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Think Forward

Emerging Transportation Technologies Briefing

presented to

CMAP Freight Committee

presented by

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CMAP Emerging Transportation Technologies Strategy Paper

- What are the long-term transformative transportation technologies?
- Which emerging technologies are more or less likely to affect the region? Where within the region?
- What can the region do to prepare for emerging technologies?
- What is CMAP's role in preparing the region?

Technology and Impact Areas

Technologies

- Autonomous Vehicles
- Connected Vehicles & Smart Infrastructure
- Alternative Energy
- Shared Mobility
- Active Transportation & Health Technologies
- Data & Information
- Communications
- Business & Logistics
- Freight Movement

Impact Areas

- Population & Demographics
- Regional Economy
- Mobility / Demand
- Safety / Efficiency / Capacity
- Land Use
- Transportation Modes
  - Highway
  - Transit
  - Freight
  - Active
  - Rail
  - Air

Technology Briefing: Autonomous Vehicles

What Is It: Driverless cars that are capable of sensing their environment and navigating without human input by utilizing GPS, radar and Lidar technology.

Watch List:

UBER

Uber launched its first self-driving fleet in Pittsburgh, the biggest step to the Shared Autonomous Vehicle vision of the future.

DAIMLER

Daimler is building an ecosystem of transportation services with AV development, Car2Go, HERE, moovel, and more.

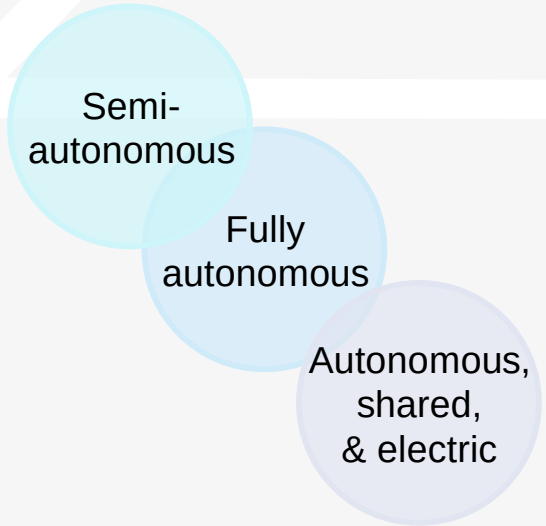
TESLA

Tesla is making strides towards dominating the autonomous electric car-sharing space, all powered by solar energy.

"The answer for cities has to be autonomous, shared, *and* electrified."
– Joseph Kopser, moovel

Major Areas of Potential Impact:

- Roadway performance – reliability, speed, safety
- Cyber security
- Vehicle ownership model
- Disruption to service and driver industry
- Land use
- VMT/PMT increase
- Mobility for elderly and disabled



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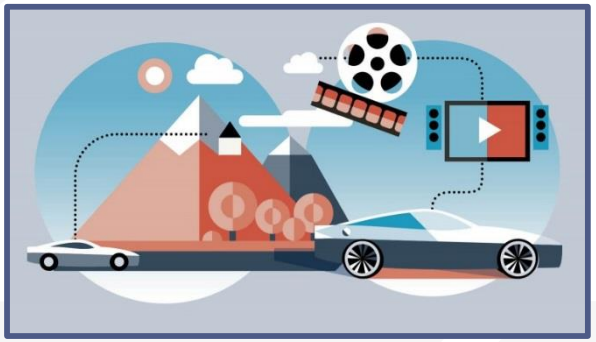
Technology Briefing: Connected Vehicles & Smart Infrastructure



What Is It: Connected vehicles and "smart" infrastructure use mechatronics, telematics and artificial intelligence technologies to interact with the environment to provide greater safety, comfort, entertainment and, importantly, a "connected-life" experience.

Watch List:

USDOT CV Pilot sites in Tampa, NYC and Wyoming are developing and testing V2V/V2I applications for inclement weather, pedestrian safety, and congestion mitigation.

Peloton's Truck Platooning System uses V2V communication, radar-based active braking and vehicle-control algorithms to improve safety and efficiency.

AT&T Mobility has partnered with the most car companies to build cellular technology into over 1 million connected cars so far.

"The car will be connected to a massive data flow, which CVTA believes will create the framework to the Internet of Things."
– Scott McCormick, CVTA

Major Areas of Potential Impact:

- Increased safety and efficiency
- Increased mobile-data consumption
- Infotainment revenue generation
- Real-time vehicle performance monitoring

Cellular technology standards

Interactive In-car surfaces

Data Security standards

Technology Briefing: Alternative Energy

What Is It: Alternative energy refers to renewable energy sources to be used in place of fossil fuels, intended to address concerns such as high carbon dioxide emissions, an important factor in global warming.

