Don’t Get Taken for a Ride!: Designing and Implementing Effective Autonomous Vehicle Regulation in Toronto, Ontario

By

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Submitted to the Department of Urban Studies and Planning in partial fulfillment of the requirements for the degree of Master in City Planning at the MASSACHUSETTS INSTITUTE OF TECHNOLOGY February 2018

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Abstract

Studies suggest autonomous vehicles can enable a more equitable, efficient, and sustainable transportation network. Yet, experts point out this outcome is not guaranteed, and that without outside policy intervention autonomous vehicle (AV) use might actually exacerbate congestion, sprawl, and inequitable access to travel. These challenges will be most acutely felt in areas under the purview of local governments—such as transportation congestion, land use, and impacts on public transit. As such, the goal of this thesis is to assist municipal policymakers with mitigating these impacts by answering the question: How can local governments effectively regulate autonomous vehicles?

Looking at Toronto, Canada, specifically, this thesis addresses the following issues:

- When is a contract, and when is a regulation, the most appropriate tool to encourage AV companies to act in ways that help foster a sustainable and equitable transportation network?
- What does the City of Toronto require to develop effective AV regulation?
- How can the City of Toronto codify broad AV policies into specific, enforceable regulations?

This thesis employs three research methods: a literature review, a document analysis, and qualitative interviews with relevant experts. The primary literature review looks at the possible benefits and harms that might come from AV development and the policies local governments can enact to correct for these externalities. Interviews were conducted with 23 experts from the public and private sectors and academia, with responses analysed and themes drawn out to develop answers to the above research questions. Finally, analysis of Toronto’s Official Plan and Municipal Code helped inform the creation of a proposed Article 10-A of the code to regulate AV rideshare companies.

Chapters three to five of this thesis develop a framework (laid out in Figure 0.1) for thinking about how best to design effective AV regulation. Firstly, the government needs legal capacity to regulate in a given area. Toronto, for example, is responsible for overseeing local rideshare company activity. The remaining four elements all relate to human resources. Interviews show Toronto’s bureaucrats believe they have a responsibility and ability to craft effective and ambitious regulations that advance the city’s goals. These willing civil servants need the time and the expertise to design good policy, and the Toronto government has an AV working group that provides a forum for such a discussion. To see regulations enacted effectively, however, the mayor and council must not only support rules eventually proposed by the working group; they may also need to approach the provincial government to convince them to craft their own complementary AV legislation.
Chapter six explores how broad AV policy can be applied concretely. Along with Article 10-A (Appendix C), it offers an example of the specific legal language for AV regulation. Divided into two broad categories—‘Equity’ and ‘Urban Form and Street Space’—the article addresses some of the anticipated issues that might arise with AV rideshare operations including a need to allow citizens without a smartphone are able to use the service, limit AV rideshare travel on local roads, and ensure all neighbourhoods enjoy a relatively similar level of service (accounting for geography and density).

Beyond the proposed article itself, chapter six provides feedback from Toronto officials as to the challenges the provisions in the article might face were the government to attempt their ratification. Positively, none of the regulations were unanimously viewed as infeasible, with staff seemingly eager to act boldly when it comes to addressing the challenges of AV activity. As such, this thesis can be used both by Toronto policymakers and their counterparts elsewhere as the basis for discussion in designing the specific rules for AV operations that will be incorporated into a future version of the Municipal Code.

*Thesis Supervisor:* Associate Professor Jinhua Zhao, Ph.D.
*Thesis Reader:* Assistant Professor Jason Jackson, Ph.D.
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First and foremost, I want to thank Professor Jinhua Zhao, who was willing to take me on as an advisee even under an accelerated writing timeline, and whose incredible enthusiasm, insights, and patience helped bring this thesis to life. Professor Zhao’s guidance made this thesis-writing process one of the most profound learning experiences of my grad school career, and I am very grateful. In addition, I want to thank my reader, Professor Jason Jackson, for his willingness to read my thesis over his winter vacation and provide invaluable comments that helped me clarify and expand on the content of my work.

I would also like to thank all of my interviewees, who provided me with some fantastic insights during my research process. The passion they have for making their cities a better place was evident, and I hope my work will contribute to that objective. In particular, I want to thank Ryan Lanyon, Vanessa Fletcher, Stephanie Simard, Mikel Murga, and David Block-Schachter for the amount of time they gave to my project and the very useful thoughts they provided.

Thank you to Yonah Freemark, Scott Middleton, and Annie Hudson for being an enthusiastic ‘AV/rideshare’ research team in my last semester and for providing their own comments and support for my work. In particular, thank you to Yonah for a number of very enlightening conversations that helped me reflect on the direction I wanted my research to go and offering many suggestions that strengthened my thesis.

To my mom and dad, who inspired in me a passion for learning and public service, and for always being my biggest cheerleaders as I spent many, many years in school. Lastly, to all the incredible people I have met in Boston over the last four years, whose intelligence and desire to make their communities better places has stimulated my own enthusiasm and fills me with optimism about the future of city planning and policy around the world.

Benjamin M. Gillies-Podgorecki, February 2018
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<th>Description</th>
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<tbody>
<tr>
<td>AV</td>
<td>Autonomous Vehicle</td>
</tr>
<tr>
<td>AVWG</td>
<td>Autonomous Vehicle Working Group (City of Toronto)</td>
</tr>
<tr>
<td>AV-PTC</td>
<td>Autonomous Vehicle Private Transportation Company</td>
</tr>
<tr>
<td>GJP</td>
<td>Good Judgement Project</td>
</tr>
<tr>
<td>GTHA</td>
<td>Greater Toronto-Hamilton Area</td>
</tr>
<tr>
<td>HTA</td>
<td>Highway Traffic Act (Ontario)</td>
</tr>
<tr>
<td>MBTA</td>
<td>Massachusetts Bay Transit Authority</td>
</tr>
<tr>
<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
</tr>
<tr>
<td>ML&amp;S</td>
<td>Municipal Licensing &amp; Standards (City of Toronto)</td>
</tr>
<tr>
<td>MTB</td>
<td>Manitoba Taxicab Board</td>
</tr>
<tr>
<td>MTO</td>
<td>Ministry of Transportation of Ontario</td>
</tr>
<tr>
<td>OAVC</td>
<td>Ontario Autonomous Vehicle Council</td>
</tr>
<tr>
<td>P-3</td>
<td>Public-Private Partnership</td>
</tr>
<tr>
<td>PTC</td>
<td>Private Transportation Company</td>
</tr>
<tr>
<td>TESS</td>
<td>Toronto Employment and Social Services</td>
</tr>
<tr>
<td>TEVO</td>
<td>Total Effective Vehicle Occupancy</td>
</tr>
<tr>
<td>TfL</td>
<td>Transport for London (United Kingdom)</td>
</tr>
<tr>
<td>TRBT</td>
<td>Toronto Region Board of Trade</td>
</tr>
<tr>
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<td>Toronto Transit Commission</td>
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<td>United States</td>
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Foreword

In spring 2017, I graduated with a Master in Public Policy from the Harvard Kennedy School. As part of the requirements for graduation, students complete a client project known as a ‘Policy Analysis Exercise’. My client was Transport for London in the United Kingdom, and the theme of my project was: ‘How autonomous vehicles will reshape London’. Returning to MIT in September to complete a Master in City Planning, I began thinking about possible topics for this thesis, with an intention to again focus on driverless cars. Around the same time, two news items caught my attention—one intriguing, and one concerning. In early May, Uber announced it would set up a new autonomous vehicle research hub in Toronto, Ontario, to test its driverless fleet. Weeks later, the mayor’s office in Pittsburgh went public over its displeasure with that same rideshare company, just nine months after Uber had set up a similar facility in Pennsylvania’s second-largest municipality.

Uber went into Steel City to much fanfare in September 2016. Mayor William Peduto had gone to considerable lengths to facilitate the company’s arrival, lobbying the state government to permit rideshare companies in Pennsylvania and helping Uber lease a large plot of land for its centre (Kang 2016). Not only working to develop a professional alliance between his administration and the company, the mayor also sought to foster a personal friendship with chief executive Travis Kalanick, even texting him a congratulatory message when Uber announced it was coming to Pittsburgh (Kang 2016). Despite these congenial overtures though, by May 2017 the relationship had soured considerably. The company began charging for rides initially pitched as free, withdrew support from the city’s $50 million federal transportation grant application, and failed to create new jobs in the underserved neighbourhood that housed its testing facility (Kang 2017).
After looking extensively at how driverless cars might reshape London, I believe this technology, thoughtfully developed and deployed, can help cities establish more sustainable and equitable transportation systems. The prospect of a local government collaborating with an autonomous vehicle company to promote an understanding of the opportunities and limitations of this technology is therefore positive, and I was excited at the opportunity the City of Toronto had to reach out to Uber as the rideshare company tested its cars in Ontario. I was concerned, however, that if not properly managed, the relationship might deteriorate as it had done in Pittsburgh. I thus decided I would use my thesis research in an attempt to help Toronto policymakers, by exploring how local officials could create contractual relationships with rideshare companies that would bring benefit to the community.

I began my research with a two primary questions. Firstly, what possible benefits could be written into a contract between the City of Toronto and Uber? Secondly, how could city officials write effective and enforceable contracts with rideshare companies? One of my first tasks in answering these questions was to reach out to officials in Pittsburgh to learn from their experience. What I discovered was eye-opening. The City of Pittsburgh never actually had a formal agreement with Uber—no signed contract, and not even a Memorandum of Understanding. They felt they had very little power to influence how Uber chose to operate in their city, because in Pennsylvania, the state utilities commission is responsible for overseeing rideshare companies like Uber and Lyft. The mayor’s strategy was thus to build a positive personal relationship with Mr. Kalanick and suggest a number of benefits Uber could provide to local residents, in hopes the company might agree to at least a few. Unfortunately, according to

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1 The sole exception is the City of Philadelphia, to which the state has given special powers to regulate rideshare companies operating inside its borders. These powers have not been extended to any other city, including Pittsburgh.
officials, once the rideshare giant had cars on the road, it was uninterested in offering what it apparently saw as unnecessary concessions.

While Mayor Peduto’s team today acknowledges the shortcomings of this approach, they also expressed frustration at their lack of regulatory authority over rideshare companies. Moreover, in speaking with Ryan Lanyon, the head of the City of Toronto’s Autonomous Vehicle Working Group—set up to devise an autonomous vehicle strategy for Ontario’s capital—I found out officials there are already looking at regulation as a way to manage driverless expansion in their community. Based on these conversations, it became clear that while contracts partnerships do have a place in helping policymakers understand how driverless cars can best serve citizens, what they need first and foremost is to lay the regulatory groundwork to adequately manage this new technology.

Many of the norms around travel today are so entrenched that politicians are loath to take them on for fear of public backlash. This is why autonomous vehicles are so exciting: Proactive policies can help shape the conversation around how this technology will develop, and the advantages of driverless cars can soften the impact of more assertive regulations. By setting out new norms now around autonomous travel, a strong legislative package can encourage autonomous vehicle development that helps Toronto—or any other city—mitigate many of the market failures that exist in our modern transportation systems. As such, I shifted my work away from contract opportunities and began looking at ways the City of Toronto can enact effective autonomous vehicle legislation.

Over the course of my research, what I found most surprising was how eager policy experts in Toronto are to act boldly on this front. In chapter six I offer a proposal for a new set of regulations for private transportation companies (such as Uber and Lyft) operating autonomous
cars. I was concerned policymakers would think my proposition totally unrealistic, but they largely supported the ideas and even wanted to go further with new rules. Where I recommended rideshare companies would need to provide data to the City of Toronto on a weekly basis for internal use, one respondent suggested this data should be made public online. Where I proposed a set-price congestion charge for circulation in the downtown, they countered with a flexible plan that varies based on when and where a vehicle travels. My findings indicate there is an appetite at the bureaucratic level to use legislation to guide autonomous development. My hope is that my work provides Toronto’s policymakers with a toolkit to start down this path towards a strong regulatory vision, and that in the future other cities follow Toronto’s lead as they too seek to build more vibrant, equitable, and sustainable places.
Chapter 1: Research Objectives and Methods

The dream of shifting northern North America’s transportation networks towards autonomy has never been closer to reality. According to Bloomberg Philanthropies, as of December 2017 nineteen cities in Canada and the United States were home to autonomous vehicle testing, with another nineteen expecting to welcome driverless trials sometime in 2018. The modern transportation system has enabled Canadians and Americans to travel farther and faster more reliably than any other generation in history, but it is not without challenges. In dense urban areas commuters spend hours a day stuck in traffic, collisions remain far too common—according to Statistics Canada, crashes kill over 1,800 people every year—and the expense of owning a vehicle makes it difficult for those of lesser means to get around. Entrepreneurs and investors backing the companies putting autonomous cars on the road, as well as many politicians working to bring driverless testing to their own communities, all argue self-driving technology will be the solution to these ongoing problems.

Studies suggest driverless cars (here defined at SAE International levels three through five, described in Table 1.1 on page 11) can enable a more equitable and sustainable transportation network while assisting with the development of vibrant communities. Yet, a number of experts point out this outcome is not guaranteed, and that without outside policy intervention autonomous vehicle (AV) use might actually exacerbate congestion, sprawl, and inequitable access to transportation. These potential challenges will be most acutely felt in areas under the purview of local governments—such as transportation equity and congestion, land use, and impacts on public transit. As such, the goal of this thesis is to assist municipal policymakers with tackling this issue by answering the question:

*How can local governments effectively regulate autonomous vehicles?*
Specifically, this thesis looks at the City of Toronto, in Ontario, Canada. In May 2017, rideshare company Uber announced it would be opening an AV testing facility in Canada’s largest city. Attracted by the strong artificial intelligence research currently underway in the Toronto-Waterloo corridor, the centre will be Uber’s third such institution and the first outside the United States. With this imminent arrival of driverless cars on its roads, Toronto must begin to prepare the policies that will guide AV development through the trial stages, which can lay the groundwork for a future urban AV mobility strategy. This thesis is meant to provide both a framework for thinking about how to best design effective AV regulation, and a proposal for what this legislation might look like as an actual legal document. The remainder of this first chapter outlines the research objectives, methods, and framework that form the basis for the following six chapters.

Table 1.1. SAE International levels of automation (Levels 3 to 5)

<table>
<thead>
<tr>
<th>Level</th>
<th>Automation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 3</td>
<td>Conditional Automation</td>
<td>The driving mode-specific performance by an Automated Driving System of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene.</td>
</tr>
<tr>
<td>Level 4</td>
<td>High Automation</td>
<td>The driving mode-specific performance by an Automated Driving System of all aspects of the dynamic driving task, even if a human driver does not respond appropriately to a request to intervene.</td>
</tr>
<tr>
<td>Level 5</td>
<td>Full Automation</td>
<td>The full-time performance by an Automated Driving System of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver.</td>
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</tbody>
</table>

1.1. Research Objectives and Organisation

Thus far, most research efforts on AV public policy have focused on what provincial, state, and federal governments can do to ensure autonomous vehicles are safe, encourage innovation, and limit impacts on employment. This thesis, however, looks at issues related to urban policy, using the City of Toronto as a case study. The primary research objective is to
discern what policy tools Canada’s largest local government has at its disposal, and how it can use them effectively, to ensure autonomous vehicles are a beneficial addition to the city’s transportation options. This primary research focus is divided into three secondary questions:

1) *When is a contract, and when is a regulation, the most appropriate tool to encourage AV companies to act in ways that help foster a sustainable and equitable transportation network and lead to more vibrant communities?*

Freemark and Zhao (2017) have laid out eight possible policies local governments can enact to guide AV expansion in a positive direction, which are described in chapter two. The first task to answering the primary research question is to discern which of these policies can have the greatest influence as a contract, and which are most appropriate as regulations. In general, regulations address the harms that come from private action, and sometimes even shape private actions for public benefit. Contracts, meanwhile, are designed to provide a specific service. Given the distinction, as discussed in chapter three cities will for the most part want to look at regulation to control the externalities that come from certain AV use choices. That said, there are opportunities to use contractual relationships to better understand how driverless technology can enhance transportation options, so it is important to consider how the two tools can work together in a complementary manner to accomplish a city’s development goals.

2) *What does the City of Toronto require to develop effective AV regulation?*

Section three of this introductory chapter outlines a framework of five elements that are helpful for enacting effective regulation. While these broad elements are likely relevant to other cities, this framework provides the lens through which to look at the characteristics of Toronto’s municipal government in particular, to suggest ways they can use their existing assets and develop new strategies to regulate autonomous vehicles. Firstly, I determine: *What legal right does Toronto have to create and enforce regulation?* As in all other provinces and states in
Canada and the United States, the provincial government is responsible for determining which vehicles can and cannot operate on Ontario roads, so it is not possible for Toronto to ban driverless cars outright. Nevertheless, cities enjoy authority over a number of other related areas—such as parking, speed limits, and in Toronto’s case, private transportation companies (PTCs)—that can be used to influence AV deployment and usage. The end of chapter three therefore looks at how Toronto’s Municipal Code, Article 10, can form the foundation of a future AV regulatory strategy in the Ontario capital.

Cities, however, require more than just the proper legal landscape to oversee private actors. They also need decision makers and powerbrokers ready and able to use the legal tools at their disposal. To that end: Are civil servants willing and able to harness their legal authority to enact strong regulation to rein in private actors? Will a mayor and her/his city council endorse these strong regulations, and be able to convince officials in higher levels of government to similarly provide any necessary support to see the new rules put into practice? Chapters four and five look at the ways in which employees willing and able to use the legal tools at their disposal, as well as elected leaders who support new rules and can engender such support among provincial politicians, are all important to advancing bold AV regulation.

3) How can the City of Toronto codify broad AV policies into specific, enforceable regulations?

A city must ultimately produce a concrete document outlining the rules by which it expects private actors to abide, and Toronto’s predominant legal document is the Municipal Code. Reading through this text and speaking with those who helped develop its bylaws, I recognised the most appropriate place for new AV rules is in the code’s Chapter 546, Licensing of Vehicles-for-Hire. Driverless cars are likely to first hit the roads under the ownership of private transportation companies (PTCs), and so where possible, cities should use their authority
to license local rideshare services to establish a set of regulations to govern their use. As such, the code’s existing Article 10-A (Private Transportation Companies) provides a guide for a proposed Article 10-A (Autonomous Vehicle Private Transportation Companies). This new article, written as part of this thesis, lays out the exact legal language the city could adopt to oversee and manage the autonomous PTC fleet operating inside its border.

Much of the text in Article 10-A is taken directly from the existing Article 10; however, the first sections of chapter five describe the new requirements that would apply to autonomous vehicles. The goal of writing this article was to actually offer a useful text city officials might be able to use in the future. As such, it was important to understand: What from the proposed Article 10-A do experienced policymakers believe is realistic, and what would be challenging or impossible to enact or enforce? Speaking with policymakers provided insights into what is possible on the ground, and can form a base for further research by city planners wanting to bridge the gap between broad hypothetical policies and the legal documents local governments use to mitigate externalities and foster stronger communities.

*Thesis Organisation*

The final two sections of this chapter outline my research methods and the general framework used to understand how local governments can implement effective regulation. Chapter two first describes the significant benefits and possible harms that might stem from a shift towards an autonomous transportation system, before outlining the eight policies Freemark and Zhao (2017) propose for addressing these risks as driverless cars develop. Chapters three through five discuss the ‘five elements to effective regulation’, using the City of Toronto (and to a lesser degree, the City of Pittsburgh) as case studies.
Chapter three looks at legal capacity and the differing roles contracts and regulations play in enhancing citizen wellbeing. It concludes by highlighting the specific sections in Toronto’s current Municipal Code that offer a precedent for enacting the policies described in chapter two.

Chapters four and five focus on the people behind the government. Chapter four looks at whether or not bureaucrats are willing to create bold regulation, and whether or not the institutional structure of their department supports officials looking to develop thoughtful, robust regulatory policy. Finally, it closes by exploring the role coalitions of cities can play in creating and enforcing effective new rules for autonomous vehicles. Chapter five shifts to elected officials, asking first whether they are willing to support new rules, and what civil servants can do to make it easier for politicians to endorse the rules they propose. It then explores the ways provincial (or state) officials might interfere when cities want to regulate, and what local politicians can do to ensure their administrations are free to carry out their plans—and even ways they can convince provincial counterparts to enact their own regulation to address municipal concerns.

Chapter six reflects an attempt at enacting the policies of chapter two as specific requirements for PTCs looking to operate in Toronto. While PTC rules are not appropriate for all of Freemark and Zhao’s proposals, they can encourage a more equitable transportation network that better integrates PTCs and public transit. Moreover, regulations can limit PTC vehicles’ impact on congestion and circulation in local communities. The general objectives of each requirement are described in chapter six, with the actual proposed Article 10-A included as Appendix C. The final section of chapter six discusses what officials from the Transportation and Municipal Licensing & Standards divisions at the City of Toronto, as well as current and former
policymakers in Massachusetts, believe is realistic and what would be challenging or impossible to enact or enforce from the proposed Article 10-A.

Lastly, chapter seven begins by offering some recommendations as to how local governments can foster institutions that facilitate strong regulatory development. Next, it looks at ways Metrolinx, as a regional agency, can provide a toolkit and other support to smaller local governments that want to bolster their own knowledge of AV policy. It concludes with some suggestions as to directions for future research.

1.2. Research Methods

This thesis employs three research methods: a literature review, a document analysis, and qualitative interviews with relevant experts. The primary literature review looked at (1) the possible benefits and harms that might come from AV development and (2) the policies local governments can enact to not only correct for these externalities, but encourage private choices that advance the goals outlined in the City of Toronto’s Official Plan in the areas of equitable access to city amenities, a robust public transit network, vibrant communities, and clean air and water. The findings from this primary literature review are provided in chapter two. Additional smaller literature reviews were conducted to supplement the qualitative interviews that provide the basis for chapters three through five, and seven.

The primary document analysis looked at the City of Toronto’s Official Plan and Article 10 of the Municipal Code. Analysis of the plan identified the major planning goals held by the city, and how AV regulation could advance those goals. Analysis of Article 10 not only identified sections that could provide precedent for new AV requirements, but also at the style and tone of the document itself, to emulate these characteristics in writing the proposed Article 10-A.
Interviews were conducted with 23 individuals to inform two major research questions:

- *When is a contract, and when is a regulation, the most appropriate tool to encourage AV companies to act in ways that help foster a sustainable and equitable transportation network and lead to more vibrant communities?*
- *What does the City of Toronto require to develop effective AV regulation?*

Prior to beginning interviews, I obtained my COUHES certification and research exemption, with documentation included in Appendix D. Interview subjects are listed in Table 1.2. Given the importance of local policymaking, nine interviewees work for municipal governments in areas related to transportation, licencing, transit, and partnerships with the private sector. As transportation planning is a regional endeavour, however, I reached out to Metrolinx, the regional transportation authority in the Toronto area, as well as the Ministry of Transportation of Ontario (MTO). Unfortunately, neither the MTO nor Metrolinx were able to provide anyone for an interview at this time. Knowledge of these agencies is therefore limited for the most part to second-hand sources, though the MTO did send a helpful email response that highlights the fact ministry officials are focused most on safety, with seemingly no communication with municipal counterparts. To supplement these secondary sources, I spoke with regional and state transportation officials in Massachusetts.

**Table 1.2. List of interview subjects**

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Employer</th>
<th>Classification</th>
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<tbody>
<tr>
<td>Ryan Lanyon</td>
<td>Chair, Automated Vehicles Working Group</td>
<td>City of Toronto</td>
<td>Local Policymaker</td>
</tr>
<tr>
<td>Vanessa Fletcher</td>
<td>Manager (Policy and Planning), Municipal Licensing &amp; Standards Division</td>
<td>City of Toronto</td>
<td>Local Policymaker</td>
</tr>
<tr>
<td>James Perttula</td>
<td>Director (Transit and Transportation Planning), City Planning Division</td>
<td>City of Toronto</td>
<td>Local Policymaker</td>
</tr>
<tr>
<td>Fahad Khan</td>
<td>Project Lead, Automated Vehicles Initiative</td>
<td>City of Toronto</td>
<td>Local Policymaker</td>
</tr>
<tr>
<td>Stephanie Simard</td>
<td>Senior Planner (System and Policy)</td>
<td>Toronto Transit Commission</td>
<td>Local Policymaker</td>
</tr>
<tr>
<td>Name</td>
<td>Position</td>
<td>Organization</td>
<td>Role</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>---------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Chris Osgood</td>
<td>Chief of the Streets, Transportation, and Sanitation, Mayor's Office</td>
<td>City of Boston</td>
<td>Local Policymaker</td>
</tr>
<tr>
<td>Kris Carter</td>
<td>Co-Chair, Mayor's Office of New Urban Mechanics</td>
<td>City of Boston</td>
<td>Local Policymaker</td>
</tr>
<tr>
<td>David Block-Schachter</td>
<td>Chief Technology Officer</td>
<td>Massachusetts Bay Transit Authority</td>
<td>Regional Policymaker</td>
</tr>
<tr>
<td>Daniel Sullivan</td>
<td>Policy Analyst</td>
<td>Massachusetts Department of Transportation</td>
<td>State Policymaker</td>
</tr>
<tr>
<td>(Name Withheld to Protect Privacy)</td>
<td>Policy Advisor, Mayor's Office</td>
<td>City of Pittsburgh</td>
<td>Political Staff</td>
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<tr>
<td>Jeffrey Mullan</td>
<td>Lawyer and Former Secretary of Transportation</td>
<td>Commonwealth of Massachusetts</td>
<td>Political Appointee</td>
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<tr>
<td>Fred Salvucci</td>
<td>Former Secretary of Transportation</td>
<td>Commonwealth of Massachusetts</td>
<td>Political Appointee</td>
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<tr>
<td>Marc Leblanc</td>
<td>Policy Advisor (Policy and Government Relations)</td>
<td>Federation of Canadian Municipalities</td>
<td>Government Relations Expert</td>
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<tr>
<td>Rafael Mares</td>
<td>Lawyer and Vice President and Program Director (Healthy Communities and Environmental Justice)</td>
<td>Conservation Law Foundation</td>
<td>Contract vs. Regulations Advisor</td>
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<tr>
<td>Bengt Holmstrom</td>
<td>Professor, Department of Economics</td>
<td>Massachusetts Institute of Technology</td>
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<tr>
<td>Erick Guerra</td>
<td>Assistant Professor, School of Design</td>
<td>University of Pennsylvania</td>
<td>Public Sector Advisor</td>
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<tr>
<td>Eric Miller</td>
<td>Professor, Department of Civil Engineering</td>
<td>University of Toronto</td>
<td>Public Sector Advisor</td>
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<tr>
<td>Steven Shladover</td>
<td>Research Engineer, Partners for Advanced Transportation Technology</td>
<td>University of California</td>
<td>Public Sector Advisor</td>
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<tr>
<td>Mikel Murga</td>
<td>Former Lecturer and Research Associate, Department of Civil and Environmental Engineering</td>
<td>Massachusetts Institute of Technology</td>
<td>Public Sector Advisor</td>
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<tr>
<td>Mark Fagan</td>
<td>Founding Partner and Advisor</td>
<td>Norbridge, Inc.</td>
<td>Private Sector Advisor</td>
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<tr>
<td>Karl Iagnemma</td>
<td>Chief Executive Officer</td>
<td>NuTonomy, Inc.</td>
<td>Private Sector Advisor</td>
</tr>
<tr>
<td>Larry Susskind</td>
<td>Professor of Environmental and Urban Planning, Department of Urban Studies and Planning</td>
<td>Massachusetts Institute of Technology</td>
<td>Negotiations Strategist</td>
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I also attempted to speak with Toronto Mayor John Tory or a member of his staff, and also reached out to two local councillors. All three referred me to Ryan Lanyon, the chair of Toronto’s Autonomous Vehicle Working Group (AVWG), as they suggested Mr. Lanyon would be the most appropriate person to answer questions related to autonomous vehicles in the city. I was able to speak with the primary advisor to Mayor William Peduto in Pittsburgh, which was important given that Uber opened an AV testing facility there in 2016. I also spoke with two former Massachusetts secretaries of transportation to hear a more political perspective. The various government-related interviewees, both political and bureaucratic, are shaded in blue in Table 1.2.

