{2\pi}}\exp(\frac{-(\ln c_{ij}-\mu)^2}{2\sigma^2})$

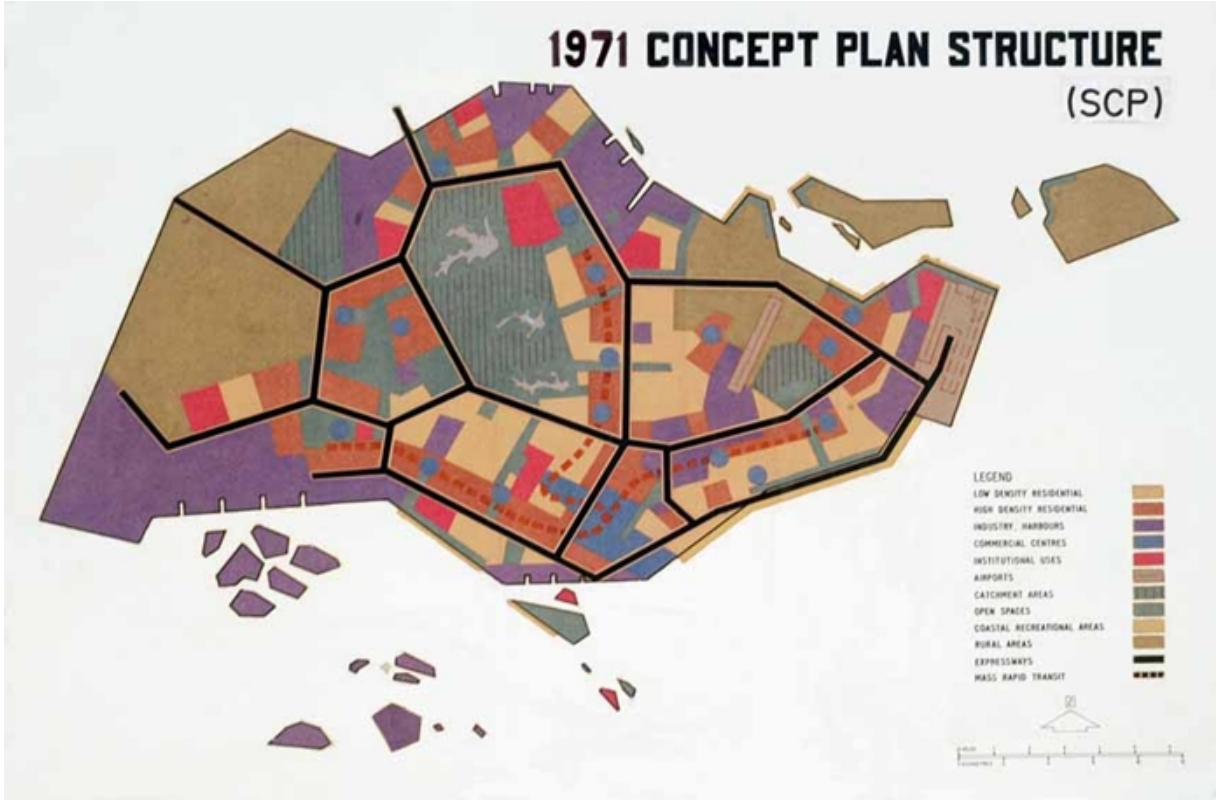
… and plotted



ACCESSIBILITY AND SPATIAL STRUCTURE | OBSERVERD HOME-WORK TRAVEL TIMES SINGAPORE

Travel survey





van Eggermond (2017) Diversity, accessibility and its impact on vehicle ownership and residential locations choices. PhD Thesis, ETH Zurich

ACCESSIBILITY AND SPATIAL STRUCTURE | OBSERVERD HOME-WORK TRAVEL TIMES SINGAPORE

Home-work trips in Singapoore by travel time

Start locations of trips between 15 and 30 minutes, n=177,002

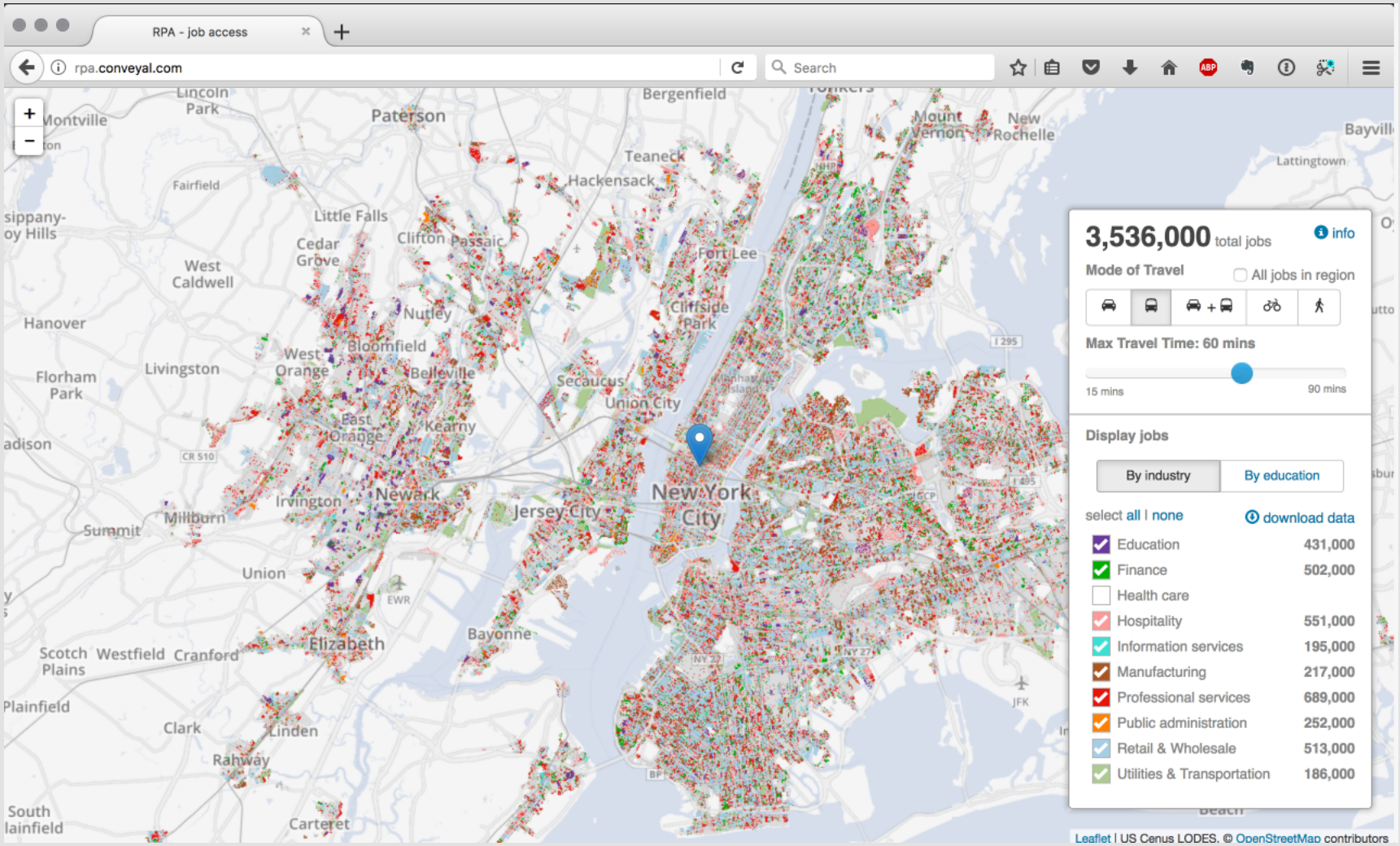
End locations of trips between 15 and 30 minutes, n=177,002

Start locations of trips between 45 and 60 minutes, n=92,718

End locations of trips between 45 and 60 minutes, n=92,718

van Eggermond (2017) Diversity, accessibility and its impact on vehicle ownership and residential locations choices. PhD Thesis, ETH Zurich

