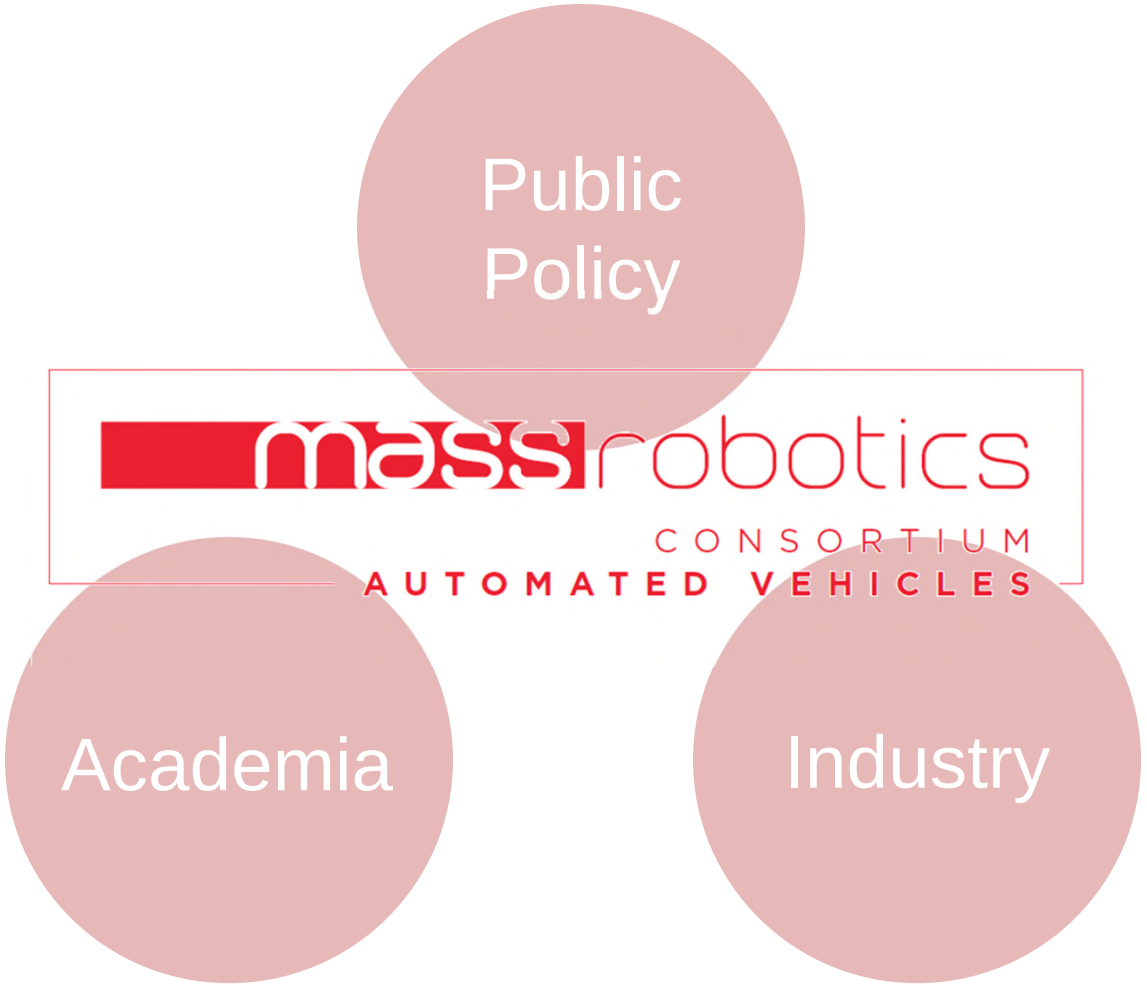
AUTOMATED VEHICLE TECHNOLOGY
AN INDUSTRY PERSPECTIVE

Paul Schmitt, CSEP

Topics

1. AV National Dialogue
2. AV Industry Perspectives
3. AV Tech Challenges

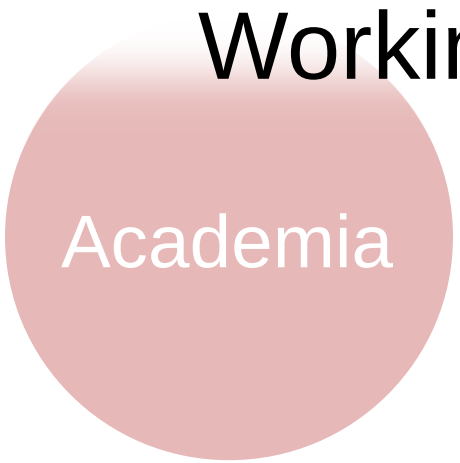
massrobotics