Lawyer Rafael Mares and Professor Bengt Holmstrom provided insight into when a contract, versus when a regulation, is the most appropriate policy tool. Professors Erick Guerra and Eric Miller, and Steven Shladover and Mikel Murga, all have extensive experience partnering with local government officials on various transportation projects, including projects looking at AV expansion. They therefore spoke to their perspective on what elements local governments require to enact strong regulation. Professor Guerra has also conducted research on why municipal officials are or are not interested in AV policy at this time, so he discussed his findings.

Mark Fagan and Karl Iagnemma spoke to their understanding of how private sector companies approach regulations—both in positive and negative ways. Finally, Professor Larry Susskind offered thoughts on ways local government officials can strengthen their hand when in discussion with company representatives to mitigate their possible opposition to new rules, as well as ways local government staff can convince provincial (or state) counterparts to support regulatory proposals.
While the priority was local policymakers given the focus of the thesis overall, future research should seek regional and elected interviewees to further expand on the insights presented in this thesis. Based on research for this thesis, it appears regional and provincial officials are less willing to participate—in part, based on the comments I received, because they do not consider their work to be relevant to urban issues. Even if this is the case, finding ways to convince them to share their perspective will fill some of the gaps in current understanding.

I also reached out to the former heads of the City Planning and Transportation divisions, but they were both unavailable for comment since they had left their departments only recently. Former high-ranking officials would likely provide a unique perspective on decision-making processes and the relationship between the civil service and the political staff, so additional research can make a point of speaking with those who have previously served in government in positions of authority.

*Interview and Coding Process*

Where possible, interviews were conducted face-to-face, and otherwise over the phone or via Skype. Most interviews lasted around an hour, though some went as long as an hour and a half. All interviews were recorded with notes taken throughout. Interviewees were informed they were free to refuse comment on a given question or end the interview altogether. They were also informed they could choose how they would be cited in the final thesis. The officials from Pittsburgh, for instance, requested their names be withheld for confidentiality reasons. While some people provided information that they asked not be attributed to them in the final document—requiring secondary sources for citation in the thesis—all were quite happy to respond to the questions overall and nobody refused to answer any questions outright. There was a wide diversity in perspectives, from respondents who seemed quite proud of what their
governments had accomplished, to those who were critical of the shortcomings of their departments with many thoughts on ways government institutions need to improve to effect better regulatory policy.

Prior to each interview an interview guidebook was prepared, a sample of which is provided as Appendix A. Each guidebook was tailored to the individual interview subject based on their area of expertise, but they all followed a similar rubric:

- Introduction;
- Subject’s background and experience;
- Areas relevant to current study;
- Reflections on areas for improvement/cautions for City of Toronto officials;
- Final thoughts and recommendations for future interview subjects

After each interview, I listened to the recording to ensure the accuracy of the transcription, then went through the text to highlight sentences based on their main theme. After completing each of the first few interviews, all previous interviews were reviewed to look for interesting “semantic content”—surface-level ideas and connected themes (Javadi and Zarea 2016)—that could be useful in future interviews. Upon completion of the fifth interview, all five transcripts were reviewed for “latent themes” revealing deeper, related concepts and ideas that were grouped together. These themes were then again used to modify future interview guidebooks. In particular, contrasting experiences are often instructive (Weiss 1994), so guidebooks were altered based on past findings to probe comparison among different local governments’ strengths, relationships with private and public sector actors, and other relevant topics.

The search for contrasting experiences meant not only asking questions in search of differences, but also finding interviewees who could offer divergent perspectives. The initial interview list was limited to City of Toronto and City of Pittsburgh staff. Once these early
discussions began to yield recurrent themes and avenues for further exploration, new interview subjects were found that could hopefully shed light on areas that had proven relevant based on earlier conversations. As more interviews were completed, I returned to previous subjects for shorter follow-up discussions where they could respond to information learned from more recent conversations. Qualitative interviews are often critiqued for not being generalizable (Thomas and Harden 2007). By following up with City of Toronto officials from earlier interviews, I probed what they thought would be relevant to their context, so that final recommendations would actually prove useful and appropriate to their particular situation.

Once all initial interviews were completed, I created a mind map of the themes pulled from the interviews, then went through every transcript a final time to categorise as many ideas as possible, and link them to one another where appropriate. This thematic analysis exercise led to the creation of the five elements of effective regulation—discussed in the following section—and a number of sub-themes, which are developed in chapters three through five.

1.3. The Five Elements to Effective Regulation

While chapter one outlines the research questions and methods and chapter two discusses the literature review, chapters three through six provide new insights offered as part of this thesis. Interviews with policymakers revealed a number of consistent themes they believe are important if a local government is to be successful in creating and enforcing effective regulation. Firstly, the government needs to have the legal capacity to regulate in that area. The City of Toronto, for example, regulates its own PTCs, whereas other provinces (like Québec) and states (like Texas) look after rideshare companies. In these territories, local governments are to various degrees prohibited from regulating what PTCs can or cannot do.
The other four elements are all related to human resources. A government needs bureaucrats who are willing to craft effective and ambitious regulations that advance the city’s broad goals, even though they might limit certain freedoms. If they are willing, these bureaucrats also then need the capacity (the time and the expertise) to actually think about regulation and design good policy. Finally, cities need politicians who are willing to support strong new rules. Not only does this mean standing by their civil servants even if the rules do upset business leaders or the voting public; municipal politicians also must be able to ensure higher levels of government do not interfere in local activity by, for instance, rescinding a city’s legal authority in a certain area. Sometimes, they even need to convince upper levels of government to either give local administrations more power, or establish their own regulations that complement new local legislation. These five elements are shown in Table 1.2.

**Figure 1.2. The five elements to effective regulation**

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<th>Legal</th>
<th>Bureaucratic</th>
<th>Political</th>
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<td>Willingness</td>
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<td>Capacity</td>
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The framework as described above suggests a specific directionality: A city possesses the legal authority, and civil servants are willing to use that authority and have the time to do so effectively. They then present their proposal to the city’s elected officials, who publicly champion the idea and lobby their provincial, state, and even federal counterparts as necessary. Obviously, however, this is only one of a number of possible manners in which the process of designing stronger regulation could progress. A mayor or a city councillor, for example, might themselves believe new regulation is necessary or that popular will is in support of stronger rules, and proactively ask the civil service to come up with a regulatory plan. Alternatively, city council might approach the provincial government and ask them to grant local officials new authority over a certain activity. In some circumstances, the province itself divests regulatory
responsibility and orders cities to come up with new rules to govern a now-unmanaged sector. This latter instance just happened recently in Manitoba, when the provincial government dissolved the Manitoba Taxicab Board and told the City of Winnipeg it was now responsible for overseeing its own taxis and PTCs.

This thesis approaches the opportunity for bold regulations from the perspective of a city or transportation planner who believes AV policy can address the problems of the existing transportation system. Specifically, it is meant for the head of the AVWG at the City of Toronto: An inter-divisional working group looking at how the local government can respond to the development of autonomous vehicles. Assuming this head official agrees with the analysis in chapter two—that driverless cars are likely to exacerbate the externalities of the existing transportation system, and regulations can help curb these challenges and also nudge AV use in a positive direction—what actions can s/he undertake to foster better local rules to curtail harms and encourage development that follows the City of Toronto’s \textit{Official Plan}?

Given this particular vantage point, the directionality noted above is appropriate. The head of the AVWG must first establish the City of Toronto has authority, which it does in certain areas through its \textit{Municipal Code}. Next, s/he needs to consider whether s/he can build support within the civil service for new regulation, and the way to foster divisional institutions and practices that make it easier for policymakers to design legislation. Finally, they must present their recommendations so as to win endorsement from the city council and the mayor, and devise a strategy as to how best to introduce their measures to the provincial government and see them assist by crafting their own complementary regulation.

If other bureaucrats, or local politicians, or provincial officials are already in support, then the AVWG head’s job is all that much easier; but this thesis assumes they must build
willingness and capacity from the ground up on all fronts. It is also not unreasonable to think they will need to present their plan to the public through community meetings or in other forums, but many of the arguments designed to make their case in front of elected officials elaborated in chapter five can be used to similarly win over the electorate.

As shown in Figure 1.1 (page 24), most experts agree the slow proliferation of autonomous cars is at least a decade away. The fact is, there are many issues that AV companies and provincial, state, and federal ministries must work through when it comes to a driverless fleet. These include the development of technological reliability, proving that reliability, protecting autonomous cars against computer hacking, and lowering the cost of these vehicles. Shladover (2016) provides an extensive discussion as to the challenges that still need to be overcome before driverless cars can operate in any meaningful capacity beyond the testing phase.

Despite the long time horizon, it is important for cities to begin thinking today about how to guide future driverless development. From studying the topic, to debating broad policy goals, to designing specific regulations, it can take years to implement legislation to govern how autonomous cars operate in our communities. Waiting until they are already on the road before taking action therefore means corporate objectives, rather than the public interest, will steer their growth. In fact, the laissez-faire strategy to early car use a century ago led to a number of serious problems that plague transportation systems to this day. As these transportation systems evolve to incorporate autonomous vehicles in the years to come, it is important to firstly acknowledge and reflect on how to correct these existing deficiencies—the objective of chapter two.
Figure 1.1. Select projections for AV market penetration

2017 Trials taking place in Europe, Asia, and North America

2025-2030 Level 5 technology on the market
   Thatcham Motor Insurance report

2030 Consumers begin to adopt autonomous vehicles
   McKinsey & Company consultant report

2035-2045 Proliferation of autonomous cars has important planning implications
   Dimitris Milakis, assistant professor of sustainable transport, Delft University

2040-2060 Meaningful impacts on congestion, safety, and pollution start to be realised
   Todd Litman, executive director, Victoria Transport Policy Institute

2050+ Most vehicles are autonomous
   IHS Markit consultant report

2065 Autonomous vehicles begin to see significant market penetration
   Raj Rajkumar, vehicles information technology expert, Carnegie Mellon University

2075 Level 5 autonomous technology is available on the market
   Steven Shladover, engineer, Partners for Advanced Transportation Technology
Chapter 2: Autonomous Vehicles: The Good, the Bad, and the Policy

The Greater Toronto Area is in a period of incredible growth. According to City of Toronto analysis, the metro population is projected to rise by 2.7 million people before 2031, with Toronto alone adding 537,000 residents and 544,000 jobs. Such development is undoubtedly exciting, but not without challenges. Millions of new Torontonians and commuters expecting services will put a strain on all city resources, but perhaps on none more so than the transportation system. Already, Toronto’s road and rail networks are struggling to accommodate demand, and Metrolinx projects there will be “three million more cars on the road during rush hour by 2041—almost fifty per cent more than today”. As a result, congestion will increase by a shocking 122 per cent (Blais and Burchfield 2017).

Yet, there is cause for hope. This forthcoming decade of urban expansion in Toronto will coincide with the first great transportation revolution of the 21st century: The rise of autonomous vehicles. Self-driving cars and trucks are literally on the roads today, and trials thus far appear to be going well. As noted in the introduction, there is considerable debate as to exactly when driverless travel will move beyond the testing stage, but within a decade or two experts suggest it is not unreasonable to believe Canadians could be on their way towards adopting a fully-autonomous fleet.

Like many cities, Toronto has an Official Plan meant to guide urban policy and development through the next quarter century. The intention is to create a community that enjoys:

- Vibrant, complete neighbourhoods made for walking and cycling;
- A comprehensive and high-quality affordable transit system that lets people move around quickly and conveniently;
- Equitable access to a range of leisure and recreational opportunities for people from all walks of life; and
- Clean air, land, and water
Studies show autonomous vehicles can help advance all these goals—even in a city twenty per cent larger than it is today. Such a successful outcome is not guaranteed, however, and a number of academics argue that if we do not simultaneously redesign some of the fundamental features of the modern transportation system, embracing autonomous technology will only exacerbate its existing flaws. This chapter therefore begins by looking at the divergent paths scholars speculate autonomous evolution might take, in particular the key shortcomings we must address in advance of AV adoption. It then concludes by outlining eight broad policies officials in Toronto can enact to correct for these deficiencies—that will be fleshed out in the four subsequent chapters.

2.1. Two Visions of Autonomous Development

Positively, autonomous vehicles are expected to offer a number of advantages over human-driven cars. “Whether shared or individually owned, electric or gas-powered, compared to the existing automobile system autonomous vehicles are projected to reduce crashes and improve traffic flow while expanding use of time for travelers, giving them the opportunity to relax or work rather than drive” (Freemark and Zhao 2017). Moreover, driverless vehicles will likely provide mobility to those who cannot drive, including those who are blind or otherwise differently-abled, young people without a license, and older former drivers. Based on a series of focus groups, in fact, KPMG predicts driverless opportunity will result in double-digit increases in travel by people ages 16-24 and 65+ (Levinson 2016).

While there is near unanimity among experts as to these benefits, however, other outcomes are far more contested. Some technologists enunciate a vision in which autonomous vehicles solve the problems of modern travel. A driverless fleet will give rise to an era where customers see mobility as a service, rather than seeking personal car ownership. With the click of
a button, someone will be able to order an autonomous PTC vehicle that arrives momentarily. Without a driver the ride is very inexpensive, and the car itself will speak to Wayze and other systems to know exactly the best route to take to avoid congestion. Always travelling the speed limit, these vehicles will also make a safer environment for pedestrians and cyclists, encouraging active mobility.

Because a ride will be just a click away, commuters will leave their cars at home (or never purchase one in the first place). Their journeys will incorporate a mix of shared PTC rides—similar to taking an UberPOOL or Lyft Line—and public transit trips. Sharing vehicles will cut the number of cars on the road by as much as sixty per cent (Frazzoli 2015; Martinez 2015), causing a significant reduction in travel times. Furthermore, as fewer cars need a place to stay during the day, cities will be able to do away with copious parking in favour of bike lanes, parklets, and other human-scaled development. Less parking and better transportation options will lead cities towards greater density, easing the financial burden on the government to maintain a sprawled infrastructure and lessening the environmental impact.

A number of planners, however, dispute these glowing predictions. As they point out, this vision goes against the prevailing choice patterns of the last century of urban development, and they question the notion we will somehow independently change course in an autonomous future. Automobile ownership has been the longstanding goal for the country’s commuters, and if people simply replace their conventional vehicle with an autonomous one, the impact on congestion in urban communities will be quite minimal. In fact, there is a strong case gridlock might actually rise due to a number of factors. Owners may forego paid parking in favour of sending their empty vehicle home for the day, for instance, doubling the vehicle kilometres needed to bring them to work. As the time cost of travel is much lower (because people can read,
watch television, or even sleep in their car), they may also be more willing to accept long-distance commutes. Not only would this further increase total kilometres travelled, but would intensify urban sprawl as commuters moved ever outward (Ewing 2003).

In general, history shows that as technology spurs cheaper, faster movement, humans travel more. As a result, when flow improves, congestion does not abate, but stays constant or even goes up. Researchers Duranton and Turner (2011) documented this effect in a study of US cities, when they found building roads has no impact on reducing traffic. When the amount of street space went up, everyone just used more of it. Without some kind of outside intervention, economists and transportation modellers anticipate the efficiencies self-driving vehicles provide will likewise quickly be overrun by latent demand. In fact, an analysis published in *Transportation Research* estimates driverless vehicles will cut the cost of travel by eighty per cent, driving up kilometres travelled by up to sixty per cent (Freemark 2015).

It is worth reflecting on why increased use is classified as a negative outcome of autonomous development. Greater mobility in itself, after all, is a promising phenomenon, as it means more people can pursue new opportunities within their community. The problem, though, is that because our current system hides the true costs of travel, it induces what might be called ‘greedy’ consumption. When governments do not charge people to use the road, there is no incentive for travellers to limit the amount of space they take up—say, by selecting a smaller vehicle, switching to public transit, or waiting until off-peak hours to make their journey. As each person demands more space, congestion increases, making it more difficult for everyone else to utilise the system as much as they would like. While this impacts all travellers in terms of slower journey times, often the poorest residents are least able to absorb the higher time-cost of travel, meaning they cut back the number of trips they take (Wood 2016).
An efficient transportation network would enable as many people as possible to move as quickly and easily as possible through their community, to access jobs, education, and any number of other welfare-enhancing amenities. But when incentives do not discourage people from choosing the forms of transportation that consume the most space or other resources, it slows the system and thus restricts the total amount of travel everyone can undertake. In contrast, if policies could influence people to have a smaller mobility footprint, it would allow them to get around as much as they needed without encroaching on their fellow citizens’ ability to move as freely as they would like, either.

Unfortunately, left unchecked autonomous vehicles will further exacerbate the trend of inducing people to take up more space, by dramatically lowering the cost of single-occupant mode choices. Already, there is evidence to suggest the ease of hailing a PTC ride is drawing people off the public transportation system and into cars (Bliss 2017). Without any human driver at all, autonomous PTC vehicles might actually become almost cost-competitive with the public transit network, making it even more attractive to go point-to-point alone rather than using the transit network (Corwin et al. 2015).

In places with low demand and excess road space, it makes sense to shift away from an underperforming fixed-route public transit network in favour of ridesharing (provided supports are in place to ensure low-income people do not struggle to afford the cost of a PTC trip if it is higher than a public transit fare). In dense areas like downtown Toronto, however, drawing people off the subway or streetcars and into for-hire cars could result in a massive increase in gridlock. Even now, we can see what the future might hold for large urban centres: Recent data show average speeds during business hours in Manhattan have dropped fifteen per cent since 2010, and evidence suggests PTCs are to blame (Bliss 2017). If autonomous travel also makes
taking a car more attractive compared to walking and cycling, it will only compound the effect. Moreover, while most people assume autonomous cars will be electric, the technology does not require this to be so. If not, then more intense use will also lead to increased emissions on top of traffic. By drawing people towards the most resource-intensive form of transportation, the appeal of cheap autonomous travel could undo decades of effort to reinvest in walkable communities supported by robust public transit that serves the entire population well.

Yonah Freemark and MIT Professor Jinhua Zhao have outlined the potential impacts of autonomous vehicles (see Figure 2.1 on page 30, reproduced from their document). While the positive impacts are optimistic and inspiring, history suggests the negative outcomes might actually be more likely. Thankfully though, policymakers in Toronto and elsewhere do not have to simply sit back and watch as autonomous vehicles move their cities further from the goals outlined in their official plans. Instead, officials can use the advent of autonomous vehicles as a catalyst that reframes the debate around transportation and establishes new norms regarding urban mobility.
Figure 2.1. Projected impacts of AV deployment (from Freemark and Zhao 2017)
2.2. Policy to Complement Autonomy

Based on Figure 2.1, the potential worst-case scenarios of AV development can be summarised as follows:

- Paid travel costs do not reflect the true costs of travel, leading to:
  - Excessive road congestion;
  - Increased urban sprawl, which strains municipal finances;
  - Inordinate environmental impacts;
- Certain segments of the population are systematically excluded from access to high-quality transportation options;
- Development decisions are biased towards automobile usage, deterring travellers from walking, cycling, or riding public transit; and
- AV technology enables travellers to avoid certain existing municipal fees, which reduces incoming government revenue.

For the most part, these are not technological deficiencies, but market shortcomings. As such, expecting autonomous vehicles to be a silver bullet that corrects for these flaws will likely prove misguided. Autonomous technology is a tool, neither inherently good nor bad. The evidence suggests they can improve the transportation system, but cannot alone address its fundamental failures as they exist today—in fact, autonomy’s laissez-faire adoption is liable to only exacerbate established inefficiencies. To see the transportation network achieve its full potential under autonomous vehicles, therefore, the City of Toronto must establish a policy foundation that rights the ship when the invisible hand of the travel market fails.

Given the uncertainties as to how AV technology will ultimately develop, policymakers can adopt a two-pronged approach to dealing with the challenge. Officials can today enact a number of measures that would be helpful in shifting the development trajectory such that it aligns with the Official Plan, regardless of whether the vehicles on the road are driven by humans or machines. Freemark and Zhao have assembled a list of eight such measures:

- Limit parking provision;
- Rethink the use of street space;
- Enact distance-based road pricing;
• Integrate for-hire autonomous vehicles and public transit;
• Offer income-based subsidies;
• Centralise data collection and distribution;
• Require minimum levels of service provision; and
• Require zero-emission vehicles.

These initiatives have been tried to various degrees in different parts of the world and have already proven their validity, but all become more effective when implemented in conjunction with self-driving technology. Admittedly, at least a few of these proposals will be difficult to enact politically given that they run against the established norms of the transportation system; however, the power of autonomous vehicles can soften the blow of these measures. As autonomous vehicles make the overall system more efficient and less expensive, correcting for longstanding deficiencies will be less burdensome than they would be were the same measures to be imposed under current circumstances.

Likely though, over time unforeseen difficulties will arise as Canadians integrate autonomous vehicles into the existing fleet. Policymakers and planners must therefore be on the watch for negative trends, and explore options to provide redress when they are identified. Chapter three looks at techniques officials can use to track changes and generate new policy ideas. For now, I offer a broad vision of how the eight measures listed above can help Toronto advance the vision in its Official Plan.

2.3. Eight Measures to Align AV Development with Toronto’s Planning Goals

According the Fred Salvucci, academic and former Massachusetts secretary of transportation, studies show limiting parking provision is oftentimes the most effective measure cities can take to reduce congestion. Research by authors including Guo (2013) and Washbrook et al. (2006) further confirms underpriced parking incentivises automobile use. Quite simply, without an affordable place to keep their car during the day, commuters have a much
greater motivation to find another way to get to work. To keep gridlock manageable, therefore, as the autonomous vehicle fleet grows the City of Toronto can reduce on-street and garage parking, decouple development projects from parking provision, and incentivise redevelopment of existing lots (Freemark and Zhao 2017)—all with the goal of encouraging commuters to choose alternative modes of travel and perhaps even give up car ownership entirely.

**Figure 2.2. Areas for future growth in Toronto (from the City of Toronto’s Official Plan)**

The City of Toronto’s *Official Plan* identifies a number of spaces primed for future urban growth. Outlined in Figure 2.2, these include the Downtown (orange), the Centres (red), and the Avenues (brown). The government intends to foster “concentrations of workers and residents […] resulting in significant centres of economic activity” in these nodes and along these corridors, supported by “high quality transit services, including priority measures for buses and streetcars, combined with urban design and traffic engineering practices that promote a street that is safe, comfortable, and attractive for pedestrians and cyclists” (City of Toronto 2016). City officials can thus focus initial parking limits in these areas, which generates a virtuous cycle
whereby fewer cars on the roads makes alternative modes safer and more attractive, further reducing automobile use and the need for parking spaces.

Of course, the ability to run without a human driver is one of the benefits of autonomous vehicles, so it is reasonable to assume a parking limit might have no effect on its own—because owners could simply send their vehicle home. In some cases this might be advantageous; if a former suburban ‘park and rider’ can send her car home, for instance, it saves on investments in large parking lots near transit stations, and enables her spouse to use the car during the day, perhaps saving the family having to buy a second vehicle. But in dense areas, unoccupied vehicles only exacerbate traffic. As such, in the downtown and centres the city might consider prohibiting empty private car travel outright.

Having already identified these five nodes for pedestrian and cyclist priority, officials can rethink the use of street space in these areas. By progressively reducing “road space for automobiles proportional to the decline in registered vehicles”, they can open up land for larger sidewalks and plazas, as well as dedicated transit and bike lanes (Freemark and Zhao 2017). Toronto launched just such a pilot project in 2017 to give priority to streetcars along King Street to increase safety and service speed for the line’s 65,000 daily riders. New York adopted a similar approach in Times Square back in 2009, creating an incredible new urban space and actually decreasing vehicular travel times by seven per cent in the surrounding area (Bloomberg and Pope 2017).

Besides closing certain streets to through-traffic completely, in the centres and other neighbourhoods the city can also “generalise pedestrian use of street right of way” and reduce speed limits so people on foot have a higher priority even where cars are permitted (Freemark and Zhao 2017). This ‘shared streets’ approach has grown in prominence in Europe over the last
few decades, as urban designers spurned conventional practice that segregated motorists from cyclists and pedestrians. They recognised that by employing a dynamic environment where cars are in constant interaction with other users, shared streets encourage drivers to act cautiously to avoid a collision (Freemark and Zhao 2017). Confirming the theory, a study of seven European shared space projects from 2004 to 2008 concluded shared streets have fewer accidents than regular ones. Despite slower speeds, traffic delays are also reduced as vehicles can move through the neighbourhood at a steady 25 kilometres per hour (Freemark and Zhao 2017).

**Figure 2.3. City of Toronto Road Classification System**

![City of Toronto Road Classification System](image)

Autonomous vehicles are particularly well suited to shared streets principles. Programmed to obey the law, they will always travel the speed limit (any tampering with a vehicle so it moves more quickly should be a serious offence) and yield to pedestrians. Moreover, their mapping algorithm can be designed such that the cars choose to avoid certain roads when making a journey. Using the City of Toronto’s official Road Classification System
(shown in Figure 2.3), Local and Collector streets could have a lower designated speed limit. This would help push through-traffic to Arterial roads, keeping neighbourhood streets predominantly for people to safely play, walk, and bicycle.

Looking at the cityscape more broadly, the government can enact new zoning guidelines to encourage greater infill development and inhibit sprawl. This clearly goes beyond transportation and into the complementary disciplines of land use and planning, but is absolutely necessary to designing an overall sustainable Toronto—from both an ecological and financial perspective. Work by the Smart Prosperity Institute at the University of Ottawa has found the costs to the local government of a house in a sprawling peripheral community are over twice as much as they are in an urban one ($3,400 versus $1,400 per year) (Schmitt 2015). The City of Toronto needs to develop means to ensure suburbanites cover the additional burden they put in the city, which will likely increase demand for more dense development.

More specific to the transportation system, Torontonians must begin to pay the full cost of their travel. One of the central assumptions Canadians have come to make about our road network is that “it is a public good; that is, the use of a road by one individual does not impede the ability of others to use the same road” (Gillies 2012). Reaching levels of traffic congestion as experienced daily in Toronto, however, roadways take on traits comparable to those of a hydro or water system. “Just as only so much electricity or water can flow through a power line or pipe at any one time, there is only so much room available for cars on the street, leaving the potential for similarly negative results if user demand surpasses available supply” (Gillies 2012). When travellers are not required to pay for the space they use, it leads to ‘tragedy of the commons’ congestion, which impedes everyone’s mobility.
To rectify the situation, economists argue governments need to treat the road transportation system just like other utilities: Provide financing for infrastructure construction, then charge consumers a fee relative to how much they use the service (Duranton and Turner 2011). A distance-based road pricing plan that charges users based on when and where they travel “would encourage higher vehicle occupancy, particularly at peak times, and would discourage the circulation of empty autonomous vehicles on public streets” (Freemark and Zhao 2017). Until now, the technology has never existed to properly track all vehicles, but in an era of cars connected directly to the Internet, such a vision is much more realistic. At night on a suburban road the charge would be almost zero, but in downtown Toronto, along an Avenue, or in a Centre during rush hour it would be quite high. The goal would be to attract more people to walk, bike, or share a ride—in either a PTC- or TTC-run vehicle—so the system can effectively accommodate as much demand as possible.