ACCESSIBILITY



http://rpa.conveyal.com/

TRAVEL AND THE BUILT ENVIRONMENT | 5 D'S

Density

Household/population density

Job density

Diversity

Land use mix (entropy index)

Jobs-housing balance

Intersection/street density

Design

Intersection density

Destination accessibility

Local accessibility

Regional accessibility

Distance to transit

Travel and the Built Environment

A Meta-Analysis

Reid Ewing and Robert Cervero

TRAVEL DEMAND AND THE 3Ds: DENSITY, DIVERSITY, AND DESIGN

ROBERT CERVERO and KARA KOCKELMAN

Department of City and Regional Planning, College of Environmental Design, University of California, Berkeley, CA 94720, U.S.A.

theguardian

Housing

Inner-city living makes for healthier, happier people, study finds

Residents of higher-density areas are more active, more socially engaged – and less obese – than people who live in the sprawl of suburbia

Reuters

Friday 6 October 2017 01.13 BST

e.g. Ewing and Cervero (2010), Cervero and Kockelman (1996), Guardian

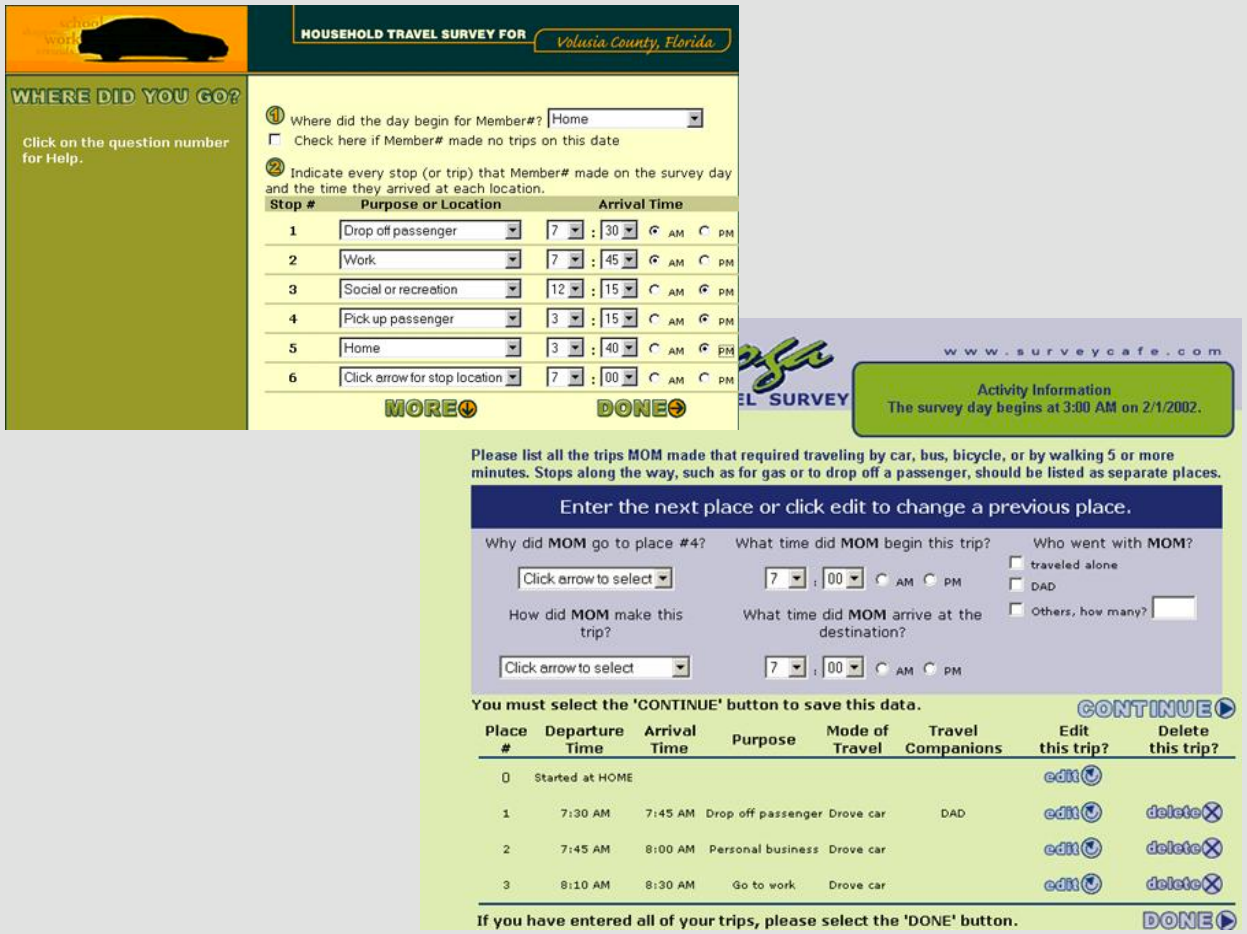
DATA

DATA

TRAVEL DIARY SURVEYS | REVEALED PREFERENCE

