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CENTER for URBAN TRANSPORTATION RESEARCH

Impacts of Transportation Network Company (TNC) and Autonomous Vehicles

CUTR Webinar, Thursday, October 1, 2015

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We are in Perhaps the Most Transformational Period in Transportation Since the Development of Personal Vehicles

- **Demographics**
- **Economics**
- **Technology**
- **Governance**
- **Culture/values**

Transportation Network Companies (TNC)

TNC – a company that leverages smart phone aps to hail livery services. Sometimes referred to as e-hailing or ridesourcing. Not Ridesharing

Offers real time information on arrival, electronic payment, electronic customer feedback. Personified by **Uber** and **Lyft** but dozens of such app-based services exist across the globe.

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Automated/Connected Vehicles

Automated Vehicles - Vehicles where some or all of the driver functions are replaced with technologies. Potentially connected with other vehicles and the infrastructure.

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Very smart people have very different opinions on the pace of implementation, market acceptance, and impacts of technology in transportation

Auguste Rodin's ***The Thinker*** *contemplates the impact of artificial intelligence as represented by the IBM Watson icon.*

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But, folks are hungry for answers

And in an absence of information speculation is running rampant.

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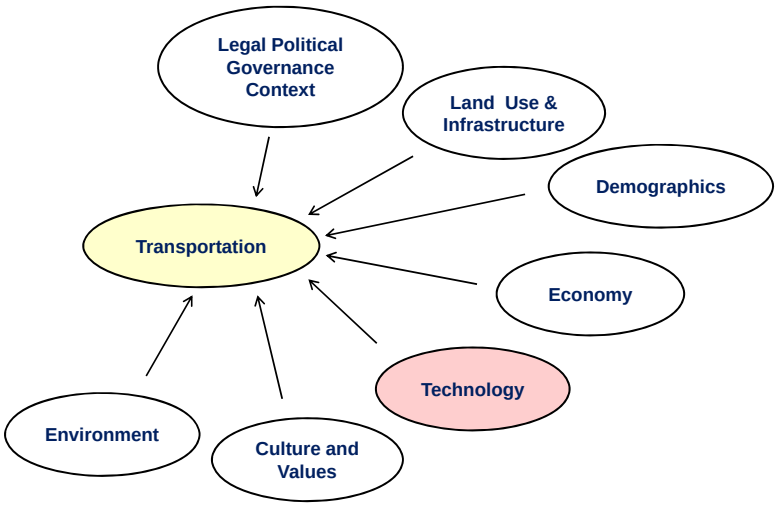
Everything Affects Transportation and Transportation Affects Everything



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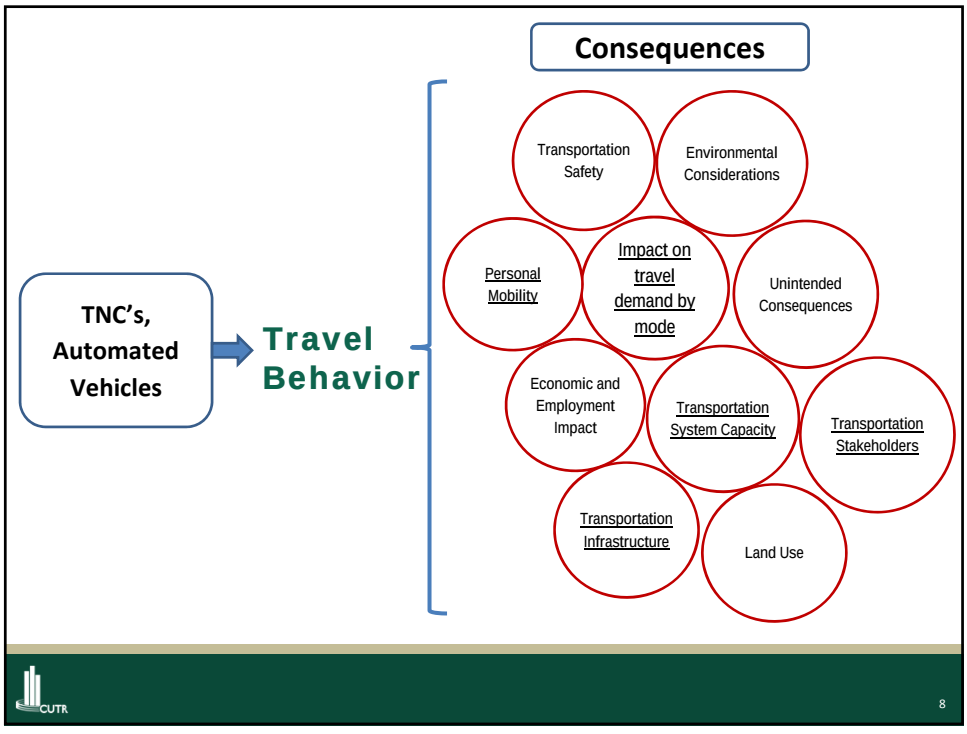