WE BRING ROBOTICS TO LIFE

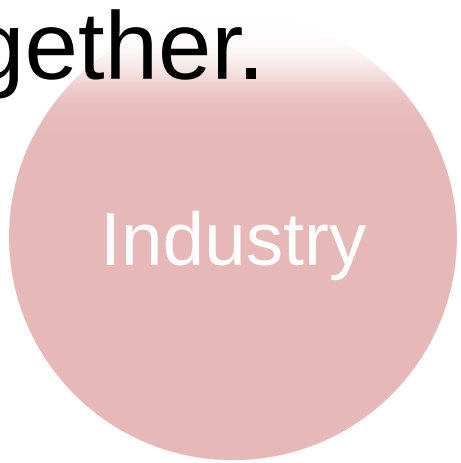

Public
Policy
mass robotics
CONSORTIUM
AUTOMATED VEHICLES
Academia
Industry

Public Policy

This is about us and our opportunities.

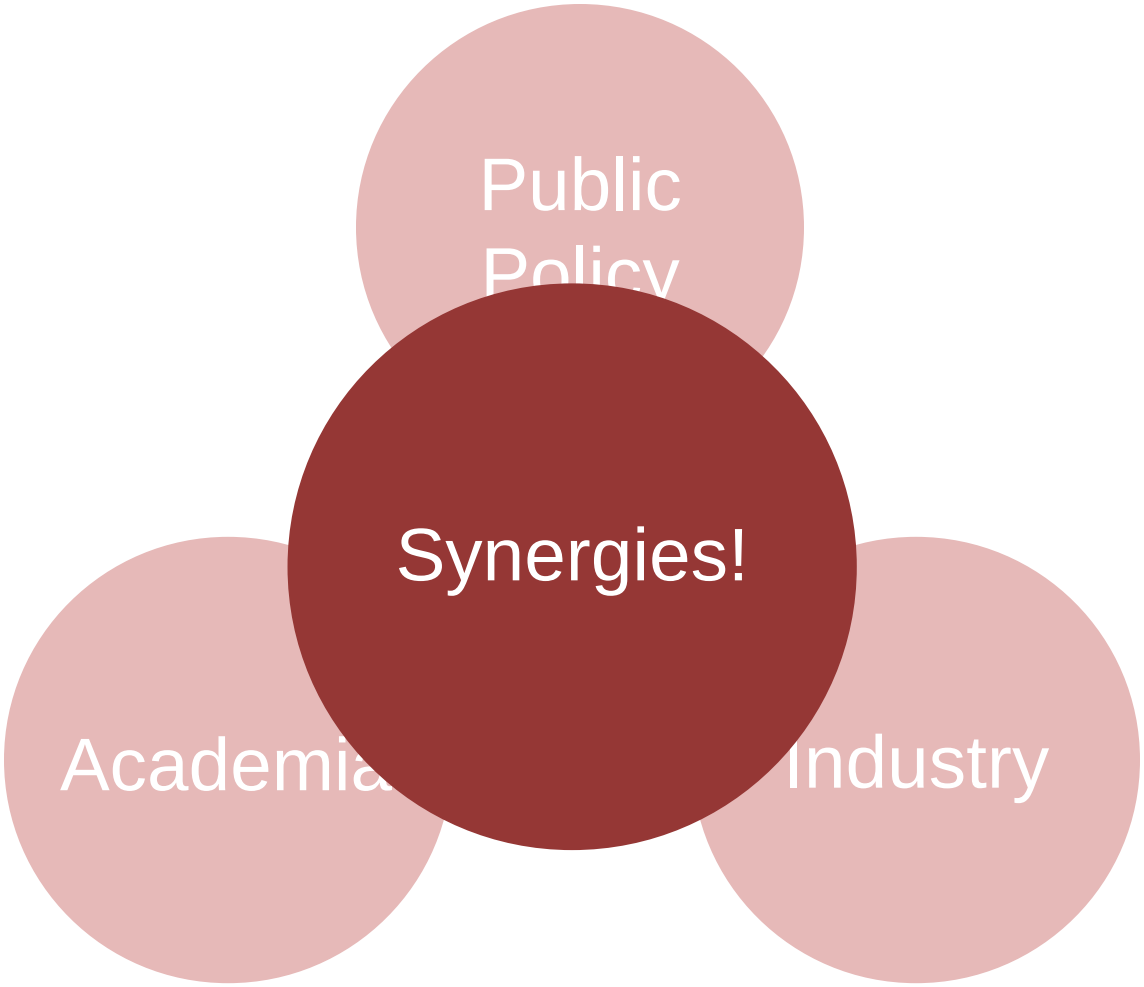
Working together.