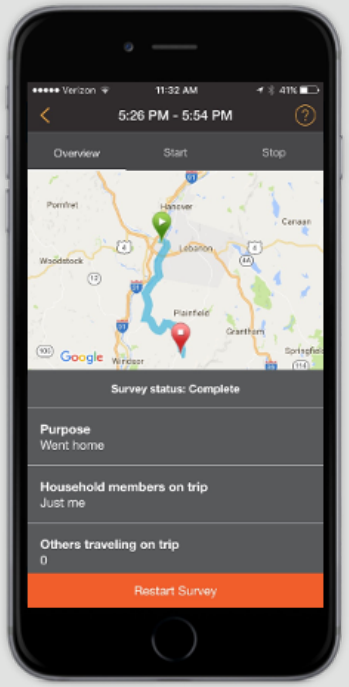
Classic

Paper-based / CAPI / CATI / Respondent-interactive

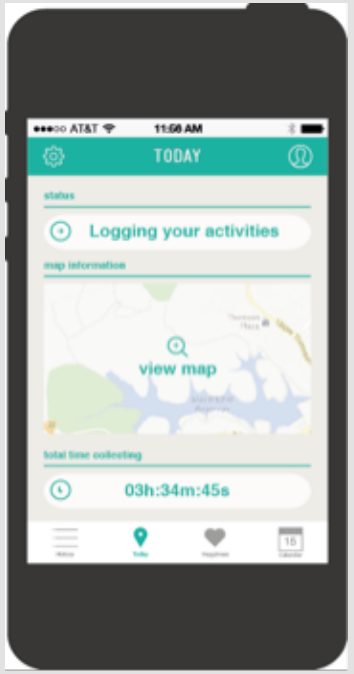


State-of-the-art

Trackers, Smartphone based surveys



Rmove by RSG



Future Mobillity Sensing (FMS) by MIT

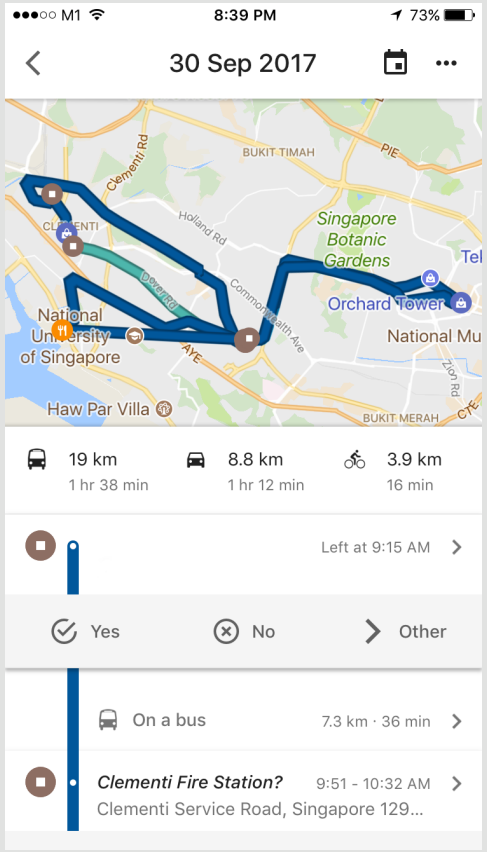
Examples from FHWA

DATA

PASSIVE TRACKING & DIY

Google

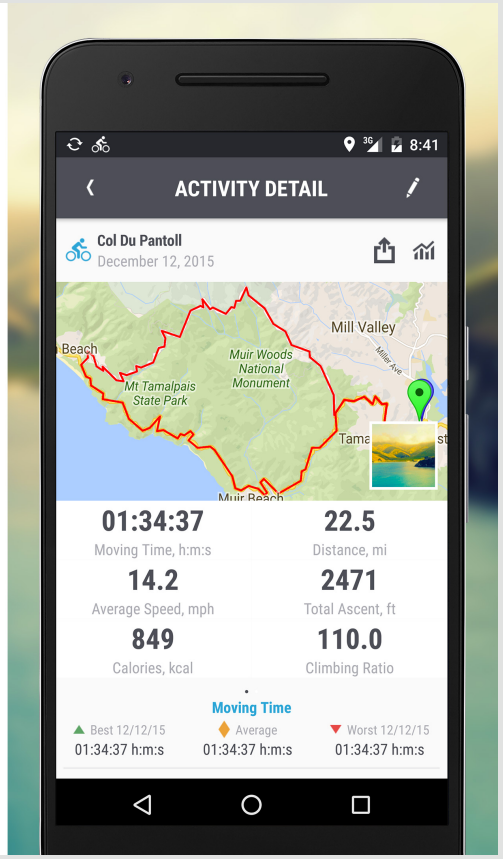
/ Track yourself by enabling timeline
/ Provides (limited) mode recognition



Information here

Strava

/ Datasets available for purchase
/ Self-selection?



Information here

Androsensor, Funf

/ Get access to a wide range of sensors

Androsensor, Funf

DATA | TRANSPORT SUPPLY

Public transport

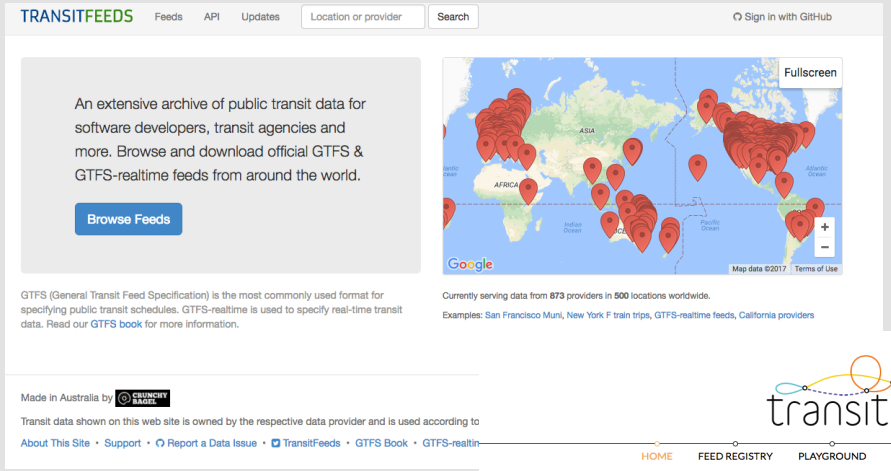
/ Generalized transit feed (schedule & real-time)

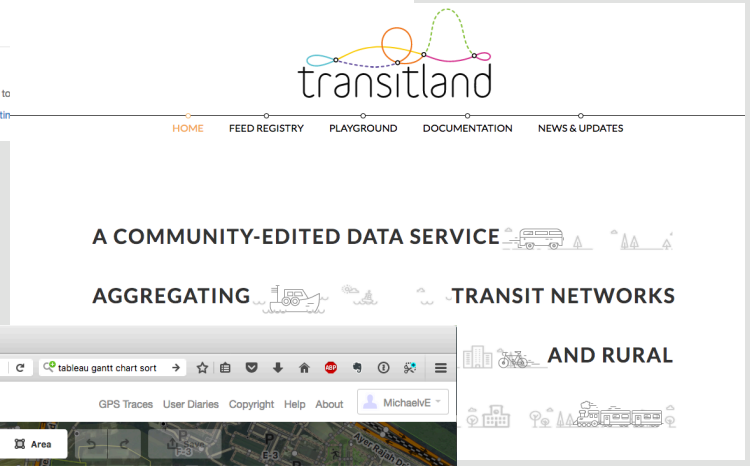
Roads

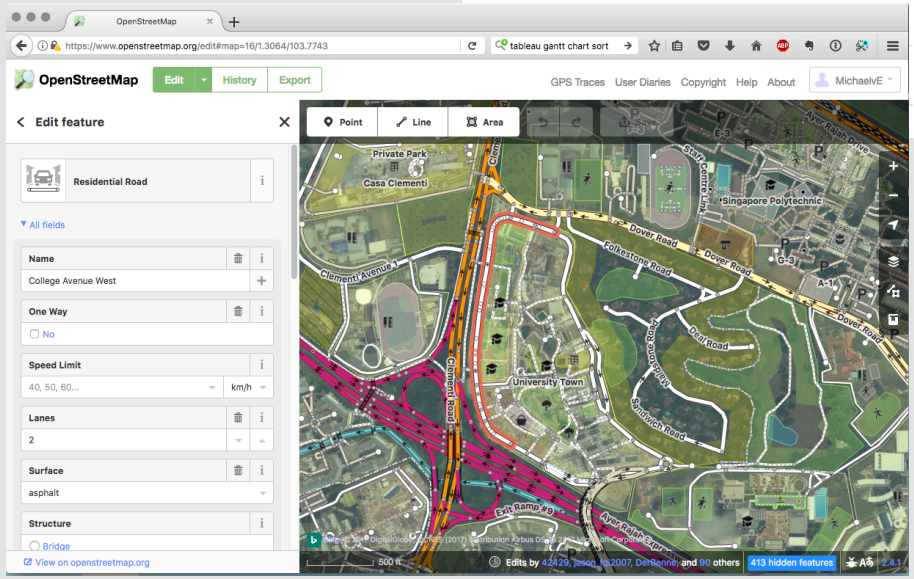
/ Teleatlas, Navteq
/ OpenStreetMap

Challenges

/ Capacity information (e.g. number of lanes)
/ Lacking speed restrictions (max speed)
/ Traffic light timings
/ Mobility services beyond public transport (e.g. bike share, Uber, Grab, company buses)