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Social and Economic Interactions Create Demand for Travel

Time

Growth in

- Income
- Knowledge

Specialization in

- Employment
- Consumption
- Social relationships
- Time use

Growth in

- Person Travel
- Communication
- Commerce

A Fundamental Need to Travel

❖ Travel is fundamental to the human desire to interact and socialize and pursue personal betterment through commerce.

❖ While people do not necessarily aspire to travel they do aspire to do things that require travel.

❖ Travel enables economic interaction and the transportation of products and is fundamental to the functioning of the economy.

Travel and Economic Theory are Clear

- Better/lower cost mobility means more travel
- More travel means better quality of life for travelers – greater employment access, access to more and better education, services, products, etc.
- And **society benefits if** externalities of more travel (congestion, air quality, energy use, safety, etc.) do not offset the benefits of greater mobility

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Technology is Already Impacting Travel Behavior

- Navigation systems minimize circuity
- Cell phones enable productive use of travel time
- Electronic toll payment reduces travel delays
- Information systems (in vehicle and road signage) minimize travel delays
- Etc.

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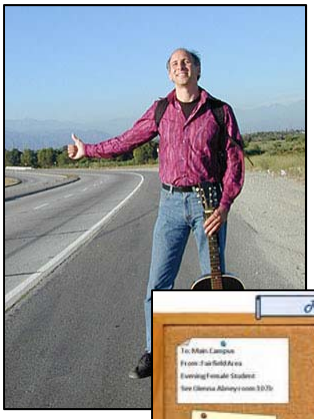
Communication Substitution for Travel

- E-commerce
- Distance learning
- E-banking
- Social media in lieu of visits
- Electronic retrieval of music, video, books, etc.
- Webinars and online meetings

Will TNC's and Autonomous Vehicles Turn Transportation on its Head?

UBER

Securing Rides is Not New



So What Will Happen in the Future?

"Prediction is very difficult, especially if it's about the future."

Niis Bohr, Nobel laureate in physics

Technology Implementation is Not Easy

August 13, 2015

THE TAMPA TRIBUNE

BELOW THE FOLD

Uber drives home its point

Ride-hailing company's drivers rally in Tampa

Lawyers sue to shutter Tampa red-light cameras

Group, including attorney who beat other Florida systems, says they're illegal

Ex-Bay Pines staffers claim cover-up, harassment

They believe Lugtons was silenced after complaint in hospital

Cuba dissidents won't be at Havana flag-raising

Kerry will meet with chairs after he opens U.S. Embassy

Bucs cornerbacks could make a big impact this season

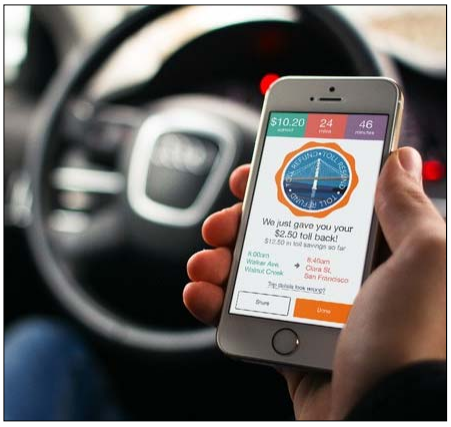
Markets rebound from drop spurred by yuan devaluation

Transportation Network Companies (TNC)

How are We Doing Implementing New Technologies for Transportation?