Academia

Industry


Public Policy
Synergies!
Academia
Industry

New England
Hotbed of Automotive Innovation
massrobotics
CONSORTIUM
AUTOMATED VEHICLES
Valeo
Autoliv
Amazon Robotics
NVIDIA
Arrow Electronics
Devens
NextDroid
Piaggio FF
Tufts
Draper Labs
MIT
Toyota Research Institute
Mighty AI
Zipcar
Volpe
NuTonomy
Neurala
iSee
Uber
Optimus Ride
Delphi
WPI
Exponent
MathWorks
Olin College
Siemens
Union Point

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Automated Vehicle Technology and Policy Roundtable Discussion

June 10, 2016

- JJ Raynor, Executive Office of the President
- Eric Daimler, Presidential Innovation Fellow
- Austin Brown, Executive Office of the President
- Invitees
  - Martial Hebert, The Robotics Institute, Carnegie Mellon
  - Jan Becker, Faraday Future
  - Karl Iagnemma, nuTonomy
  - Ryan Chin, Optimus Ride
  - Paul Schmitt, MassRobotics

Key Discussion Points

- Technology Challenges
- Reaction to first accident
- Promoting Adoption
- Reducing the Scope
- Pedestrian Interface
- Thoughts on V2V and V2I

Technology Challenges

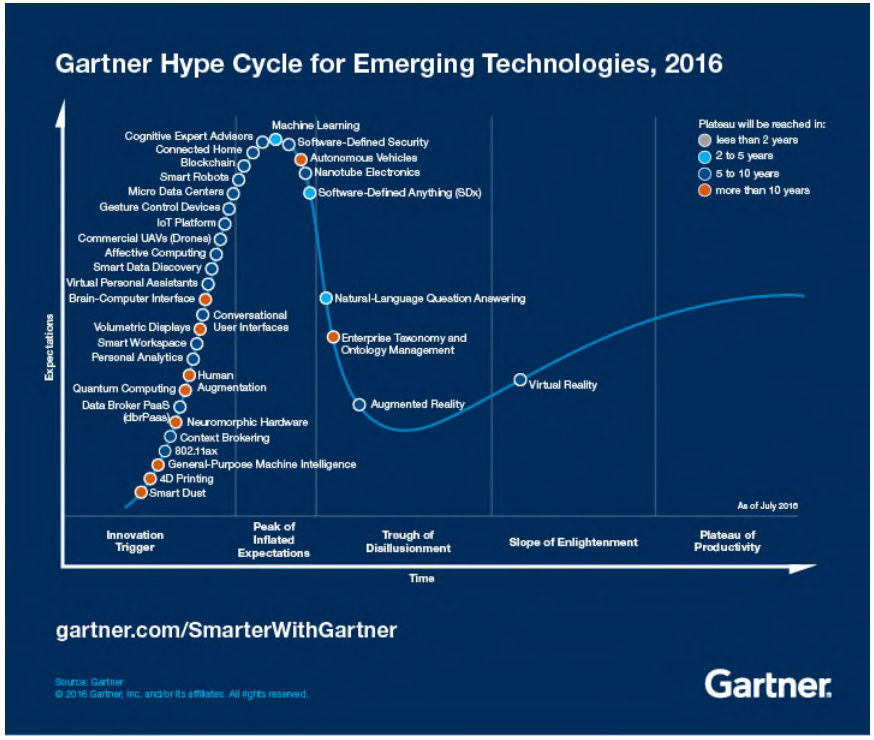
- The middle SAE levels, 3 and 4: Conditional Automation and High Automation.
  - Easy for drivers to confuse Level 3 with Level 5.
  - Transition of control from the human driver to the AI driver and vice versa
  - Difficult to assess driver engagement. Sensors may show that eyes are open, but is driver engaged?
  - Some choose to skip these levels
  - Toyota has interesting approach
    - Guardian Angel
    - Chauffer

