Planning for Autonomous Vehicles

Stephen Buckley
WSP | Parsons Brinckerhoff
KINETIC
October 6, 2016
When will we see AVs on our roads?

- 0-2 Years
- 2-5 Years
- 5-10 Years
- 10-15 Years
- 15+ Years
Overview

• Background on AVs
• What it Means for Planning
• Toronto Experience
A Long Time Coming…..
Evolution
Revolution
The Promise of AVs

• Improved road safety
• Economic benefits of less wasted time
• More equitable access for all
• Increased travel options
• Reduced stress of driving
• Reduced fuel consumption and emissions
Complexities of AVs

- Technology
- Standards
- Infrastructure
- Communications Systems
- Liability
- Ethics
- Regulation
- Consumer Preference
- Data
- Security
- Privacy
- Human Factors
- Safety
- Economics
- Business Models
- Planning
Complexities of AVs
Fundamentals of Planning for AVs

- It’s not if, but when
- It will likely be very, very disruptive
- Over time, will likely transform mobility as we know it
- Will impact how we design, build and operate not only roads, but our entire transportation system
Goal for Today

Elevate the discussion about why and how cities and regions should SHAPE the development of AVs
NHTSA Levels of Automation

- **Level 0**: No Automation
  - No steering or braking/throttle control
  - e.g. crash warning systems

- **Level 1**: Function-Specific Automation
  - Braking/Throttle or Steering control, but not in combination e.g. automatic braking systems

- **Level 2**: Combined Function Automation
  - Integration of braking, throttle, and steering control
  - Driver available at all times to retake control

- **Level 3**: Limited Self-Driving
  - Integration of braking, throttle, and steering control
  - Driver expected for occasional control
  - Driver can cede full monitoring and control authority

- **Level 4**: Full Self-Driving Automation
  - Integration of braking, throttle, and steering control
  - Driver **NOT** expected for control
  - Responsibility for safe operation is solely rests with the vehicle

Image Source: Thinkstock/USDOT
Two Paths

Private Ownership Model
Driven by Current Auto Industry
Incremental Moves in Functionalities
Mostly Privately Owned
Here Today

Shared Mobility Model
(MaaS/TaaS/Robo-taxis)
Driven by Tech and TNCs
Jump to Fully Automated (Level 4)
Transportation-as-a-Service
A few (or many, many) years away
Driving Changes: Automated Vehicles in Toronto

Discussion paper

David Ticoll
Distinguished Research Fellow
Innovation Policy Lab
Munk School of Global Affairs
University of Toronto

October 15, 2015

David Ticoll
University of Toronto
“Driving Changes: Automated Vehicles in Toronto”
Three Scenarios

Ownership Leads

Mixed

Shared Leads
What Do AVs Mean for Planning?

• Will they increase trip-making?
• Will they increase the distance of trip-making?
• What will be the impacts to transit?
• Will it be complementary or supplementary?
• Will we see fewer cars or more?
• Will we see more VMT or less VMT?
• Will we see more congestion or less congestion?
• Will they support or undermine land use polices?
• How will they impact the economy, industries and jobs?
Key Fundamental Unknowns

- Speed of Technological Advancement
- Economics
- Public Acceptance
Speed of Technological Advancement

‘What we’ve got will blow people’s minds, it blows my mind… it’ll come sooner than people think’

- Elon Musk on Tesla fully autonomous car,
  Electrek, August 4, 2016

Uber starts self-driving car pickups in Pittsburgh

- Tech Crunch September 14, 2016

Seattle Tech Vets to Propose Driverless Stretch of Interstate

- Bloomberg September 19, 2016
## Speed of Technological Advancement

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Source: Mashable
Economics

Cost per Mile

Source: ARK Investment Management
Economics

Figure 3: Average Unlinked Passenger Trip Length, 2011

Source: APTA 2011 Fact Book
Illustrative Mode Share at Various per Mile Prices

- **$3.00**: 50% Auto, 20% Transit, 10% Walk, 10% Cycling, 10% Taxi
- **$2.00**: 60% Auto, 20% Transit, 10% Walk, 10% Cycling, 10% Taxi
- **$1.00**: 70% Auto, 20% Transit, 10% Walk, 10% Cycling, 10% Taxi
- **$0.50**: 80% Auto, 20% Transit, 10% Walk, 10% Cycling, 10% Taxi
### Public Acceptance – Trust of AVs

**58% say they would take a ride in a fully self-driving car**

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<th>Country</th>
<th>Very likely</th>
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<th>Neutral - Neither likely nor unlikely</th>
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**... but only 35% of parents would let their children ride alone in one**

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Public Acceptance – Shared Use

Unknovns

- Speed of Technological Advancement
- Economics
- Public Acceptance

*Without a clear understanding of the future, how do we plan?*
How is this Unfolding?

