Harnessing the mobility revolution to build the Canada that we want

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A nation building opportunity

When we step onto a city street somewhere in Canada today, we instinctively understand its transportation logic – including its strengths, weaknesses, efficiencies and workarounds.

In twenty years or so, a new transportation logic will have taken hold. Will it be the logic of a Canada that we want – or something else? Will Canada's leaders have effectively foreseen and maximized the benefits of vehicle automation while minimizing and addressing the downsides?

Many questions raised by the connected and autonomous vehicle (CAV) are much like those raised by the mass-produced motor vehicle a century ago. They include practicalities like safety, traffic rules, fuel availability (then gasoline, now electric) and technical standards. They also include big societal questions like jobs, urban design, and environmental impact.

This paper focuses on the big societal questions, bringing in the practicalities where pertinent. Otherwise it presumes stakeholders will sort out the practicalities.

How did Canada make out with the motor vehicle on societal questions like jobs, urban design, and environment? On jobs, very well. We built a major auto sector. Transportation became a foundation of a resource, industrial and service economy that produced good jobs and incomes for millions of people. On urban design, not quite so well. Motor vehicles were a defining force for modern city life. But today's urban planners spend too much time fixing the problems of car-centric cities: congestion, lack of "walkability" and "bikeability", insufficient green space and public realm, and unsafe streets. As for environmental impact, the motor vehicle was far superior to horse-drawn transportation. But today's cars and trucks are responsible for 25% (or more) of Canada's greenhouse gas emissions, a primary cause of global warming.

To do better on societal impacts this time around, policy leaders might consider the issues of the past (such as jobs, urban design and environmental impact), as well as other, new issues presented by CAVs as hybrids of physical mobility and information technologies. Among the new issues are the role of digital information in Canadian society – and the role of information-based global firms.

The time for such thinking is now. The 2017 budget includes many initiatives that will accelerate the development and use of connected and autonomous vehicle (CAV) technologies in Canada. It also begins to identify and address some of the policy issues discussed above. Examples in the budget include:

- $76.7 million for Transport Canada to develop regulations, pilot projects, standards and certifications for CAVs and unmanned aerial vehicles (drones).
- $1.26 billion allocated over 5 years for a Strategic Innovation Fund to consolidate and simplify existing business innovation programming. Of its four priorities, two are the Automotive Innovation Fund and the Automotive Supplier Innovation Program.
- $35 billion Canada Infrastructure Bank, whose priorities will include transit and transportation networks.
- $950 million for platform and disruptive technology innovation superclusters, including potentially public transit, infrastructure and transportation.
- $300 million over 10 years to launch a Smart Cities Challenge competition, to accelerate new and innovative approaches to city building. Infrastructure and transportation will be eligible sectors, linked to the innovation supercluster initiative. Inspired by a US initiative, the Smart Cities Challenge will be a project of the new Impact Canada Fund. This Fund will use a "mission- or 'challenge'-based approach" to "help focus and accelerate efforts towards solving Canada's big challenges" in collaboration with innovators in the private sector, non-profits, social enterprises, and individual citizens.
- $125 million for a pan Canadian artificial intelligence strategy (AI is a core CAV technology).
- $229 million investment in research and development for clean energy and transportation. Green infrastructure and public transit inclusion in Pan-Canadian Framework for Clean Growth and Climate Change.
- Undertake an "ambitious data initiative on Canadian infrastructure", and $14.5 million for a clean technology data strategy.

Clearly, the Government of Canada views CAVs as a priority. The underlying question is, what will be the transportation logic of our country for our children and grandchildren twenty years from today?

This paper proposes that the pending arrival of CAVs presents Canada with a once-in-a-century nation building opportunity.[1] We have leveraged major transportation initiatives for nation building before, in with the CPR the 19th century and the TransCanada Highway in the 20th. In our sesquicentennial year, what could be more timely than to launch another such an initiative – to address the economic, social and environmental priorities of the 21st century. The Government's focus on infrastructure and mobility investment and innovation in the 2017 budget provides powerful levers to move forward on a wide variety of CAV policy issues.

