FUTURE OF STREETS

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N Vermont Ave, Los Angeles
Current Condition
Vermont / Santa Monica Station, LA
Image: Foteini Bouliari
Autonomous Vehicles

Hell

Heaven
HELL
Vermont / Santa Monica Station, LA
Image: Foteini Bouliari

- Pick-up/Drop off lot
- Exclusive AV freeway
- Railings to prevent pedestrian crossings
- Pedestrian Overpass
- Broken down AV blocking a lane of traffic
- Abandoned transit stop
- Drive-through restaurant
Heaven
Vermont / Santa Monica Station, LA
Image: Foteini Bouliari

New infill building   Active retail facades   Shared AV pickup/drop-off zones
Elevated intersection   Continuous bike lanes
New trees and street vegetation
Restaurant with outdoor seating
Shared AV pickup/drop-off zones
Elevated intersection
Continuous bike lanes
New trees and street vegetation
Restaurant with outdoor seating
Amara’s Law

We tend to overestimate the effect of a technology in the short run and underestimate it in the long run...
Amara’s Law

Ford Model T 1908

Federal Highway Act 1956

GI Bill 1944

Uber 2018
Disruptive transportation technologies

Shared

Autonomous

Electric
Transportation technologies in the making

Source: Comet Labs / Wired.
GM planning to launch its commercial driverless electric taxi service in SF next year. Many others are competing...

But autonomous operations in complex urban environments still years away...
Disruptive transportation technologies

Shared

Autonomous

Electric

Livable streets?

- Sustainability goals
- Multimodal mobility
- Economic development
- Spatial equity
Future of Streets research project at Harvard

Mobility firms, OEMs, TNCs

Harvard University
Graduate School of Design

Public Sector

Infrastructure and public space design, engineering
The project explores the future of urban mobility and access along three key dimensions...

1. How could new street-based infrastructure projects for shared, electric, and autonomous vehicles affect accessibility on other modes, particularly walking, biking, and public transit, as well as alternative uses of streets for social, commercial, and cultural activities and interaction?

2. What impact could street modifications for new mobility technologies have on land values, residential displacement, and by extension, broader spatial accessibility to urban amenities, services, and resources among different socio-economic groups?

3. What policy options, planning templates, and political strategies can help cities promote adoption of new street-based mobility solutions that maximize multi-modal, socially inclusive, and environmentally sustainable outcomes?
Evolution of streets

1900

2000

2050?
GM Futurama exhibit at 1939 World Fair, in NY
Technological Utopia?
Car-centric dystopia
Boston, MA
How do we foster street-based mobility solutions that maximize multi-modal, socially inclusive, and environmentally sustainable outcomes?
Streets are not just for mobility
Anderson (1984)

1. Space of public claim
2. Space of occupational claim
3. Space of private claim
Occupiable realm
Many functions of streets
Automated Taxi VS Personal Car: 20-year Cost Projection
Ref: Current TNC cost ~ $2 / mile

Source: Rocky Mountain Institute. Peak Car Ownership.
How will ‘robotaxis’ affect streets?

- Personally owned cars stand parked 95% of time. Automated TNCs will keep their fleet running as much as possible.

- Less cars and parking spaces needed to service the same nr of trips.

- But due to lower cost, VMT will considerably increase.

- Paradoxically, a city with fewer cars will have more traffic on streets.

- Lower personal mobility costs will expand cities and produce more sprawl on the edges.

- Since AVs are unable to engage in eye-contact and body language with pedestrians and bicyclists (like human drivers do), their operators will demand exclusive lanes for AVs, where people can’t step on roads.

- Combined with more trafficked roads, this will produce a significant threat to pedestrian and bike accessibility that cities need to push back against.
Space needed to transport 48 people

Bus

Bike

Car

Source: Bicycle promotion fund
Space needed to transport 48 people

Car

Electric Car

Automated Car
Modal capacity
Maximum people per 9ft lane per hour per direction (w/o uncomfortable congestion)

Car-based mobility solutions can not service high-density environments.