- Next Generation Air Traffic Control
- Positive Train Control
- Red Light Cameras
- VMT Fees for Vehicle Use
- Electronic Toll Collection
- Smart Card Fare Systems
- Automatic Passenger Counting Systems
- Real Time Transit Information
- Smart Signal Systems

Technology

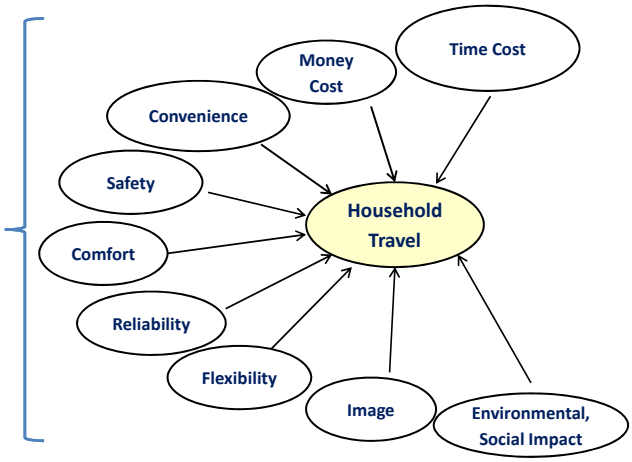


- Powerful global positioning satellites
- Ubiquitous wireless communication capability
- Powerful portable computing
- Powerful web computing capability for pathfinding and optimization
- Sophisticated sensors
- Artificial intelligence/ machine learning

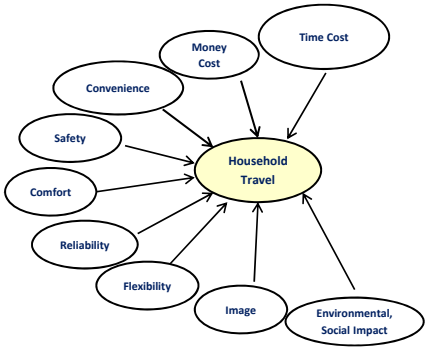
Integrated with new materials, designs, propulsion systems, etc.

Factors that Influence Travel Behavior

- Real time information
- Electronic payment
- Matching services
- Trip planning
- Trip scheduling
- Navigation/trip tracking
- Electronic hailing
- Trip aggregating /ride matching
- Dynamic pricing
- Electronic satisfaction feedback

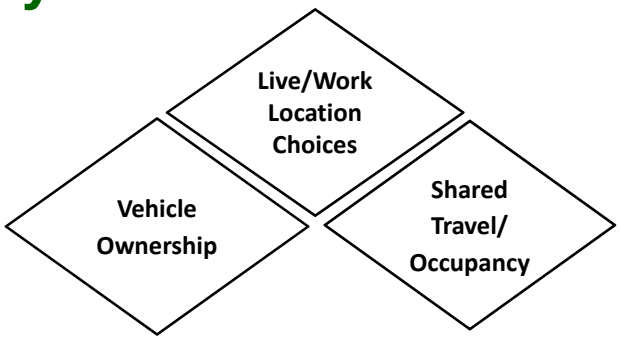


Factors that Influence Travel Behavior



1. Number of trips made (trip generation)
2. Destination (trip distribution)
3. Mode choice
   - Drive personal car
   - Ride with family/friend
   - Taxi
   - Ridesourcing, e-hailing
     - Uber, Lyft, Sidecar
   - Rideshareing
     - Carma, eRideShare
   - Carsharing
   - Personal bike
   - Bikesharing
   - Transit
   - Transit Alternatives/Feeders "microtransit"
     - Bridj, ~~Leap~~, MetroBee, TransLoc
   - Walk
4. Path (assignment)

Impacts of Technology is Highly Dependent on Three Key Decisions



The Vehicle Ownership Decision

- Average car driven about 10,000 to 12,000 miles per year
- About one hour per day at an average of 30 mph
- About 13+ million new vehicles purchased by households annually
- Households own about 215 million vehicles
- Avg. life of 17 years and 163,000 miles before scrapping
- Households responsible for about 2.25 trillion VMT annually
- U.S vehicle fleet valued at over 2 trillion.

Household Vehicle Ownership Distribution

HH Vehicles	National Household Vehicle Ownership Distribution, 2009					
	Number of Adults in HH					
	1	2	3	4	5+	All
0	3.49%	1.12%	0.15%	0.04%	0.01%	4.80%
1	17.29%	8.94%	0.62%	0.12%	0.02%	26.99%
2	3.72%	34.89%	2.10%	0.34%	0.05%	41.10%
3	0.77%	12.56%	3.75%	0.59%	0.07%	17.75%
4	0.20%	3.63%	1.50%	0.73%	0.10%	6.17%
5+	0.12%	1.72%	0.75%	0.44%	0.17%	3.20%
All	25.59%	62.84%	8.86%	2.27%	0.43%	100.00%

2009 NHTS

5% no veh

13% veh < than adults

57% veh = adults

25% veh > adults

Ownership Not Just a Mobility Decision

Functional transportation

Ego

Investment

Hobby

Image

Entertainment

Transportation plus?