This charge is perhaps the key instrument to achieving the planning and transportation outcomes the City of Toronto envisions in its Official Plan (Freemark and Zhao 2017). Furthermore, it will help compensate for the lost revenues that result from a shift towards greater autonomous travel. Admittedly though, it is also likely to be the most difficult measure to enact politically, as it goes against one of the most entrenched transportation norms we know today: A right to ‘free’ car travel. With a shifting technological landscape that comes with the advent of driverless technology, there is an opportunity to enact this measure as citizens come to rethink what they need and expect from the transportation system. If Torontonians do not want to be stuck in congestion that becomes far worse as the population increases, empty cars roam the streets, and commuters drive farther due to a sprawling urban landscape, it is imperative everyone begins paying the true cost of their travel.
Yet the city does not need to frame this in threatening terms, but can argue these charges are just one measure in a more holistic strategy to design a cost-effective and efficient network that most successfully meets citizens’ needs. The emphasis is on a network, integrating for-hire autonomous vehicles and public transit alongside active mobility options and private vehicles. Where public transit makes sense given demand and density, the city should maintain and increase the service, but in other areas fixed routes might give way to smaller on-demand options. Looking at current TTC data, for example, the agency operates 189 surface bus and streetcar routes. On a typical day, riders took 1.69 million trips, but these were not distributed evenly across the network. Rather, the top ten routes absorbed 26 per cent of all trips in 2016, and half were made on 25 routes. Over ninety per cent of all trips took place on just half the routes in operation (Toronto Transit Commission 2017).

In the future, fixed-route scheduling would remain available for high-density corridors, while demand-responsive service served areas with low ridership and intermittent demand (Zhao 2017). The TTC would likely largely maintain its top 25 routes, with these being good candidates for shorter headways and future heavy or light rail development. The 44 routes that today serve fewer than 1,500 trips per day, including all night buses, on the other hand, could be eliminated outright. Meanwhile, the remaining 106 routes, which currently serve 49 per cent of trips, could be redesigned. Routes could be streamlined rather than meandering through low-density neighbourhoods, with shared-ride autonomous vehicles accommodating those customers who no longer enjoy direct nearby access to fixed-route service. These passengers could hail an autonomous rideshare service, or perhaps the TTC could pick them up in smaller autonomous shuttles with routes that change daily based on orders placed the night before.
The objective in this approach is to provide complementary rather than competing service, with AV options “filling the gaps inherent in fixed-route systems” (Freemark and Zhao 2017). Areas where urban fabric and citizen desires support further densification can be linked into a robust fixed-line network in anticipation of their future population growth. Those who live off the network would be encouraged to use ridesharing options for the first/last kilometre of their journey, but funnelled to the fixed lines where it made sense. This would increase demand and therefore financial sustainability for public transit operations. Moreover, because rideshared services would provide mobility on demand and the transit network would have such frequent headways, far more commuters could conveniently leave their cars at home.

If the TTC ceases to operate more affordable public transit options in some areas, however, there must be a mechanism in place so low-income residents are not unduly burdened by the cost of travel. Once again there must be a transportation-land use approach to this issue, with the city finding ways to stimulate the construction of housing, particularly affordable housing, near the fixed routes. This will allow low-income Torontonians to live near the network, limiting their need to take what could be more expensive PTC rides. Not only will this assist these residents, it also makes the system itself more viable as there is greater demand along the line.

Nevertheless, there must additionally be some mechanism to support those of lesser means who are unable to live near the fixed-route corridors. An income-based subsidy can fill the gap. This subsidy “should not be viewed as a subsidy to AV services specifically, but rather to people using the multi-modal network”, and could be provided “through the same regulatory mechanism that cities use to regulate transit and taxi fares” (Freemark and Zhao 2017). The city might mandate reduced fares for qualifying customers who opt for ridesharing, for instance, or
provide incentives to riders who share their PTC trips or only hail a PTC car for their first-/last-
kilometre rides. To accomplish this objective, the city can work with Metrolinx to enable
customers to pay through their PRESTO card. The PRESTO system could deduct the price of a
shared PTC ride when a customer taps into the TTC network near their pick-up location, so the
total ride cost is no more than taking transit. Though the transit agency will lose revenue under
this policy, the amount they save not having to service low-demand routes might justify the
expense.

To strengthen and develop a complementary system, the City of Toronto can centralise
data collection and distribution in a way that allows people to “choose between operators and
connect to multimodal trips offered by the transit system” (Freemark and Zhao 2017). The
government already collects data on PTC trips made in Toronto, and this information can be
paired with transit origin-destination statistics to see where fixed routes make sense and explore
other options like flex-route TTC shuttles. On the distribution side, the city can advocate for
Metrolinx to integrate PTC services into the Triplinx trip planning system so customers are able
to see the different travel times and costs when deciding how to reach their destination.

Moreover, officials can create expected minimum levels of service provision—such as a
requirement that an autonomous PTC vehicle arrive at a hail point in no more than ten minutes—
then use the collected data to determine whether private operators are meeting these benchmarks.
The City of Toronto has 140 recognised neighbourhoods, so the government can allow service
standards to vary within these based on density. This approach guarantees all residents have a
minimum access to rideshare services no matter where they live, without imposing an unrealistic
and burdensome citywide absolute standard on operators.
Finally, to alleviate the pollution generated by the conventional fleet, cities can require that operators use only zero-emission vehicles. Vehicles are to a great degree responsible for localised poor air quality, so limiting pollutants at the tail pipe cuts the environmental and health burdens imposed by a fossil fuel-based transportation system.

Implementing the measures outlined above addresses some of the problems that would not be neutralised by autonomous technology. While the last few pages outline these measures in broad strokes, ultimately they must be enforced using a specific legal tool. As such, chapter three explores where these policies can be incorporated into the city’s constitutional mandate, and then chapters four and five look at the human resources needed to deploy this power.


Chapter 3: Regulation and Contracts

Chapter one explored the policies cities could adopt immediately to cultivate a more effective and equitable transportation system. The task over the next three chapters is to discern how local governments can actually compel private actors to make choices that move future development in this direction. To expect a company or citizen to do something, of course, a city must have the right to enforce the requirement. As such, it is important to understand the potential of the two legal tools local governments have at their disposal to undertake such a mandate: Regulations and contracts.

For the most part regulation is the most appropriate approach to addressing the challenges outlined in the previous chapter. As Chris Osgood at the City of Boston contends, contracts are useful for “delivering specific services, in specific places, at specific prices”, whereas governments use regulation to address the harms that come from private actions. In order to regulate, however, a local administration must have the legal capacity (cell A in Figure 3.1) to do so. That is, the provincial (or state) government must have granted city council jurisdiction over the area in question. Some municipalities enjoy more power than others, which either enhances or constrains their ability to take action when it comes to the various technological or social changes that impact citizens’ lives. Toronto, for example, has control over local PTC regulation, which gives the administration a considerable advantage when looking to influence local AV development.

Figure 3.1. The five elements to effective regulation—legal capacity

<table>
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<th>Willingness</th>
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<th>Bureaucratic</th>
<th>Political</th>
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<tr>
<td>Capacity</td>
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That said, all is not lost if a city does not have regulatory capacity. It can either try to acquire this power (a strategy explored in chapter four looking at political capacity) or use a
contract to shape how companies conduct their business. Where regulation employs an ‘if/then’ framework—*if* a company chooses to provide a good or service, *then* it must meet certain standards—contracts induce a firm to provide the good or service in the first place. Contracts are therefore more about cooperation than coercion, but thoughtfully employed can yield significant benefit. In fact, effective public policy often involves a mix of regulation and contracts, as the latter can ensure a city enjoys an array of services without the government having to develop the capacity to provide them all itself. With this in mind, section one below discusses regulation while section two explores what role contracts can play in autonomous transportation policy. Finally, section three breaks down how Toronto, specifically, can use the legal power of its *Municipal Code* to yield the outcomes outlined in chapter one.

### 3.1. Regulation: Addressing the Harms of Private Action

Given their scale, the issues outlined in chapter one will not be addressed with a single operator providing a narrow service under contract. Instead, government use regulation to curb the harms that come from private decisions across a range of actors. If cities want to establish a mobility system that promotes equity, efficiency, and liveability, therefore, they need legislation to counteract the negative externalities of the conventional transportation system. Admittedly, regulation has “an inevitable paternalistic effect since consumers are presumably protected from making bad decisions” (Harrell 2004). While this tool must accordingly be used sparingly, it is necessary when the results of one person’s actions affect others. As discussed in the first chapter, traffic congestion, environmental pollution, and development that promotes sprawl are the most significant externalities when it comes to urban transportation. Regulation can ensure the full cost of these impacts is reflected in the price people pay to travel. Additionally, decisions by private operators may systematically inhibit certain groups from being able to access
transportation services. With cities including Toronto recognising that mobility is critical to resident wellbeing, legislation can guarantee everyone will enjoy sufficient transportation options at a reasonable cost.

When officials use regulation to accomplish certain goals, they care less about the means as much as the final outcome. As Vanessa Fletcher, the manager of policy in the ML&S division at the City of Toronto sees her role: “We do not use licensing to deliver services. We do not control a business; we oversee it”. Because regulations grapple with externalities in a global manner, acting across an entire industry rather than influencing only individual firms, regulators must be thoughtful and strategic when deploying this power. Sappington (1993) and Harrington (2008) have come up with a number of considerations policymakers must contemplate to design good regulatory policy. These include:

- Choosing the most effective policy instrument;
- Balancing trade-offs and considering economic effects; and
- Ensuring adequate commitment ability.

Officials need to select the right policy instrument, and generally the options are either direct or market-based regulation. As Harrington notes, “With direct regulation, there is a bright line that determines whether behaviour will be tolerated. With economic incentives [i.e. market-based regulation], the relationship between performance and consequences is continuous and gradual. There is no bright line, just steadily increasing rewards for better performance” (Harrington 2008) Incentive regulations delegate decision-making to the firms themselves, with companies enjoying rewards when their performance meets specified targets (Sappington 1993). A carbon tax is a popular example of an economic incentive, with companies rewarded (with a lower tax assessment) should they reduce their carbon output.
Governments using direct regulation, meanwhile, dictate what expectations they have for companies intending to operate. Sometimes called ‘command and control’ regulation, direct regulation can be very specific—with policymakers laying out in great detail what actions are permissible or must be taken—or more discretionary; that is, where the regulator provides certain broad standards to be met, and the firm is free to choose their own approach for compliance (Sappington 1993). In the former case, the government might require, for instance, that a coal-fired electricity company install a specific carbon ‘scrubber’ in their plants, whereas in the latter they might simply set the amount of carbon dioxide the company can emit per hour, with the operator able to select the best approach to meeting the target. In both instances, public officials monitor corporate activity and should a firm fail to comply with their expectations, it will be sanctioned (Environmental Protection Agency).

While economic incentives tend to be more cost-effective due to the reduced enforcement costs, critics allege their greater flexibility compromises their effectiveness (Harrington 2008). Proponents of market-based economic incentives, on the other hand, argue command and control regulation gives companies little reason to outperform the limits set by the government, whereas under a market approach they can go beyond the minimum standard—and because they know their business better than the government does, can potentially do so in a more cost-effective manner than by following strict government edicts (Berg 2013). It is therefore up to the individual agency to decide what is reasonable, based on their resources and goals.

Secondly, policymakers must be cognizant of the costs and policy interactions engendered by regulatory activity. Officials should be cautious an initiative in one area does not have adverse effects on another (Harrington 2008)—or if it does, that the tangible benefits of the new policy outweigh the impact. Moreover, there are usually economic ramifications to a
regulation (Harrington 2003). While this is not a reason to avoid taking action, officials will want to thoughtfully consider rules that limit the costs of compliance. In Boston, for example, Kris Carter from the Mayor’s Office of New Urban Mechanics points out that when he was negotiating with AV companies in advance of trials beginning there, firms expressed frustration that in California they were required to inform the Department of Motor Vehicles every time they disengaged their autonomous system. The companies argued this could actually discourage test drivers from disengaging when they felt they were in an unsafe situation, as they knew they would have to report it—ultimately increasing the risk of harm.

Rather than follow the same principle, Carter and his team realised they were not concerned about the number of times a driver disengaged a car per se, but the reasons why s/he did so (whether due to faulty technology, unclear road signage, or a bad interaction with a pedestrian or motorist, for instance). As such, they required companies to provide a narrative about their disengagements rather than a simple number. This more nuanced obligation accomplished the city’s goal of understanding safety threats, without imposing an unnecessary and even dangerous burden on AV testers. Effective bureaucrats will similarly strive to understand constituent and corporate concerns, and seek solutions to mitigate negative effects without compromising their regulatory goals.

Last but certainly not least, Sappington points to the importance of ‘commitment ability’: How difficult will it be to enforce a regulation? If a regulator does not have the resources necessary to ensure operators follow a city’s mandates, they may be greatly limited in what they can take on (Sappington 1993). Where cities can follow through, adherence will likely be much higher. David Block-Schachter, current chief technology officer at the MBTA and former chief scientist at Bridj, notes his old employer was not able to flaunt regulations the way Uber or Lyft
has done, for instance; with only a few well-identified Bridj shuttle buses on the road, it was ultimately much easier for the police to target them for breaking the law than it was to track hundreds of unidentified PTC cars. In this case it was the features of the companies that made one easier to regulate than the other, but it illustrates the point that when private actors know the government has the resources needed to monitor the situation, those actors are more likely to comply with what is asked of them.

In speaking with a number of policymakers, one of the biggest concerns they have when it comes to AV legislation is acting too hastily in an area of uncertainty and change. Ryan Lanyon, the chair of the City of Toronto’s AVWG, suggests moving quickly could stifle innovation when there is still so much the city does not know about AV technology and growth. Down in Boston, officials in the Mayor’s Office of New Urban Mechanics similarly agree they do not yet know what needs to be regulated when it comes to driverless vehicles.

Given the wealth of opportunity surrounding autonomous vehicles, governments do not want to discourage innovation, but it is possible to build flexibility into regulatory activity. In Australia, for example, the central government began adopting sunset clauses in 2005 for a wide range of legislation, with departments required to conduct evaluations and impact statements to assess what needs to be updated and what works well (Government Summit 2013). Under a sunset clause, policymakers converse with stakeholders in the period leading up to the sunset, deciding whether the regulation is accomplishing its goals and ought to be renewed, or whether it needs to be modified or even scrapped altogether because it has become obsolete. These clauses also give companies a sense of certainty, as they know the timeline for re-evaluation and can be prepared for potential change.
Closer to home, many industry leaders cite California’s 2015 AV regulations—including the need to report how many times a driver disengages a vehicle—as an example of what happens when regulators are too hasty and therefore too strict. They argue Sacramento’s early heavy-handed policies compelled at least some companies to leave the west coast in search of less restrictive state testing rules (Mitchell 2017). Learning from past experience, Steven Shladover at the University of California notes that today California updates its regulations every year to accommodate the shifting landscape. This approach obviously requires a fair bit of effort on the part of officials to keep abreast of current knowledge, but enables them to maintain control over the many AV companies testing in their roads while alleviating the burden any dated rules might place on firms.

Certainly, there are a number of questions surrounding autonomous vehicles; however, there are also many informed predictions we can make about what AV rollout will look like based on an understanding of how North Americans travel today and discussed in chapter one. If citizens are not required to pay the full cost—including the congestion and environmental cost—of transportation, they will be incentivised to make certain choices reflecting this artificial price. If someone cannot access a service because they do not have the technology they need to connect to the provider, it disadvantages them and inhibits their mobility. If left unchallenged, these and other current norms will in all likelihood continue under autonomy. As such, local officials can adopt a combined proactive/wait-and-see approach to regulation: Acting now on known harms while gathering data and implementing pilot projects to test new opportunities, with results potentially codified down the road.

Cities including San Clemente (California), Altamonte Springs (Florida), and Summit (New Jersey), for instance, have launched test projects with Uber and Lyft that see the
companies supplementing or replacing public transit service. These initiatives have revealed a number of findings, including the challenge of taking electronic payments from residents without smartphones (Moran 2017). Given these results, perhaps a future mandate will require PTCs to develop alternative means for accessing their platform (such as the ability to order a ride on a conventional telephone), to address equity issues.

Meanwhile, the Los Angeles County Metropolitan Transit Authority imagines an AV-public transit integrated future, where transit agencies act “more like travel agents” connecting customers to different, multi-modal transportation opportunities (Marshall 2017). Dipping their toe into the water, the LA authority recently put out a call for proposals for an on-demand transit program that could be the first step towards this larger vision (Marshall 2017). If things go well, in the future all rideshare operators in Los Angeles might be required to integrate into the public transit system through their trip planning website and/or their transit smartcard, pulling in lessons learned from these early trials.

Ideally, developing the rules will be a conversation between elected officials, policymakers, citizens, and the private sector. The bureaucracy receives its authority from the legislature, with the mayor and city council laying out the broad vision they hope to accomplish—say, an equitable and efficient transportation system and a liveable urban community. This mandate empowers departments to take bold steps in that direction as they develop the specific approach necessary to achieve those ends. While at the state rather than local level, for example, Massachusetts Governor Charlie Baker’s Executive Order on AV testing laid out expectations for trials in the state, including an obligation to consult local jurisdictions (Commonwealth of Massachusetts 2016). Kris Carter argues this directive was
helpful for municipal officials, as it strengthened their hand to make requests when speaking with interested private parties because they knew companies needed their buy-in before testing.

Of course, policymakers will want to communicate with and seek advice from citizens, corporate actors, and experts in the field, so they can accomplish their regulatory objectives without imposing any unintended or unnecessary costs on society. In a dynamic and rapidly changing environment, they must also carry out ongoing reassessment as to how they can most effectively address shifting harms and nudge private choices based on current information about incentives and reactions. When a local government does have jurisdiction and is able to devote the resources to these tasks, however, regulation can be a powerful tool to nudge private choices in a direction that advantages the entire community.

3.2. Contracts: When Regulation is Not an Option

In 2016, Uber established an AV testing facility similar to the one it set up in Toronto a year later, and at that time into the mayor intimated his team had an agreement with the rideshare company that would see them offer a number of benefits to his electorate: Free rides, new job opportunities, and data that would help the city better understand local transportation demand (Kang 2017). Despite the promise of an advantageous relationship between Uber and Mayor Peduto’s administration, though, this alliance existed in name only. The city never signed contract and did not even draw up a Memorandum of Understanding. There was no formal partnership. Rather, Uber had shown corporate generosity previously—members of the mayor’s team cited Uber’s provision of free transportation and financial support to residents of local women’s shelters, for instance—and public officials were hopeful the company would maintain and even expand their beneficence as they conducted their AV testing.
The decision not to attempt to put anything in writing was, as insiders point out, not based on a naïve optimism Uber was an inherently generous firm. Officials adopted this approach because they believed they actually had no power to compel the corporate giant to act in any one way or the other. The state government is in charge of both vehicle permitting broadly and PTC ordinances more specifically in most parts of Pennsylvania, leaving Pittsburgh with what it saw as little legal clout to bring Uber to the table. Feeling helpless, the mayor’s staff proposed a number of actions the company might take to spread the wealth of its testing in hopes Uber might be willing to comply with a few of them, but they did not bite.

**Figure 3.2. Regulation Versus Contracts**

<table>
<thead>
<tr>
<th>Government Objective</th>
<th>Yes</th>
<th>No</th>
</tr>
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<tbody>
<tr>
<td>Correct a market failure or address a harm that stems from private action?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Possess the authority to regulate?</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Regulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penalty-based?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Reward-based?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Direct Regulation</td>
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<tr>
<td>Market-based Regulation</td>
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With no legal authority to regulate PTCs, Pittsburgh believed it had no choice but to attempt the contract route with Uber. While it clearly did not achieve the outcome they desired, this strategy was not predestined to end poorly. Thoughtfully-created contracts do have a place in the government toolkit, and are being used in many jurisdictions to help cities solve problems they cannot tackle alone. In contrast to a regulation that applies to all similar companies in (ideally) the same way, lawyer and former Massachusetts Secretary of Transportation Jeffrey
Mullen points out a contractual relationship is “closely supervised, controlled, and limited; appropriate for a test”. Unlike a regulation, therefore, contracts do not require a government to treat companies equally. Once public officials have put out a request for proposals and received bidders’ applications, they can choose the offer they think is most attractive. If market competition is working well, this enables them to take advantage of private sector creativity to solve public problems.

For these partnerships to be effective, however, the government must decide quite specifically what exactly it will be testing or trying to accomplish, and how to measure success. Obviously, a company enters into a contract voluntarily, and will therefore be expecting something in return for compliance. While this is often a financial benefit, creative organizations can devise clever alternatives that do not require spending money. The MBTA, for instance, signed an agreement with Transit App, receiving the company’s data on transit users in exchange for their endorsement as the MBTA’s preferred transit planning application (MassDOT Press Office 2016).

According to David Block-Schachter, this partnership accomplished a number of goals for the transit agency: It pushed customers towards a single transit app in order to streamline and improve service, meant the MBTA did not have to build its own in-house application, and gave them access to transit user data. In exchange, Transit App enjoys a boost in business that comes from the MBTA encouraging riders to download their system (Enwemeka, 2016). This creative collaboration will hopefully prove to be advantageous for both parties and help improve transit service all without any money changing hands.

Like this partnership, contract agreements work particularly well when a private actor can provide a complementary service to that which is already being provided by the public sector, so
the relevant city agency does not need to make major new investments in infrastructure that might be outside of its area of expertise. If the project goes well, the agency might decide to continue to contract out that service, or else invest in its own capabilities with more information about how revamped operations might look. As former Bridj employee Mary Rose Fissinger notes, the Kansas City Area Transit Authority adopted such an approach a few years ago when it partnered with her former company to offer targeted service to suburban riders.

In this situation, the public operator provided buses and drivers, while the company used its technology platform and customer support team—assets the transit authority did not have, and would have required significant investment to develop when there was uncertainty as to its applicability. A contract is an appropriate tool in such a circumstance, as the transit agency required specific outcomes and it is not clear how they could regulate a company into providing the service they need anyway.

Certainly, governments must enter into contracts carefully to maximise constituent benefits. Besides being explicit about their objectives, a department or administration needs to consider the trade-offs of different negotiation options. As Jeffrey Mullan argues, cities must be particularly wary of restricting their own ability to enact regulation in the future should it prove necessary, or offering up too much just to reach a deal. Chicago’s billion-dollar parking meter privatisation, for example, relinquished this municipal asset for just half its assessed value while constraining the government’s power to limit parking and expand bus service down the road (Cohen and Farmer 2014). Such unfavourable terms clearly disadvantage and impoverish a city and its people, and must be avoided. Prior to entering into negotiations, officials must ergo understand their own red line—the point at which they will walk away, because the value of the
final agreement will be lower than no partnership at all—and be prepared to actually leave the table if they cannot meet their minimum value.

Once both sides have agreed on the provided services and remuneration, negotiators must also be sure to outline clear and strict controls on performance, and penalties for non-performance. This ensures the government will not be left holding the bag should there be cost overruns or inadequate service provision. Moreover, they need to incorporate periodic performance reviews, outline the maximum a service provider can charge to avoid unreasonable user or service fees (this would be particularly relevant for providers that, for instance, employ practices such as ‘surge’ pricing), and maintain an ability to exit a contract should it fail to live up to expectations (Loxley 2012). Perhaps most importantly, it is critical to lay these items out explicitly in writing to avoid haggling and headache down the road. Indeed, if a private counterpart is unwilling to so formalise the arrangement, David Block-Schachter argues the responsible choice is for officials to end the discussion and begin a new search for a binding partnership, rather than talking about issues that cannot ultimately be enforced.

As officials in Pittsburgh note, they were unprepared when Uber came to town, and their strategy was thus to put a number of ideas on the table in hopes a few would stick. Other than perhaps some positive press, there was really nothing of clear value in this arrangement for Uber, which left the company with little incentive to continue the discussion once their vehicles were on the road. Yet, for a long time prior to these talks Pittsburgh had been interested in leveraging new technology to address citizens’ major mobility challenges, such as accessing healthcare easily and affordably, using data to make more targeted capital investments, and improving transit’s appeal by offering a better first-last mile option. These objectives are all ripe for a contractual agreement to test-drive a concentrated and targeted initiative that could be scaled
down the road. Had the mayor’s office approached Uber with a proposal for a paid pilot project that integrated a specific user service, the company might have reacted more positively as it recognized an opportunity to test its vehicles and develop expertise in a targeted setting with a clearly-defined segment of the population—gaining competence and experience that could be deployed to refine its system and sell it to other cities.

Furthermore, Uber would have developed a relationship with Pittsburgh that might have led to future partnerships and ideas for testing in new areas, slowly building on one success after another. By throwing everything against the wall, the mayor’s team became unfocused and lost Uber’s interest, given that they were already able to test uninhibited in the city anyway. While certainly not guaranteed, a more selective strategy with clear mutual benefit might have kept the company at the table and even left them willing to entertain future proposals that built on initial positive results. Admittedly, such an approach would have likely only accomplished one objective, unlike a package of ordinances touching on a number of the policies discussed in chapter one; however, when a government lacks the ability to regulate, designing and signing a well-written and thoughtful contract can be an acceptable and advantageous alternative approach.

As pointed out in the introduction to this chapter, though, Toronto officials enjoy very different regulatory powers than their counterparts in Pittsburgh. The City of Toronto has quite a sweeping mandate, including the right to look after the PTCs that operate inside their boundary. Given this arrangement, they need not be limited to an agreement with a single AV operator, but can instead use their regulatory authority to nudge private decisions in a direction that benefits the people of Toronto in a far more comprehensive manner.
3.3. AV Regulation in Toronto: Powers Built on Precedent

Being assertive with regulation while not becoming heavy-handed is a delicate balance in government. Yet, when an administration enjoys regulatory authority, it should not shy away from using its mandate responsibly. In speaking with policymakers and reading its *Municipal Code*, it is evident Toronto’s approach to PTCs is an impressive example of the strength a government can have and the respect it can enjoy when it acts clearly and decisively within its authority. Of all the complaints North American officials seem to have about Uber, perhaps the most prevalent today is the company’s unwillingness to share its data. There are many stories of frustrated policymakers who have sat across the table from Uber negotiators who brushed off one request after the other to hand over information on trips their customers took. While the rideshare company would often offer up excuses about privacy and corporate privilege, the result was that time and again, civil servants left the meeting empty-handed.