- Discussions are happening primarily at the federal and state levels

- Economic development considerations have seemed to be a significant driver of the policy discussions

- Because of the potential “winner take all”, stakes are high, companies are moving fast...
Goals of Cities

- Safety
- Accessibility
- Mobility
- Economic Opportunity
- Quality of Life
- High-Quality Natural and Built Form
- Environmental Sustainability
- Social Inclusion
- Financial Sustainability
## Impacts of Private vs. Mixed vs. Shared

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<th>Impact</th>
<th>Private</th>
<th>Mixed</th>
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<td>Collisions</td>
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<td>Congestion</td>
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<td>Vehicular Mobility</td>
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<td>Equitable Mobility</td>
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<td>Cost of Private/Semi-private Vehicular Travel</td>
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<td>Carpooling</td>
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<td>Passenger Kilometers Travelled</td>
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<td>Vehicle Kilometers Travelled</td>
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<td>Fixed Route Transit Demand</td>
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<td>Active Transportation</td>
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<td>Trend of Intensification</td>
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<td>Parking Demand</td>
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<td>Right-of-way allocated for vehicles</td>
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<td>Residential Building/Lot Size</td>
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<tr>
<td>Impervious Areas</td>
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Approaches We Could Take

Actively Discourage

• Prohibit or Restrict AVs or TaaS

Actively Encourage

• Tax credits
  • Create AV-only zones
  • Create AV-only facilities

Passive

• Wait and See

• Outfit signals with transmitters

• Map curbside regulations

• Conduct a pilot or demonstration
Toronto Working Group

Transportation
Economic Development
City Planning
Licensing & Standards
Police Services
Parking Authority
Parking Enforcement
Revenue
Fleet
Budget
City IT
Privacy Commission
Toronto’s Draft Vision Statement

Toronto needs to harness the potential of AVs to help us create the City that we want.
Toronto Transportation Services Work Plan

PREPARING FOR AUTONOMOUS VEHICLES

Divisional Workplan 2016-2018
Toronto Transportation Services Work Plan

GOAL 2
PREPARATION
To prepare for the arrival of AVs no matter when and how they are introduced and adopted.

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<th>Objectives</th>
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<th>2017</th>
<th>2018</th>
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<tr>
<td><strong>2.1 Improve Understanding and Clarity</strong></td>
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<tr>
<td>2.1.1 Create and maintain a common lexicon of terms and concepts for consistent understanding.</td>
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<td>2.1.2 Identify and understand the broad range of potential implications of AVs.</td>
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<td>2.1.3 Define the interests of Transportation Services in vehicle automation across all sections and districts.</td>
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<td>2.1.4 Undertake public opinion research to assess and establish baseline attitudes toward AVs, expectations of government, and how AVs may influence travel behaviour and modal choice in the Greater Toronto and Hamilton Area.</td>
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<td>2.1.5 Develop detailed scenarios – ranging from no change, to a completely new transportation paradigm – for consistent forecasting and planning pathways; use these scenarios on a scale of possible to probable.</td>
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<td>2.1.5.1 In partnership with the Organization for Economic Cooperation and Development's International Transportation Forum, undertake a modelling exercise to further develop and refine potential scenarios.</td>
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<td><strong>2.2 Prepare a Foundation</strong></td>
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<td>2.2.1 Improve the management and current function of traffic control devices, particularly signage and pavement markings.</td>
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<tr>
<td>2.2.1.1 Increase asset management and lifecycle analysis of traffic control devices, particularly signage and pavement markings.</td>
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<td>2.2.1.2 Review and consider the need for pavement markings on local streets.</td>
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<td>2.2.1.3 Improve the visibility of traffic control devices under all weather conditions.</td>
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<td>2.2.2 Work with mapping providers to investigate the potential for AV-supportive mapping to be conducted in Toronto, and determine the appropriate role for Transportation Services and the City.</td>
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<td>2.2.3 Begin to engage with technology providers, automobile manufacturers, and transportation network companies to discuss municipal preparations and potential pathways.</td>
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Takeaways for Today

- This is coming at us fast – guide it or respond to it
- Cities have a chance to shape this, but need to move
- While there are still many unknowns, we need to start factoring this into our planning
- Don’t let the complexities and unknowns paralyze us
Acknowledgements

Ryan Lanyon

David Ticoll

Barrie Kirk
When will we see AVs on our roads?

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- 2-5 Years
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