Vehicle Ownership and the Mode Choice Decision

Fully Amortized Auto Operating Cost	$0.575/ mi.	
Maintenance and Operation	$0.23	Auto owners "feel" $0.14 per mile costs in mode choice decision
Out of Pocket	$0.14	
Source: IRS		
BLS Consumer Expenditure Survey	$0.44/ vmt	
	$0.26/ pmt	
Transit fares	**~ $0.25/mi**	
TNC	**~$1.00-1.50/mi**	
(sequentially shared vehicle, not concurrently shared ride)		
Automated Vehicle	**~<$0.20-????**	

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Factors Influencing Vehicle Ownership or Sharing Decision

- Special equipment or use of vehicle:
  - car seats
  - tools
  - hitch, bike/roof rack
  - work or personal equipment/materials/inventory
  - Personal items, golf clubs, change of clothes, emergency equipment, etc.

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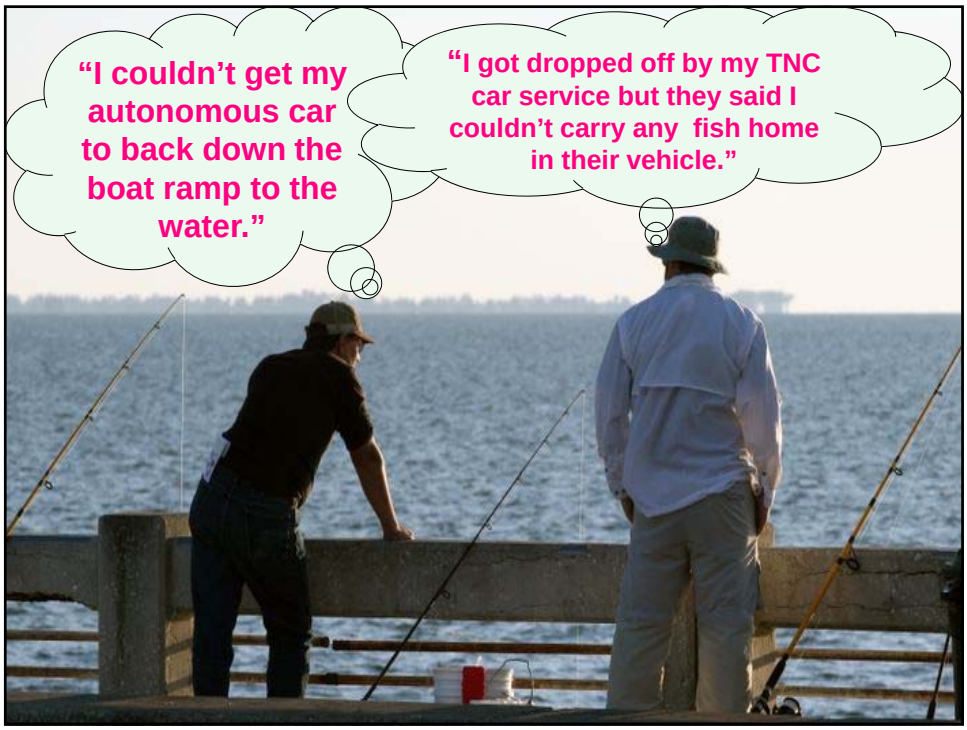
Factors Influencing Vehicle Ownership or Sharing Decision

Criticality of having vehicle immediately available:

- pregnant spouse, fragile infant, fragile household member
- need to evacuate – hurricane, wildfire, flood
- Exurban – remote location impeding prospect of conveniently available shared vehicle
- Special vehicle requirements – greater than 4 passengers, wheelchair ramp, etc.



It remains to be seen what share of households would be willing to relinquish one or more vehicles.

Vehicle Ownership

Key Decisions

Live/Work Location Choices

Land Use Impacts

Drive till you qualify becomes nap till you qualify?

Or do new technologies make urban living more convenient and affordable?