Yet, in reading the City of Toronto’s *Municipal Code* (Article 10), it clearly states PTCs must keep a record of all pick up and drop off locations, start times and dates, and length of time elapsing between the passenger’s service request and start of trip for all transactions beginning or ending in Toronto. More importantly, notes Ryan Lanyon of the AVWG, companies must provide this information to ML&S on a regular basis; this data can be distributed to other city departments, and eventually will be used by the Transportation division to make better mobility planning decisions. Given the difficulty other governments have had in extracting this very information from Uber and Lyft, this accomplishment is no small feat—and illustrates that when the five elements of effective regulation come together, a city can successfully extract certain concessions from corporate actors. Just as critically, it shows companies will comply when the legal capacity is there and the decision-makers are willing to wield it effectively.
Of course, the City of Toronto does not control everything that goes on within its borders; no government in Canada—whether that of a city, a province, or the nation itself—enjoys full sovereignty over its geography. When it comes to transportation, Lanyon points out Ottawa looks after the safety of motor vehicles, while the provinces regulate drivers. Provided a company complies with the Ministry of Transportation of Ontario (MTO)’s requirements, Toronto therefore cannot stop Uber or others from testing its vehicles on city roads. Despite this limitation, the city’s mandate to regulate local PTCs is a powerful tool that can be deployed to shape private actions surrounding AV testing and deployment in a very meaningful way. From conversations with representatives in ML&S and the Transportation division, Toronto can already stipulate a great deal regarding their operations, autonomy notwithstanding: The city can put restrictions on where a car can go. It can dictate where it can and cannot park. It can institute certain policies about serving the entire community. It could even mandate that PTC vehicles must begin or end a passenger trip at a transit station. While interviewees agreed it is unlikely the city would ever actually go this far, this is a strong illustration of the power a local government can have when it enjoys the legal capacity to regulate.

Looking towards the future, according to at least some officials nothing is off the table when mitigating the possible harms autonomous cars may cause, because the disruption could be so significant. Should it so desire, therefore, there are clear precedents in the existing Municipal Code that Toronto could expand in future to adopt the provisions laid out in chapter two. Specifically:

*Sub-section 546-112*\(^2\) prohibits PTC drivers from picking up passengers at a cabstand. This could form the basis for a regulation limiting where an autonomous PTC vehicle can park.

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\(^2\) The complete Article 10 (Private Transportation Companies) is provided as Appendix B of this thesis, with relevant regulations highlighted in yellow.
Sub-section 546-113 mandates all PTC vehicles have four doors, a maximum seating capacity of seven passengers, and be no more than seven model years old. This could form the basis for a regulation requiring PTCs to operate only zero-emission cars.

Sub-section 546-115 (along with Appendix C – Schedule 12 of Chapter 441 on fees and charges) requires PTCs to charge a minimum fare of $3.25 and remit $0.30 per trip to ML&S. This could form the basis for a regulation mandating distance- and congestion-based road pricing.

Sub-section 546-116 requires PTCs to maintain records of the pick up location and destination, date and time the trip started and ended, the length of time elapsing between the passenger’s service request and start of the trip, and number of passengers paying separate fares for all trips beginning or ending in Toronto, and to provide this information to ML&S on a weekly basis or as requested. This could form the basis for a regulation requiring PTCs to provide information to feed the data clearinghouse.

Sub-section 546-116 requires PTCs to report on accessible delivery of services, including information on average wait times of accessible PTC vehicles, and Sub-section 546-119 requires and PTC with more than 500 drivers to provide wheelchair accessible service. Moreover, it states the licensing division will determine the average wait time for non-accessible service. This could form the basis for a regulation establishing minimum service levels.

Even regarding policies where the precedent has not been established, the City of Toronto has proven it can act boldly to craft regulation that advances the government’s agenda. Quite simply, while it cannot prohibit self-driving car companies from testing their vehicles (and given the potential benefits, there is no reason to want to prohibit their circulation outright), as soon as autonomous cars or buses begin to interact with the public, the Municipal Code has the authority to establish a very clear direction for development.
In the future, the City of Toronto might consider creating its own specific by-law to deal with autonomous vehicles—just as it has by-laws for green roofs, holiday shopping, street vending, fences, and many other facets of urban life. Licences are created to ensure the basics of limiting harms are satisfied, so ideally city council should enact a new, more targeted legislation just for autonomous vehicles where they can consider broader planning goals. As MIT city planning Professor Jinhua Zhao argues, however, given that the city currently enjoys licencing authority, it makes sense to harness this power carefully to inspire the most efficient mobility system possible. Irrespective of whether it is the ideal vehicle, the bold precedent identified above shows a new article for autonomous PTCs can wield significant leverage. The question, though, is whether authorities are willing to harness this potential. The answer depends on the bureaucratic and political realities in Toronto—the subject of the next two chapters.
Chapter 4: The Bureaucracy

In 2015, the US Department of Transportation announced their Smart Cities Challenge, awarding $40 million to one winning local government to help it explore what it means to be a ‘smart’ city in the 21st century. According to his advisors, like many Mayor Peduto was keen to see his hometown win the prize, and assigned one of his top staff people to work on Pittsburgh’s application. To their credit, Pennsylvania’s second-largest city was one of just seven to make it to the final round. When the Peduto administration learned Uber was coming to town, the mayor tasked the same employee with negotiating with the company, given that driverless cars fit the realm of ‘smart cities’. Despite having no experience with autonomous vehicles and without even a real transportation division to turn to for help, the policymaker went up against a giant. Facing such odds, it is perhaps not surprising the talks bore so little fruit.

This story of a government staff member struggling under an overwhelming workload at a task for which they are not fully qualified highlights how critical human resources are to good governance. As such, the remaining four elements to effective regulation (and effective contract negotiation as well) are all related to the people who make up the government: Their expertise, how they allocate their time, their ability to think strategically, and their social acumen. These categories—political and bureaucratic willingness and capacity—are messy and intersect, but the power and influence both civil servants and their elected superiors can wield between one another, up and down the chain of command, and towards higher levels of government are, more often than not, directly related to the regulatory results they achieve.

Figure 4.1. The five elements to effective regulation—bureaucratic willingness and capacity

<table>
<thead>
<tr>
<th></th>
<th>Legal</th>
<th>Bureaucratic</th>
<th>Political</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willingness</td>
<td></td>
<td>B</td>
<td>D</td>
</tr>
<tr>
<td>Capacity</td>
<td>A</td>
<td>C</td>
<td>E</td>
</tr>
</tbody>
</table>
The province (or state) may grant a city government the legal capacity to regulate in a certain area, but that capacity will go nowhere without people on both the political and bureaucratic sides of the office who are willing and able to thoughtfully consider how to derive maximum advantage from their mandate. While there needs to be a boldness to take on the challenge in the council chamber, generally “legislation brought in by elected officials determines only the guidelines for meeting governmental goals”. It is up to bureaucrats to design and propose the specific programs to achieve the objectives set out by the administration or the elected house (Bianco and Canon 2010). As such, this chapter looks at cells B and C of Figure 4.1: How a decisive and creative public service undergirded by institutional structures that nurture thoughtfulness and vision are key to enabling a city to deploy its legal capacity to its maximum potential.

4.1. Bureaucratic Willingness

On the surface, it might seem willingness is synonymous with ‘wanting to do a good job’, but this does not capture the sense of the term as used here. Effective regulation means weighing the myriad interests of constituents and job creators, to nurture an equitable and prosperous society while addressing the harms that arise from private choice. Unsurprisingly, citizens feel passionately about their communities and can sometimes be quite vocal with their displeasure over proposed policy. Meanwhile, negotiating with large companies can be daunting, as they are able to send a team of lawyers who have more time and resources to devote to the issue at hand than a civil servant trying to juggle a number of files. Given such opposition, policymakers may decide to pick their battles and avoid an extended and arduous confrontation by being less assertive when it comes to developing rules, even though they remain committed to exercising their role to the best of their ability.
Yet, insights from interview subjects show willingness runs deeper than this. Policymakers across a city government do not always share the same understanding of the purpose behind regulation, and this influences how interventionist they believe policy should be. In Toronto, transportation planners are not necessarily opposed to taking fairly drastic action to address the externalities PTCs bring—even remaining open to, for example, requiring autonomous PTC trips to either begin or end at a transit station—while members of other divisions see no clear policy rationale for such assertive moves. If regulations are meant firstly to correct for societal harms, there are differing opinions as to what a ‘harmful’ activity might be. Should Uber pull people off public transit, denying the agency fares and increasing congestion on the street, is this harmful, or merely a side effect of improving commuter choice? Those who see it as the latter are less inclined to act boldly to curb such activity.

Further complicating the situation is a lack of consensus across departments as to each one’s position and role in government operations. Based on conversations with officials from the TTC, the agency views itself as part of the municipal government, deserving of the same privileges as the other divisions. Technically, however, they remain an arms-length agency, and other City of Toronto employees expressed their opinion the TTC is thus not entitled to such parity. Moreover, at least some officials consider the transit agency to be strictly an operator rather than a ‘long-term planning’ organisation, despite the fact the TTC designs its network.

With such divergent perspectives on agency roles, it might prove difficult for different divisions to coordinate objectives. Directly related to the policies explored in chapter two, for example, Stephani Simard, senior system and policy planner at the TTC, notes her agency does not currently receive any city data from Uber, despite their desire to gain access to that information. If other employees do not push to include a provision to share these statistics with
the transit operator in the *Municipal Code*, either because they do not see the TTC as a part of the municipal bureaucracy or because they do not think transit planners need those statistics to fulfill their mandate, this could make it difficult to integrate PTCs with public transit or build a data clearinghouse down the road.

This challenge is not limited to the City of Toronto. A number of interviewees commented on the silos of government, describing departments so involved with their own activities they rarely have time to talk across departmental lines and understand other agencies’ perspectives and objectives. As a result, there can be significant differences as to what each is trying to achieve with policy. Indeed, Toronto may be actually further ahead than other cities in breaking down barriers, as the Transportation division has convened its AVWG composed of representatives from twenty agencies (outlined in List 4.1). While its purpose is to discuss the intricacies and opportunities of driverless transport, given the differing opinions outlined above, this group could go a step further (or perhaps, take a step back) by providing an excellent forum for conversation about each member’s roles and their relative say in regulatory development.

**List 4.1. The twenty divisions of Toronto’s Autonomous Vehicle Working Group (alphabetical)**

- City Clerk
- City Manager’s Office
- City Planning
- Economic Development
- Environment & Energy
- Fire Services
- Fleet Services
- Insurance & Risk Management
- Information & Technology
- Legal
- Municipal Licensing & Standards
- Revenue Services
- Toronto Building
- Employment & Social Services
- Office of Partnerships
- Parking Authority
- Police Services
- Public Health
- Toronto Transit Commission (not a City of Toronto division)
- Transportation

Ms. Simard says that during the development of Article 10 there were many conflicting views on what to include from various departments, and therefore not all views and requests were accommodated in the final policy. If members of the AVWG use this space not only to find
out what each member wants, but also why they do, more measures might be included in the regulatory documents the city produces down the road. Should the Transportation division understand the TTC as a planning organisation, for example, they can work closely in designing the public transport corridors of the future by integrating autonomous vehicles while shifting resources from underused routes to higher-order transit. They can also begin to envision the policies and spending plans that would most effectively achieve such consolidation.

Additionally, by talking to one another it is possible to find compromises that work for the different parties? While there may be privacy concerns when it comes to sharing all Uber data with the TTC, Simard says the agency would be keen to have even aggregated PTC information—such as how many trips start in each neighbourhood, and where those journeys end—and would welcome an opportunity to discuss with divisional counterparts ways to make it easier to share useful data. Could agglomerated information be provided to the transit agency, even if ML&S cannot share more granular reports? If everyone understood how each branch views its mandate and the areas where it could play a meaningful role around autonomy, this could ultimately make the whole team more effective in deploying the tools they have at their disposal. Lastly, the divisions can collectively develop a consensus around the boundary between reasonable nudges and infringement on individual rights, exploring options to use economic incentives rather than command and control rules to move private actors in one direction or another.

It may be tempting to dismiss bureaucratic willingness as secondary to the political willingness explored in chapter four. After all, if a politician so desires, can s/he not order the civil service to begin taking action in a particular direction? Undoubtedly, public officials do answer to their elected counterparts, but they nevertheless enjoy considerable autonomy within
government operations. Take the AVWG, which is currently drafting a list of ten policy statements as to how the city should evolve when it comes to driverless vehicles. City council will eventually debate these statements, and whatever is adopted will guide AV development for years to come. Of course, any city councillor can take initiative in building their own deep understanding of driverless technology and the relevant policy implications, but this is only one issue before them—and arguably is not even the most pressing topic on their docket. As such, whether they will do so is much less certain. Alternatively, Professor Eric Miller at the University of Toronto warns they may bring forward proposals based on questionable assumptions, such as the idea driverless technology will make all public transit fully obsolete.

Are bureaucrats willing to gently counter these positions with research and enunciate a vision of the future based on the values outlined in their city’s plans, or will they simply take such arguments at face value? If left to flesh out the details of a broad policy objective, what will they bring forward to council for discussion, and what will they argue the city does or does not have the right to do? As Rob Garrity, chief of staff to Massachusetts Secretary of Transportation Stephanie Pollack, points out, on many subjects, what staff members propose is what legislators discuss, and what gets discussed is what gets enacted. Within such a reality, the policymakers’ willingness to think outside the box and outline a range of options and scenarios, be more brazen with their proposals, and challenge assumptions can shape the future of their city in a very tangible way.

4.2. Bureaucratic Capacity: Where There is a Will, is There a Way?

As important as bureaucratic willingness is, the institutional capacity to take on what could be complex and ongoing regulatory development is just as critical. I noted above that policymaking means engaging in dialogue with concerned parties, trading interests, seeking
creative solutions, and ultimately making and accounting for choices that will be unpopular with some. This all takes time, and even when staff want to be bold, if they are overwhelmed with the day-to-day tasks of running the government they may simply lack the bandwidth to give broader questions of regulatory development their due. It is quite simply not enough to want to take advantage of one’s legal capacity; civil servants need the skill and time to use it effectively.

This chapter began by documenting the struggles of a one-person negotiating team in Pittsburgh, but there are myriad examples of local governments that have been unprepared to stand up to the power of large corporations. Professor Eric Miller at the University of Toronto, who has worked very closely with city officials, asserts Toronto itself was caught off guard by Uber’s arrival a few years ago, as their disruptive approach to both transportation networking and blatant disregard for the rules caused all kinds of headaches for the city at the time. To their credit, however, policymakers in both Pittsburgh and Toronto have learned from these experiences. Pittsburgh established a proper department of transportation and has set up an organizational structure to engage with emerging mobility—even hosting summits and strategy sessions to discern how autonomous mobility fits into their larger urban vision. In Toronto, Ryan Lanyon notes his AVWG is explicitly designed to ‘ask better questions’ and help policymakers think deeply about the future of this incredible technology.

In setting up such new departments and working groups, officials show they recognise the importance of a forum for reflection, planning, and good decision-making. They are certainly not alone. Over the last fifty years there has been an expansion in literature on making choices efficiently and seeing them through to implementation, and while hiring talented and motivated staff is certainly important, the institutional process is critical to enabling effective decision-making and creativity. These kinds of bodies are necessary for both forward- and backward-
looking study, learning from the successes and shortcomings of past recommendations while gathering information about what the future is likely to bring. All of this data is then used to reach more accurate conclusions about the best path forward.

Likely more so than with the arrival of any other previous transportation technology, today city officials recognise the incredible influence individual mobility choices have on the development of our urban spaces. With such awareness, they are actively trying to see what new opportunities, and obstacles, driverless vehicles bring to designing liveable, equitable communities. Yet while such proactivity is laudable, it is difficult when there are so many uncertainties. Will the cars all be connected—and if so, will, say, a Toyota car and a Ford truck be able to understand one another? Will they be able to speak with ‘smart’ infrastructure—and if so, who will be responsible for maintaining that infrastructure? How will pedestrians interact with autonomous vehicles? These and many other questions need to be answered, and it is not clear in which direction the results might go. With transportation and urban investments made decades in advance, however, officials in Toronto—and elsewhere—need to make decisions today even though the future is far from clear.

Positively, there is a growing body of evidence-based work explicitly designed to help humans more accurately predict what will happen in the years to come. In particular, psychologist Philip Tetlock has spent his life studying forecasting theory. As testament to his efforts, in 2011 he co-founded the Good Judgement Project (GJP) to better understand the science and art of prognostication. He established the project to compete in a US government-sponsored competition to assist the intelligence community in predicting political and economic trends (Tetlock 2015). The GJP team was one of five competing, all of which had to answer 500 questions over four years. The GJP results are impressive. The team beat the control group by
sixty per cent in year one, and outperformed the other university competitors—including the University of Michigan and MIT—by thirty to seventy per cent. Perhaps most surprisingly, they did so not by hiring experts, but using regular citizens who signed up online. Tetlock simply helped them with some tried-and-true methods for improving their chances of success (Tetlock 2015).

Tetlock argues one of the fundamental shortcomings people make when looking ahead is never looking back to see how they fared in past forecasting (Tetlock 2015). For a variety of reasons, government agencies can likewise be guilty of making a prediction and planning based on initial assessments, without ever determining whether their early assumptions were correct. In contrast, Tetlock states forecasting is not a static process, but a never-ending sequence: Forecast. Measure. Revise. Repeat. This cycle accomplishes two objectives. Firstly, it allows operatives to gauge their accuracy over time, and secondly, enables them to update their prediction framework with new information, so the next estimate is more likely to be correct. Moreover, forecasters should break a large question down into its component parts, to identify what they do and do not know. Even if they are still guessing on some aspects of the question, filling in known information leads to better overall accuracy (Tetlock 2015).

Already, the founders of the AVWG have adopted many of Tetlock’s recommendations. Indeed, studies show one of the single best strategies when developing prognoses is to work in groups (Larson 2017). While each person comes to the table with their own biases and mistakes, they all also enjoy insights into the question at hand. Whereas the errors people offer all likely point in divergent directions, each nullifying the other, the valid information points to the same answer. On balance, the aggregated judgements pull the final decision towards a more accurate prediction (Tetlock 2015). To further enhance their effectiveness, teams want to employ a strong
regimen of critical thinking and reality testing. This involves gathering and synthesizing information and analytical ideas from many sources, and discussing possibilities rather than certainties. By bringing multiple diverse stakeholders to the table and adopting a strongly exploratory approach, the AVWG is already on sound footing to be an effective forecasting force.

To this end, the AVWG should not be simply a temporary unit, but one to remain active for decades. Moreover, the ‘investigatory’ phase of their work should not be only an initial foray, but an ongoing exploration of contemporary issues, updated with new information. It makes sense to spend two years now doing research, then crafting broad policy statements, and finally designing specific regulations to meet the goals; however, Tetlock’s research shows the AVWG should constantly return to their initial assumptions, asking whether they were correct and updating as new data is available. Above all, participants should never be afraid to question assumptions—even outside their realm of expertise—and confront uncomfortable facts. When participants can maintain open minds, encourage curiosity, and welcome vigorous debate, they are better able to ward off ‘groupthink’ (the unconscious development of a collection of shared tunnel vision) and thus the wisdom of the group becomes more than the sum of its parts (Tetlock 2015).

In this initial fact-finding phase, the AVWG is conducting research, literature reviews, and interviews. As it matures, the group may want to go beyond inquiries and begin exploring multiple possible scenarios they can use to shift development in a specific direction. Already, policymakers possess a number of techniques for exploring areas of deep uncertainty such as strategic planning, contingency planning, and scenario planning. Yet, while these have all helped officials grapple with future policy, the number of scenarios they generate is severely limited
(Lempert et al. 2003). Over the last fifteen years, however, computer programs have developed such that software can supplement human brainstorming to dramatically expand the range of possible outcomes policymakers consider, with a goal of developing robust policy strategies that perform well across multiple scenarios.

When designing policy under deep uncertainty, officials want to be cautious of two common errors: under- and over-prediction of change. Although change in all aspects of our lives is accelerating dramatically, we often tend to imagine the future without such a rapid pace of development (Schoemaker 1995). By identifying basic trends and unknowns, computer modelling constructs a series of alternative paths that unearth the wealth of possibilities about what might come (Schoemaker 1995). Yet at the same time, it harnesses human rationality to keep the scenario ensemble realistic: “If the computer simulations suggest scenarios that violate knowledge possessed by humans, such scenarios can be excluded as implausible.” Simultaneously, “if humans suggest a future that […] violates basic scientific, economic, or other principles”, the computer models will illustrate the deficiency (Lempert et al. 2003).

To expand the range of possibilities participants can see while avoiding a drift into unbridled nonsense, they first divide their knowledge into three separate classes:

- What they know;
- What they know they do not know; and
- What they do not know they do not know.

The first class “casts the past forward, recognising that our world possesses considerable momentum and continuity” (Lempert et al. 2003). Shifts in demographics, for instance, tend to follow a relatively stable, predictable path. Humans have a tendency towards tunnel vision when thinking about the future though, focusing only on this class of knowledge while ignoring the potential for black swans: Those rare, hard-to-predict events that lie outside the world as it exists
today, of which we may or may not be able to conceive (think of someone from the 1950s trying to understand the Internet or a smartphone).

Under complex conditions, “humans rapidly lost the ability to track long causal links and the competing forces that may drive the future along one path or another”, whereas “computers excel at handling large amount of qualitative data. They can project without error or bias the implications of those assumptions, no matter how long or complex the causal chains”. Thus, computers are able to widen the tunnel to consider complicated interactions and potential black swan outcomes. Of course, “it is still not possible to say with certainty what the future actually holds. By seeking to recognize what they do not know and what some of the major relevant factors of change might be, however, planners are better able to search for information that offers insight into the direction the world is going” (Gillies 2017).

Professor Miller at the University of Toronto asserts his team of transportation engineers can work with the AVWG to provide models that help better understand the capacity constraints of roads with high AV usage, likely autonomous vehicle-pedestrian interaction, ways in which the public transit system can change, and myriad other questions surrounding the future of transportation. The purpose is not to attempt accuracy because there are so many uncertainties on the road ahead, but to think deeply about how to build systems and policies that perform “reasonably well compared to the alternatives across a wide range of plausible futures” and are “explicitly designed to evolve in response to new information” (Lempert et al. 2003). Because it is rare to generate a strategy that performs well in all plausible futures, it is then up to policymakers to juggle difficult trade-offs and judge which values and scenarios should weigh more heavily to create the final approach to addressing future harms (Lempert et al. 2003).
As the AVWG moves into this decision-making phase—likely to come once city council approves its ten proposed policy statements—it may want to consider evolving from a large body into a number of smaller groups. In the initial exploratory phase it makes sense to draw in as many voices as possible, and having many members at the table builds excitement at the prospect of driverless potential that generates buy-in from stakeholder divisions. Management literature shows, however, that while group decision-making is more effective than individuals making a call unilaterally, when teams become too large, productivity begins to dissipate. Specifically, research has found five to seven people is the ideal range for reaching effective conclusions (Larson 2017). At that point, personal and group performance is highest while the complexity of managing the team has not gotten out of hand (Larson 2017).

The advanced AVWG could therefore become a collection of AV committees, each one composed of representatives from five to seven agencies that have the most relevant impact on one or a few of the policy statements. If three of the statements relate to transportation and land use integration, for instance, they can be grouped together and assigned to a committee composed of policymakers from the Transportation, City Planning, Municipal Licensing & Standards, Parking Authority, and Public Health divisions, and the TTC. Beyond enabling better decision-making, such smaller panels also facilitate some of the interpersonal communication I outlined above in the Bureaucratic Willingness section, and can build trust among participants.

Of course, it will remain important to bring together the larger group for workshops periodically and to consult with them. If the Transportation & Land Use AV Committee determines streets can be narrowed with autonomous vehicles, for example, they will want to work with the Fire Services and Fleet Services divisions to discern how their own trucks can be right-sized to fit a smaller lane. These reunions would be only periodic and designed more to
brainstorm strategies once a decision has already been made though, rather than to make a determination about a specific policy direction in the first place.

Already the city is funding the chair of the AVWG, and this role could become the coordinator of the newly-developed AV committees. More than one interview candidate noted this staff member should enjoy seniority high enough to get the attention of high-ranking officials in the various divisions, and be empowered to manage the file full time. This leader would be in charge of overseeing these cross-functional groups formulating and evaluating alternatives for the major strategic initiatives surrounding AV testing and growth; by running workshops and encouraging an aura of openness and exploration, this leader will facilitate decision-making within the group. Finally, they would also be responsible for reaching out to civil servants in cities elsewhere, to further expand the return on investment in AV policy exploration.

4.3. External Coalitions: Expanding Capacity Without Expending Effort

Toronto is the fourth-largest city in North America and the biggest in Canada. Due to its size, it already enjoys a wealth of bureaucratic resources that are just not available to many smaller jurisdictions, and in many ways it uses them well. That said, as the AVWG develops it can have an outsized return on its efforts by not only facilitating communication across its own departments, but in reaching out to other cities as well—finding communities that have faced or are likely to face similar obstacles to enacting effective AV regulation, and learning from their experience. By sharing lessons and best practices, such partners can rapidly build on existing expertise rather than having to spend time learning what policymakers elsewhere have already discovered.
When establishing such a knowledge-sharing coalition, it makes sense to first discern which cities are liable to face comparable challenges based on the future of autonomous development. Since many of the first driverless cars are likely to be owned by rideshare companies, those cities that, like Toronto, enjoy greater PTC control would be prime candidates for partnership. Additionally, though we often care most about the metro area when it comes to transportation, in this case ridesharing rules end at the municipal boundary; as such, the second important factor is a population large enough to have sufficient market demand to attract PTCs in the first place. Using these two criteria, we can narrow the list of all candidate cities in North America down to just ten (in Table 4.1) that have at least 650,000 people and enjoy primary control over the PTCs operating inside their border.

Table 4.1. Possible partners for AV information sharing

<table>
<thead>
<tr>
<th>City</th>
<th>Province/State</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York</td>
<td>New York</td>
<td>8,550,400</td>
</tr>
<tr>
<td>Toronto</td>
<td>Ontario</td>
<td>2,826,500</td>
</tr>
<tr>
<td>Chicago</td>
<td>Illinois</td>
<td>2,720,550</td>
</tr>
<tr>
<td>Philadelphia</td>
<td>Pennsylvania</td>
<td>1,567,450</td>
</tr>
<tr>
<td>Calgary</td>
<td>Alberta</td>
<td>1,230,900</td>
</tr>
<tr>
<td>Ottawa</td>
<td>Ontario</td>
<td>956,700</td>
</tr>
<tr>
<td>Edmonton</td>
<td>Alberta</td>
<td>899,450</td>
</tr>
<tr>
<td>Mississauga</td>
<td>Ontario</td>
<td>751,300</td>
</tr>
<tr>
<td>Winnipeg</td>
<td>Manitoba</td>
<td>718,400</td>
</tr>
<tr>
<td>Washington</td>
<td>(District of Columbia)</td>
<td>672,200</td>
</tr>
</tbody>
</table>

| Total Population | 20,893,850 |

Ontario and Manitoba have no provincial PTC rules whatsoever. With the exception of Oregon and Vermont, all states have a baseline statewide regulation; however, the states in Table 4.1 allow their largest city more substantial autonomy over local PTC regulation. Edmonton and Calgary are in a similar position. As such, the American and Albertan cities in Table 4.1 have a ‘floor’: The province and states have set certain standards around insurance and a few other issues, but granted these six cities the ability to enact more aggressive regulation should they...
choose. In contrast, most other municipalities (including large cities such as Montréal, Los Angeles, and Houston, for example) have been given, at most, a ceiling: Their overarching state allows them some regulatory autonomy, but has set a limit as to how far they can go. While there are lessons to learn from these latter communities, they would likely be less valuable as part of a tight association as those municipalities that enjoy a greater amount of power. The list in Table 4.1 suggests the municipalities that come closest to wielding Toronto’s level of control, though only Ottawa, Mississauga, and Winnipeg match it exactly.