https://www.openstreetmap.org
http://transitfeeds.com/
https://transit.land/

DISRUPTION

DISRUPTION

CARGO DELIVERY

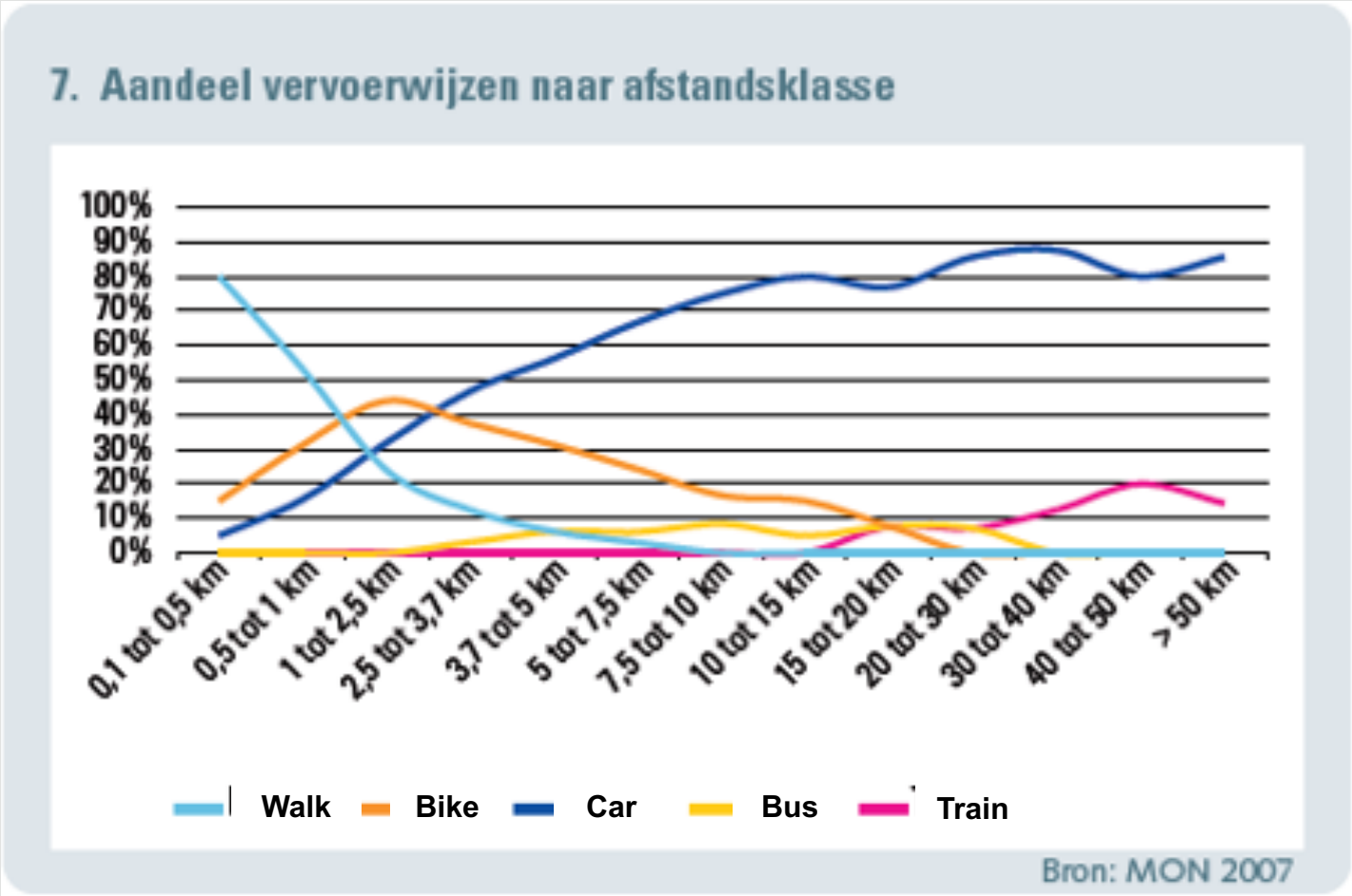
How the delivery economy is disrupting Philadelphia's street grid (2017) The Inquirer Philidelphia, http://www.philly.com/philly/columnists/inga_saffron/how-the-delivery-economy-is-disrupting-philadelphias-street-grid-20170608.html

Popstation @ Ang Mo Kio https://www.mypopstation.com/locations

DISRUPTION

E-BICYCLES

Now



Future: e-bicycles

< 2,5 km no increase

- 2,5 -5 km increase by 10%,
- 5- 7,5 km increase by 43%,
- 7,5-10 km increase by 23% and
- 10-15 km increase by 38%.

CROW (2012) E-bike kan fietsverkeer met meer dan 20% doen toenemen, http://kpvvdashboard-6.blogspot.sg/2012/09/e-bike-kan-fietsverkeer-met-meer-dan-20.html

DISRUPTION

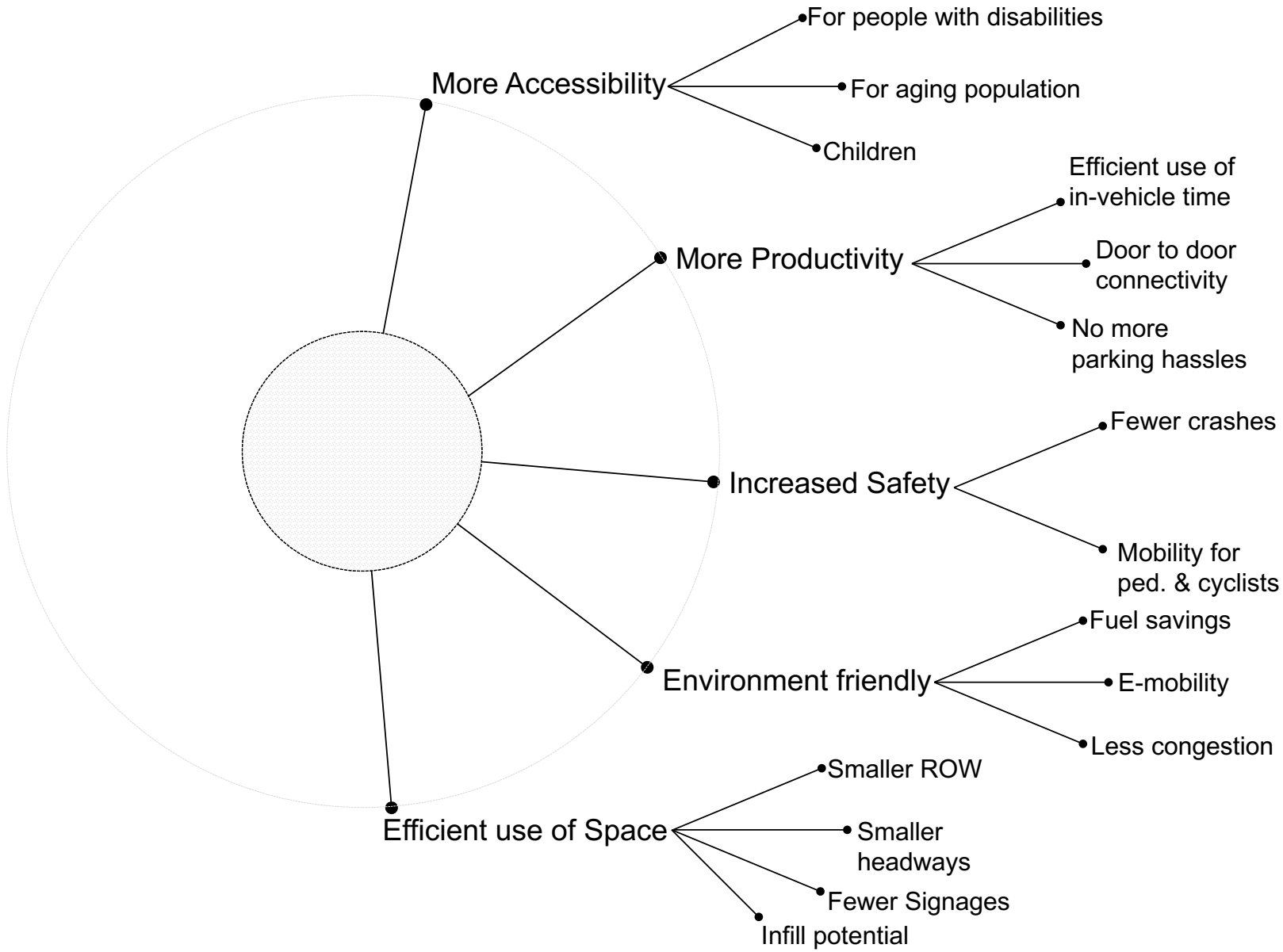
AUTONOMOUS VEHICLES

The Magic Highway“ (1958)