The stakes

Connected and automated vehicles (CAVs) are emerging as a new kind of general purpose technology – or, as some might call it, a technology platform – that will both enhance and challenge the lives of Canadians. CAV-related choices by firms, citizens and governments will transform everyday activities, environmental strategies, business models and jobs, urban design, fiscal assumptions, and many other aspects of life in the 21st century.[2]

[1] David Ticoll, "Vehicle Automation: The missing piece in Canada's green infrastructure puzzle", *The Globe and Mail*, June 9, 2016.

[2] For more details on the opportunities and issues discussed in this section and elsewhere in this paper see David Ticoll, *Driving Changes: Automated Vehicles in Toronto* (University of Toronto Transportation Research Institute, 2015), available at http://bit.ly/1TyNsJJ

The mobility revolution is more than self-driving cars, buses and trucks. It includes freight transportation, specialized robotic vehicles (e.g., delivery and street cleaning robots), industrial equipment (automated farm tractors and mobile mining robots), unmanned aerial vehicles (i.e., drones) that deliver people and goods, connected infrastructure, and other categories yet to be invented. Information technologies like artificial intelligence applications and big data will eclipse vehicle hardware as the core assets of the CAV era.

Connected, automated, (potentially) shared and electric or hydrogen fueled vehicles could significantly mitigate climate change, improve safety and health, cut congestion, facilitate productivity and innovation, transform our cities and towns, increase social equity and inclusion, and save a lot of money. They present Canada's automotive and technology sectors – as well as other sectors across the economy – with innovation and growth opportunities. Maximizing the benefits requires government policy and action. Two examples among many: The Federal 2017 budget includes several investment initiatives to foster a domestic CAV sector. Governments could also invest in a shift from vehicle ownership to on-demand, multimodal mobility as a service (MaaS).[3]

Here are some quantified opportunities and benefits:

- Use on-demand, electrified CAVs to progress Canada's Paris GHG commitments.[4]
- Eliminate many traffic-related annual 1800 deaths and 10,000 serious injuries
- Achieve Innovation, productivity and growth in tech, auto, retail, transportation and other sectors
- Deliver better mobility for elderly, young, disabled, and low-income Canadians including a projected one million elderly citizens who will have difficulty using public transit in 2030[5]
- Reduce the total cost of vehicle ownership/operation up to 50% or more (i.e., $100B++ per year)

CAVs will, in the normal course of things, deliver all these benefits – somewhat. It will take concerted action, however, to maximize these benefits. For example, our back of the envelope calculation suggests that maximum adoption of on-demand electric CAVs could, by itself, achieve all of Canada's Paris commitments for GHG reduction. CAV adoption in the range of 75% could end nearly all traffic fatalities and injuries.

The mobility revolution also brings economic, policy and organizational challenges. These include:

- Industries and jobs
    - Canadian auto and parts manufacturers will be challenged to adapt to new (information-based) sources of value, different physical platforms, new competitors, and new business models. And since no global OEM is headquartered in Canada, CAV technologies present new kinds of downsizing risks.
    - On-demand mobility services will disrupt related sectors including vehicle dealers and distributors, after-market parts suppliers, and car insurers.
    - CAVs could produce job losses in sectors or occupations that employ over 1.1 million Canadians. In addition to auto sector and insurance jobs, CAVs may eventually displace many of Canada's 500,000 professional truck, taxi and delivery drivers. New jobs will arise too, but it's hard to see how the net outcome will be positive.[6]
- Transportation infrastructure, transit, and urban design

[3] Per the MaaS Alliance, 'Mobility as a Service (MaaS) is the integration of various forms of transport services into a single mobility service accessible on demand." Several European countries, including the UK, Finland and Sweden, have launched MaaS initiatives.
[4] Author's estimate based on GoC data.
[5] Author's estimate based on GoC data
[6] Based on author's analysis of 2011 Census data. See cited report, *Driving Changes*, pp. 46-49, for underlying assumptions.