Watch List:

Department of Energy's ORNL team designed a working 20kW wireless charging system for electric passenger vehicles.

Goodyear is exploring the use of piezoelectricity and thermoelectricity to generate and capture electricity from tires.

This Munich-based start-up designed a self-chargeable battery-electric car that uses photovoltaic body panels.

"Biggest bang for our buck if we can transition city vehicles to electric."
– Sean Wiedel, CDOT

Major Areas of Potential Impact:

- Emissions
- Air quality
- Fuel consumption and associated revenue streams
- Electrical grid
- Fueling infrastructure

Wireless power transfer

Electrified roadways

Clean grid power

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Technology Briefing: Shared Mobility

What Is It: Sharing transport is disrupting traditional business models with its ability to leverage spare capacity and expand systems without large investments, the exponential effect of collaborative experimentation and learning, and the ubiquitous nature of distributed capacity.

"Ridesharing is just the first phase of the movement to end car ownership and reclaim our cities."
- The Third Transportation Revolution

Watch List:

DIVVY

Divvy is experimenting with electric bikes and systems where the technology is bike-centric (instead of station-centric).

BREEZE

Breeze enables fractional vehicle ownership so that people without a vehicle can start generating revenue as a driver.

Metromile

Metromile's pay-per-mile insurance policy is designed for the Shared Economy and uses a wireless mileage tracking device.

Major Areas of Potential Impact:

- Multimodalism / transit linkages
- Mobility cost and pay structure
- Personal vehicle ownership
- Parking
- Loss of revenue from services which are traditionally taxed

Reduced private vehicle ownership

Parking structure conversions

Land use designed for people

Technology Briefing: Active Transportation & Health

What Is It: Active transportation refers to any form of human-powered transportation – walking, cycling, using a wheel-chair, skateboarding, etc. Benefits of active transportation include opportunities to be physically active while reducing congestion and greenhouse gas emissions.

> "The millennial generation chooses the most practical transportation mode (driving, public transit, biking or walking) for each trip, and this flexible concept of mobility is spreading."
> *- American Public Transportation Association*

Watch List:

STRAVA™

Cities use Strava Metro to capture pedestrian and bicyclist popular and avoided routes, peak commute times, intersection wait times, and origin/destination to improve infrastructure.

U.S. Department of Transportation Federal Highway Administration

FHWA has been exploring the potential to use wearable sensors to collect data on environmental, physiological, activity, and location variables for travel-behavior research.

GeoOrbital

GeoOrbital designed a motorized wheel that fits with more than 95% of adult-sized bikes and charges via USB.

Major Areas of Potential Impact:

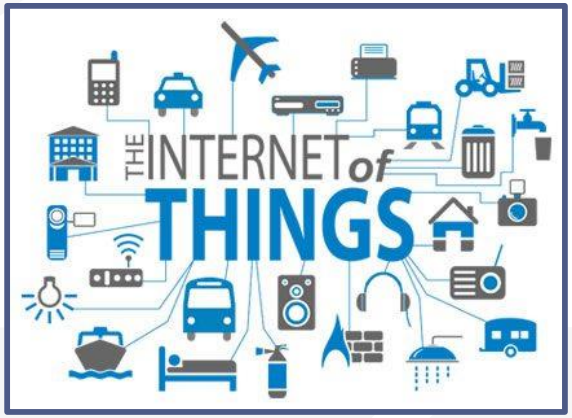
- Multimodalism / transit linkages
- Data / connectivity
- Infrastructure needs
- Safety
- Health

Shared electric bicycles

Performance based insurance policies

Quantitative health benefits

Technology Briefing: Data & Information



What Is It: The explosion in data availability (both volume and velocity) can be leveraged to create value, increase accurate predictions, and provide approaches that drive sound decision making.

Watch List:

HERE aims to create a 3D rendering of the real world, enabling self-driving vehicles to handle challenging situations (no lane markings, snow, etc.).