DISRUPTION

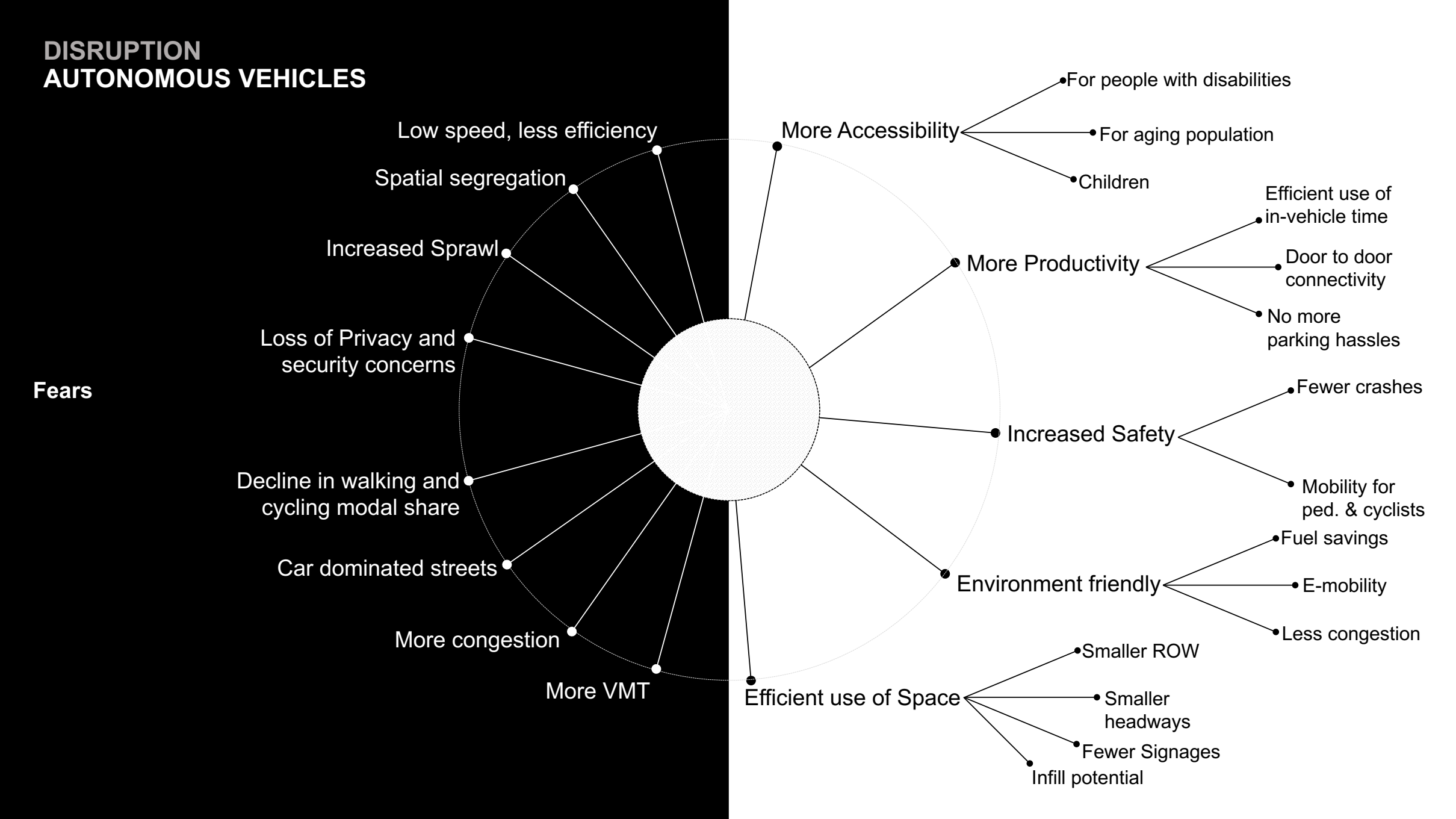
AUTONOMOUS VEHICLES

Potential Gains



DISRUPTION

AUTONOMOUS VEHICLES



DISRUPTION

LEVELS OF AUTOMATION

Level 0
Driver controls the car

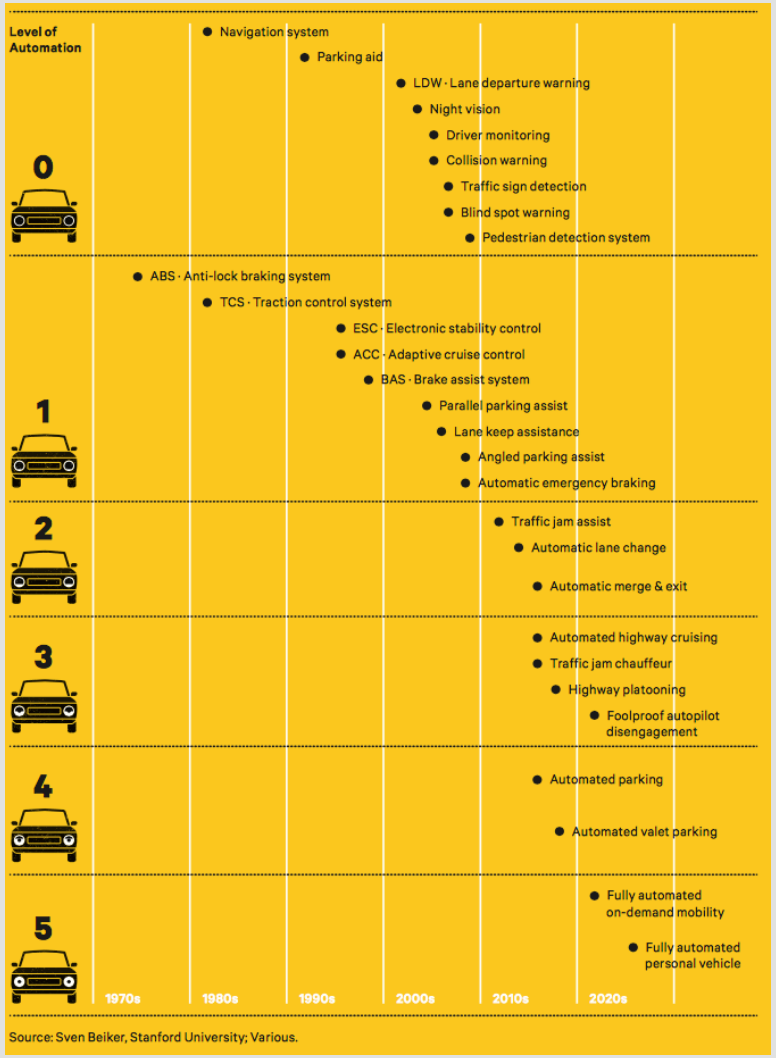
Level 1
Driver-assistance; specific functions can be done by the car

Level 2
One driver assistance system of both steering and accelerating using environment information is automated

Level 3
Drivers are still in the car, but can shift safety-critical features to the vehicle