This list has six Canadian and four American cities, home to almost 21 million people. Small in terms of the total Canada-United States population, they nevertheless offer a sizeable market. New York, Toronto, Chicago, and Philadelphia alone are four of the eight largest municipalities in the two countries. Working together could therefore give these cities’ regulators significant heft in any negotiations with PTCs over new AV rules. State legislatures have passed AV legislation in all three states and the District listed above. Only Ontario currently has self-driving legislation north of the border, but a lack of provincial rules has not stopped Edmonton and Calgary from preparing for the arrival of driverless vehicles. Indeed, most of these cities are looking at the prospect of autonomous cars hitting their roads.

While the cities all share the PTC control and size criteria, they are different along a number of other axes, so there are two coalitions that could potentially develop in order to explore multiple themes. An East Coast coalition would align New York, Toronto, Chicago, Philadelphia, and Washington. These cities all have well-developed public transit, high transit ridership, and dense cores. As such, they can explore AV-transit integration, and would likely be more accepting of measures to limit automobile circulation in certain key areas to promote public and active transportation. They could make combined investments in modelling studies to
determine what densities make sense to maintain public transit corridors, and share information on initiatives like Toronto’s King Street pilot that limited traffic along the city’s busiest streetcar route.

Meanwhile, a Canadian coalition of Toronto, Calgary, Ottawa, Edmonton, and Mississauga would look at autonomous vehicle testing in Canada’s environmental and political climates. (Winnipeg is left off this list for now because the local government is not looking at autonomous vehicles at this time; if the city began to show a greater interest in this technological development, it should be invited to the table.) With almost one in every five Canadians living in these five cities, the ability to speak with one voice when dealing with ridesharing companies could give this group some genuine leverage in negotiations over what rules are appropriate. As Toronto is the largest of the five and home to a well-developed AVWG, it might be reasonable for its officials to take a leadership role in forming this partnership and inviting their counterparts to join them.

Both coalitions would be about more than sharing information; they would come together to develop a virtuous cycle of regulatory development. As a first step, local regulators can look across all partner cities at their existing non-AV PTC regulations and pull out the strongest requirements, then use these precedents when proposing their own updated legislation. The objective would be to avoid a battle that has already been won elsewhere: They can offer the regulations from other cities as proof they can enact the same stipulations locally without repercussion from operators. As data begins to flow from the autonomous vehicle tests being conducted in each city, officials can circulate this information, and as with the conventional documents, use it to strengthen one another’s proposed regulations. They could also provide testimony in front of one another’s city councils on what has worked and what they have learned,
providing confirmation and outside authority to help sway council and the electorate as to the reasonableness of a given approach.

These cities are obviously not the only ones that can benefit from sharing information to avoid reinventing the regulatory wheel. Pittsburgh, for instance, might collaborate with other cities in a similar situation by sharing experiences and proven tactics to get their concerns heard at the state or provincial levels. If city-to-city partnerships mature, representatives from coalition municipalities could even negotiate contracts with rideshare companies together, pooling resources when up against ridesharing companies. This strategy could actually be advantageous for both sides: With one signature, the company would gain access to all participating cities; in return, the terms for the local governments would need to be more beneficial than if they had gone into talks individually. Ultimately, the structure of these coalitions will depend on what local officials understand to be in their best interest, but by thinking creatively around such relationships, the bureaucratic capacity of the whole could be greater than the strength of its discrete parts.

Depending on the level of engagement, such coalitions could well require the blessing of local councillors or the mayor. It is therefore time to turn to the final two elements of effective regulation: The political willingness, and an outward-focused political capacity.
Chapter 5: Politics and Persuasion

There are similarities between willingness and capacity at the bureaucratic and political levels, but these elements do not completely overlap. Where bureaucratic will and ability is inward-facing—revolving around what an employee views as their job, and the resources they have to carry it out—politics looks outward in trying to convince, negotiate, or even charm others into accepting the regulatory approach the civil service has created. Bureaucrats need a willingness to expand the horizon of possible policy options, and the skill to build an effective path forward. Once they have such a proposal though, politicians are the ones who must defend that plan in front of the electorate, and prevent higher levels of government from intervening as local officials carry it out.

Figure 5.1. The five elements to effective regulation—political willingness and capacity

<table>
<thead>
<tr>
<th>Willingness</th>
<th>Legal</th>
<th>Bureaucratic</th>
<th>Political</th>
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<tbody>
<tr>
<td>Capacity</td>
<td>A</td>
<td>B</td>
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The stakes for the mayor and councillors are higher than for civil servants, because while advocating for a strong regulation within the corridors of city hall may earn a public official a rebuke from elected superiors, facing citizens in justifying a rule that in some way limits their freedoms might cost a politician her or his job. Personal political acumen and confidence therefore play a greater role for politicians than for bureaucrats; civil servants certainly want those skills to persuade their superiors a plan is worth adopting, but a mayor needs to be inclined and able to act as a salesperson taking the proposal to the people. As such, when designing new regulations it should be a civil servant's responsibility to not only come up with the

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3 To be sure, there are times when a bureaucrat, especially one who heads their department, has felt strongly enough to resign when they believe the government is moving in the wrong direction, but this is the exception rather than the rule.
recommendation itself, but also a strategy to convince representatives of its merits and suggest how they can garner stakeholder support for the proposal.

Before beginning, it is important to address whether it is appropriate for a bureaucrat to attempt to influence an elected leader’s decision in this manner, rather than remaining impartial. As articulated in chapter two, rules should be grounded in the city’s planning document, which itself was created by a previous democratic council. Certainly, if those currently in power move in a different direction after staff have made their case, they need to respect the decision; but when civil servants believe a slate of regulations can advance goals laid out in the official plan, they have a responsibility to enunciate this position to the administration. Sometimes, of course, elected leaders themselves want stronger regulation and task their departments with their design. In this case, the politician already possesses the will so their team can focus on building capacity. Below, however, the assumption is neither is present, meaning staff must first win over elected officials so they can present the plan to the public.

5.1. Political Willingness: Persuade, Then Persuade Again

In late September 2017, Uber received a significant blow across the Atlantic: Transport for London (TfL), the government body responsible for transport in the British capital, deemed the company “not fit and proper” to operate and were therefore not renewing its local licence. The transportation authority cited a number of shortcomings in their decision not to renew, including Uber’s “approach to reporting serious criminal offences, obtaining medical certificates and background checks on drivers, and its explanation of the use of “greyball” software that it said could be used to thwart regulators” (Rojas 2017). Unsurprisingly, corporate lawyers immediately threatened legal consequences while the head office marshalled its customer base to protest the ruling.
To take such action against Uber, TfL needed jurisdiction to manage London’s PTCs. It also required policymakers who were willing to go up against a large company—not only prepared to negotiate with their lawyers, but able to stomach the negative campaign that inevitably came with cutting off a popular service. Moreover, those decision-makers had to possess sufficient resources to devote to the media and legal battles that ensued (Rojas 2017).

Yet even with all those key elements in place, it is unlikely TfL could have taken on Uber without the blessing of the mayor, Sadiq Khan. As he said in a statement on this Twitter account when TfL released its verdict: “All companies in London must play by the rules and adhere to the high standards we expect—particularly when it comes to the safety of customers […] I fully support TfL’s decision—it would be wrong if TfL continued to licence Uber if there is any way that this could pose a threat to Londoners’ safety and security”. In the mayor’s view, it seems, rideshare rules are in place for a good reason, and even a $70 billion company must adhere to them; if they are unwilling to comply, then they should not be permitted in Britain’s largest city.

The mayor’s decision to support his transit agency is a clear illustration of the political will needed to enact or enforce a strong slate of regulations. With 40,000 drivers and 3.5 million Uber users in London, (Rojas 2017), there were many voters who could be potentially upset by this move. As soon as the decision came out, meanwhile, the company’s local general manager issued a statement arguing the ban “would show the world that, far from being open, London is closed to innovative companies who bring choice to consumers” (Rojas 2017). Had the mayor been spooked that frustration or criticism of the decision would cost him at the ballot box, he could have ordered TfL to extend the licence as soon as they released their announcement, or quietly addressed the whole situation before it even went public. But instead he publicly stood by the ruling, seemingly because he believed the benefits of enforcing the regulation—in his own
words, keeping Londoners safe—outweighed the possible backlash, and that he would be able to convince his constituents of this fact as well.

Policymakers do not, of course, always enjoy such political backing. In fact just this year in Toronto, the situation was just the opposite when former Chief Planner Jennifer Keesmaat publicly argued dismantling the Gardiner Expressway was the correct choice from an urban planning and community-building perspective, but Mayor John Tory opposed the proposal because of its impact on congestion and travel times (Gray 2017). It is unclear whether the mayor was personally against taking it down or simply felt he would be unable to win over his constituents, but either way the outcome was the same: The city plans to keep the expressway elevated (Powell 2016).

For policymakers hoping to enact effective change, the lesson from these divergent stories is that if they want to achieve a certain outcome, they need to think about a two-step persuasion process to engender the political willingness they need. Firstly, they must convince the mayor (and councillors) their plan is the best choice for the city. This in itself is not enough, however, because if elected officials do not believe they can sell an initiative to the public, they are likely to be much less willing to carry it forward. As such, when proposing any plan civil servants need to accompany the idea itself with a strategy that shows politicians how they can persuade others of its merits.

While Mayor Khan supported TfL when Uber came out swinging against their bold move, often many politicians are concerned their administration will be tagged ‘anti-innovation’ if it is too ambitious with setting or enforcing rules. To pre-empt this criticism, officials can try to win private sector endorsement of their public policy before presenting it to the administration. Admittedly, there is a common notion business opposes all regulation, but this is
not inherently the case. In fact, there are some rather surprising examples of companies favouring new rules, even when they pose a challenge to their business model. Perhaps the most noteworthy is the growing number of energy firms lining up in support of measures to address climate change, with executives of oil and gas giants including Cenovus, Berkshire Hathaway Energy Canada, Shell Canada, and Suncor all encouraging Canadian carbon pricing (Fletcher 2017; Rosenberg 2017). Down south, even long-standing opponents of intervention in the oil patch—including ExxonMobil—have become proponents of such a move (Roberts 2017).

There are a number of reasons why firms come to support regulation. Firstly, board members might recognise the harms their industry causes and want to lessen the impact, but acting unilaterally increases their costs or decreases their competitiveness. When the government forces all operators to shoulder the same burdens, it levels the playing field and allows them to improve. Additionally, regulations provide certainty. Nicolette Bartlett, director of carbon pricing at CDP, a global non-profit organisation that works with companies on environmental impacts, argues that, “if you accept that society is going to deal with this problem, you want approaches you can understand, manage, and work” (Rosenberg 2017). Ben van Beurden, the chief executive officer of Shell oil company, echoes this sentiment, stating: “one of the biggest concerns I have around climate change is the unpredictability in which governments will go about it. [...] If we have a very clear understanding that governments, successive governments, will continue to act consistently with a certain policy set that we believe in, I have no issue with it” (Raphelson 2017).

These quotes highlight the importance of clarity and an evident relationship between a harmful activity and the rule meant to address that harm. “Regulation should not be there for regulation’s sake”, argues David Wright, a financial service policy leader at the International
Organization of Securities Commissions, “it should be there to regulate activity on the basis of a clear definition of what the problem is, a clear definition of what the public interest is, where there is a market failure, and it should respond adequately to all of that” (Cooper 2014). Peter Achterstraat, a change management expert at Evans & Peck Management Consulting, similarly suggests governments want to enunciate a connection between a regulation and the policy objective to which it is tied. Furthermore, both experts agree that if cities take a consultative approach in the design phase of regulatory policy, then carry out a rigorous impact analysis and adapt laws based on new information, companies will likely raise fewer objections in accepting the new ordinance (Cooper 2014).

Already, Toronto’s Article 10 is evidence of the value of a clear, consultative policymaking process. Despite the quite stringent operating requirements laid out in the Municipal Code, both Uber and Lyft have chosen to run in Ontario’s capital. Vanessa Fletcher at ML&S argues one of the reasons her department was so successful in implementing strong PTC policies with little pushback from ridesharing companies was because Toronto has an accessible, democratic consultation process for their development, which helped generate stakeholder buy-in.

While there may always be some companies that oppose regulation regardless of the means by which it was formed, employing a transparent, engaged process makes it more plausible companies will come out in favour of the rules, or at least not openly challenge them. In fact, measures that improve the transportation system might in some cases actually be appealing to AV firms in tech-heavy cities like Toronto; because they are not only service providers but also local employers, they need to attract an educated workforce, and the people
they seek often want to live in engaging, sustainable communities. If regulations improve the quality of life in a city, it therefore makes it easier to retain top talent.

That said, while public agencies should consult with operators and be clear with their rationale, companies might still push back on rules they see as too onerous. To prepare for any private sector threats to leave the market due to ‘stifling’ requirements, local officials can conduct an assessment of their city’s own strengths from a private sector perspective, and weigh these against the price of complying with any new ordinance. Uber, for instance, chose Toronto for its third AV facility despite vigorous PTC rules because it appreciates proximity to the Vector Institute for Artificial Intelligence and the talent pool at the University of Toronto and other nearby institutions (Kalanick 2017)—not to mention access to millions of customers in the metro region.

Politicians are liable to feel more comfortable standing up to the private sector when they have compelling evidence that even with forceful regulations in place, staying in the local market remains worthwhile for these operators. This strategy also highlights the benefits of inter-city collaboration; after all, if Toronto, Pittsburgh, Chicago, and New York all stand together on similar requirements, PTCs will likely adapt their operations to meet the new standards rather than withdraw from four of the largest markets in Canada and the United States.

Furthermore, politicians may not so much concerned with being anti-innovation because of the impact on companies per se, but out of fear citizens will turn against anyone who stifles private sector investment. If the public is overall in support of new rules because they believe restrictions have merit despite the impact on corporate activity, it is much easier to push back when companies speak out against a requirement. Despite the large rideshare customer base in London, a plurality of Londoners—43 per cent—agreed with TfL’s decision, versus just three in
ten who thought it was wrong (Scott 2017). The poll that uncovered this result unfortunately does not say why exactly locals back the transit agency’s move, but TfL and the mayor have consistently made the case the rules are in place to keep Londoners safe. Here again, citizens will likely be more receptive to a regulation when they see it is clearly addressing harmful activities and therefore improving the wellbeing of their community.

Ultimately, the voting public’s response to new policy may be of even greater concern to local politicians than corporate criticism. When it comes to autonomous vehicles, however, opposition to stronger regulations might actually be quite muted. As an unproven and powerful technology, citizens will probably agree more stringent directives are necessary. More specifically, there are no existing AV owners or customers, meaning the number of people who would have a compelling motivation to raise opposition to new measures would likely be small to nonexistent. Furthermore, the regulations will not have much of an impact for another few years since companies are only now in the early testing phases. As such, it will be at least one election cycle before this might become a top-of-mind issue among the electorate.

If the AVWG can convince city council to successfully enact strong regulations now when there is no constituency to stand against them, they will set the norms for future development, limiting the chance for resistance down the road. This is similar to the strategy Singapore employed establishing its car registration charge: As MIT Professor Jinhua Zhao points out, the government instituted the fee before anyone owned a car, so when consumers did begin purchasing new vehicles it was seen as simply part of the cost of ownership.

Finally, people are more likely to champion an idea if it can be linked to positions they have supported in the past (Lax and Sebenius 2006). Mayor Tory and his executive committee voted in favour of a plan to offer transit discounts to low-income users (Spurr 2016), for
example, so it makes sense to point out a provision to do the same when it comes to shared AV-PTC rides would further assist those in need. He also just recently supported a motion to begin tolling the city’s two expressways to raise funds for transit and other capital projects, so charging AV-PTC congestion fees aligns with this position to use economic incentives to generate income and address traffic (Torstar News Service 2017). By explicitly linking the rules to what the mayor seemingly already believes is good policy, it increases the likelihood policymakers will effectively convince him these are appropriate moves for the city to make.

By employing private sector endorsement, linking new measures to past priorities, and showing why there will likely be little public pushback to new rules, bureaucrats can hopefully placate local leaders’ concerns, meaning they will be prepared to champion the regulations their department has proposed. With task one accomplished, officials then need to look outward to see what tactics the administration can employ to keep upper-level legislatures from intervening in local affairs.

5.2. Political Capacity 1.0: Keeping the Province (or State) at Bay

The decision mentioned above to begin tolling the Gardiner Expressway and Don Valley Parkway could not have been an easy one for the mayor or city council to make—yet they did, because they believed it was in Toronto’s best interest. Unfortunately for the councillors, this was not the last word on the issue. When Ontario Premier Kathleen Wynne got wind of anger among suburban commuters who did not want to have to pay for their drive to work in downtown Toronto every morning, she intervened. Despite the fact the City of Toronto owns, operates, and maintains the two highways and their democratic council voted in favour of implementing a toll, the Ontario government prohibited City Hall from putting their plan into action (Torstar News Service 2017).
This case shows that on the road to effective regulation, political willingness is not enough—and in fact, any indirect considerations about the public’s reaction to a regulation package might be secondary to the very direct reaction provincial (or state, or even federal) authorities have to the project. After all, it is not guaranteed there would be any severe electoral repercussions to an unpopular regulatory move; because voters elect a person, not an individual idea, they may still support an incumbent mayor or councillor even if they oppose certain measures the official supported, as overall they continue to believe s/he is the best person for the job. In contrast, for better or worse cities exist at the pleasure of the provinces and states in North America, meaning higher-level politicians retain the right to intervene in local affairs should they deem it to be in their best interest. If they do not like the direction the administration is going, they may well find a way to stop the process.

Obviously, it is not guaranteed higher governments will act in ways that frustrate the preferences of local officials, but there are a number of examples of such involvement. In 1998, then-Ontario Premier Mike Harris forced Toronto to amalgamate with the five surrounding municipalities to form the City of Toronto as we know it today, despite the fact 76 per cent of voters opposed the merger (Farooqui 2016). More recently, state officials across the United States have sparred with cities over who would be responsible for regulating PTCs. Texas Governor Greg Abbott captured the attitude of many (often conservative-leaning) state legislators in the statement he released when he signed a bill that put primary jurisdiction in the capitol’s hands; he was very clear his purpose was to inhibit local government from taking aggressive action, writing: “In Austin, we’re going to override burdensome, wrongheaded regulatory barriers that disrupt the free-enterprise system […] which has elevated Texas to be the No. 1 state in the entire country for doing business” (Mekelburg 2017).
Whether due to ideology or self-interest, the gatekeepers of municipal sovereignty have proven they are prepared to take away the key when it suits them. It is therefore up to the local leadership to figure out how, either through negotiation or persuasion, they can keep their provincial or state counterparts at bay as they implement new ideas.

Helpfully, the general principles mentioned above as regards civic leaders can also be employed to win over provincial ones. The AVWG will want to think about what motivates Queen’s Park in order to design a strategy to keep the province from reacting to any new AV regulations. That said, the Government of Ontario might have minimal incentive to do much about new regulations anyway, given that PTCs are currently under the city’s control and the number of voters who would put up much of a fight were Toronto to enact new rules for AV-PTCs is likely quite small. Toronto might therefore not have as much concern in this regard. Other cities including Pittsburgh that do not currently enjoy local PTC regulation, however, might want to be more ambitious, employing political capital to convince the higher authority to divest of their jurisdiction and give it to the city. If municipal officials are able to justify the move in a manner that speaks to the worldview or interests of the provincial or state government, they might be successful with such an undertaking.

Just this past March, the Government of Manitoba tabled a *Local Vehicle for Hire Act* that dissolved the Manitoba Taxicab Board (MTB) and for the first time gave the City of Winnipeg direct control over both taxis and PTCs (Taylor 2017). Though it does not appear Main Street lobbied the province directly in this case, a transportation task force had earlier recommended MTB dissolution, and such a move fits the provincial Conservative government’s general desire to save money by doing less within their own departments. If local officials can
make an argument that aligns with upper-level interests in this manner, it is not unreasonable to believe legislatures could pass down jurisdiction.

For Toronto though, its own bolder aspiration might be to sway the Ontario government to enact AV rules that complement new measures written into Toronto’s Municipal Code. Transportation issues cut across municipal boundaries, so a number of the policies from chapter two ultimately make more sense if established at a regional or provincial level. City Hall might therefore seek to convince Premier Wynne that encouraging the MTO and Metrolinx to address some of the shortcomings of driverless cars will help her accomplish her own political objectives and improve Ontarians’ wellbeing.

5.3. Political Capacity 2.0: From Passivity to Action

Chapter three laid out the precedents within the existing Municipal Code that enable the city to enact the policies from the first chapter. Yet, the AVWG must ask whether they should move alone in this regard, because making autonomous ridesharing too onerous might deter potential customers from leaving their own cars at home. If AV cars are limited in where they can park, will this increase wait times and make a PTC ride less attractive? Would a congestion charge applying only to car-share vehicles make them more expensive and therefore less appealing? While Toronto can enact heavy regulations on PTC vehicles, it is much more limited in its ability to influence private drivers, so acting alone might exacerbate rather than curb identified harms.

The AVWG therefore wants to consider the policies from chapter two along two axes. Firstly, which level of government—the local, regional, or provincial—should enact a regulation, and secondly, should the regulation apply to all driverless cars and trucks, PTC cars alone, or private vehicles alone? Using this division of labour and application, the goal is to have the
greatest reach possible in most effectively addressing imposed harms, based on the areas over which each level of government has jurisdiction. With control over PTCs, it makes sense that Toronto look after those provisions that apply to rideshare operators. Moreover, as the city oversees parking through the parking authority and road management, it is also reasonable for the local government to limit parking and reconsider road prioritisation to accommodate all users.

As Toronto’s transit system is strongly harmonised with the Metrolinx PRESTO fare card and Triplinx trip planning system, the city will need to partner with the regional transit agency to properly integrate autonomous vehicles and public transit. This is not necessarily true in other places, however, so some local governments might have enough control over the transit system to keep these regulations solely under their purview. Likely no municipality in Canada would be able to enact comprehensive distance- or congestion-based road pricing or a zero-emission mandate though, as this power lies with provincial governments. Toronto will therefore need to partner with the MTO should it want these requirements to apply to private AV owners as well as rideshare companies. Lastly, Freemark and Zhao (2017) suggest local governments can use speed limit legislation to modify AV use, but this would be problematic for cities in Ontario as the province sets default speed limits and these limits must apply to all vehicles (Koehl and Black 2018). As such, enacting widespread speed limit reform would require some kind of collaboration between the City of Toronto and the Government of Ontario.

Chapter six goes into detail on the proposals in column one of Table 5.1 (on page 83), but the remainder of this section discusses the important role the Government of Ontario can play through Metrolinx and the MTO. As the regional transportation provider, Metrolinx administers the PRESTO fare card and Triplinx planning system, which should be the primary consumer-
facing tools integrating autonomous vehicles and public transit. Metrolinx can, for example, offer any PTC that would like to participate the ability to integrate into the Triplinx trip planning system. A new version of the website can be designed to scan all participating PTC rates and predicted pick-up times when a customer is planning a given trip. The customer can select whether they would like to have a faster total travel time or a lower cost, and the system can make recommendations based on these preferences. It can also offer multi-modal trip advice integrating both public transit and PTC rides, suggesting a subway station at which the customer could be dropped off where they could ride transit to their final destination.

Table 5.1. Proposed distribution of AV regulations

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<th>City of Toronto</th>
<th>Metrolinx</th>
<th>Ministry of Transportation</th>
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<tbody>
<tr>
<td><strong>All</strong></td>
<td>• Lower parking provision (with designated PTC/taxi spaces)&lt;br&gt;• Rethink the use of street space</td>
<td>• • Mandate zero-emission autonomous vehicles&lt;br&gt;• Enact distance- and congestion-based road pricing</td>
<td></td>
</tr>
<tr>
<td><strong>PTCs</strong></td>
<td>• Impose minimum levels of service provision&lt;br&gt;• Offer income-based subsidies</td>
<td>• Integrate autonomous vehicles and public transit&lt;br&gt;• Design and manage a data clearinghouse</td>
<td></td>
</tr>
<tr>
<td><strong>Private</strong></td>
<td>• Prohibit empty-vehicle circulation in certain urban zones</td>
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Metrolinx can also work with PTCs to enable payment through the PRESTO card, to address the challenge of customers without a bank account using car-share services (this ideas is outlined in greater detail in chapter five). The transit agency can even look at allowing customers to order a car directly through Triplinx, and might offer a rider a reduced transit fare if they choose to transfer onto the public network. Having statistics on origin and destination requests
will help the agency build a database of PTC operations, and this information can in part help with planning future local and regional transit lines.

Concurrently, the MTO has its own role to play. It can require all autonomous vehicles operating in Ontario to be zero-emission, and enact a distance- and congestion-based road-pricing scheme. These two priorities should apply to all autonomous vehicles, whether personal or corporate, because all travellers generate physical and environmental congestion. As discussed in chapter one, these measures are critical: Without a system where Ontarians begin to pay the full price of their trips, the risk we will simply replace single-passenger human-driven cars with single-passenger autonomous ones is much greater.

Admittedly, the two proposed MTO regulations might be difficult to enact politically, as the pricing plan, in particular, goes against the convention of ‘free’ motorised travel that has been in place for over a century. It will likely require a very ambitious strategy on the part of Toronto and other interested local governments to convince the province to even consider such a plan, and it will probably need to happen at the political, rather than bureaucratic, level. Multiple attempts were made to speak with a representative from the MTO as part of this research, but the ministry was only able to provide a form email about their AV program. The response stressed that safety is of paramount and seemingly sole importance to the ministry, and while they are working with Ottawa on ensuring driverless vehicles are safe for Canadian roads, they have very little engagement with Ontario’s municipalities. As such, it appears the MTO will require a directive from the minister to expand their mandate to consider congestion and the environmental impacts of transport.

To increase the likelihood the Government of Ontario hears Toronto’s concerns, City Hall needs to design a targeted communications strategy that speaks to provincial leaders’
interests. Positively, Premier Wynne already recognises gridlock is cause for concern in the Greater Toronto-Hamilton Area (GTHA), and there is clear evidence congestion in the Golden Horseshoe is generating serious difficulties for the regional economy. Back in 2013, the premier told the Toronto Region Board of Trade (TRBT) that, “Toronto’s congestion is a major issue affecting its reputation and its productivity” (CBC News 2013). Supporting this sentiment, a recent TRBT report notes ongoing gridlock means raw materials and finished goods are not getting to where they need to go on time, with traffic costing $125 per household per year in the Toronto-Waterloo corridor (Copun 2017).

Given the premier’s comments, it would seem she recognises the need for action, but it is understandable she would be reluctant to allow the local administration to implement road tolls when her party risks getting caught in the crossfire between the City of Toronto and angry suburban commuters. Mayor Tory and his team can thus pitch road pricing as one strategy to take congestion seriously without having to pay a personal political price. Autonomous vehicles can be the catalyst for an entirely new way of thinking about mobility, with Ontarians coming to prioritise access rather than ownership. The first step in this new vision is to have everyone paying the true cost of their travel, and setting this model up now when there are few to raise their voices in opposition will be a concrete step towards more efficient mobility. The mayor could suggest all funds raised can be used to pay for much-needed transit—the solution Premier Wynne advocated in her 2013 speech. Such an approach will establish new norms around transportation, but delays the impact of the tolling until after autonomous vehicles are more prevalent.