    - Any new infrastructure investments based on pre-CAV assumptions could seem overly expensive or even obsolete by the time they are built.
    - New policy toolkits and actions may be needed to redesign roads, transportation infrastructures, traffic management and regulations, while minimizing increased vehicle use, sprawl, and congestion.
    - Public transit must assess and act on new opportunities and risks. Should they operate fleets of automated taxis and minibuses? Will privately owned fleets could supplant public transit, potentially impacting accessibility & consumer costs?
- Information assets
    - If Canadians switch from car ownership to on-demand CAV mobility, a handful of global mobility companies could end up owning and managing most of the cars on our streets. Is this good or bad? How should governments respond?
    - Should governments learn to treat mobility data as an appropriately regulated public asset comparable to the money supply, health, urban land, and natural resources? Data policy is about a lot more than privacy and security [7]
- Considering these changes, all levels of government would be well served to review their fiscal and budgetary assumptions.

Canada needs to maximize the opportunities and minimize or mitigate the downsides. This will require leadership, organizational and human capacity, a willingness to face up to difficult issues, and the ability to define feasible (and sellable) solutions.

To achieve such leadership, governments need new kinds of policy frameworks and competencies. For example, transportation data is rapidly being appropriated away from the public domain to the private sector. This raises questions of ownership, control, availability for the pursuit of public interest objectives, and appropriate use. Data policy for CAVs should encompass, but also go well beyond, privacy and security to encompass issues like vehicle safety, incident reporting, compliance and fraud (e.g., re environmental and operational regulations), consumer access, and open data. The Government of Canada, along with others, is beginning to address this challenge. But for the time being, few if any government authorities have departments or divisions with the mandates, policy toolkits, and resources to deal with the data issue.

Conceptual vision and action plan

Canada has unique advantages. Lacking a domestically headquartered automotive OEM or tier 1 tech platform company, the country is well positioned to achieve a model for 21st century mobility that reflects the broad public interest. Such an agenda can achieve synergies among technology/auto sector innovation, economy-wide innovation and industry development, environmental, safety, accessibility, and urban planning and transportation infrastructure goals. By necessity, such a game plan would require support, commitments and actions from all 3 levels of government, the private sector, non-profits, social enterprises, and other stakeholders.

[7] See cited report, *Driving Changes*, pp. 40-43

Here is an example of a potential vision. By 2025 or sooner, Canada emerges as a global leader in the effective adoption of CAV technologies to:

- protect the environment,
- improve health, safety, accessibility and our quality of life
- revitalize our cities and communities,
- enhance individual and collective information rights,
- and build a vibrant, equitable and innovative 21st century economy

Realizing this vision might mean that by 2040, for example:

- People typically get around Canada's cities via app-based, seamless multimodal Mobility as a Service
  - Walking, cycling and other forms of active transportation, on complete, greenery filled, streets, are pervasive
  - Automated mass transit, automated buses/streetcars, and paratransit (automated minibuses) account for most personal vehicular trips
    - Automated taxis cover most of the rest
    - Traditional "driver" cars are restricted to limited sets of streets
- Decline compared with 2015:
  - End to end GHG and other toxic emissions due to personal transportation - 80%
  - Vehicle crashes/fatalities/injuries - 98%
  - Annual personal transportation costs – 60%
  - Average commute time – 50%
  - Vehicle mobility barriers (youth, elderly, disabled, low income) – 90%
- Canada's vibrant CAV technology sector:
  - 20% of value of implemented mobility solutions is from Canadian-based companies
  - Canada's CAV GDP is higher than the leading US state
  - 20% of CAV trips are via public services (in addition to large scale, publicly owned mass transit)
  - Open transportation data (anonymized) re technologies, activity, incidents etc. facilitates startup innovation, efficiency, safety, proper use, privacy, and transparency
  - Canadian firms in 3-5 non-transportation sectors have harnessed CAVs to achieve global leadership
- Key issues addressed/mitigated
  - Revitalization of urban design and land use for active transportation, complete streets, environmentally friendly
  - Market power of global mobility platform players
  - Information/data policy
  - Employment, inequality
  - Sprawl, excessive vehicle use
  - Fiscal changes