Reaction to First Accident

- Public will watch – Let's create a public relations opportunity

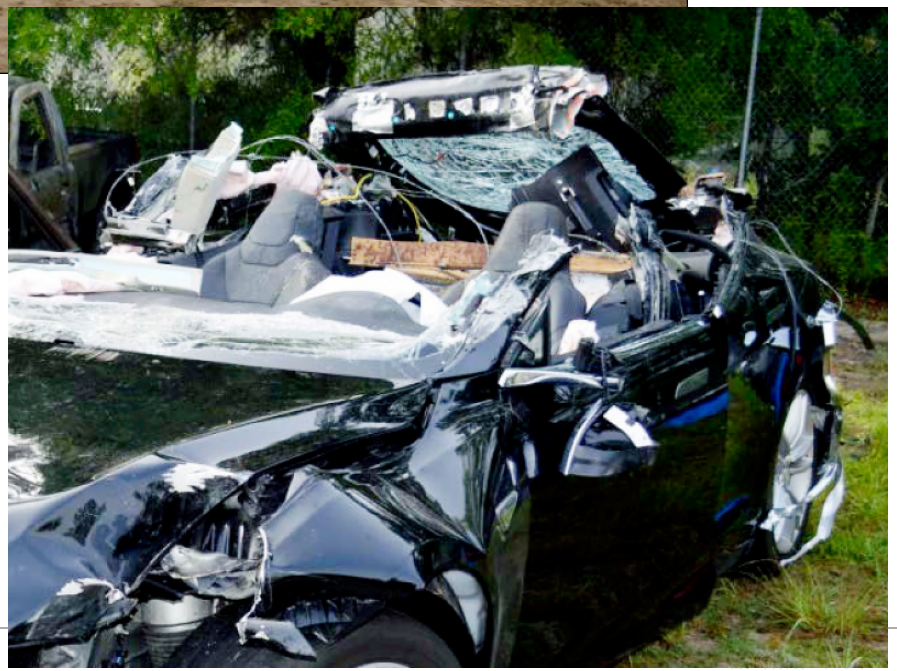
MassRobotics – © 2016

Reaction to First Accident



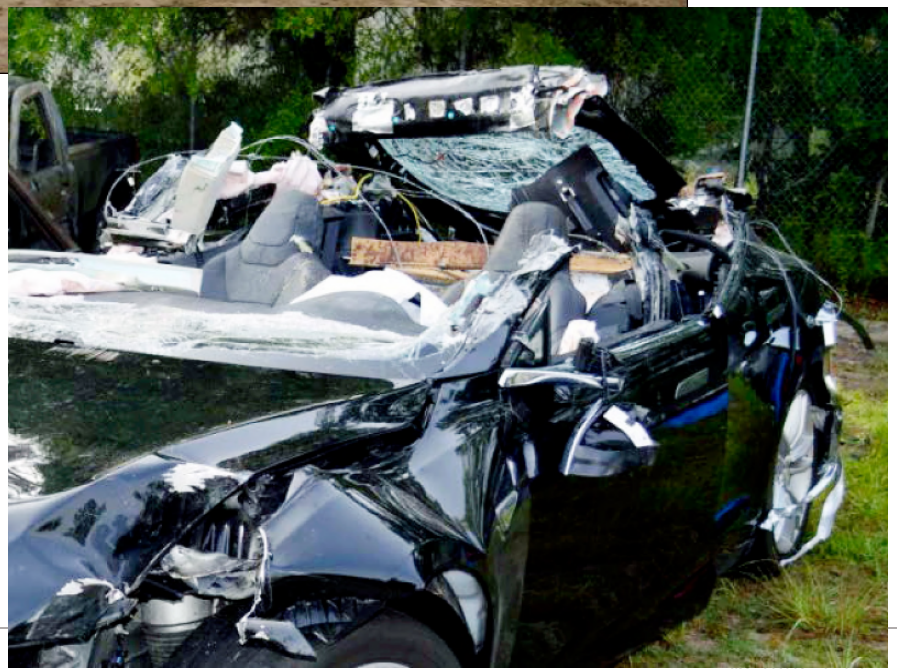
- Public will watch – Let's create a public relations opportunity
- Hype curve
- Should be similar to NTSB investigation
- Data from vehicle should be available

Notes from Joshua Brown's Tesla Accident



- NTSB was brought in
- Vehicle data reviewed
- Set a cautious tone
  - "overreliance on the [Tesla Autopilot] automation"
  - "…lack of understanding of the system's limitations…"
  - "[Tesla Autopilot] not designed to … identify the truck crossing"
- The driver confused this Level 3 system as a Level 5

Why Didn’t the Tesla System Brake?