Linking this back to the economy is a very purposeful approach to framing the conversation. As Professor Eric Miller at the University of Toronto argues, the Government of
Ontario already views autonomous vehicles as an economic development tool, though through a rather different lens. The Wynne administration is hopeful that if AV companies can test in the province, they will someday manufacture their vehicles there too. The strategy outlined above simply takes this priority further, arguing a welcoming atmosphere for AV companies is not the only—or even the most effective—way to harness this technology to engender economic growth.

In late 2017, urban economic development made headlines when Amazon announced it would build a second headquarters in one North American city, bringing with it tens of thousands of jobs. The company’s request for proposals reads, “like an urbanist’s dream, specifically outlining a preference for sites offering dense, pedestrian-friendly, connected neighbourhoods” (Bellamy 2017). This ‘connectivity’ means sidewalks, bike lanes, public transit, and other creative options to foster connectivity among a young, educated workforce. To attract the companies of the future, Ontario’s cities must build the kinds of communities where employees want to be.

Studies show strong urban development is a prerequisite for investment among Millennial entrepreneurs (Florida 2014), so if the province is keen to encourage new growth, developing a robust transportation system is key. Furthermore, congestion pricing actually makes it more attractive for PTCs to set up shop in Ontario, because it means private driving is relatively more expensive—encouraging commuters to choose a shared ride. Uber has endorsed this exact strategy, arguing broad-based road pricing provides a “marketplace for efficiency” that will incentivise people to travel together (Bliss 2017). Toronto could therefore ask for their support to attract Premier Wynne’s attention.

Lastly, Toronto can bring the federal government on board as an ally to convince Ontario of the merits of congestion pricing. In the 2015 election, Prime Minister Justin Trudeau has made
public transit infrastructure, expert-led development, and entrepreneurship the main planks of his party’s economic strategy, and the proliferation of self-driving vehicles impacts all three to various degrees. His Liberal Party even made a commitment to “consult with the provinces, territories, and municipalities and propose an integrated, intermodal national transportation strategy that serves large and small communities” the number one Priority Resolution in their current platform (Liberal Party of Canada).

The Canadian coalition described in chapter four can lobby Ottawa to become a proponent of AV policy across the country. Toronto, Calgary, Ottawa, Edmonton, and Mississauga are together home to twenty per cent of the national population, meaning they could command significant political pull on Parliament Hill. The coalition can outline a vision for the Liberals’ national transportation blueprint: Framing it as ‘moving the economy of the 21st century’, they can make the case a strong national urban mobility master plan that incorporates autonomous transportation is really an economic development strategy by another name. This vision would stress the need for holistic ‘transportation and land use’ planning, and acknowledge AV technology necessitates a new understanding of mobility that includes an economic framework to paying for travel. Such measures will alleviate the congestion that inhibits economic development and slows exports, help foster dynamic communities in which entrepreneurs want to invest, and raise money to pay for transit.

In Premier Wynne’s 2013 TRBT speech, she argued massive, targeted bus and rail investments will be key to addressing congestion in the Toronto-Hamilton region. “Transit in the GTHA needs tens of billions of dollars over the next twenty years”, and it is her responsibility to ensure “Ontario’s largest city can move with ease” (CBC News 2017). Given the history of infrastructure funding in Canada, Ontario will almost assuredly not be paying for these
investments alone, but will be looking to the federal government for additional cash. As such, by building enthusiasm among national leaders for AV road congestion pricing, implementing this measure could be linked to future federal funding. The city coalition might even be able to convince the federal Liberals to develop a national AV congestion-pricing plan similar to their carbon pricing plan; that is, provinces would be subject to a national baseline price on AV travel, but free to establish their own more ambitious initiative should they choose.

City of Toronto officials must ultimately come up with the approach they think will be most effective at winning over the provincial Liberals. Whether by reframing the debate, bringing in new stakeholders, or employing other tactics, however, they will hopefully expand the MTO’s mandate, enabling them to work closely with their provincial counterparts on a range of AV issues. With the ministry crafting policies for all autonomous vehicles, the city can enact a complementary set of AV-PTC regulations that revolutionise Torontonians’ travel choices.
Chapter 6: Proposed Article 10-A in the City of Toronto’s Municipal Code

The last three chapters looked at how Toronto planners can develop regulation in general, but ultimately the actual rules must reside in written form as by-laws within the city’s Municipal Code. Planners and policymakers can sometimes leave the task of creating these documents to their legal team, but a critical component of this research was to attempt to develop in specific detail the policies advocated above. The result is the proposed Chapter 546, Article 10-A of the City of Toronto’s Municipal Code, for autonomous vehicle private transportation companies (AV-PTCs).

Included as Appendix C, Article 10-A is inspired by Toronto’s existing Article 10 (Licensing of Vehicles-for-Hire). Where appropriate, Article 10-A maintains the exact text of the existing article, while removing those sections that no longer apply and adding new items as necessary. Article 10-A intends to illustrate explicitly what AV policy can look like on the ground, and is based on the objectives laid out in the City of Toronto’s Official Plan. As such, the government’s goals justify employing these concrete regulatory measures, which should give regulators confidence and leverage when discussing these rules with PTCs and other stakeholders.

The document is meant to codify the policy measures from chapter four that are most appropriate at the local level:

- Lower parking provision (with designated PTC spaces);
- Rethink the use of street space;
- Impose minimum levels of service provision; and
- Offer income-based subsidies.

In addition, because Metrolinx does not have regulatory authority over PTCs, Article 10-A provides the legal requirements to integrate AV-PTCs with the public transit system through Triplinx and the Metrolinx smartcard (today known as the PRESTO card). In this scenario it is
presumed Metrolinx, rather than the City of Toronto or the TTC, will manage the infrastructure. Finally, a measure to enact congestion pricing in downtown Toronto is included as part of the regulations, but if the MTO were to set up its own road-pricing plan, this section could be removed.

This chapter begins with a brief discussion looking at Article 10 compared to Article 10-A, before outlining the eight specific new requirements found in Article 10-A. These are divided into two broad categories: ‘Equity’ and ‘Urban Form and Street Space’. In order to understand the shortcomings in the proposed regulations, Ryan Lanyon at the AVWG and Vanessa Fletcher at ML&S offered feedback on what was reasonable and what appeared problematic with the proposal. A summary of their comments is included at the end of this chapter.

6.1. Regulation Leapfrog: Article 10 Versus Article 10-A

Article 10-A is designed to stand alone within the Municipal Code. That is, it is technically and legally unrelated to Article 10. If a company operates only autonomous vehicles, they will not be subject to Article 10. PTCs operating no driverless cars will similarly not need to follow Article 10-A. Businesses with both driverless and human-driven vehicles, however, will have to comply with the regulations in both Article 10 and Article 10-A as concerns the vehicle requirements and broader company operational expectations.

One might read Article 10-A and argue that the requirements expected of autonomous vehicle rideshare companies are more onerous than those for conventional PTCs. This is both true and intentional, ensuring the future transportation regulatory ecosystem more effectively addresses the known harms of private action. Operators might therefore argue it is unfair to burden AV-PTCs with rules that do not apply to conventional companies. This perspective is important, but the city should not be tempted to dilute strong regulatory proposals simply
because they would be more onerous than existing rules. Rather, they should look to revise Article 10—as well as other articles in Chapter 546 (Licensing of Vehicles-for-Hire) in the Municipal Code—so these old codes meet the new standards.

Policymakers should always strive to improve on what they have gleaned from past proposals and new information, meaning newer bylaws may be more favourable to industry participants and/or citizens as they better reflect current realities and best practice. For instance, Article 10-A proposes a concession price for qualifying low-income rideshare customers, which is not currently available in Article 10; leaving this as it is will therefore disadvantage low-income PTC customers who do not enjoy this discount, which is why it is important to eventually change the old articles. There will always be a degree of temporal inconsistency, however, where old and new regulations related to new industries and activities do not align completely. This is reasonable for a period of time, but eventually regulators will want to examine and revise old articles so different regulations do not advantage or inhibit one group of companies or citizens over others.

That said, while the long-term objective should be harmonisation, it is not desirable to wait until all regulations are aligned before putting new rules into place. It would take time to properly consult with established actors—in this case, taxicab, limousine, and rideshare companies—who will be affected by changes to PTC and taxicab or limousine legislation. Waiting to consult with them, then crafting new rules, then opening them to public debate and finally changing the law could take years. Waiting until that has all happened before bringing in AV-PTC regulations would leave the new industry without rules for a long period of time. As such, the most appropriate approach is likely to first determine what is necessary to properly
oversee the AV-PTC market, then with those rules in place, bring older articles up to modern standards.

Admittedly, this is a never-ending process, as once this round of updates are complete it will be time to modernise Article 10-A. Moreover, not all the policies below are appropriate for conventional rideshare or taxicab companies, so there will always be some disparity given the technological and operational limitations of one industry over the other. Nevertheless, adopting an iterative perspective on regulatory development will hopefully ensure city statues address known harms properly while having the smallest impact on the overall market. As one reads the following, one is encouraged to consider which of these rules could apply to PTCs and taxicab companies to further this objective.

6.2. New Provisions: ‘Equity’ and ‘Urban Form and Street Space’

Beginning in chapter two and progressing through this thesis, the objective has been to become increasingly more explicit as to what a final regulatory package can look like. As the culmination of this endeavour, Article 10-A is meant to provide the literal text that could someday be included in the Municipal Code. There is one caveat, however: No modelling or other quantitative analysis was conducted as part of this thesis research, so for any quantifiable measures below, the proposed numbers are meant to be illustrative only.

Article 10-A proposes, for instance, that a company’s minimum customer wait time for a given neighbourhood should be determined as a 1:1 ratio of the wait time in the neighbourhood where that company performs best, modified based on the neighbourhood’s geographic density (the details of this policy and a clarifying example are provided below). For this and other similarly numeric requirements, while the principle is meant to be real, there is not enough data to say firmly whether the actual proposed numbers are optimal. Analysis might reveal, say, that
the 1:1 ratio for minimum wait times is either too onerous or too lenient; in any actual Article 10-A therefore, the ratio would then need to be modified accordingly. Thus, while the reader should understand the directionality of the proposals to be firm, the specific numbers are meant to be flexible and may be modified based on future insights.

**Equity**

The City of Toronto recognises that access to mobility helps improve citizen wellbeing. Torontonians who can easily get around are able to take full advantage of the city’s economic opportunities, cultural life, wellness institutions and hospitals, parks, and a variety of municipal services (City of Toronto 2016). Unfortunately, low-income residents often lack such access, which can restrict their options and opportunities. As such, Article 10-A proposes that in the future the City of Toronto can expect all transportation providers—both public and private—to share in the special responsibility of assisting under-resourced residents.

Two of the major impediments to accessing PTC services are a lack of a bank account or credit/debit card, and/or a lack of smartphone. Furthermore, all neighbourhoods deserve access to adequate mobility services, and given the critical role mobility plays in urban life, no individual should be unduly burdened with transportation costs. To address these shortcomings and assist with these goals, the articles requires all AV-PTCs in Toronto to:

1) **Be integrated into the Metrolinx transit smartcard system.**

As part of Article 10A, the City of Toronto will co-sponsor the establishment of an enhanced Metrolinx smartcard system that links a customer’s AV-PTC account with their registered Metrolinx smartcard, rather than a bank account. Should they choose, any customer with a registered Metrolinx smartcard will be able to register for an AV-PTC account with their smartcard, and use uploaded smartcard funds to pay for an AV-PTC ride. When Metrolinx
smartcard-registered customers complete a ride, money will be transferred from a Metrolinx bank account where the customer’s funds have been stored to the AV-PTC bank account, rather than from that customer’s private bank account directly. Metrolinx will monitor customers’ smartcard accounts, and should a customer have insufficient funds on their card at the time a ride is ordered, they will be permitted to complete their trip but their account will be frozen until such a time as they have paid the balance owing to Metrolinx. This accommodation is similar to the existing PRESTO card ‘emergency balance’ feature.

The City of Toronto will act as guarantor for all Metrolinx smartcard accounts held by Torontonians. Any account freeze will therefore not prevent an AV-PTC from receiving what it is owed for trips made by customers prior to their accounts being frozen; however, when an account is frozen Metrolinx will inform all AV-PTCs, and it will be their responsibility to prohibit further travel by those customers until such a time as Metrolinx had sent notification the account had been reactivated.

AV-PTCs will be prohibited from discriminating in any manner against or otherwise treating differently those customers who had registered with a Metrolinx smartcard in lieu of a bank account. The only exception will be the manner in which they accept funds from these customers; specifically, the AV-PTC will accept the funds from the Metrolinx bank account that manages all the smartcard-linked accounts, rather than from the individual’s bank account directly. Article 10-A assumes proposal that once ML&S has approved an operator, they (or Metrolinx) will provide the company with detailed information on how to connect their system to the smartcard system. While this kind of integrated payment platform is quite novel in North America, in Asia there have been similar types of payment platforms in existence for a long time, so the technology exists already.
2) **Have a customer-facing application that:**
   a. Can be accessed on a computer, tablet, or smartphone; and
   b. Offers a conventional telephone option using voice or keypad activation.

   The objective with this proposal is to ensure all Torontonians will be able to utilise AV-PTC services, regardless of whether they have access to a smartphone. The article stipulates that information provided to customers must be similar across all platforms, though it may be abbreviated for customers calling in on the telephone, given that all communication must be done orally rather than in a visual format. As with the point above, AV-PTCs will be prohibited from discriminating against any individual or group of customers based on how they choose to access the AV-PTC application and hire a ride. This includes (but is not limited to) charging different prices (including ‘surge’ prices) based on the application they choose to use to hire a ride, or determining their place in the queue in such a manner that could negatively impact their wait time compared to those who have ordered a ride by a different means.

3) **Provide qualifying low-income customers with a reduced rideshare fare.**

   Autonomous vehicles offer a unique opportunity to assist low-income residents. In exchange for operating in Canada’s largest travel market, through Article 10-A AV-PTCs will be required to provide a small concession to assist the city’s most needy residents. This concession will be available to those who qualify as low-income, as defined by Statistics Canada’s ‘Low-Income Measure After Tax’. In 2016, approximately 500,000 Torontonians qualified under this criterion (City of Toronto 2016).

   The new City of Toronto-sponsored ‘Fair Pass’ program offers a 33 per cent reduction on adult single TTC fares to qualifying low-income residents (with qualification based on the same Statistics Canada metric). To encourage shared-ride trips, AV-PTC operators will similarly be required to provide a 33 per cent concession to qualifying low-income customers on all shared-
ride services, from the prevailing market-rate fare at the time the shared ride is ordered (adjusted for any ‘surge’ pricing). The concession will be linked to a user’s account and automatically applied, with users required to renew their qualifying low-income status annually.

Once more, AV-PTCs will be prohibited from discriminating against any individual or group of customers based on their qualification in this program. This includes (but is not limited to) limiting a qualifying individual’s ability to hire a shared ride, charging different prices (including ‘surge’ prices) based on qualification and/or participation in the program, or determining a qualifying customer’s place in the queue in such a manner that could negatively impact their wait time compared to those who are paying full price.

Surge pricing is a useful tool to help smooth traffic congestion; however, the article stipulates surge pricing must be based on travel demand, and companies cannot use it in any targeted manner to discourage low-income ridership. To ensure compliance, all AV-PTCs will be required to provide the surge pricing charged for every ride requested or provided that begins or ends in Toronto (this is no different than the existing Article 10 requirement that PTCs provide information on the cost of each paid ride to ML&S).

ML&S will evaluate the surges as they relate to general traffic patterns and AV-PTC customer requests for service. Should it determine that AV-PTCs were imposing surge charges at times when low-income riders are more likely to travel, when such increased fare is not merited based on overall demand, ML&S will impose a financial penalty on the AV-PTC. For subsequent offenses, the penalty will increase and could result in the termination of the operating license in Toronto. Penalties can be appealed and rescinded should an AV-PTC be able to illustrate to ML&S its surge pricing was based on demand rather than discrimination. While this subsidy might seem extreme, it is arguably less of an imposition on PTCs than current fare
maximum requirements on taxicab operators. After all, it limits the amount the company can charge only for qualifying residents rather than putting a cap on fares across all operators for all customers. It therefore allows the market to set prices overall, while targeting directly those who need financial assistance.

4) **Provide a minimum level of service provision across all Toronto neighbourhoods.**

The City of Toronto recognises 140 neighbourhoods, and citizens in each deserve similar access to transportation; however, the size and density of neighbourhoods vary, and it is impractical to expect wait times to be the same in a small community with a dense population and one with a small number of residents spread over a large area.

To address the conflict between spatial/demographic differences and a goal of comparable wait times, under Article 10-A all AV-PTCs will be required to provide the City of Toronto with information on the length of time elapsing between the moment a passenger places a service request and the start of the trip, for all trips beginning inside city limits. For a given AV-PTC, wait times will be categorised based on neighbourhoods, and the average wait time for each neighbourhood will be multiplied by the neighbourhood’s population density to provide a neighbourhood ‘wait score’. These scores will be ranked, and the wait time score in the lowest-performing neighbourhood for that AV-PTC cannot be greater than the company’s score in the neighbourhood where absolute wait times are shortest.

As an example, the Church and Wellesley neighbourhood has a population density of 24,358 people per square kilometre, while Banbury has a density of 2,442 people per square kilometre. If an AV-PTC had an average response time of one minute for calls made in the Church and Wellesley neighbourhood, their Church and Wellesley wait score would equal:

\[(1 \text{ minute}) \times 24,358 = 24,358\]
Assuming this was the company’s lowest average response time, their Banbury
neighbourhood wait score could therefore be no higher than 24,358. Given Banbury’s population
density, the maximum average wait time would therefore equal:

\[ 2,442 \times (\text{Maximum Average Wait Time}) = 24,358 \]
\[ \text{Maximum Average Wait Time} = 9.97 \text{ minutes} \]

By pegging a given company’s minimum average wait times to its own best performance
rather than an absolute number, the regulation neither excessively burdens small companies that
might struggle to meet a standard, nor allow large companies to meet only this low standard in
less profitable communities and then concentrate the bulk of their fleet in wealthier or higher-
demand areas. This approach therefore minimises the harm while maximising social good. That
said, this regulation does imply companies will be required to serve all neighbourhoods rather
than only specialising in some areas, so city officials will need to determine this is an expectation
they deem reasonable.

Unlike conventional PTCs that rely on contract drivers, an AV-PTC operating an
autonomous fleet is able to control exactly where its vehicles are deployed, ensuring wait time
parity across the city. This measure could provide a small positive feedback loop, whereby
neighbourhoods have an incentive to embrace greater density to benefit from better wait times.
As they do, AV-PTCs would have more customers in a smaller geographic area, which would
reduce deadheading. While this is obviously only one factor in a consideration of evolving urban
form, it does provide a nudge in a direction of more dynamic, dense communities.

*Urban Form and Street Space*

In addition to better serving all Torontonians, self-driving vehicles enable new
opportunities to rethink street space, with the goal of moving towards communities that prioritise
pedestrians and cyclists. Autonomous vehicles can quite literally have transportation norms
programmed into their trip-planning decisions. Ideally the provisions in Article 10-A will complement measures that the MTO will enact, to encourage more efficient use of scarce road space. To this end:

1) *AV-PTC vehicles shall only be allowed to park in designated AV-PTC parking spaces.*

The City of Toronto is working to reduce parking in certain areas in order to reclaim street space for sidewalks, pocket parks, and other community amenities. With parking at a premium, the City of Toronto will not want AV-PTC vehicles and private drivers competing for the same spaces. As such, as a complement to Article 10-A the City of Toronto will establish a number of designated AV-PTC spaces throughout the city. The number of spaces will change yearly based on the number of AV-PTC vehicles in operation, and will be evaluated to ensure vehicles are parked in such a way as to allow them to reduce deadheading and limit customer wait times as much as possible.

Lowering parking spaces overall makes it less attractive to drive oneself, but offering designated AV-PTC parking spaces means AV-PTC vehicles can stay in an area to have a better response time when they are called, without circling the block—simultaneously making this mode choice more appealing and limiting congestion.

2) *AV-PTC vehicles shall be required to pay a fixed-rate congestion charge when entering the downtown during ‘peak hours’.*

Given the predominance of public transit users, pedestrians, and cyclists in the downtown core, all efforts should be made to encourage these more efficient means of transportation. While the City of Toronto is looking at different measures to encourage such use, they can discourage customers from travelling via AV-PTC inside the downtown boundary, to make it easier and safer for commuters to choose public transit, walking, and cycling.
Peaks hours will be defined as 7:00-18:00 from Monday to Friday, and 9:00-18:00 on Saturday. AV-PTCs will be required to pay this charge for every trip that either begins or ends in the downtown. AV-PTCs will only be charged once for any shared rides that begin or end in the downtown. This charge will be set bi-annually by the City of Toronto based on congestion levels over the last six months, with the City of Toronto informing all AV-PTCs of the upcoming charge on January 1st and July 1st. If the MTO enacts its own effective road-pricing scheme, the city can re-evaluate whether this charge is necessary, and remove it should they deem it redundant.

3) AV-PTCs shall incorporate the City of Toronto’s road hierarchy classification into their trip-planning algorithms.

With the exception of public laneways, every street in Toronto has been given one of five classifications (from the 2013 City of Toronto Road Classification System):

1. Local Roads: Provide access to properties with a minor role in carrying motorised traffic. Traffic volumes and speeds should be low. Over time, the City of Toronto shall move towards permitting all modes of travel throughout the right of way.
2. Collector Roads: Collect and distribute traffic between local roads and arterial roads.
3. Major and Minor Arterial Roads: Provide the major corridors for traffic (including surface transit) movement. Are also important for pedestrians and cyclists. As motor vehicle speeds and volumes are higher on these roads, special facilities such as bicycle lanes are necessary to ensure the safety of cyclists.
4. Expressways: Carry high volumes of motor vehicle traffic at relatively high speeds, with no amenities for pedestrians and cyclists.

The City of Toronto will assign a point score to each street type:
1. Expressways and Major Arterial Roads – 1 point
2. Minor Arterial Roads – 2 points
3. Collector Roads – 3 points
4. Local Roads – 4 points

Any vehicle travelling in Toronto will therefore have a ‘travel score’ for a given trip, calculated as follows:

\[ = 1 \times (\text{Expressway kilometres}) + 1 \times (\text{Major Arterial Road kilometres}) + 2 \times (\text{Minor Arterial Road kilometres}) + 3 \times (\text{Collector Road kilometres}) + 4 \times (\text{Local Road kilometres}) \]
As an example, if a vehicle travelled on Dundas Street (a Major Arterial Road) for 0.25 kilometres, then on Sherbourne Street (a Minor Arterial Road) for 0.35 kilometres, then finally on Linden Street (a Local Road) for 0.20 kilometres before arriving at its destination, its travel score would be:

\[ 1 \times (0.25) + 2 \times (0.35) + 4 \times (0.20) = 1.35 \]

The algorithms for route navigation for any AV-PTC vehicle operating on any City of Toronto road will need to be written such that any trip is within twenty per cent of the lowest travel score possible between the requested origin and destination. Effectively, as much as possible vehicles should remain on Expressways and Major Arterial Roads, only running on lower-order streets when departing from an origin point or nearing a destination.

This may add travel time to an AV-PTC journey, given that vehicles will need to travel along more congested corridors rather than taking smaller side streets; however, the purpose of the road classification system is, in part, to acknowledge the importance of different types of road users (pedestrians and cyclists, transit users, and motorists). The algorithm-based decision-making process employed by autonomous vehicles provides the City of Toronto with a unique opportunity to ensure the user hierarchy is respected. This algorithmic technology will need to be developed to ensure autonomous trucks avoid roads where trucks are prohibited, so it is not unreasonable to request AV-PTCs employ the same mechanisms in their own operations to reduce their impact on the community.

It is worth discussing why this measure employs direct regulation (limiting travel based on street characteristics) rather than a more flexible travel fee varied based on street type. As the City of Toronto notes, “a street network performs most efficiently and safely from both a traffic operations and a road safety perspective if roads [...] serve their intended purposes”. While
economic incentives are thus often appropriate—as with the downtown congestion pricing above, for example—optimising the network requires a more stringent approach. If a residential street lies between downtown and a wealthy suburb, for instance, commuters might happily pay to travel quickly between their home and office, but this impacts those who live along that stretch of road. Just as nobody is able to pay to circumvent the needs-based prioritisation that lies at the heart of the Canadian healthcare system, an efficient system and a universal right to safe local streets take priority over anyone’s willingness to pay for preferential access. Through direct regulation, Article 10-A reflects this commitment.

6.3. Expert Feedback

Throughout the period of this thesis research, the AVWG was crafting its own broad policy statements that will eventually inform future AV regulations and bylaws. As the group had not begun to develop specific legislation, there was an opportunity for this thesis research to offer a novel sample of the language these rules might take. It was therefore important to receive feedback on Article 10-A, both to offer policymakers a starting point as they develop actual regulation, and so their comments could provide future city planners with a better understanding of what can work in translating policy into practice.

This feedback was, in a word, surprising. None of the policies put forward in Article 10-A were unanimously rejected by policymakers, and in a number of cases, officials in Toronto actually suggested the legislation could be even stronger in its expectations. Both Vanessa Fletcher in the ML&S division and Ryan Lanyon in Transportation division asserted that in the future, PTCs and taxicab companies will begin to look very similar. With no drivers, both types of companies will own fleets of vehicles, and will likely use Internet platforms to enable customers to hail a ride. As such, the City of Toronto might want to amalgamate AV-PTC and
autonomous taxicab regulations. This could mean all for-hire autonomous vehicles would be able to accept a ride from a passenger on the street (currently prohibited for PTCs) and use taxi stands. When developing real AV policy, the AVWG and ML&S should consider what, if anything, would make PTCs different than taxis, and whether it makes sense to create a single by-law for all driverless for-hire vehicles.

The two Toronto policymakers liked the idea of assisting low-income Torontonians, though there was some difference of opinion as to whether a requirement that PTCs provide the concession was too onerous on the private sector. Mr. Lanyon said this was an unfair burden to place on rideshare companies, while Ms. Fletcher did not think this was so. She did point out, however, that companies would likely increase everyone’s fare to compensate for the lost revenue from the concession. This leads to a question as to whether only rideshare customers should have to pay for the subsidy for low-income travellers, or whether it would be more appropriate if the government covered that cost so it could be distributed among all citizens.

Though there was disagreement as to who should pay for low-income concessions, the Toronto officials liked the idea of integrating the Metrolinx smartcard into PTC operations to assist those of lesser means. Ms. Fletcher pointed out the city had already discussed putting PRESTO systems into taxicabs, so a move to offer this amenity for PTC trips made sense. On the equity side, Mr. Lanyon pointed out that Toronto Employment and Social Services (TESS) currently preloads debit cards to give to qualifying citizens in need, so they could similarly sign people up with a PTC account and issue them a transit smartcard with a certain sum available.

While he in general liked the idea of an emergency balance, he contended it might need to be more nuanced than the existing PRESTO feature. Where TTC pricing is fixed, PTC charges vary. Mr. Lanyon suggested it might therefore make sense to install measures that limit the
maximum emergency fare the system would provide. If someone tried to hail an AV-PTC ride through their Metrolinx smartcard that was estimated to be too much above the amount they had on their card, they might be prohibited from placing the order. It would be important to consider the implications of this to ensure nobody was (sometimes quite literally) left out in the cold without a way to get home, while also limiting the amount of money either the City of Toronto or Metrolinx would be required to cover for emergency fares. Mr. Lanyon did suggest that for qualifying low-income customers, TESS could cover any overdrafts, and if these customers did dip into too much of an emergency balance, they would need to visit TESS to have their card reissued if they did not put more funds on the card in a timely manner.