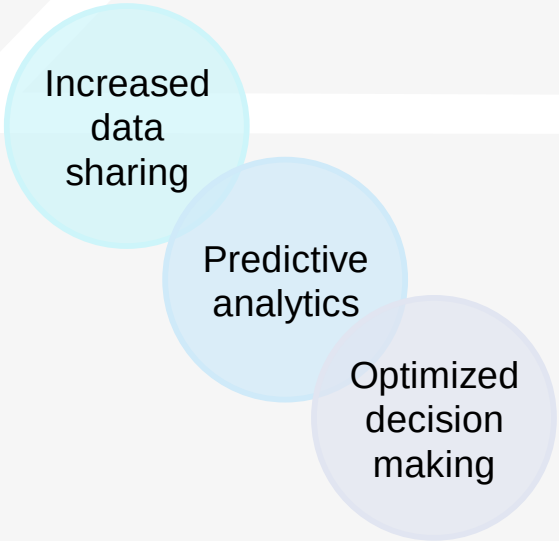
Although car companies are expected to be the next player in the Big Data evolution, they will take a very cautious approach to data sharing.

Urban Engines combines big data and spatial analytics to help transit agencies, delivery companies and taxi services make sense of their data.

"We have a tendency to think that transportation data is coming from transportation, but it is really coming from the umbrella of consumer data."
– Valerie Shuman, CVTA

Major Areas of Potential Impact:

- Improved decision support
- Data storage needs
- Privacy concerns
- Marketing opportunities
- Need for workforce with analytical experience to figure out how to unite domain expertise with data science



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Technology Briefing: Communications

What Is It: Wearables, smartphones and connected products are changing our working lives and spaces, creating a complete relationship that a worker has with the information they need to do their job as well as possible, regardless of the physical location.

Watch List:

ODG smart glasses include Wi-Fi, GPS, and a host of sensors including a gyroscope, humidity sensor and altitude sensor.

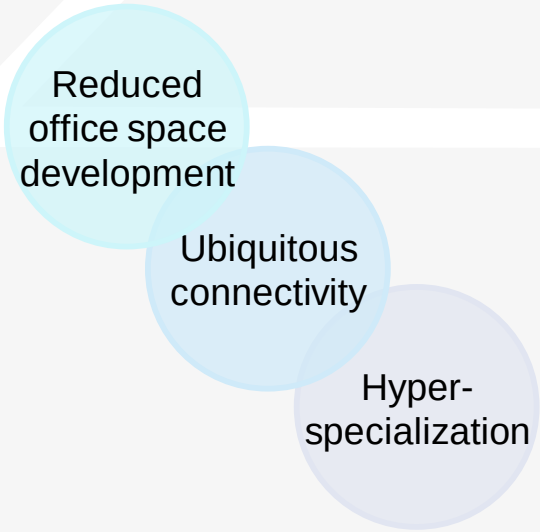
The LiquidSpace market leverages idle hard assets, incorporating office real estate into the Shared Economy.

Security is the top concern as companies extend their business to the cloud. Okta is an identify management solution that uses a single, secure login.

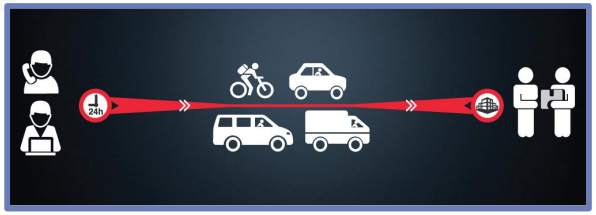
"New technologies have sped up the digitization of businesses in every industry, allowing them to get much closer to their customers." - *PricewaterhouseCoopers*

Major Areas of Potential Impact:

- Mobility demand
- Land use (office/meeting space)
- Worker productivity
- Hyperspecialization



Technology Briefing: Business & Logistics



What Is It: The process of planning, implementing, and controlling the efficient, effective flow and storage of goods, services and related information from point of origin to point of consumption.

Watch List:

ALTIUS FARMS

Cost of first/last mile transport is a huge cost factor for local producers. Vertical urban farming enables more centralized production that can have a huge impact on urban areas.

COYOTE

Leading third-party logistics service provider who has done a great job building a millennial culture to attract younger talent.

CUBIC

NextCity platform aims to coordinate information and payment for all modes of transportation, attacking congestion using price elasticity.

"Evolving consumer preferences, increased speed of communication and technology advancement are driving the need for new business models." – *Chris Ricciardi, Logistical Labs*

Major Areas of Potential Impact:

- Demand for mobility
- Geographically distributed production
- Transportation network optimization
- Unified transportation payment

3D printing

Drone delivery

Unified platforms

Technology Briefing: Freight Movement

What Is It: Freight transport is the physical process of transporting commodities and merchandise goods and cargo via ground, ship, air or intermodal and a quarter of all freight in the nation either originates, terminates, or passes through metropolitan Chicago.