As milestones toward these goals, Canada might aim to achieve the following by 2030 (examples and numbers are illustrative):

1. Vehicle GHGs down 35%
2. Traffic fatalities down 35%
3. Canada is well on the way to Mobility as a Service
   - Ten of Canada's largest cities offer multimodal MaaS

- 30% of passenger vehicle kilometers travelled are via on-demand automated taxis and minibuses
- 35% of these are via public services (e.g., transit)
- MaaS is affordably available to 75% of accessibility users in Canada's cities (youth, elderly, people with disabilities, low income)
- Rural & remote regions are well served by innovative CAVs

4. Canada has a vibrant and growing CAV economy:
   - Canada-based companies are global innovators in applications that create, support and exploit CAV platforms. This is a $20B industry.
   - Canadian designed CAV technologies are transforming several domestic & international industries.
   - In addition, Canada's $50B CAV sector employs 50,000.
   - 10% of public sector procured CAV technology investments are designed in Canada, 20% built in Canada
5. Canada's infrastructure and urban design are maximizing mobility opportunities
   - All transit & roads built post-2020 use or support CAVs
   - 20% of urban street parking has been converted to "complete streets" (greenery, bike, walking, etc.)
   - Urban sprawl is under control
6. Challenges dealt with:
   - Job impacts addressed proactively
   - Comprehensive mobility data policies, mandates, industry partnerships, and enforced regulations are in place

Potential 2017 action items

The Government's focus on infrastructure and mobility investment and innovation in the 2017 budget provides powerful levers to move forward on a wide variety of CAV policy issues. For example, it could use these investments to encourage:

- Consideration of CAV for infrastructure and transit investments.
- CAV considerations in Smart City Challenge projects – such as cross-sectoral innovation, jobs, accessibility, complete streets, active transportation, zoning innovation, congestion management, transit innovation, safety, and environmental payoffs.
- Use of CAV data to maximize policy and project goals.
- Use of Canadian-developed and produced CAV technologies.
- Mobility as a Service pilot projects.
- Mobility information policy frameworks and capabilities.

A possible first step would be to create a mandated/budgeted CAV policy/program unit, comparable to the UK Centre for Connected and Autonomous Vehicles. This would be situated in an authoritative position, with executive leadership. It would have a cross-government mandate, with structured involvement of key partner departments such as Industry, Science & Economic Development; Environment & Climate Change; Employment & Social Development; Infrastructure & Communities; and Finance.

A “C-CCAV” could be tasked with developing and implementing a scenario/evidence/simulation-based vision and action agenda including 2030 goals and immediate actions.

Its mandate could include consultations and commitment management with cities and provinces across Canada, the private sector, non-profits, and other stakeholders. This could potentially help develop a shared perspective on how we can use CAVs to help build the Canada that we desire for ourselves, our children and grandchildren.

The US Department of Transportation recently announced the membership of a Federal Committee on Automation.[8] Canada might consider something similar at the appropriate time.

Additional topics

This paper has covered only part of the policy agenda for CAVs. Among other items for consideration, I suggest the following examples:

- Locations
  - Suburbs, towns, rural areas
  - First Nations communities
  - Remote communities
  - Mines, forestry etc.
- Functions
  - CAV impacts on government services and programs
  - Vehicle-dependent trades & activities (e.g., construction, police, national defence)
  - Freight
  - Vehicle-based services (e.g., snow removal, garbage collection, street cleaning)
- Other technologies
  - Drones
  - Mini-mobile robots (e.g., for delivery)
  - Complex mobile robots (e.g., for street cleaning, mining, agriculture)

[8] See https://www.transportation.gov/briefing-room/dot0717