As a point to note, Uber does allow cash payments in some cities including Singapore (Brueck 2016), so it is perhaps reasonable to require all AV-PTCs to accept monetary payment, to reduce the risk a customer could be stuck if they do not have enough money on their Metrolinx smartcard. Officials would need to consider whether this would make these vehicles into attractive targets for thieves, though, and whether there are ways to limit the risk of vandalism or theft.

The sections on equity and transit integration appeared to stimulate some reflection by the policymakers on what role the TTC has to play in an autonomous future. Mr. Lanyon pointed out there is already a debate as to how the government should assist with housing: Should it provide housing directly, or should it offer vouchers so people can pay for market housing? Similarly, should the TTC provide travel services, or would it be less expensive and/or more effective for the City of Toronto to simply provide concession fares to those in need? Mr. Lanyon wondered whether the TTC might provide door-to-door trips, or contract out these services to the private sector with pricing parameters in place. This would be a TTC-branded
service similar to how buses in London, United Kingdom, operate: Private providers would bid on how much of a subsidy they would need to run the service, and the TTC could choose the most competitive proposal. In effect, the transit commission would be compensating the rideshare company for maintaining fares at a certain level.

These questions clearly revolve around what role the city decides for the TTC, and AV-PTC regulations will need to reflect the outcome. Mr. Lanyon was quite excited about the idea of a transit co-fare option, however. Currently, when transferring between the TTC and GO Transit customers enjoy a reduced rate, so there could be a measure whereby transferring from a rideshare to the public transit network would be similarly rewarded. Mr. Lanyon pointed out that if TTC stops become transfer points for people, it would generate demand at these stations. As such, the TTC could look at transforming more park-and-ride stalls into AV-PTC spaces, so when customers get off the subway at the end of the day, there would be a fleet of vehicles waiting to take them home.

On the topic of parking, while Article 10-A requires AV-PTCs to park only in designated spaces, both Ms. Fletcher and Mr. Lanyon thought this section should be filled out further. Mr. Lanyon believes the city needs to find a way to ensure these parking spots are entirely off the street. They could be provided through an arrangement with the Toronto Parking Authority or with parking garages, which in an autonomous future may be looking for new arrangements to fill their spots. While the assumption in Article 10-A was that these spots would be provided free of charge by the city, Ms. Fletcher instead thought the companies should be required to pay for this space.

Both agreed they do not want autonomous cars circulating empty on the roads. Existing regulations do not show much concern for taxis and PTCs travelling without passengers, but
given the growing recognition that PTC deadheading, in particular, is adding congestion to the streets, this must be curtailed in the future. Mr. Lanyon thought it might be reasonable to allow a certain amount of empty travel kilometres for each PTC, based on the neighbourhood where their vehicles were operating—similar to the Article 10-A proposal on minimum wait times that vary based on neighbourhood density. In the downtown, companies would be able to circulate very little without a passenger, whereas in a suburb they would have more flexibility because they would likely need to travel farther between one rider’s drop-off and their next pick-up. If the company were to go over the threshold, they would then have to pay a mileage fee.

Whether for filled or empty travel, Ms. Fletcher thought the proposed congestion charge may need provincial approval—or that at very least, there could be a risk Queen’s Park might intervene to prohibit this rule as they had done with the Don Valley Parkway and Gardiner Expressway toll initiative. Both she and Mr. Lanyon agreed that if possible, a congestion fee based on where and when vehicles were travelling was ideal, but barring that, a flat fee for circulation in the downtown is reasonable.

There were a number of sections where Ms. Fletcher thought the regulations could be quite a bit more forceful than Article 10-A proposed. She suggested that as with the proposal in Section 546-123 that all AV-PTCs must be zero-emission, it is also reasonable that all AV-PTC vehicles must be universally designed. This is even more assertive than the requirement in Article 10-A for accessibility, which stated that only companies with more than 500 vehicles had to provide wheelchair service. In contrast, Mr. Lanyon was a bit concerned about the zero-emission stipulation. Firstly, it would need to be consistent with taxis, but even still, it might be too much of a reach in overseeing PTCs. Does this requirement make sense for stopping a harm from PTC operations? While one could argue emissions from vehicles are harmful to
Toronto, Mr. Lanyon though this rule might overreach what is reasonable for a PTC bylaw—and should be a requirement imposed on all driverless vehicles by the province.

On the topic of data, Ms. Fletcher suggested that not only should AV-PTCs be required to provide their circulation data to ML&S, but that the law should state the City of Toronto will view this data set as belonging to the public. Just as TTC data is open data, she argues the city could upload AV-PTC data to their open source website for use by everyone. Ms. Fletcher initially disagreed with the road hierarchy proposal because it seemed inefficient to keep cars off empty road space, but after mulling it over came to appreciate its usefulness in maintaining a certain balance to the streets, while Mr. Lanyon also liked this provision. Both officials approved of the minimum level of service provision requirement and thought it was a very eloquent solution to this particular challenge.

Ms. Fletcher also liked the mandate that AV-PTCs could not discriminate since she said there is evidence to show taxicab and PTC drivers do unfortunately treat certain groups unfairly, but cautions the city will need to think about how they could realistically enforce such a requirement. In particular, she suggested the stipulation that AV-PTCs be prohibited from discriminating based on surge pricing against low-income customers might be a concern that would be better attended to by the Consumer Protection Bureau at the federal level, rather than in the AV-PTC legislation municipally.

Both Mr. Lanyon and Ms. Fletcher thought there were a few items missing from Article 10-A. Mr. Lanyon recommended that AV-PTCs be required to have some kind of control facilities somewhere in Toronto. If a car malfunctions and begins to ‘go rogue’, the company needs a system in place to deal with the deficiency quickly and safely. This could be difficult if the only connection the company had to the car was through a control room somewhere very far
away. There should also be a condition that cars have some kind of redundant control so that if there is a failure of the primary system there is another way to shut the vehicle down.

Ms. Fletcher thought there should be a greater safety emphasis in the article, to assuage concerns over traveller security. Some people have recommended installing cameras in PTC cars, so that would make sense for AV-PTCs. When a person enters an AV-PTC vehicle, it should be mandatory that a light turns on, and there needs to be an emergency stop and perhaps even a ‘call for help’ feature so a customer can signal if there is an issue and get out of a vehicle in an emergency situation. She pointed out that California has certain record-keeping requirements around accidents, so a similar expectation could be included in this legislation.

Regarding the style, Ms. Fletcher noted Article 10-A advocated for its policies a little too much, where actual legislation should remain more neutral: It should just state the expectations, rather than making the case for the legislation. Mr. Lanyon similarly suggested certain sections had too much detail, where they should more simply state the expectations. He also noted the regulations should avoid using SAE International levels as their criteria, and instead spell out in words what expectations were. He pointed out that SAE International might change their definitions, so being explicit would avoid having to ever alter the regulations. For instance, rather than referring to Level 3, the article could simply say, ‘Any AV-PTC that requires a human driver as a back-up must have a steering wheel’. He also suggested the article should at some point stipulate all AV-PTCs must be programmed to strictly obey all municipal bylaws. As well, the article should use the PRESTO card’s formal name rather than its brand name (assuming they are different), to ensure clarity. Overall, however, it does seem Article 10-A is a reasonable first attempt at effective AV regulations, and could inform the development of a final legislative document in the years to come.
Chapter 7: Moving Beyond the 407

While this thesis has looked at regulatory development in Toronto specifically, new rules in the Queen City will likely be most effective if complemented by strong oversight in other nearby municipalities as well as at the regional and provincial levels. As such, it is important for policymakers outside Toronto to consider what role they have to play in building strong AV legislation. Accordingly, this final chapter recommends ways Metrolinx can assist municipalities around Ontario’s capital buttress their own knowledge and become more creative when it comes to new rules for driverless cars, and outlines steps other local governments can take to confront this issue. It ends with four avenues that would be useful for future research to assist all parties with better understanding the challenges, opportunities, and limits of regulatory power.

Prior to moving beyond Toronto’s borders, however, it is worth briefly discussing the implementation phase of its regulatory operations. From the police, to the parking authority, to TESS, to ML&S, a number of divisions would have a role in ensuring rideshare companies adhere to the various measures found in Article 10-A and providing support for the integration of autonomous vehicles with existing municipal services. As with regulation development, implementation requires officials who are both willing and able to properly monitor private actors, and understand both what is and is not permissible and the tools they have to enforce requirements.

As the ones responsible for autonomous vehicle policy and licencing, respectively, the AVWG and ML&S will want to have a clear understanding of where implementation and enforcement will happen, and then work with those officials to ensure they have the knowledge and infrastructure to properly monitor private activity in the new areas of AV operations. To build support among officials to ensure their colleagues devote the time and attention to properly

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4 Highway 407 is a major road that rings around the city of Toronto.
enforcing regulations, the AVWG is already on the right track in bringing different divisions into the development process as members of the working group, and will want to be sure enforcers understand the rationale behind any new rules (Larson 2017). Finally, it will be important to determine what metrics shall be used to determine the effectiveness of a given policy and who will be responsible for gathering data and evaluating outcomes.

Moreover, the AVWG and ML&S will want to partner with Metrolinx to develop cohesive regional AV transportation integration, and perhaps even assist other local governments in thinking about driverless potential in their own jurisdictions.

7.2. A Role for Metrolinx

With driverless cars on the road today, it makes sense Toronto is devoting resources to understanding their development. Urban planner Erick Guerra points out, however, that in many municipalities autonomous vehicles factor very little into transportation and transit plans, because policymakers simply do not have the resources to grapple in any meaningful way with their impacts. They are so involved with tackling pressing issues, such as a lack of consistent funding and a changing climate, he argues, that they lack the capacity to explore the challenges and opportunities driverless cars might provide a decade or more from now.

Autonomous vehicles may revolutionise transportation, but it is understandable that planners and transit operators feel the pressure to address today’s issues rather than thinking about longer-term questions. Because transportation problems do not respect municipal boundaries though, it would be helpful if more jurisdictions around Toronto (or any other large city) began to grapple with the issues and policies outlined in this thesis. It would therefore be useful for a higher-level agency—in Ontario’s case, Metrolinx seems the appropriate choice given its current mandate to manage and integrate road and transportation in the Golden
Horseshoe region—to become a resource base for local governments to generate that knowledge more quickly and efficiently.

Firstly, they can build a resource library available to cities interested in learning more about, and partnering with, AV companies on different projects. The library would offer reading materials on the current knowledge regarding AV technology, modelling, by-laws enacted elsewhere, and other useful research. David Block-Schachter argues that in many smaller cities, when a policymaker is tasked with learning more about a particular subject, their first step is to sift through Google search results. This library would therefore allow them to move more quickly beyond the knowledge-building stage, as they will not need to spend time searching for useful materials themselves.

The documents provided by Metrolinx would not need to be limited to information about autonomous vehicles alone. Given the role public-private partnerships (P-3s) may play in AV growth, the agency can supply information about how to properly assess whether a P-3 is advantageous. As economist John Loxley (2011) argues, public agencies often lack the legal know-how to protect themselves from cost overruns or other shortcomings that might arise when contracting a service to the private sector. Even large cities struggle to sign contracts that protect the public interest, as evidenced by the Chicago parking metre agreement. Loxley therefore outlines ten questions a government should ask before signing a contract, a number of which are relevant to AV partnerships including:

- Will the municipality be responsible for guaranteeing the private sector’s revenues, and who will be liable for cost over-runs or project deficiencies;
- Does the municipality have the capacity and resources to properly evaluate, administer, and monitor a contract of the length, scale, and complexity of the P-3;
- Does the P-3 permit the municipality the flexibility to make future changes in service delivery or other public policy decisions, to end the P-3 in the procurement stage, and terminate the contract if it is not meeting the public interest; and
• What are the prospects of small- and medium-sized local businesses bidding on the project?

To protect municipalities and encourage healthy public-private collaboration, Metrolinx could be charged with developing a set of guidelines around autonomous partnerships that incorporates these questions, techniques to evaluate a potential contract, and guidance as to what legal rights cities have in drawing up an agreement. This would be appropriate given not only the complex nature of P-3 contracts, but of the very technology under discussion itself. What is a fair price to charge for a service? What is a reasonable expectation around service standards?

In Massachusetts, Daniel Sullivan points out the state department of transportation has developed the outline for a Memorandum of Understanding that municipalities can use when in talks with companies, so Metrolinx could similarly design sample memorandums and offer examples of strong contract language cities can use to inform their decisions at the bargaining table. Moreover, it could provide a platform through which municipalities would be able to share insights and perspectives on autonomous development. It will ultimately be up to the cities themselves to decide whether a given relationship makes sense, or even whether it would be best to develop the in-house capacity to trial a certain autonomous service, but Metrolinx can offer the tools to better understand and implement what could become very complex contracts.

Secondly, Metrolinx can convene an advisory board of experts from Toronto’s AVWG; academia; and perhaps other interested and knowledgeable parties (such as lawyers), provided they can remain impartial. This ‘Ontario Autonomous Vehicle Council’ (OAVC) could offer insights into the state of technology, policy, and planning surrounding autonomous vehicles, to help answer some of the questions around what is reasonable for both regulation and P-3 negotiations. They could even review and advise on proposals brought forward by local Ontario governments embarking on their own AV initiatives.
Massachusetts has its own AVWG comprised of the secretary of public safety, the secretary of housing and economic development, the registrar of motor vehicles, the highway administrator of the Massachusetts Department of Transportation, and a number of political appointees. Ontario could have a similar, and expanded, council. As MIT Professor Jinhua Zhao points out, in China academic councils are used frequently to provide the government with impartial advice. While ultimately it will be up to an administration to make its own decision, Metrolinx’s convening power could make this resource of experts available when it would be impossible for any one local government to do so on its own.

If a jurisdiction expresses an interest in testing a pilot project, Metrolinx could help them consider new tests that are not already underway elsewhere in the province. Once again the final decision to establish a trial would remain with the local authority, but Metrolinx would encourage the development of a more connected testing network where the results gleaned from one test are provided to the advisory councilmembers, who can harvest insights and propose follow-up trials other municipalities might try.

Finally, Metrolinx can share physical tools with municipalities that may otherwise not have an opportunity to acquire them themselves. Ryan Lanyon in Toronto points out that the AVWG has come to recognise there are a great many factors governments need to consider beyond congestion, safety, and transit integration. How should firefighters and police officers respond to a fire or accident in an autonomous vehicle—are there any flammable components they need to be aware of? Metrolinx could provide vehicles and informed officers who can visit each municipality and offer training to local emergency services crews. Since the province is the one permitting driverless vehicles on the roads, and these can travel to any city or small town in
Ontario, they should be responsible for ensuring local crews can respond properly should there ever be a distress situation.

The purpose of establishing the library and council would be to empower local governments that, knowing they have such support, might be more willing to explore driverless technology initiatives. This would offer many more testing centres, rather than leaving only the largest centres like Toronto, Ottawa, and Mississauga as the only municipalities willing to test driverless projects, as they are the only ones that can devote ample resources to this file.

If there is one city in Ontario (and Canada) that is able to act independently in building a knowledge base around autonomous technology, it is likely Toronto. That said, the country’s largest city is home to just 2.7 million of the 9.24 million residents of the Golden Horseshoe, and transportation considerations do not respect municipal borders. If other cities can have more meaningful policy conversations and take on initiatives around autonomous vehicles, it would likely prove helpful for Toronto by better integrating transportation networks and platforms.

Suburban residents might begin to understand mobility as a service, for example, which could lessen congestion and commute times into the large job centres inside the city. It could also make it somewhat more palatable to accept congestion charges in the future. As such, the city might consider approaching Metrolinx with an offer to share resources between the AVWG and the OAVC, and to provide leading planners from the AVWG who can sit on the new council.

7.2. Developing Local Capacity

Through many interviews, there was an underlying theme of overworked city employees struggling to negotiate—whether to sign a contract or develop new regulations—with large and well-resourced corporations. Certainly, seeking ways the public sector can be more effective when dealing with private counterparts would be helpful for all government employees looking
to advance the public interest, but when dealing with a new and dynamic industry like autonomous technology the need is even more important. While a full exploration of how city departments can maximise their human resources is beyond the scope of this thesis, there are a few points worth discussing.

Studies such as Kirby et al. (2002) and Alonso-Almeida (2015) have found proactive thinking improves performance and operations. Where officials in Pittsburgh note they were reactionary in their approach with Uber, future staff members, in larger cities especially, will want to begin preparing now for when autonomous vehicles hit their local roads. As Freemark and Zhao (2017) and Guerra (2015) have found, most of the biggest cities in North America do not even mention driverless cars in their official plans, as this technology is not on their radar. Even the plans that do mention these vehicles “use language that prioritizes “innovation” and “flexibility” rather than concrete regulatory strategies. The Go Boston 2030 plan, for example, recommends an AV policy with “an initial focus on the testing of new technology,” leading to “generating best practices,” but little specificity” (Freemark and Zhao 2017).

While it is true this technology is still very new, AV expansion can either risk or advance many of the most important goals local governments consistently champion in their official plans such as equity, efficiency, liveability, and environmental sustainability (Freemark and Zhao 2017). According to the National Conference of State Legislatures, as of September 2017 a full half of all US states had an executive order or legislation allowing autonomous vehicles on the roads, and large cities have thus far proven to be some of the most popular places to test this technology. It is thus in the local governments’ best interest to have regulations in place prior to arrival so that city halls are, as much as possible, steering future AV growth in a positive direction.
Establishing an AVWG as Toronto has done would be a helpful starting point for municipalities going forward. Ryan Lanyon states he and former Transportation Division Head Steve Buckley launched the working group out of a recognition that AV growth was not just a transportation issue, but one that will impact many facets of urban life. The purpose of the AVWG, according to Stephanie Simard at the TTC, is to move beyond the surface-level discussion around autonomy and build a deeper understanding of its many impacts, then collaborate on building solutions to recognised problems. By soliciting the expertise of the group, Lanyon argues, they have been able to “ask better questions” that will help inform and develop future policy. In speaking with emergency services, for example, they came to realise the city would need regulations around how an autonomous car calls for help in case of an accident, and information from car manufacturers on the flammability of various AV components.

The multi-division makeup of group brings a more holistic knowledge to the table, which is helpful for determining how best to intervene when it comes to autonomy. As was evident in interviews, policymakers working in the government do not necessarily know the specific legal authority that allows their government to impose certain requirements on private actors. Toronto officials, for instance, did not all know how the city is able to prohibit trucks from circulating on certain roads.5 By soliciting the expertise of a body of experts from different departments, a city’s AV working group can generate a list of all the tools at their disposal and think more holistically about how to regulate driverless cars.

Having a group that meets regularly also helps with proactivity. Had Pittsburgh staff members been more prepared, they could have mapped out an understanding of what they

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5 Nazzareno Capano, the city’s manager of transportation policy and planning, confirmed the city has this authority under the Highway Traffic Act (HTA), based on the weight of the vehicle; the government can prohibit ‘heavy trucks’ (defined in the HTA) from circulating on some roads.
expected of an AV partnership and how they could achieve that goal. Such strategic planning—
“examining the organisation’s current situation and future trajectory, setting goals, developing a
strategy to achieve those goals, and measuring the results” (Osborne 1993)—is happening with
greater frequency in government. Boston’s Smart City Playbook is an example of a pre-emptive
message to private partners, letting them know what the city is looking for before they come
calling. It articulates six broad key points—‘stop sending sales people’, ‘solve real problems for
real people’, and offer ways to make ‘better decisions, not just better data’.

A city’s AVWG can similarly offer a few main points to private actors, which will vet
companies before they approach the city government. These can be based on the AVWG’s
policy priorities, but selected and laid out in a language that speak to corporations and illustrates
that the City is eager to hear new ideas, but ones that advance its interests. Acting in a proactive
manner would also allow the working group to acknowledge that sometimes it is acceptable to
bypass an opportunity to talk about a partnership when the government has a relatively weak
hand or is unprepared. Furthermore, if regional actors could reinforce these local efforts by
providing additional resources and support, it could lead to an outsized impact as cities work to
establish new regulations.

Finally, a new AVWG can reflect on how best to capture the attention of upper levels of
government to convince them to take local concerns seriously. This effectively means city
officials will likely need to be lobbyists for their own agenda, which is not an easy task. As
negotiations expert Professor Brian Mandell at the Harvard Kennedy School notes, it will mean
thinking about how to link the city’s agenda with the interests of those in power at higher levels
of government. Furthermore, it may mean building coalitions—as has been recommended
above—to strengthen a local administration’s influence when negotiating with their counterparts.
Already, according to Mayor Peduto’s staff, the City of Pittsburgh is reaching out to establish an alliance to ward off pre-emption and give municipalities more local control when it comes to autonomous vehicles, and other cities can similarly consider partnerships.

7.3. Final Reflections and Future Research Directions

Article 10-A is meant to be the beginning of a conversation around effective AV regulation in Toronto, rather than the final say on that objective. Already as part of the process of garnering feedback on the proposal, I have recognised other aspects worth incorporating. Professor Jinhua Zhao at MIT suggests the article should require companies to disclose their total effective vehicle occupancy: The number of individual passenger kilometres travelled divided by the total number of fleet kilometres travelled. As noted in chapter six, policymakers require more concrete data before they can propose the quantitative requirements of their regulation, and total effective vehicle occupancy will help them understand what impact AV-PTCs are having on congestion in order to inform the requirements. If the city does determine AV-PTCs are having too significant an impact, they could allot each company with a certain number of un-tolled vehicle kilometres, with any company that surpasses their allowance required to pay an additional fee. This will discourage empty circulation and promote ridesharing, as presumably the cost will be split amongst all passengers in the vehicle.

Given the current uncertainty over the impact AV-PTCs might have, it is worth considering whether Article 10-A can incorporate some kind of flexibility, so city officials would not need to return to the council floor to modify certain quantitative parameters should they prove either insufficient or unduly burdensome on operators. Could the regulations be written, for instance, committing to a certain principle, but stating the numeric requirements might vary by twenty per cent in either direction based on new information provided to policymakers? Such
an approach might streamline decision-making and allow officials to respond to new understandings in order to maximise the positive impact of the regulation.

Building on the findings of the last two chapters, a worthwhile exercise would be to look at other large cities and conduct the same process that was undertaken in Toronto for this thesis research: Look at the powers the local government has, and the structure of its bureaucracy, and propose a means by which officials can establish new AV regulation. Beyond such an undertaking, this final section provides four research questions that are logical future areas of inquiry that extend from the research in this thesis.

1) When both vehicles are autonomous, what is the difference between a taxicab and a PTC car; moreover, what is a public transit agency’s role in the future transportation ecosystem?

Given Ryan Lanyon and Vanessa Fletcher’s reaction to Article 10-A, it is important to reflect on what future differences between taxis and rideshare companies, and whether it is appropriate to regulate them separately. The assumption is both types of businesses will own their own fleets of vehicles and will want to use Internet platforms to allow customers to hire a car. Taxi companies will likely want to maintain a monopoly on street-side ride-hailing, but is that an artificial distinction made by the government? Research on this topic could investigate what differences, if any, PTC and taxi companies believe there will be between them. Provided it is appropriate to amalgamate the two, this research could consider a strategy that would be least disruptive to for-hire services.

Understanding the differences would be part of a move to either align the various vehicle-for-hire articles, or do away with some altogether, as they are deemed obsolete. Whether they are aligned or left to stand on their own, as much as possible vehicle-for-hire regulations should be uniform across the different operational categories, so future research can determine what from Article 10-A can be transferred backwards to Article 10 and the limousine and taxicab
regulations. Obviously some criteria—such as those related to human drivers—will never be aligned, but as much as possible, the City of Toronto will want to align their legislation so as not to disadvantage any segment of the market.

Moreover, where does the TTC fit into these various operations? Could the TTC purchase its own fleet of driverless vehicles to operate alongside its high-capacity corridors? These could perhaps be used for on-demand point-to-point service on off-peak hours, and pre-ordered point-to-point service taking a customer to or from a transit station during the peak periods. Does it make sense for a public transit agency to compete with the private sector in this manner, and if so, where would they want to provide a directly competitive service, and where (if anywhere) would they leave a specific portion of the market solely to the private sector, offering complementary services elsewhere? Understanding how public transit services will be different and where public and private offerings can or will begin to converge will be critical for determining how agencies like the TTC and Metrolinx can best invest in infrastructure in the years to come.

2) What are the differences in PTC legislation across provinces and states in Canada and the United States?

Most states and a number of provinces have state or provincial PTC regulation, but this legislation is not uniform across all jurisdictions. Some states and provinces have granted cities the right to regulate certain aspects of PTC activities. In a handful of brief interviews with a few transportation officials in Texas and New Mexico, however, in at least some places there appears to be strong uncertainty as to what local governments can and cannot do—leading to at least some policymakers choosing to do nothing at all. If researchers are able to conduct a document analysis on states and provinces’ PTC regulations to clarify what powers (if any) cities have and where powers are similar or different across jurisdictions, that could be the first step in
recommending ways cities can influence autonomous development to address the challenges of the modern transportation system.

From there, local governments can look at what tools they have at their disposal to enact specific rules. Even if they cannot regulate PTCs, perhaps they can use the same powers that allow them to establish truck routes, for instance, to influence AV-PTC circulation. They might even be able to set up a stand-alone AV bylaw that would apply to all autonomous vehicles, depending on local division of powers. If policymakers are not able to undertake such research themselves due to a lack of resources, an academic nudge can set them down the path towards using the powers at their disposal most effectively.

3) What do different policymakers view as a reasonable level of expectation to place on private actors, and how might they react to these responsibilities?

The proposed Article 10-A requires a number of concessions from AV-PTCs, and at least some policymakers suggest these could be made even stronger. It will be important for public officials to fully understand what the implications of this mandate will be, how companies will react, and when the burden might become unreasonable due to a changing operational environment. Researchers can speak to rideshare staff to learn which companies see which provisions in Article 10-A as acceptable or problematic (and the level of concern they have), explore case studies of similar regulatory expectations from the transportation sector and elsewhere, and conduct cost projection studies to help regulators make decisions about what they deem reasonable when it comes to preconditions for the privilege to operate in Toronto.

Article 10-A, for example, requires AV-PTCs to allow customers to order a ride using a computer and a regular phone. Unsurprisingly, it does not similarly expect them to offer a platform for a telegraph or fax machine, because these technologies are clearly obsolete. At what point, therefore, will it equally be unreasonable to do away with the expectation that a customer
can order a ride with an unconnected telephone? Currently, estimates suggest almost one quarter of all North American adults do not have access to a smartphone (Smith 2017), which is why Article 10-A mandates other options for ordering a ride. As this number shrinks, the return on investment for setting up alternative ordering platforms will similarly decline. At what point does it become unreasonable to demand such a cost from private operators? How can regulations and/or other government intervention ensure those who still do not have access to a smartphone are able to travel without difficulty?

The transportation sector might be able to itself provide case studies and precedent on this issue, in particular as regards the use of smartcards versus cash to pay for public transit rides. London, UK, for instance, did away with accepting cash payment on its buses, and Boston is planning to follow suit in the next few years. Are there lessons from these and other initiatives to improve overall service and lower cost, without harming low-income populations who are less likely to have a travel smartcard that researchers can apply to the smartphone dilemma?