- Walk: 10,000
- Bikes: 10,000
- Cars: 2,000
- Bus: 6,000
- Light rail and BRT: 11,000
- Heavy rail and metro: +25,000
Urban mobility beyond the car

a. Destinations to walk to around home and work, with comfortable and safe walking routes.
b. AVs expand the list mile to the last 3 miles
c. Longer trips serviced by public transit.
Three competing AV futures

Private
high cost
no share

Fleet
medium cost
medium share

Public
low cost
high share
Three competing AV futures

**Private**
- high cost
- no share

**Fleet**
- medium cost
- medium share

**Public**
- low cost
- high share
Singapore to run an automated on-demand feeder bus servicing metro stations in three public housing towns by 2020.
“I think public transport is painful. It sucks. Why do you want to get on something with a lot of other people, that doesn’t leave where you want it to leave, doesn’t start where you want it to start, doesn’t end where you want it to end? And it doesn’t go all the time. It’s a pain in the ass, that’s why everyone doesn’t like it. And there’s like a bunch of random strangers, one of whom might be a serial killer, OK, great. And so that’s why people like individualized transport, that goes where you want, when you want.”

Elon Musk
Exclusive lanes?
How could street-based mobility solutions maximize multi-modal, socially inclusive, and environmentally sustainable outcomes?
NACTO Blueprint for Autonomous Urbanism

- Zero Emissions Vehicles
- Access for All Ages and Abilities
- Affordable, Reliable and Frequent Mobility
- Slower Speeds, Safer Streets
Newbury Street, Boston
Current Condition
Newbury St, Boston
Image: Chenglong Zhao

- Bus Stop
- Street Parking
- Active retail facades
- Four-way Crossing
- Traffic Light
- Outdoor Seating
Pedestrian Overpass
Stalled AV
Pick up / Drop off area
Exclusive AV Lane
Narrow Sidewalks
Road Separation
Concrete Railing
Heaven
Newbury St, Boston
Image: Chenglong Zhao

Extended Sidewalks
8ft AV lanes
New trees and street vegetation
Bike/AV Separation
Two Way Bike Lane
AV Bus Stop
Bicycle parking
Pick up / Drop off area
Diagonal crossing
Outdoor Seating
Active retail facades
Instead of having the car industry direct urban development (again), what if we instead thought about the kind of a city we want and then prioritized mobility systems that lead us there?
Continue to enforce modal hierarchies that prioritize active and public transportation:
Importance of jaywalking
Estimated walks between retailers
N Vermont Ave, LA

w/o jaywalking
35.5
Estimated walks between retailers
N Vermont Ave, LA

with jaywalking 41.1

If we allow jaywalking, pedestrian accessibility between retailers improves by +30% on avg!
Importance of jaywalking
Data most cities have: road networks
Data we need for a more holistic picture

Category counts:

391 pedestrians
  342 walking
  38 standing
  3 baby strollers
  8 running

7 cyclists

14 passenger cars
  1 truck
  4 buses
Curb space management
Real-time curb space management
Ref: Sevtsuk 2007

**Scenario 1**
Drivers can reserve open parking spaces.

**Scenario 2**
Only nearby drivers are guided to their nearest open parking spaces.
Effect of demand and supply balance
(6 parking spaces)

- Reservations Scenario 1
  - 6 cars: 17.11
  - 24 cars: 214.77

- Dispatch to nearest Scenario 2
  - 6 cars: 14.14
  - 24 cars: 46.47

Avg search time
AV Threats

A sharp decrease in the per-mile travel costs on shared, electric AVs could produce a significant increase in car-based travel, contributing to congestion.

Opportunities

Discourage private vehicle ownership and encourage a transition to shared, pooled AVs.

Example policies

Singapore’s Certificate of Entitlement (COE) policy requires each vehicle to have a 10-year COE, which are auctioned to the highest bidder. Whereas COEs were previously capped at a 1% annual increase, they are now frozen at a 0% increase.

AV Threats

A price decrease in shared, eclectic robotaxis could also lead to a significant increase in vehicle miles travelled.