Level 4
Fully autonomous under certain driving conditions

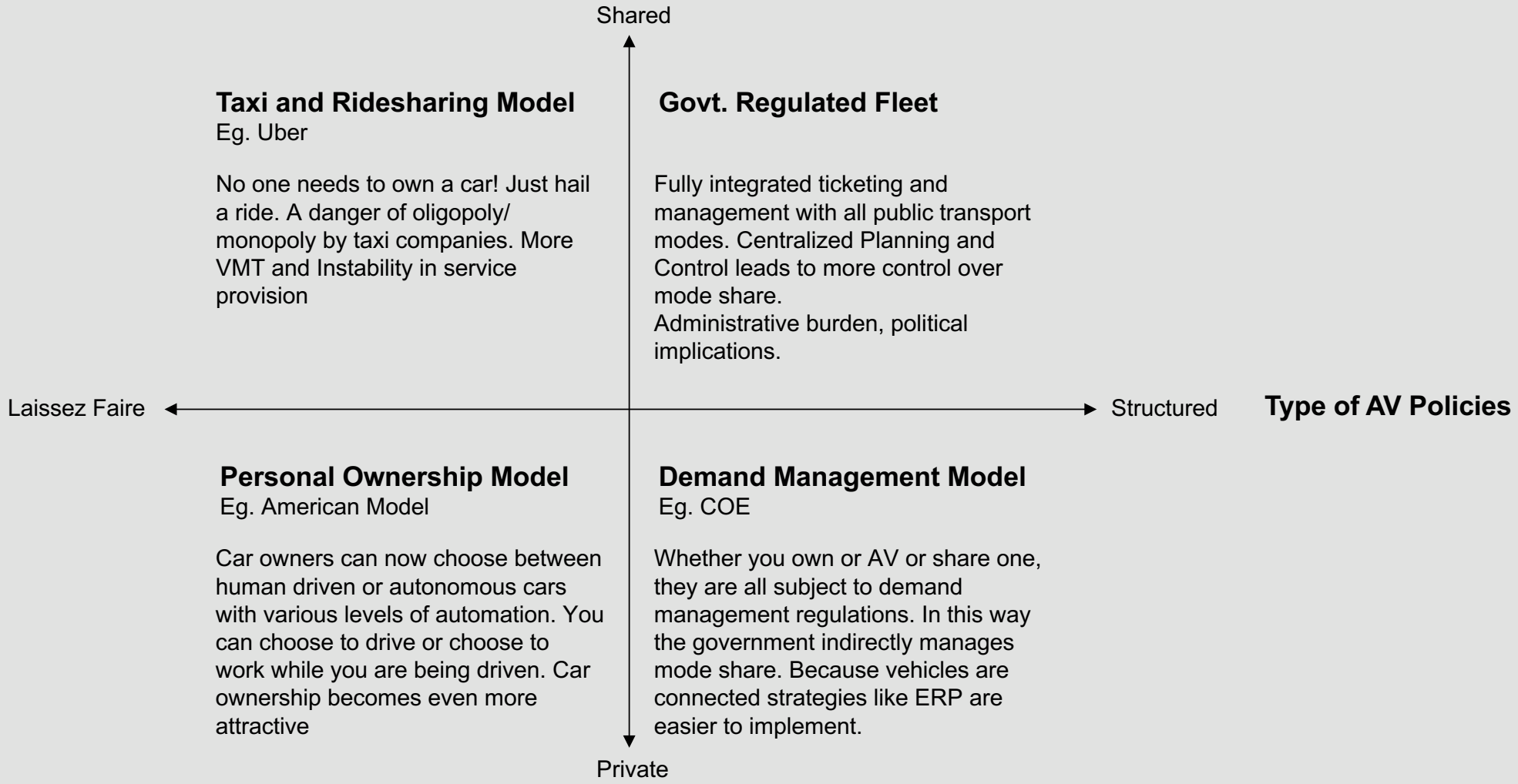
Level 5
Fully autonomous under all driving conditions



Anthony Townsend (2017) Taming the Autonomous Vehicle

DISRUPTION

OWNERSHIP MODELS



DISRUPTION

TYPES OF VEHICLES

Autovot / Taxibot

- Uber, GM/Lyft, nuTonomy
- 4
- 4,000–6,000 lbs
- 4–6 passengers
- 25–35 mph
- Pittsburgh, San Francisco, Singapore

Driverless Shuttle

- Navya, Local Motors, Easymile, Auro Robotics
- 4
- 6,000–8,000 lbs
- 10-12 passengers
- 25-35 mph
- Lyons, Helsinki, Washington D.C.

Deliverybot

- Starship Technologies
- 6
- 40–55 lbs
- 0 passengers
- 4 mph
- Talinn, London, Bern, Redwood City, CA, Washington D.C.

Software Train

- Otto (Volvo), Scania
- 18
- 33,000 lbs
- 44,000 lbs cargo
- 55 mph
- Colorado, Rotterdam, EU (various)

