THE FUTURE OF MOBILITY THROUGH INNOVATIONS IN INTELLIGENT TRANSPORTATION INFRASTRUCTURE

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AAAS 2018: Advancing Science Discovery to Application
February 16, 2018
MOBILITY21: Strategic Investments for Transportation Infrastructure & Technology

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FUTURE MOBILITY WILL IMPACT SAFETY, EFFICIENCY QUALITY OF LIFE

**SAFETY**
- 94% of U.S. crashes involve human error. [1]
- 1.2 million deaths worldwide due to vehicle crashes in 2013. [2]
- 37,461 road deaths in the U.S. in 2016 and 2.4 million injuries in 2015. [3]
- 2 out of 3 people will be involved in a drunk driving crash in their lifetime. [4]

**SOCIETY**
- $594 billion in harm from loss of life and injury each year. [5]
- $277 billion in annual economic costs. [6]
- $160 billion in gas burned and time lost each year. [7]

**MOBILITY AND QUALITY OF LIFE**
- 3 million Americans age 40 and older are blind or have low vision. [8]
- 79% of seniors age 65 and older living in car-dependent communities. [9]
- 42 hours wasted in traffic each year per person. [10]

On the road to fully self-driving, Waymo Safety Report, October 2017
2. Key Findings

The Passenger Economy represents a US$7 trillion global opportunity in 2050.

The Passenger Economy will stimulate value creation from the adoption of Mobility-as-a-Service and other new mobility services as well as emerging new applications and services as well as from savings in time and money associated with vehicle use and from the resulting freedom of movement.

Our research finds that autonomous driving technology will enable a new "Passenger Economy" worth US$7 trillion – more than the projected 2017 GDPs of Japan and Brazil combined.
FUTURE TRENDS

1. AUTONOMOUS PLATFORMS
2. CONNECTIVITY
3. CITY-SCALE DATA
4. USER-AUTONOMY INTERACTION
1. AUTONOMOUS PLATFORMS
Tesla Autopilot Crash video

24 year old dies on the spot
Have Self-Driving Cars Stopped Getting Better

New reports from California suggest limits to autonomous vehicle performance
RESEARCH CHALLENGE: SAFE AUTONOMY

For vehicle model, & safety requirements specified over time

Lane merge
Roundabout
Stop signs
Pedestrians

Provide safety guarantees for integration of controller, sensor, computing, learning

Who is responsible when autonomous cars crash with human-driven cars?
A Driver’s License Test for Autonomous Vehicles

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A NEW WIRELESS HACK CAN UNLOCK 100 MILLION VOLKSWAGENS
2. CONNECTIVITY

V2V

V2I
Vehicles connected to the cloud generate 1.5GB monthly data
Autonomous vehicles can generate up to a 1TB real-time data per trip!
There are one billion cars in the world that are increasingly sensor-rich
Internet of mobile autonomous platforms
Instrumented cars serve as infrastructure sensors
Networking with very high data rates for see-through buildings intersection (mm-wave)
V2V communications require low-latency, high-reliability wireless at high speeds.
3. CITY-SCALE DATA

Mobile Millenium, ITS, UC Berkeley
Fast machine learning with real-time, streaming physical data
Privacy-aware algorithms and computation over user/car data
Access and sharing of SmartCity and transportation data
Data ownership models (economy?) for transportation data

SmartBay Project, ITS, UC Berkeley
RESERCH CHALLENGE: DATA PRIVACY

April 2015 Report by

Sen. Deb Fischer (Nebraska)
Sen. Cory Booker (New Jersey)
Sen. Kelly Ayotte (New Hampshire)
Sen. Brian Schatz (Hawaii)
4. USER-AUTONOMY INTERACTION

Users exploit richness of real-time data for safe and efficient routing. Mobility-as-a-service provides new ownership models, new incentives, new economics. Variable autonomy levels from human driver to fully autonomous. Distracted driving results in 9 deaths and 1,000 injuries every day in the U.S.
RESEARCH CHALLENGE – IMPACT OF USERS HAVING ACCESS TO NEW DATA SOURCES
Driving apps like Waze are creating new traffic problems

By ELI WIRTSCHAFTER • MAR 23, 2017

The app Waze suggests a circuitous route around traffic in Fremont. (Screenshot)

ELI WIRTSCHAFTER
Driving apps like Waze are creating new traffic problems

Roadshow: Stay off my street! Waze woes spreading to more cities
FINAL THOUGHTS

Opportunities across heterogeneous transportation/SmartCity modalities
Data integration and optimization across biking, cars, subway, energy grid, etc

Research will require collaboration across many disciplines
Computing, transportation, social scientists, economics, law, etc

Very limited research initiatives that holistically address these challenges
DoT centers, NSF CPS, NSF S&AS, NSF Smart & Connected Communities

Transportation planning institutions are more reactive than proactive in planning for new technology and regulating/accommodating as necessary.

Partnerships between academic, government, city planners, and industry are critical
Interoperability, standards, urban data access, data ownership, safety regulation, privacy norms, autonomy liability etc

Analyze skills and education requirements to facilitate new technical jobs for shared, autonomous and data-driven transportation. Rethink education across boundaries to prepare the workforce