Opportunities

Implement a distance and time-based AV pricing system that encourages shared and public transit ridership.

Example policies

Singapore is implementing a next-generation GPS-based electronic road pricing system, where vehicles miles are taxed city-wide, depending on the level of congestion: https://www.lta.gov.sg/apps/news/page.aspx?c=2&id=0bd76988-3c70-4b1f-9b68-65bb7fb47d56

London and Stockholm have their own electronic congestion charging systems.
AV Threats

An increase in privately operated transport mode share makes it difficult for the public sector to plan urban transport.

Opportunities

Require that all Transport Network Companies (TNCs) share trip origin-destination data anonymously with public sector agencies.

Example policies

NACTO’s SharedStreets data standard lets companies and cities seamlessly exchange information, bridging previously incompatible formats for public and private use: [http://sharedstreets.io](http://sharedstreets.io)
AV Threats

Transport network companies (TNCS) and “robo-taxis” will decrease public and active transport mode share.

Opportunities

Incentivize multi-modal mobility, where TNCs and “robo-taxis” work as feeders to heavy-rail, light-rail and bus transit systems.

Example policies

Public transit subscription passes, such as the Oyster Card in London, are extended with appropriate price incentives to bike-share and car-share programs for last-mile coverage. For instance, Pittsburg’s ConnectCard users already get a 15-minute free ride on the city’s bike-share system: https://healthyridepgh.com

Implement EV and AV technology in public transit systems.


Andres Sevtsuk, PhD | University of Minnesota CTS | AVs in Minnesota | Harvard GSD City Form Lab | slide 55 of 62
AV Threats

Automated vehicle technology faces significant difficulties when it comes to interactions with pedestrians and bicyclists. AV operators will start demanding exclusive driving lanes and heavy fines for jaywalking.

Opportunities

Ensure that public transport, pedestrians and bicyclists are prioritized in the modal hierarchy of transport planning and public space design.

Example policies

A number of cities prioritize transit, walking and biking over cars. Automated vehicles are still vehicles and should still be subjected to the same design constraints as human-driven vehicles. NACTO and IDTP promote human-centric street design guidelines to cities around the World:

- [https://nacto.org/publication/urban-street-design-guide/](https://nacto.org/publication/urban-street-design-guide/)
- [https://www.itdp.org/publication/walkability-tool/](https://www.itdp.org/publication/walkability-tool/)
AV Threats

TNC drivers are double-parking, causing congestion and accidents.

Opportunities

Develop designated pick-up and drop-off stations on every block, with variable capacity.

Example policies

Transport for London has invested significantly into new bus and taxi waiting shelters that provide weather cover and real-time information displays: [https://trueform.co.uk/products/tfl-bus-stops/](https://trueform.co.uk/products/tfl-bus-stops/)
**AV Threats**  
TNC based AVs will cause cities to lose significant parking revenues, further threatening public transit funding. Cities cannot introduce taxes to compensate.

**Opportunities**  
Implement curb-side pick-up and drop-off fees, where price varies by location.

**Example policies**  
San Francisco uses dynamic pricing in street parking, where price is determined based on the level of demand. A similar system can be adapted for pick-up and drop-off stations: [http://sfpark.org](http://sfpark.org)
AVs entering sidewalks too...
Planning AVs holistically

**Traffic paradigm**
Planning for vehicular throughput.

**Mobility paradigm**
Planning for multi-modal transport.

**Accessibility paradigm**
Planning jointly for multi-modal transport, land uses, urban form as well as demographics.
Conclusion

• AVs will increase mobility at a lower cost, but unless we continue to prioritize active and public transit and regulate AVs and TNCs, we might be headed back to an automobile-centric city development paradigm.

• Capturing the “heaven” scenario with AVs requires proactive policy and planning NOW.

• Promoting public transit and active mobility are essential to livable cities. AVs could also become part of the public transit network.

• Cities need to maintain sight of the bigger picture – accessibility not traffic or mobility – and coordinate transport, urban form and land uses together.
Thank you!

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