Anthony Townsend (2017) Taming the Autonomous Vehicle

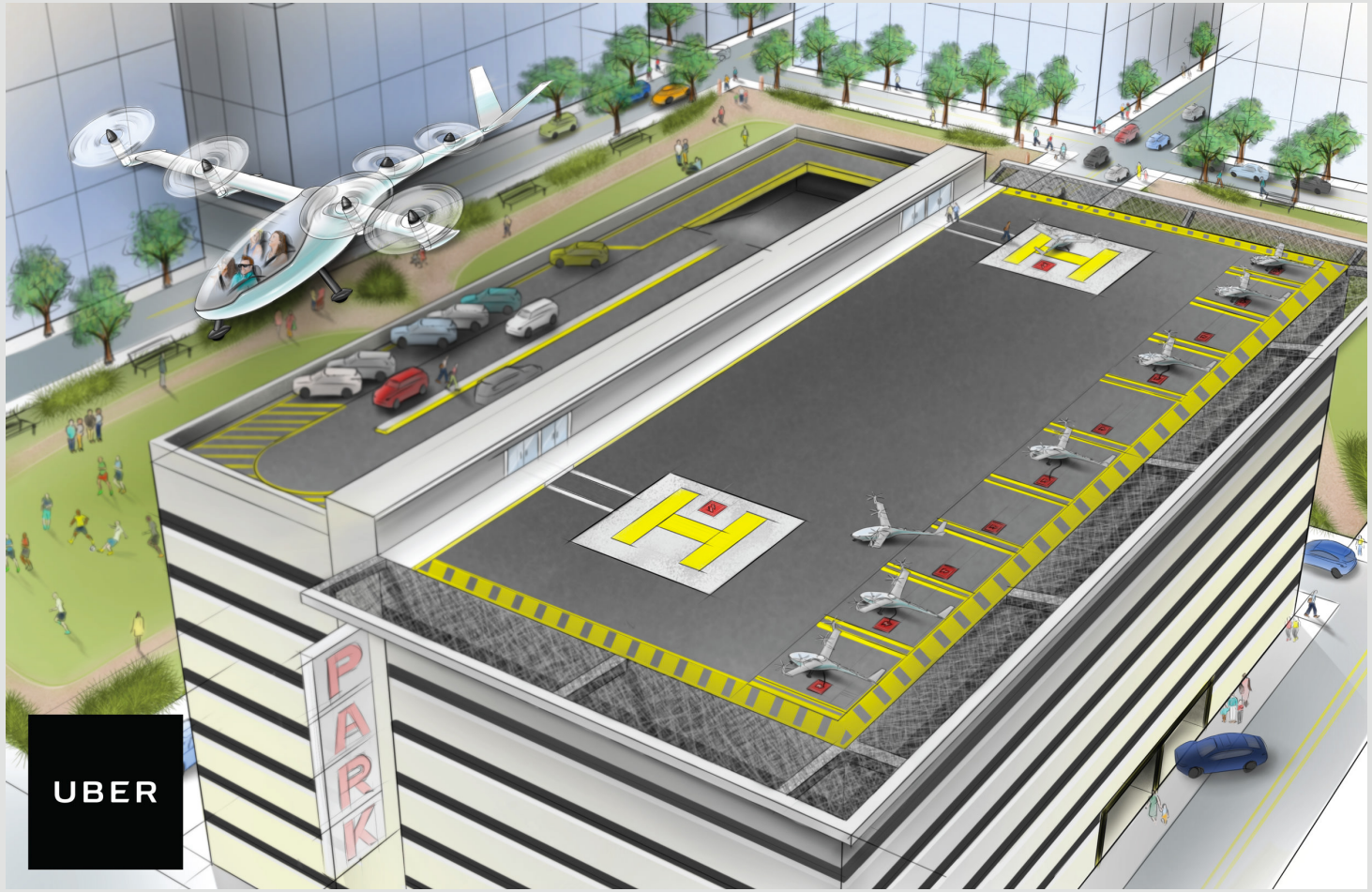
DISRUPTION

FLYING CARS

MOTIVATION

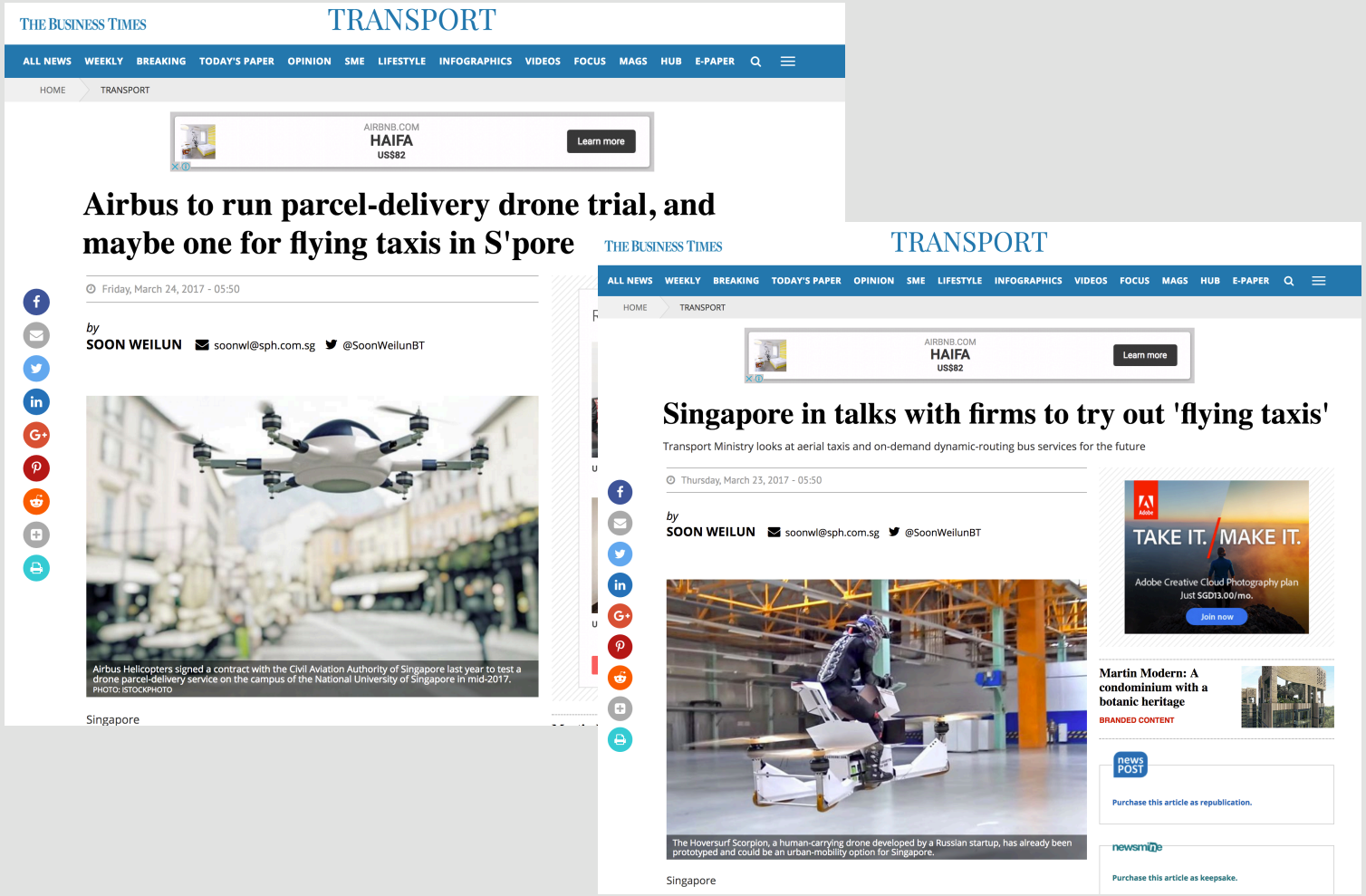
Flying taxis

- / Uber.com/elevate
- / It’s closer than you think
- / Low noise, safe, autonomous (after FAA approval), electric
- / Starting in 2020 in Dubai
- / Cheap retrofitting of existing parking structures
- / Typical expectation is reducing travel time by > 50%, door-to-door, of 60%+ of trips over 15km
  (depending on the city – see white paper)



MOTIVATION

- Attracting serious money (here)
- Big industry support (here)
- Uber is not alone (here)
- See, e.g., PM of MOT's vision of future SG (here)



THE BUSINESS TIMES TRANSPORT

ALL NEWS WEEKLY BREAKING TODAY'S PAPER OPINION SME LIFESTYLE INFOGRAPHICS VIDEOS FOCUS MAGS HUB E-PAPER

HOME TRANSPORT

AIRBNB.COM HAIFA US$82 Learn more

Airbus to run parcel-delivery drone trial, and maybe one for flying taxis in S'pore

Friday, March 24, 2017 - 05:50

by SOON WEILUN soonwl@sph.com.sg @SoonWeilunBT

Airbus Helicopters signed a contract with the Civil Aviation Authority of Singapore last year to test a drone parcel-delivery service on the campus of the National University of Singapore in mid-2017. PHOTO: ISTOCKPHOTO

Singapore

THE BUSINESS TIMES TRANSPORT

ALL NEWS WEEKLY BREAKING TODAY'S PAPER OPINION SME LIFESTYLE INFOGRAPHICS VIDEOS FOCUS MAGS HUB E-PAPER

HOME TRANSPORT

AIRBNB.COM HAIFA US$82 Learn more

Singapore in talks with firms to try out 'flying taxis'

Transport Ministry looks at aerial taxis and on-demand dynamic-routing bus services for the future

Thursday, March 23, 2017 - 05:50

by SOON WEILUN soonwl@sph.com.sg @SoonWeilunBT

The Hoversurf Scorpion, a human-carrying drone developed by a Russian startup, has already been prototyped and could be an urban-mobility option for Singapore.

Singapore

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Martin Modern: A condominium with a botanic heritage

BRANDED CONTENT

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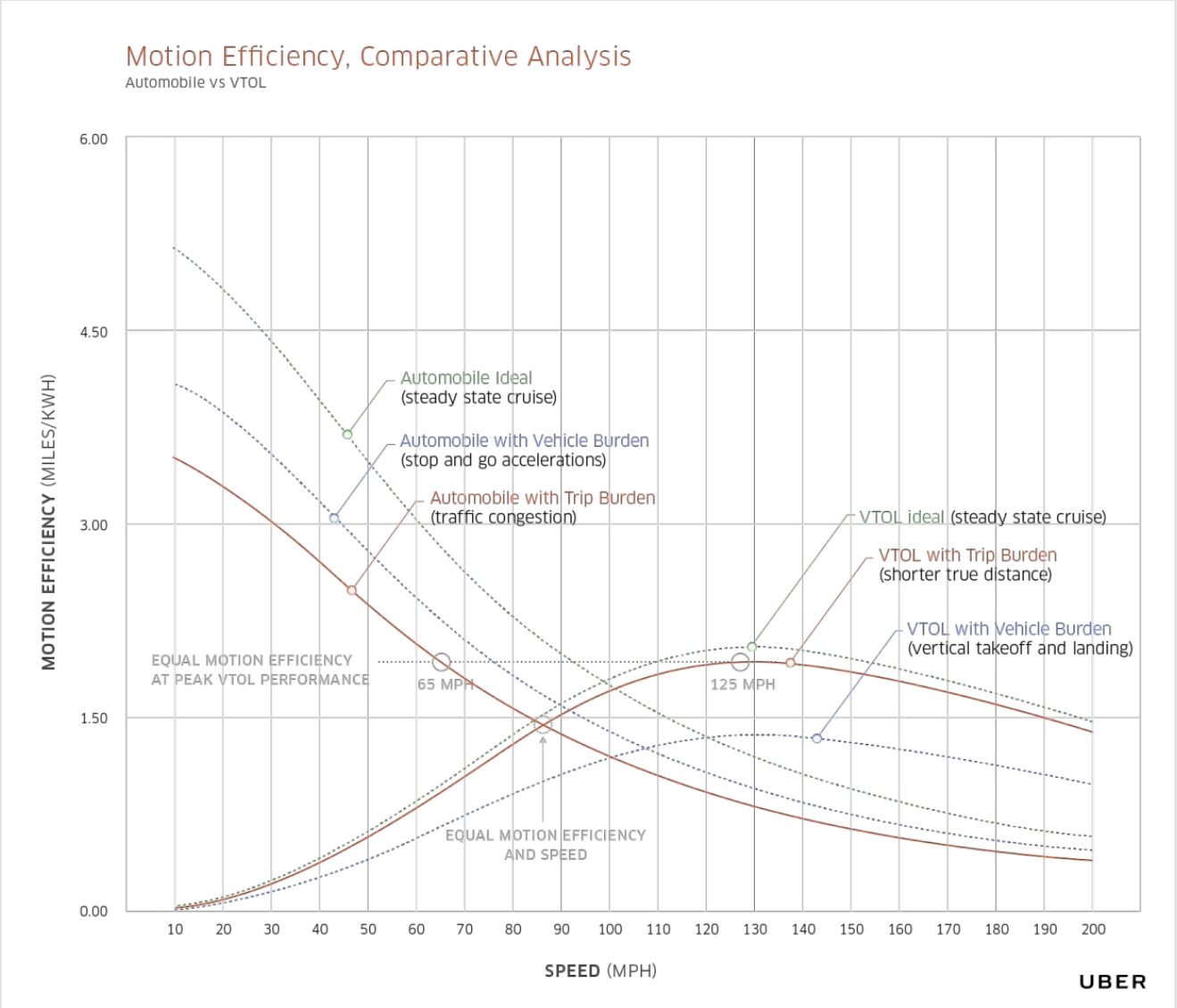
IMPLICATIONS