- Radar-based “Traffic-Aware” Cruise Control
- Radar-based Automated Emergency Braking
- Dismisses most low-speed objects
  - Overhead signs
  - Bots dots
  - Coke cans

Promoting Adoption

- Trust is needed
- Safety is a key aspect of trust
- Mechanism to communicate safety performance is needed
- What if we had a metric for “How safe is safe?”

Promoting Adoption

- With a safety metric
  - Industry would have clear design target – technical and legal
  - Public would know what is considered to be state of the art
- The metric should be a moving target as tech advances
- Recommend the Five Star model
- Recommend NHTSA partner with neutral third party (e.g., SAE, ISO, etc.) to develop this model.

Promoting Adoption

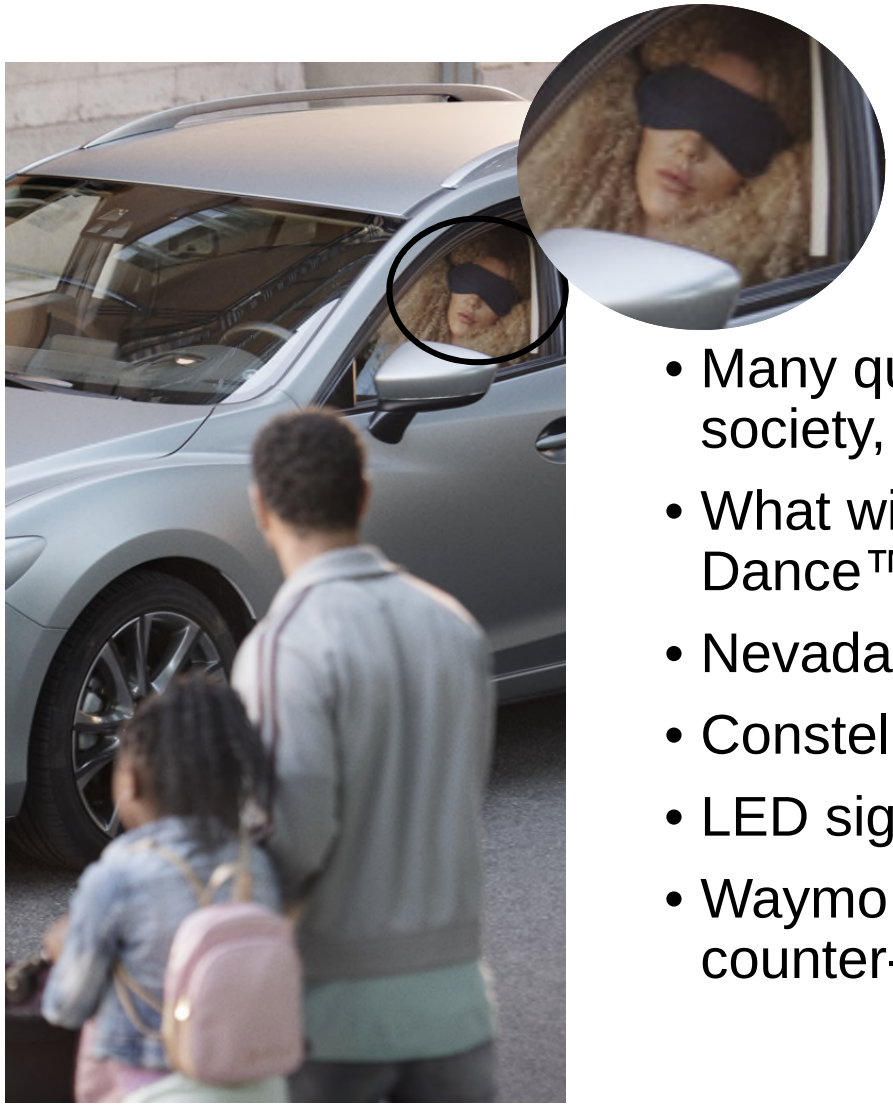
- Heaven or Hell Scenarios*
  - Hell – We all own driverless cars
    - Driverless robots running our errands
    - Circles neighborhood
    - Gridlock
  - Heaven – World of shared vehicles
    - Fewer vehicles
    - Repurposed streets