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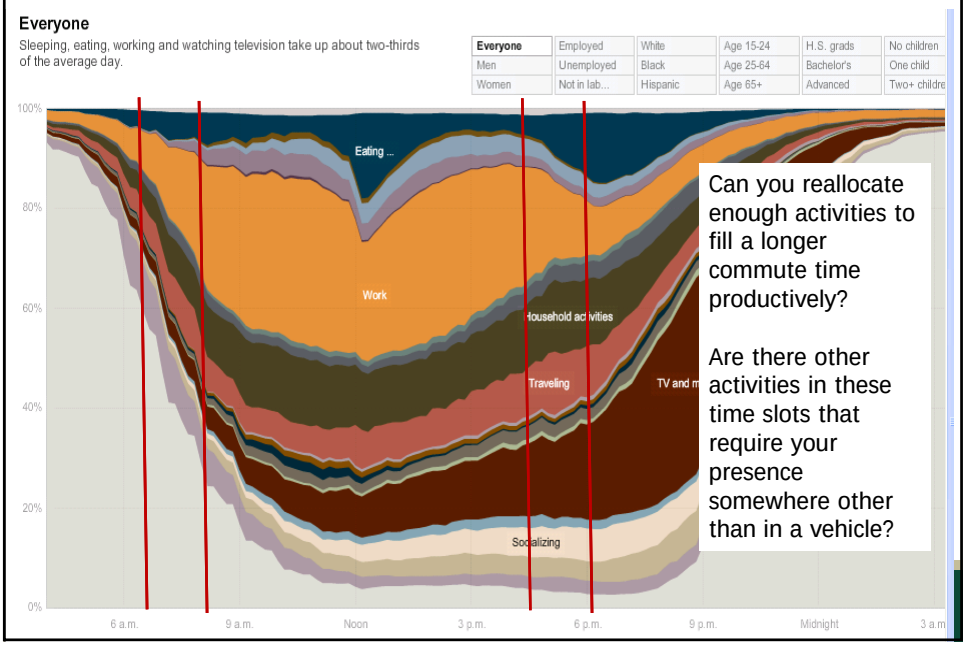
What is the Value of "Freed Up" Time?

Time Use Allocation



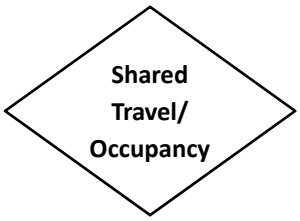
Can you reallocate enough activities to fill a longer commute time productively?

Are there other activities in these time slots that require your presence somewhere other than in a vehicle?

It remains to be seen how travelers will react to the ability to be passengers during their vehicle travel.

Live/Work Location Choices

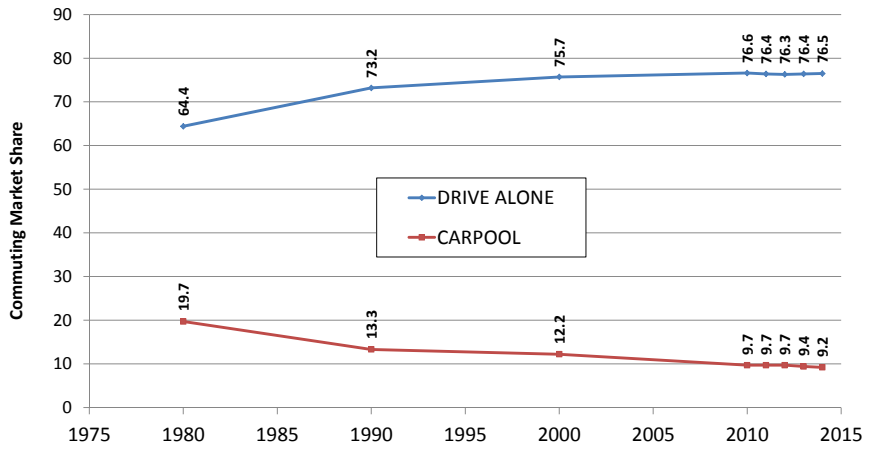
Key Decisions



Sharing vehicles **sequentially** versus sharing vehicles **concurrently**

The Demise of Carpooling: Are Travelers interested in Sharing Travel?

Drive Alone and Carpool Mode Share - U.S.



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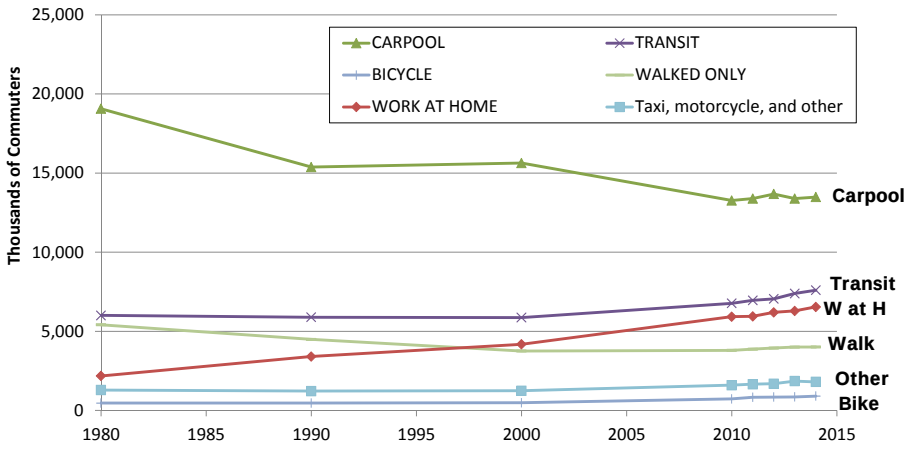
"Usual Commute" Market Size