- / Longer distance trips due to dynamics and efficiency
- / (Implication on share of those trips..?)
- / SG implication (high speed rail)
- / The comparison is about speed, but does not highlight the implication on trip distance
- / Transport equity



IMPLICATIONS

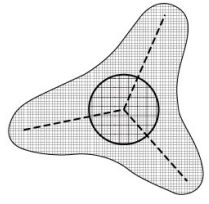
Walking-Horsecar
1800-1890

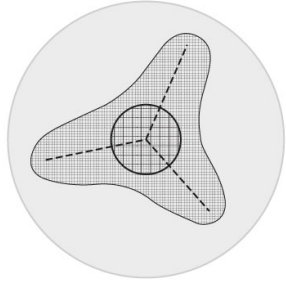
Electric Streetcar
1890-1920

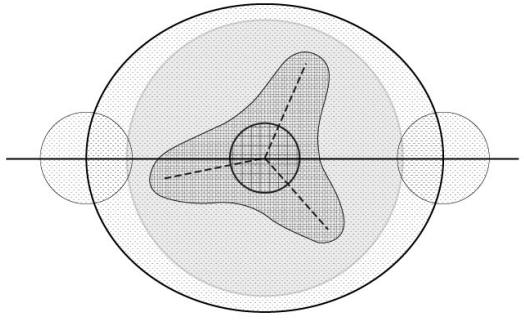
Recreational Automobile
1920-45

Freeway
1945-Present

Future





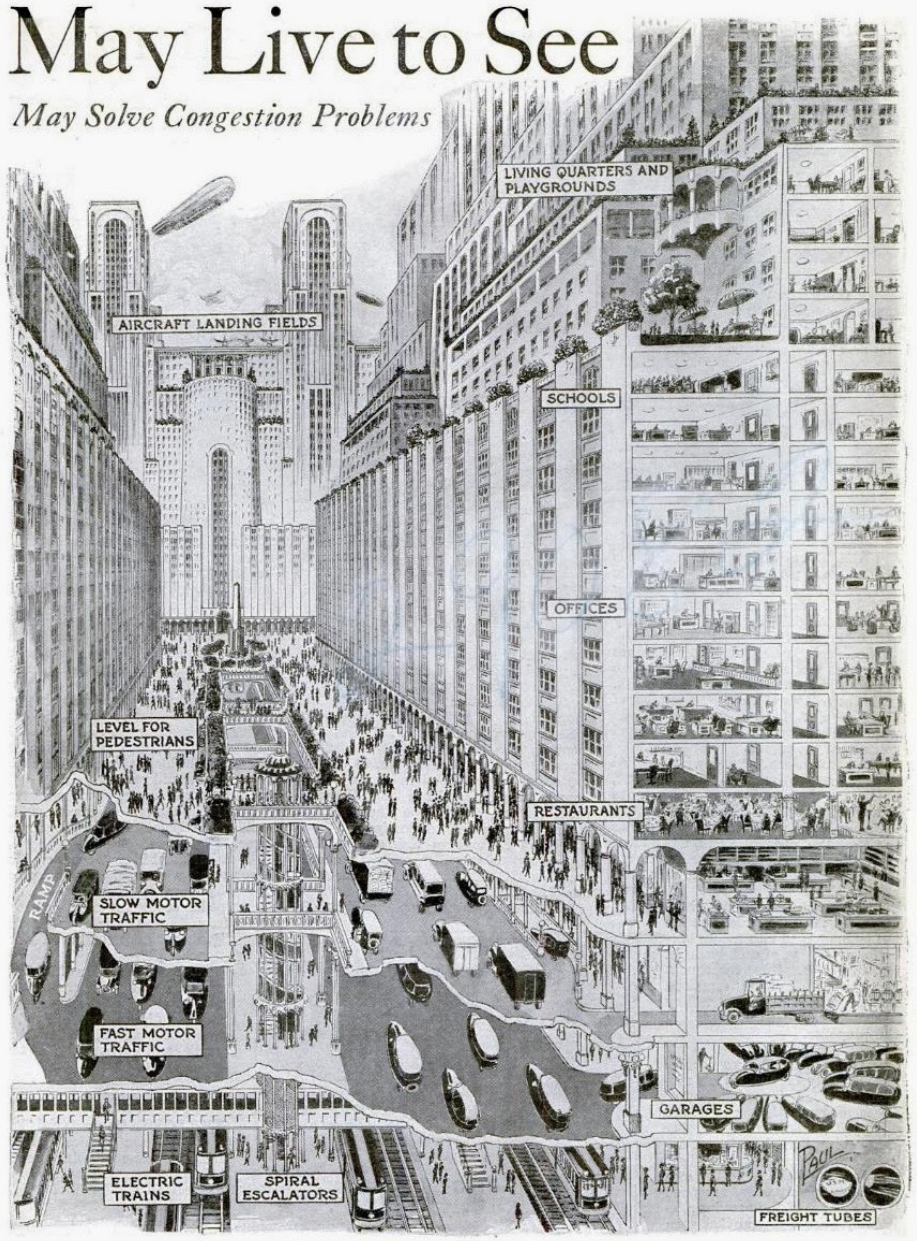


Pictures:
http://s.picture-russia.ru/wpic/l/9/b/9bc4c2405b56fcc00df114add273aaa5.jpg
https://www.6sqft.com/worlds-first-streetcar-began-operation-in-lower-manhattan-on-november-14-1832/
Diagram adapted from Peter O. Muller's Transportation and Urban Form

Corbett style cities, taken from here

May Live to See

May Solve Congestion Problems



How You May Live and Travel in the City of 1950

Future city streets, says Mr. Corbett, will be in four levels: The top level for pedestrians; the next lower level for slow motor traffic; the next for fast motor traffic, and the lowest for electric trains.. Great blocks of terraced skyscrapers half a mile high will house offices, schools, homes, and playgrounds in successive levels, while the roofs will be aircraft landing-fields, according to the architect's plan

Source: Ministry of Transport

DISCUSSION

- Let's assume it happens, and price drops to existing taxi prices (Uber's ultimate vision)
- What are the implications for urban development?
- Consider speed, cost of development compared to rail infrastructure
- Anticipate collective human reaction to disruptive transport tech
- Consider implications of 1950s decisions still today when faced with similar situation

- In groups of 5-8, discuss and sketch out the dystopian and utopian mind-map visions of a future where aerial mobility is a reality, such as the example on the right for autonomous vehicles
- Consider context (1 ea. group?):
  - Asian cities, e.g. Jakarta, Manilla, Bangkok
  - Regional development & integration e.g. Indonesia, Sijori
  - US suburbs
  - Africa
  - …
- Social and psychological factors
- Does zero emissions imply zero environmental impact?

RECOMMENDED READINGS & REFERENCES

Littman, Todd (2017) Evaluating Accessibility for Transport Planning Measuring People's Ability to Reach Desired Goods and Activities, available here

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