*“Will a World of Driverless Cars Be Heaven or Hell?”, Robin Chase, April 3, 2014

Time Horizon: Reducing Scope

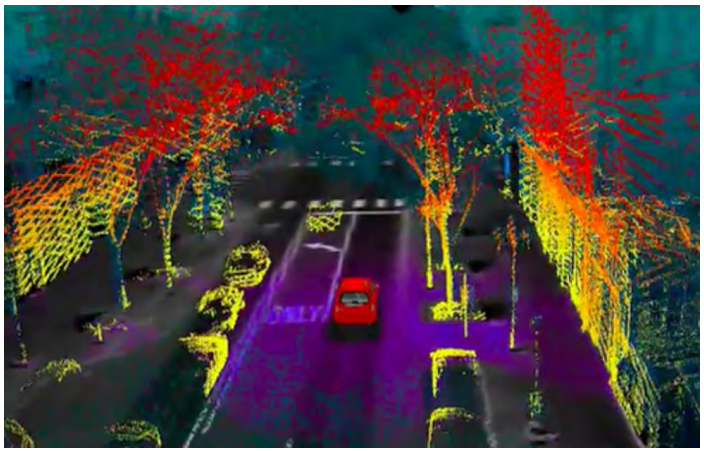
- Technology that works in all conditions, all the time is years away.
- Reducing scope simplifies the challenge
  - Waymo's low speed approach
  - GM and Otto highway-only system
  - Pre-programmed, consistent route
  - Or Uber and nuTonomy's limited, geo-fenced area

Pedestrian Interface



- Many questions on integration into society, this is a key one
- What will replace the Glance Dance™?
- Nevada has red license plate
- Constellation of sensors on roof
- LED signal lights?
- Waymo has found people react counter-intuitively

Thoughts on Maps and V2V, V2I



- Maps
  - Map reliability is an issue.
  - Out of date minutes after it is published
  - Accuracy/safety rating only possible on the process, not the map itself

Thoughts on Maps and V2V, V2I*

- V2V/V2I
  - Complementary technology
  - Safety system can't rely on technology below 100% penetration
  - Average age of vehicle is 11.4 yrs.
  - Will take decades to reach 90% penetration!

*Vehicle to Vehicle Communication
Vehicle to Infrastructure Communication

Harnessing Connected and Automated Vehicle Technology to Achieve Positive Environmental Outcomes

November 28, 2016

- Blair Anderson, Undersecretary, Department of Transportation
- Dave Friedman, Acting Assistant Secretary for Energy Efficiency and Renewable Energy. DOE.
- Chris Atkinson. ARPA-E
- Karl Simon. Director of the Transportation and Climate Division, EPA
- **Auto and Technology Representatives from** Bosch, CityFi, MassRobotics, FCA, Toyota Research, Zipcar
- **Environmental and Policy Community Representatives from** CAP, CMU, EDF, EF, ICCT, MIT, NextEnergy, NRDC, ORNL, RAND, SAFE, U of M, U of W

Federal Perspectives

- Blair Anderson, Undersecretary, Department of Transportation
- Motivated first by safety. 94% of fatal accidents are caused by human error.
- Researching Mobility and Environmental benefits.
- Also studying platooning. Research shows that it can have a 10% fuel savings benefit.
- Assessing how to regulate AVs in the future. Proactive vs. reactive?
- V2V communication notice of proposed rulemaking is going through the approval process.

Federal Perspectives

- Chris Atkinson. ARPA-E.
- AVs could represent
  - 60% reduction of fuel consumption or
  - 200% increase in fuel consumption.