Source: Census, American Community Survey

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Where Have All the Carpoolers Gone

- The most significant change in commuting behavior in the past few decades is the decline in carpooling.
- In 2014 there were 5.6 million fewer carpoolers than in 1980. There were 2.15 million fewer carpoolers than in 2000.
- The decline in carpooling since 2000 impacted 25 percent more commuters than did the increase in transit use.

The Decline in Carpooling

- In spite of higher gas prices, declining vehicle availability, and a challenging economy – carpooling continued to decline since 2000.
- Of all modes, the change in use between 2000 and 2014 was the third largest for carpooling and the only absolute decline (+14.4 million drive alone,+2.4 million work at home, -2.2 million carpoolers)

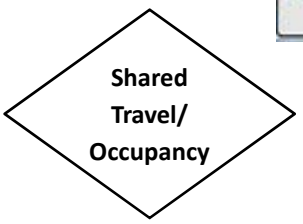
Tidbits on Carpooling

- Work trip auto occupancy is approximately 1.13.
- Approximately half of the passengers riding with commuters are other work commuters and half are persons carrying out other activities (go to school, go to daycare, etc.)
- Thus, for every 100 vehicles commuting to work about six have a fellow commuter, approximately half are fampools.

Why have All the Carpoolers Gone?

- Dispersion of population and employment
- Greater worker schedule flexibility impeding carpool formation
- Declines in employment types conducive to carpooling (manufacturing, construction, etc.)
- Cell phones, audio systems, in vehicle eating, etc. – resulting in persons wanting privacy.
- A growing share of workers not accustomed to sharing (bedrooms, bathrooms, televisions, etc.) – and not wanting to share travel.
- A premium on travel time due to the competitive economy.
- Better transit options?
- Other?

It remains to be seen how accommodating of vehicle sharing travelers will be and what the cost benefits and time penalties will be.



What Does it Mean?

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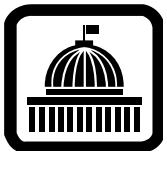
Emerging Insights into Behavior Impacts

- In a survey of over 10,000 bikesharing members found that 40% reduced their automobile use as result of bikesharing and 39% of bikesharing members reduce the amount that they use public transit as a result of bikesharing (Shaheen et al 2012).
- Buck et al. (2013) corroborated this shift away from public transportation, reporting that 35% casual users and 45% of annual members of Capital Bikeshare in Washington DC replaced a public transit trip with bikesharing.
- As of March 2015, the number of Uber vehicles in New York overtook the number of medallion cabs (Licea et al 2015).
- As of January 2015, the taxi market in San Francisco was about $140M per year, while Uber's gross revenues in the same city were approximately $500M per year and growing at a rate of 200% per year (Blodget 2015).
- Ride-hailing may be substituting for both transit and driving trips (Rayle et al 2014).

Are the Institutional Roles and Cost Structures Governing Mobility Going to Remain the Same?



Fundamental Changes in Transportation and its Impacts

- Great opportunity for improved safety
- New talent in the field
- New (and powerful) stakeholders
- Potentially transform industries
  - auto industry
  - insurance industry
  - transit industry
  - roles of pubic and private sectors
- Change the economics of mobility
- Change development patterns
- Impact environment

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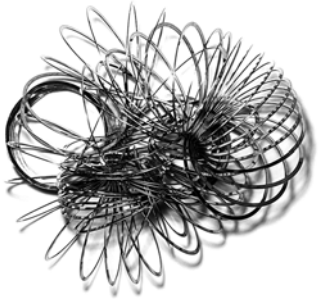
A Different Planning World

- Time frames for investment implementation and amortization exceed our window of confident predictions
  - 5-10 years to plan,
  - 5-10 years to construct,
  - 25-50 years to amortize investments
- This multiplies risk and uncertainty in a world of rapid change. Planning has to adopt.

Contact Information



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