Watch List:

Walmart's "WAVE" concept truck has advanced aerodynamic design, carbon fiber trailer, and microturbine engine that runs on natural gas.

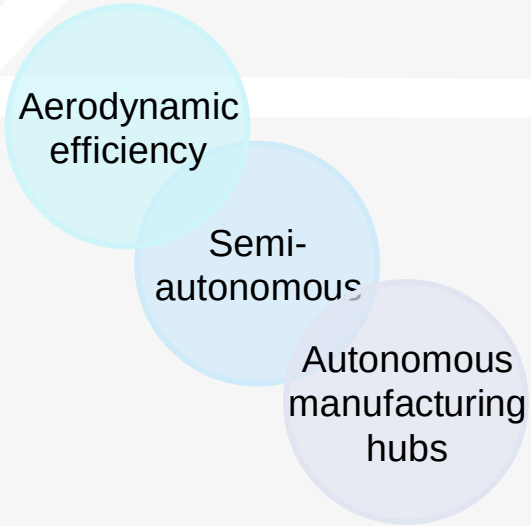
Otto and Uber are joining forces with self-driving trucks and a new way to connect drivers and shippers.

Amazon patented mobile 3D printing delivery trucks to create "mobile manufacturing hubs".

"The slow technology adoption rate of the freight industry may need a push in the form of government regulation." – *Steve Viscelli, UPenn*

Major Areas of Potential Impact:

- Demand for mobility
- Evolving land use needs
- Fuel savings
- Driver job displacement
- Reduced delivery time



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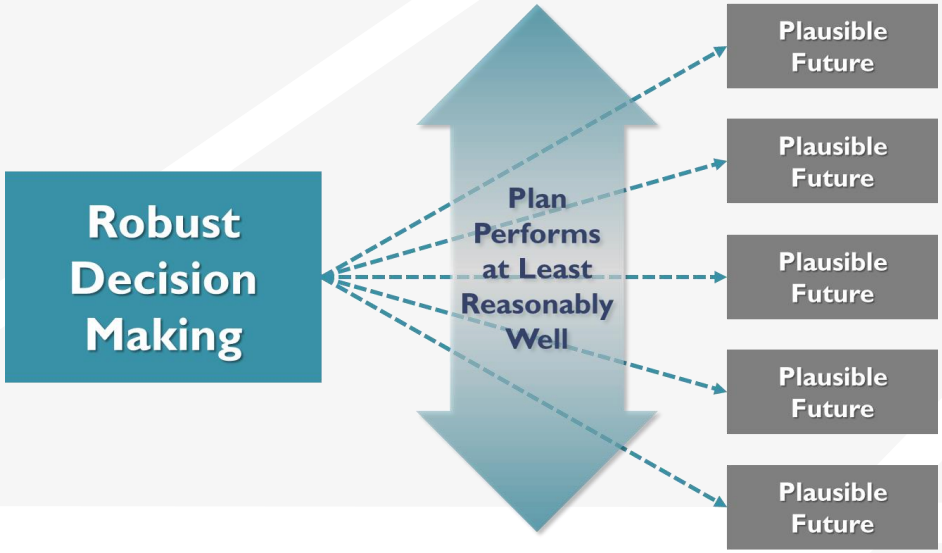
Noteworthy Interview Takeaways

- Private companies building ecosystems of transportation services through company acquisitions
- Increasing role of fleet management
- Needed regulation of after-market safety systems
- Slowing adoption rate of electrification, especially among commercial vehicles
- Cost drives innovation – it was all about electrification when fuel prices were higher, now all about labor costs
- Overpromise of logistics innovation
- Roads and rails

Robust Decision Making Principles



- Near-term (NT) *Effective at achieving objectives in all futures, regardless of risk*
- Hedging (H) *Riskier, but hedge against a future that you absolutely seek to avoid*
- Shaping (S) *Riskier, but with the potential to promote desirable future*
- Deferred Adaptive (DA) *Can be safely deferred to later time*

High-level Summary of Transit Report Recommendations

- Near-term NT
  - Implement technologies with existing benefits as “future-proof” as possible
- Hedging H
  - Prepare for future with explosive personal VMT
- Shaping S
  - Pilot and test opportunities which advance the region’s goals
  - Adapt infrastructure investments to shape future
- Deferred Adaptive DA
  - Monitor performance and cost of transit innovations

Next Steps

- What are the long-term transformative emerging transportation technologies?
- Which emerging technologies are more or less likely to affect the region? Where within the region?
- What can the region do to prepare for emerging technologies?
- What is CMAP's role in preparing the region?

Thanks

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