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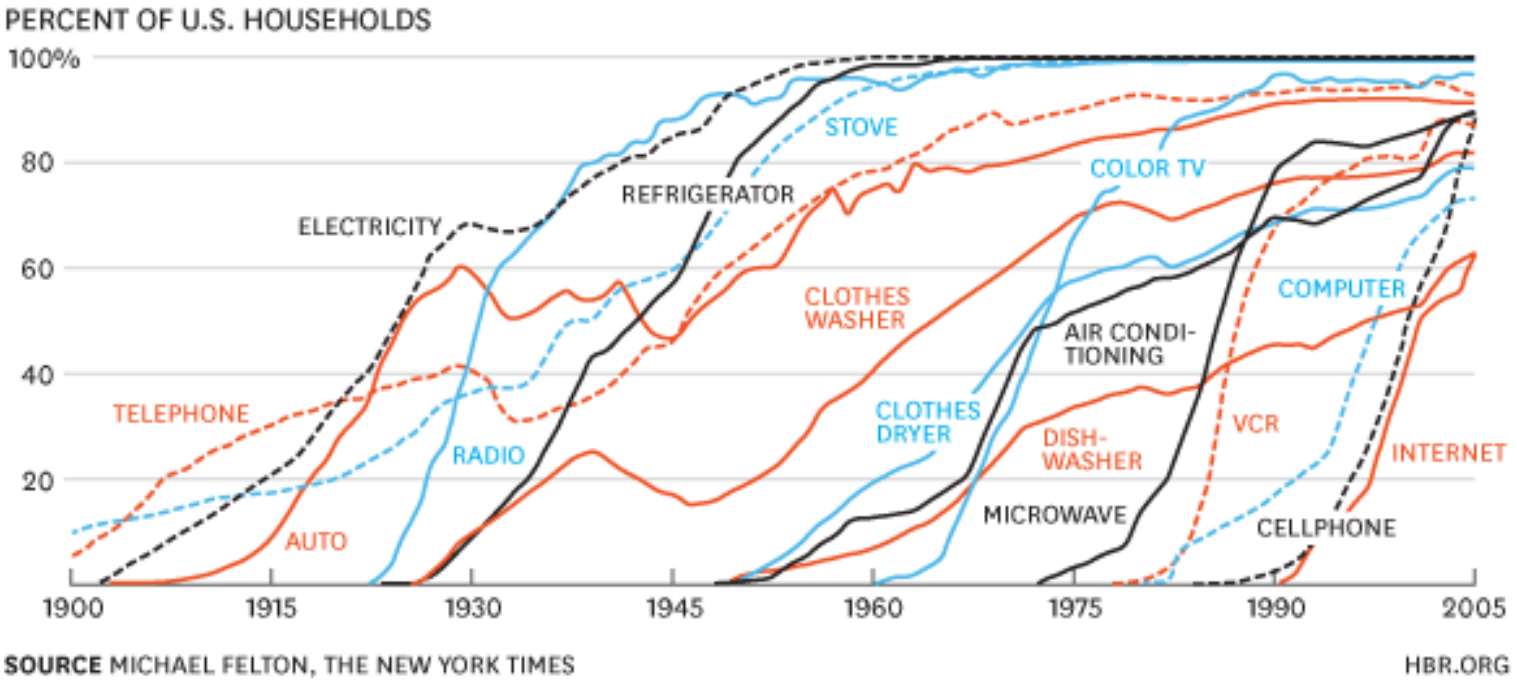
When Will We See AVs on the Road?

- "Level 4 or 5 won't happen for a long time."
  - Terry Litzi, General Motors Government Relations
- "A technology that works all the time in all conditions is years away."
  - Jan Becker, AV Director, Faraday Future
- "…hoping that paid self-driving rides will start in Singapore second quarter 2018."
  - Karl Iagnemma, CEO nuTonomoy

MassRobotics Perspective

- AV Tech is still very much in its infancy
  - S Curve hasn't started



MassRobotics Perspective

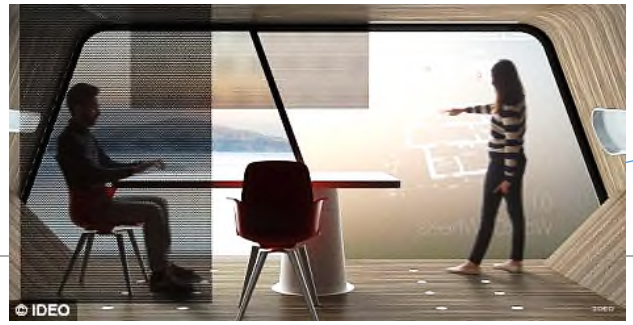
AV Tech is still very much in its infancy

Volkswagen Group of America
Mercedes Benz
Waymo
Delphi Automotive
Tesla Motors
Bosch
Nissan
GM Cruise LLC
BMW
Honda
Ford
Zoox, Inc.
Drive.ai, Inc.
Faraday & Future Inc.
Baidu USA LLC

Wheego Electric Cars Inc.
Valeo North America, Inc.
NIO USA, Inc.
Telenav, Inc.
NVIDIA Corporation
AutoX Technologies Inc
Subaru
Udacity, Inc
Navya Inc.
Renovo.auto
UATC LLC (Uber)
PlusAi Inc
Nuro, Inc
CarOne LLC
Apple Inc.

Bauer's Intelligent Transportation
Pony.AI
TuSimple
Jingchi Corp
SAIC Innovation Center, LLC
Almotive Inc
Aurora Innovation
Nullmax
Samsung Electronics
Continental Automotive Systems I
Voyage
CYNGN, Inc

MassRobotics Perspective



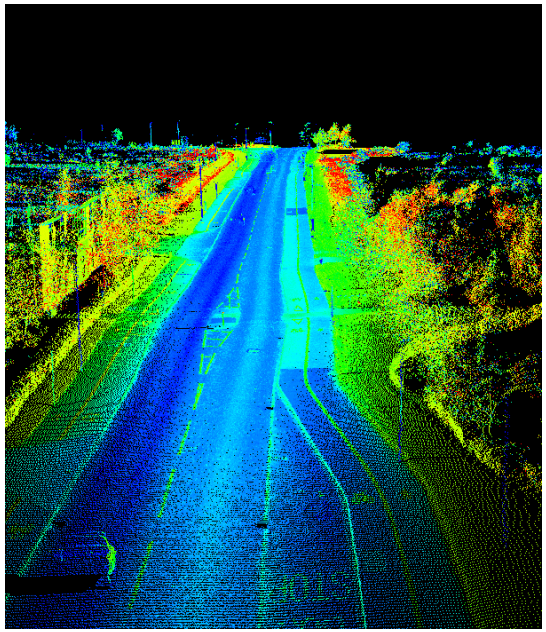
Business models are still being developed…

- Personal self-driving vehicle
- Guardian Angel vehicle
- Personal driverless vehicle
- Shared-ownership driverless vehicle
- First/Last-mile Public Transit Extension
- Driverless taxi
- Driverless Shuttle
- Driverless Vanpool
- **Virtual Soccer M.O.M.™**
  - Mobilizing Our Minors (M.O.M.)
  - The “Kid Kar”
- Self-driving long-haul freight transport
- Resort transport
- Disney Parking Lot Shuttle
- Open-source self-driving technology sales and support
- Pizza delivery
- **Mobile McDonald’s**
- Mobile Motel
- **Mobile Meeting Room**
- Mobile Gym
- Health-care Transit
- Self-Driving Saloon

Data Collection

- Cities want insight into their infrastructure

Data Collection



- Cities want insight into their infrastructure
- Industry has terabytes of data

Data Collection

- Cities want insight into their infrastructure
- Industry has terabytes of data
  - Not categorized as cities would like
  - Overwhelming when request isn't specific

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AUTONOMOUS VEHICLE
nuTonomy

SOUTH STATION

Current State of the Art

AUTOMATED VEHICLE TECHNOLOGY
AN INDUSTRY PERSPECTIVE

Paul Schmitt, CSEP

Fostering an AV Development Environment

- AV Industry growing fast and competitive
- Where can I get the tech on the ground quickly?
- Educational grants
- Public education
- Support testing
- Encourage test facility investment
- Establish test localities and corridors
- Clear path towards permit

Electric Vehicle Stipulation

- EV and AV tech are different, not co-dependent
- Both technologies advancing and evolving at incredible pace
- Impacts start-ups and small companies with limited budgets or with limited powertrain options
- EVs require supporting infrastructure

Electric Vehicle Stipulation

- AV tech power requirements are not insignificant, even at rest*
  - Power consumed by Sensors, Signal Processing, AI Algorithm Processing, User Interface, Steering Control, Braking Control
  - Equivalent energy of ~75 laptops
  - 3 kilowatts
  - 5% - 10% fuel economy impact

"Self-Driving Systems Need Lots of Power. So Do EV Motors. That's a Problem.", AutoWeek, October 16, 2017