Moreover, what is the difference between making transit agency data available to the public versus doing the same for rideshare company information. Citizens own their transit agencies either through the city government or as arms-length enterprises. It accordingly makes sense transit agencies would make their data available to the public. Private AV-PTCs, on the other hand, do not owe anything to the general public so it might not be appropriate to make their data available. In fact, if competitors learn their pricing schedules, most successful pickup locations, and other key information, they could use this to push back against their rivals. Policymakers might ultimately determine the benefits of the requirement outweigh the possible risk, but it is important to properly assess these ramifications prior to enacting a new article.
Finally, Article 10-A stipulates AV-PTCs must provide a discount for qualifying low-income customers. This measure was proposed because for the first time, there are no drivers who might lose out on lower-fare passengers, and given the overall substantial market in Toronto, it was deemed reasonable to expect rideshare companies assist with the advancement of equity goals by providing a small concession for those who need it most. One issue with this approach, however, is that companies will know automatically which customers are low-income, and while the article does explicitly prohibit them from discriminating based on this knowledge, it might nevertheless be most appropriate to find an alternative solution so the companies do not need to find out who among their passengers is low-income.

Furthermore, Vanessa Fletcher pointed out the likely result of the concession condition is that companies will raise their prices across all riders to cover this cost. Is it reasonable that only AV-PTC customers subsidise the cost of low-income riders, or should this expense be spread across Toronto’s entire population? If the latter is the optimal choice, then the government should be the one to subsidise their rides, with funds raised through broader taxation. As Ryan Lanyon notes, TESS already provides pre-loaded debit cards to qualifying residents, so they could also potentially manage a system meant to lower the cost of their rides. By further thinking through the implications of the proposed measures, the City of Toronto can begin to understand the limits it deems reasonable for those companies looking to operate under their jurisdiction.

4) What is the best way to build a coalition of cities interested in AV regulation?

As discussed in chapter four, there is a role for a coalition or a few coalitions of cities to play in developing effective AV legislation. Future research can therefore explore some of the details of how this might look. Should it be policymakers in one city convening a gathering of their counterparts, or would it be better received if an outside third party called and facilitated the
meeting? How should individual representatives from the different cities be selected, and what is the optimal structure and agenda for advancing their goals? What is realistic to expect the coalition to accomplish, and in what kind of timeline? Larger cities can be champions for strong policy to assist smaller municipalities; could this AV coalition become the vehicle through which that championship takes place? How can the coalition have its interests heard by provincial, state, and federal officials as well as rideshare companies themselves?

With autonomous vehicles being so new and everyone still uncertain as to how they might develop and what the impacts shall be, interviews for this thesis suggested there is a willingness among civil servants to consider novel ideas for preparing and controlling this development. There is therefore an opportunity to gather a willing group of city leaders together should one be able to propose a clear value-adding service. Understanding how to design such a service is an ambitious undertaking, but could also be one of the most powerful and valuable initiatives a researcher could take to advance the cause of liveable, equitable, and efficient cities through the power of autonomous vehicles.
Appendix A: Sample Interview Guide

James Perttula, Director (Transit and Transportation Planning), City Planning Division

Opening: Introduce myself and the general goals of the research.

1. Explain the basic overview of the study:
   a. Overview:
      i. I am an MCP student; I am conducting this study as part of my thesis research to understand how cities can craft a contract with AV companies.
   b. Why I am conducting these interviews.
   c. Who I am interviewing.
   d. What I am hoping to get out of this process.

2. Ask for consent. I am providing you a consent sheet, and I am reviewing it quickly.
   a. I’d like to remind you quickly that:
      i. The interview is voluntary; You do not have to answer any question you are uncomfortable with, and you can stop the interview at any time if you’d like, though I don’t think you’ll need to.
   b. Are you willing to be recorded during the interview?
   c. What information are you willing to have included as part of the study, if I publish anything?
      i. Name, Title, Direct Quotes.

Getting to know the person and their relationship with AVs

1. Can you give me a bit of a background:
   a. What role do you play at the City Planning division?
   b. Has your department been looking at AVs? For how long?

The City of Toronto (CoT)’s major planning goals and alignment with AVs

1) What are Toronto’s major planning objectives?
   a) What is the strategy for achieving those objectives?
   b) What do you see as the major barriers that will make achieving those objectives more difficult?

2) Has your agency thought much about AVs and the impact they might have?
   a) What possible benefits does your agency think AVs can bring?
   b) What are the risks to allowing AVs?

3) How do AVs align with the CoT’s existing transportation goals?
   a) How do you see AVs integrating with the public and active transportation networks?

Regulatory framework and AV regulation
1) From your perspective, what are some key tools the city needs to be able to regulate urban development effectively?

2) Is your agency taking any steps to encourage positive AV expansion? If so, what are they?

3) What regulatory power does the municipal government have on this issue?
   a) Is the CoT reaching out to other levels of government to provide a coordinated approach to AV development—given the widespread impact they might have?
   b) Are the various relevant agencies—Metrolinx, the city planning department, Toronto Transit Commission, etc—working together on coordinated policies for development?
   c) What other tools do you wish you had to more effectively address the challenges of AV activity?

Partnership with Uber

1) Do you believe having Uber test its vehicles in Toronto is a good idea?

2) Do you think there should be a specific contract with Uber, or is this something better left to regulation?

3) Assuming there is a place for a contract, do you see a way that certain trial regulations could be incorporated into a contract with Uber in order to test drive these rules—to see whether they make sense for more widespread rollout in the future?

4) What are the ‘red lines’ in your mind regarding a contract with Uber; that is, what are some items/objectives that absolutely MUST be a part of the contract, otherwise Uber should not be allowed to test?
   a. What are other high priorities that should be included in the contract?
   b. What are offers you believe the negotiating team could make to Uber in exchange for your high priorities?
Appendix B: Toronto Municipal Code, Chapter 546, Licensing of Vehicles-for-Hire

ARTICLE 10
Private Transportation Companies (pp. 546-64 to 546-74)

§ 546-110. General requirements.

A. A PTC shall only permit passengers requesting transportation to submit a request for transportation through a software application.

B. A PTC shall not permit, encourage, or condone the acceptance of hails or the solicitation of passengers by PTC drivers, whether on the street or at a cabstand or in any other manner or at any other location.

C. No PTC shall impose a mandatory arbitration clause on individuals accepting or making requests for service or require that the law of any jurisdiction other than Ontario be applied in relation to use of the PTC platform in Toronto. To the extent that clauses contrary to this requirement are included in any PTC agreement with individuals using its services in Toronto, such clauses are unenforceable.

§ 546-111. Application requirements and licence renewal process.

A. To apply for a PTC licence, a PTC shall submit to ML&S a licence application, in a form prescribed by the Executive Director, together with all applicable fees and in compliance with § 546-3.

B. The application submitted by an applicant for a PTC licence shall be in the form prescribed by the Executive Director and require the PTC to provide:

1. The PTC's registered business address in the Province of Ontario;
2. The name, telephone, and email contact information for the person authorized to receive and respond on behalf of the PTC to any and all communications from the City relating to the PTC's licence or the PTC's conduct of the business;
3. An indemnity in favour of the City of Toronto from and against claims, demands, losses, costs, damages, actions, suits, or proceedings that arise out of, or are attributable to, the PTC's business and services, which shall be in a form satisfactory to the City;
4. A copy of the PTC identifier that the PTC is submitting for approval by the Executive Director;
5. A copy of the PTC's certificates of insurance, as required by § 546-114; and
6. Information sufficient to describe or demonstrate:
   a. Where applicable, the legal relationship between any persons that, acting together, carry on the business of a PTC;
   b. That the PTC will have the ability to maintain and deliver data in the form and manner, and with the frequency, required by this chapter;
   c. That the PTC has data security measures in place to protect the personal data collected by the PTC relating to passengers and drivers;
   d. That the PTC has appropriate agreements, contracts and/or processes in place to screen the criminal and driving histories of drivers providing transportation to passengers through the PTC's platform;
e. That the PTC maintains records as required by this chapter for each driver that has contracted with it to provide services through the PTC's platform and can provide regular daily or weekly updates to ML&S of this information, as required by the Executive Director; and

f. That the PTC maintains and can produce, in the form and with the frequency required, to ML&S or police, all data or records maintained in accordance with the requirements of this chapter.

C. When a PTC licence is issued by ML&S, the PTC shall be on probation for six months from the date of the new licence issuance. During this 6 month probationary period, ML&S may:

1. Conduct random audits or investigations to evaluate compliance with this chapter; and
2. Suspend or place conditions upon the licence, without a hearing, for up to 14 days, if the Executive Director has reasonable grounds to believe that the continued operation of the business poses an immediate danger to health or safety of any person or to property.

D. To renew a PTC licence, an applicant shall complete a licence renewal application, in a form approved by the Executive Director and in compliance with § 546-3.

1. When submitting a licence renewal application, an applicant shall provide documentation sufficient to satisfy the Executive Director that the applicant has met, and will continue to meet, the PTC licence requirements applicable as at the date of the licence renewal application.
2. At the time that a PTC submits a licence renewal application, the PTC shall be up to date in the payment of all applicable annual PTC driver and trip fees charged or collectible for periods prior to the renewal date under Chapter 441, Appendix C - Schedule 12, Municipal Licensing and Standards. [Amended 2016-07-15 by By-law 750-2016]

E. A PTC shall ensure that the mailing address, e-mail address, and phone number provided to ML&S in the licence application or renewal process is up to date at all times. Any written communication to the PTC by ML&S shall be deemed received by the PTC when delivered to the mailing address or email address on file.

§ 546-112. PTC driver requirements.⁶

A. Every driver affiliated with or providing transportation services in Toronto through a PTC shall hold a valid PTC driver's licence issued by ML&S before providing transportation to passengers.

1. To meet the qualifications for a PTC driver's licence, the PTC driver shall be affiliated or registered with a PTC.
2. If a PTC driver does not meet, or ceases at any point to meet, the qualifications for a PTC driver's licence, a PTC shall immediately suspend or terminate the PTC driver's account and his or her ability to provide transportation commencing in Toronto to passengers, and advise ML&S of the suspension or termination. The individual's PTC driver's licence shall be deemed suspended for the entirety of the

⁶ Yellow highlights identify the sections that can be used as precedent to enact the policies recommended by Freemark and Zhao (2017).
period that the PTC driver's account is suspended. The PTC driver's licence shall be terminated if the PTC's driver's account is terminated.

3. If a PTC driver's provincial driver's licence is suspended or revoked, the individual's PTC driver's licence shall be deemed suspended for the entirety of the period that the individual's provincial driver's licence is suspended or revoked and the PTC shall immediately suspend or terminate the PTC driver's account for the entirety of the period that the individual's provincial driver's licence is suspended or revoked.

B. A PTC shall not permit any individual to provide transportation services through the PTC to any passenger travelling from any location in Toronto unless the individual

1. Holds a current PTC driver's licence issued by ML&S;
2. Meets the screening criteria, which shall be evaluated by the PTC at least annually in respect of each PTC driver;
3. Has confirmed that they are the owner of the PTC vehicle to be used to offer transportation through the PTC, or provided confirmation that the PTC vehicle owner understands that they are also legally responsible for any contraventions of this chapter or any other applicable law when the PTC vehicle is being operated to provide transportation through the PTC platform;
4. Has provided confirmation that the insurance company insuring the vehicle they will be operating has been advised that they offer or intend to offer transportation through a PTC;
5. Has been advised that information about them may be requested by ML&S or police for the purpose of auditing compliance with this chapter, investigating complaints, investigating potential breaches of the law, or general law enforcement purposes;
6. Has consented to the disclosure by ML&S of information about them to the PTC, which may include information relating to the current or pending offences or their driving record, among other things; and
7. Has consented to the disclosure to ML&S and/or law enforcement of information provided by them to the PTC and of information about them and the transportation services they have provided.

C. A PTC driver shall:

1. Be affiliated or registered with a PTC;
2. Be at least 18 years of age;
3. Hold an unrestricted Class G, or higher, Ontario driver's licence;
4. Have at least one year of driving history; and
5. Be able to communicate in English.

D. An application for a PTC driver's licence shall be made through the PTC with which the individual seeking to be a PTC driver is to be affiliated.

E. On behalf of an individual applicant for a PTC driver's licence, the PTC with which the individual applicant is to be affiliated shall provide the following information, which shall be submitted in an electronic format satisfactory to the Executive Director:

1. The name of the PTC submitting the application and with which the applicant is registered or affiliated;
2. The applicant's full name;
3. Complete information relating to the applicant's unrestricted Class G, or higher, Ontario driver's licence;
4. A criminal reference check;
5. A driving record abstract;
6. A certificate of insurance for the PTC vehicle the applicant will be operating confirming that insurance sufficient to satisfy the requirements of this chapter is in place;
7. The licence plate number, vehicle identification number, make, model, and model year of the PTC vehicle that the applicant will be driving when providing transportation to passengers making a request through the PTC platform;
8. The annual PTC driver fee required to be paid under Chapter 441, Appendix C - Schedule 12, Municipal Licensing and Standards; and [Amended 2016-07-15 by By-law 750-2016]
9. Such other information as required by the Executive Director.

F. To renew a PTC driver's licence, a PTC shall provide the same information as is required at that date for the initial issuance of a PTC driver's licence, which information shall be submitted in a form satisfactory to the Executive Director, together with all applicable fees.

G. PTC drivers shall only provide transportation services in response to requests for service received through a licensed PTC and via the PTC's software application.

H. PTC drivers shall not pick up passengers at a cabstand or in response to a street hail.
I. PTC drivers shall not solicit rides in any manner.
J. No PTC vehicle owner shall permit his or her vehicle to be operated in contravention of Subsections G, H or I. [Amended 2016-10-07 by By-law 974-2016]
K. PTC drivers shall carry and, upon request, produce to ML&S:
   1. Their Ontario driver's licence;
   2. Their PTC driver's licence issued by ML&S;
   3. Proof of applicable insurance;
   4. A copy of the most recent mechanical safety inspection certificate issued for the PTC vehicle; and
   5. Evidence of a trip in progress or the last completed trip.

§ 546-113. PTC vehicle requirements.
[Amended 2016-10-07 by By-law 974-2016]

A. No PTC or PTC driver shall operate or permit the operation of a PTC vehicle unless that vehicle:
   1. Has four doors;
   2. Has a maximum seating capacity of seven passengers, plus the driver;
   3. Is no more than seven model years old;
   4. Displays a PTC Identifier in a location approved by the Executive Director at all times when the vehicle is available to provide or is providing transportation to passengers;
   5. Is equipped with snow tires or all-weather tires from December 1 to April 30; and
   6. Has no roof light or markings that have the effect of making the vehicle look like a taxicab or identify it to any person as being available for hire.
§ 546-114. Insurance requirements.

A. Policy of insurance; certificate

1. A PTC shall ensure that each PTC vehicle affiliated or registered with it is insured under a policy of automobile insurance for $2,000,000 (exclusive of interest and costs) or more to provide coverage for:
   a. Loss or damage resulting from bodily injury to or the death of one or more persons;
   b. Loss or damage to property resulting from an accident; and
   c. Third-party liability.

2. The PTC shall deposit a certificate of any applicable automobile insurance policy with ML&S.

3. Any applicable automobile insurance policy shall be endorsed to give ML&S at least 30 days' prior notice in writing of any cancellation, expiration or variation in the amount of the policy.

B. For each trip, the applicable automobile insurance policy for a PTC vehicle shall provide coverage from and including the point in time that a request for transportation is accepted by a PTC driver and until the PTC driver has completed the trip.

C. The applicable automobile insurance policy for the PTC vehicle shall identify the PTC driver using that PTC vehicle as a named insured or, in the alternative, the PTC shall have an automobile liability insurance policy in place that provides at least equivalent insurance coverage that meets or exceeds all of the insurance requirements for PTC Vehicles required for this by-law.

D. When the PTC has an automobile insurance policy in place to satisfy the insurance requirements of this chapter, the PTC shall provide a certificate of the policy to ML&S.

E. Where the PTC requires PTC drivers to have individual automobile insurance policies in place to satisfy the insurance requirements of this chapter, the PTC shall retain on file a certificate of each PTC driver's policy and produce it to ML&S or a police officer upon request.

F. A PTC shall have commercial general liability business insurance coverage of at least $5,000,000.

G. The insurance policy referred to in Subsection F shall contain a term or endorsement requiring that ML&S shall receive at least 30 days prior notice in writing from the insurer of any cancellation, expiration or variation in the amount of the policy.

H. ML&S may immediately suspend the licence of a PTC and PTC driver, without a hearing, if a PTC or PTC driver fails to comply with any or all of the insurance requirements of this chapter at any time, until the automobile liability insurance or commercial general liability insurance policy, as applicable, is reinstated or renewed or an equivalent replacement insurance policy is in place.

§ 546-115. PTC Fares.

A. For each trip, a PTC shall charge a minimum fare of $3.25.

B. For each trip, a PTC shall remit to ML&S the PTC trip fee charged under Chapter 441, Appendix C - Schedule 12, Municipal Licensing and Standards. [Amended 2016-07-15 by By-law 750-2016] [Note: Please see fee schedule below]

C. A PTC shall, prior to the start of a trip, clearly communicate to each passenger:
   1. The rate to be charged;
2. The provincial licence plate, make, and model of the PTC vehicle providing transportation to the passenger;
3. The first name of the PTC driver providing transportation to the passenger; and
4. Upon request, a photo of the PTC driver providing transportation to the passenger.

D. A PTC shall ensure a record is maintained confirming that the passenger accepted the rate prior to the start of the trip.

E. The PTC driver and PTC vehicle identified by the PTC to the passenger immediately prior to the commencement of the trip shall be the PTC driver and PTC vehicle that provide the transportation.

F. At the conclusion of every trip, a PTC shall provide a receipt to the passenger. A receipt may be in an electronic or paper format and shall include information on:
   1. All rates, fees and/or surcharges charged for the trip;
   2. Total fare amount paid;
   3. Date and time of trip;
   4. Location at which the passenger was picked up and location to which the passenger was driven;
   5. Driver first name and provincial licence plate number;
   6. The driver's City-issued PTC driver licence number; and
   7. Total time and distance of trip.

§ 546-116. PTC record keeping requirements.

A. Unless otherwise specified or approved, all information provided by a PTC to ML&S shall be provided electronically and in a format prescribed or approved by the Executive Director.

B. With respect to every driver operating or affiliated with it and providing transportation that commences in Toronto, a PTC shall maintain:
   1. A copy of any criminal reference checks and driving record abstracts for that driver; and
   2. A record of the issuance of the PTC driver's licence for that individual.

C. A PTC shall maintain business records that include, at a minimum, the following information in relation to transportation commencing or terminating in Toronto:
   1. For trips involving one passenger or one fare:
      a. Pick up location and the destination (by reference to the intersection);
      b. Date and time the trip started and terminated; and
      c. Length of time elapsing between the passenger's service request and start of the trip.
   2. For trips involving more than one passenger or for which multiple fares were charged:
      a. Total number of passengers paying separate fares;
      b. Pick up location(s) and destination(s) (by reference to the intersection) for each trip;
      c. Dates and times the trips started and terminated;
      d. Length of time that elapsed between the time the passenger(s) requested service and the trip started for each passenger;
      e. The fare(s) paid for the trip; and
      f. Number of trips involving multiple passengers paying separate fares.
D. A PTC shall maintain business records that include, at a minimum, the following information in relation to transportation requested in Toronto that was not provided due to the cancellation or rejection of the request:
   1. The PTC driver name and City-issued PTC driver identification number:
   2. Pick-up location and, if provided, destination (by reference to the intersection); and
   3. Date and time the trip was requested.

E. A PTC shall maintain records that include, at a minimum, the following information in relation to PTC drivers and PTC Vehicles providing transportation commencing in Toronto:
   1. Information provided by the PTC to passengers in their receipt;
   2. PTC driver name, PTC vehicle licence plate number, and municipal PTC driver licence identification number;
   3. Type of service provided, if the PTC offers different categories or tiers of service;
   4. Total time (measured in hours and minutes for each calendar day) that the PTC driver was available to provide transportation services through the Platform; and
   5. Total time (measured in hours and minutes for each calendar day) that the PTC driver was available to provide transportation services through the Platform categorized according to the following:
      a. Period 1: total time a PTC driver had activated or was logged into a PTC Platform and available to receive or accept requests to provide passenger transportation service;
      b. Period 2: total time elapsing between the time a passenger request for transportation is accepted by a PTC driver and the arrival of the PTC driver at the passenger’s pick up location; and
      c. Period 3: total time elapsing between the time a PTC driver picks up a passenger(s) until the passenger(s) has arrived at their destination(s).

F. The PTC will report on accessible service delivery, including information on average wait times of accessible PTC vehicles, in a frequency prescribed, and in a form approved, by the Executive Director.

G. The records a PTC is required to maintain under the provisions of this chapter shall be maintained for a minimum of three years. [Amended 2016-07-15 by By-law 750-2016]

§ 546-117. ML&S audit and investigative authority.

A. ML&S may audit all records a PTC is required to maintain under this chapter for the purpose of investigating compliance with the requirements of this chapter and a PTC shall comply with directions given by ML&S related to such an audit. [Amended 2016-07-15 by By-law 750-2016]

B. A PTC shall be required, if requested by ML&S, to create passenger accounts and driver accounts for use by ML&S to investigate compliance with this chapter. A PTC shall not obstruct, in any manner, access to any accounts established for use by ML&S to investigate compliance with this chapter.

C. With respect to any PTC information or records required by the police for use in any investigation of potential breaches of the law, a PTC shall provide the requested records directly to the requesting authority within 24 hours of its receipt of the request.
D. With respect to any PTC information or records requested by ML&S for investigative or audit purposes, a PTC shall provide the requested records, or any reports based on the information requested in a format approved by the Executive Director, within 30 days of the receipt of the request, unless the Executive Director requires the records or reports within 24 hours.

§ 546-118. Public disclosure required by PTC.

A. A PTC shall disclose to the public on its Platform or through its website:
   1. Rates to be charged;
   2. The criteria applied to PTC drivers and PTC Vehicles providing service through the Platform;
   3. Information on the categories of services available to passengers through the Platform and the distinctions between these categories or types of service, if any;
   4. A plain-language explanation of their insurance coverage, including detailed information on how to initiate a claim; and
   5. Notification that personal information collected by the PTC may be disclosed to the City for the purposes of licensing enforcement when the passenger obtains transportation services in Toronto.

§ 546-119. Accessible vehicle service to be offered by PTCs.

A. Any PTC with more than 500 PTC drivers licensed by ML&S shall provide wheelchair accessible service to the public.

B. Providing wheelchair accessible service to the public requires a PTC to:
   1. Ensure wheelchair accessible vehicles are available when requested by a passenger through the PTC's platform within the average wait time for non-accessible taxicab services; and
   2. Charge fares for accessible vehicles that are the same or less than, the fare charged by that PTC for its lowest cost non-accessible service.

C. The average wait time for non-accessible service shall be determined yearly by the Executive Director and calculated based on the average time that elapses between a passenger's request for non-accessible taxicab service provided to passengers in Toronto and the arrival of a taxicab at the passenger's location.
### Appendix C – Schedule 12, Municipal Licensing and Standards

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Appendix C: Proposed Article 10-A

Chapter 546, Licensing of Vehicles-for-Hire, ARTICLE 10-A
Private Transportation Companies Operating Autonomous Vehicles

§ 546-120. Preamble.

Autonomous vehicles provide a perhaps unparalleled opportunity to rethink mobility and accessibility in Toronto. Working alongside Metrolinx and the Ministry of Transportation, the City of Toronto is designing a holistic set of measures that encourage AV development within its borders in a manner that advances a number of long-standing goals including enhanced safety, greater equity and access, and improved urban liveability. While only the Ministry of Transportation regulates the entire automobile fleet, the City of Toronto regulates all Private Transportation Company (PTC) vehicles that pick up or drop off passengers inside city limits. This new Article 10-A, written expressly for PTCs operating autonomous vehicles (hereafter known as AV-PTCs) allows these companies to operate profitably and successfully in the city while simultaneously leveraging the power of this technology to help further the aforementioned objectives to the benefit of the people of Toronto.

For the purposes of these regulations, “automated vehicle” means: a motor vehicle with an automated driving system that operates at the Society of Automotive Engineers (SAE) International driving automation Level 3, 4, or 5.

AV-PTCs can legally be the same companies as PTCs, but they must acquire a separate license for their AV-PTC vehicles. While there may be some overlap between the requirements in Articles 10 and 10-A, AV-PTCs are responsible for ensuring they adhere to the regulations outlined below when operating any autonomous vehicles for hire. The remainder of § 546-120 provides detail on the requirements that differ substantially from Article 10 above, with the itemised regulations found from § 546-121 to § 546-130.

§ 546-120a. Equity.

The City of Toronto recognises that access to mobility helps improve citizen wellbeing. Torontonians who can easily get around are able to take full advantage of the city’s economic opportunities, cultural life, wellness institutions and hospitals, parks, and a variety of municipal services. Unfortunately, low-income residents often lack such access, which can restrict their options and opportunities. As such, the City of Toronto believes all transportation providers—both public and private—share in the special responsibility of assisting under-resourced residents. Two of the major impediments to accessing PTC services are a lack of a bank account or credit/debit card, and/or a lack of smartphone. Moreover, the City of Toronto believes all neighbourhoods deserve access to adequate mobility services, and that no individual should be unduly burdened with transportation costs, given the critical role mobility plays in urban life. To address these shortcomings and assist with these goals, all AV-PTCs in Toronto must:

1. Be integrated into the PRESTO fare card system.

The City of Toronto has sponsored the establishment of an enhanced PRESTO system that links a customer’s AV-PTC account with their registered PRESTO card, rather than a bank account.
Should they choose, any customer with a registered PRESTO card can register for an AV-PTC account with their PRESTO card, and can use uploaded PRESTO card funds to pay for an AV-PTC ride.

As with the current PRESTO system, customers will upload funds to their PRESTO card, which can be used to pay for an AV-PTC ride just like a public transit ride. When PRESTO card-registered customers complete a ride, money will be transferred from a Metrolinx bank account where the customer’s funds have been stored to the AV-PTC bank account, rather than from that customer’s private bank account directly. Metrolinx will monitor customers’ PRESTO card accounts, and should a customer have insufficient funds on their card at the time a ride is ordered, they will be permitted to complete their trip but their account shall be frozen until such a time as they have paid the balance owing to Metrolinx. This accommodation shall be similar to the existing PRESTO card ‘emergency balance’ feature.

The City of Toronto shall act as guarantor for all PRESTO card accounts held by residents of Toronto. Any account freeze shall not prevent an AV-PTC from receiving what it is owed for trips made by customers prior to their accounts being frozen; however, when an account is frozen Metrolinx shall inform all AV-PTCs, and it is their responsibility to prohibit further travel by those customers until such a time as Metrolinx has sent notification that the account has been reactivated.

AV-PTCs are prohibited from discriminating in any manner against or otherwise treating differently those customers who have registered with a PRESTO card in lieu of a bank account, with the exception of the manner in which they accept funds from these customers; specifically, the AV-PTC shall accept the funds from the Metrolinx bank account that manages all PRESTO card-linked accounts, rather than from an individual’s bank account directly.

2. Have a customer-facing application that:
   b. Can be accessed on a computer, tablet, or smartphone; and
   c. Offers a conventional telephone option using voice or keypad activation.

The objective is to ensure all Torontonians can utilise AV-PTC services, regardless of whether they have access to a smartphone.

The information provided to the customer must be similar across all platforms, though it may be abbreviated for customers calling in on the telephone, given that all communication must be done orally rather than in a visual format.

AV-PTCs are prohibited from discriminating against or otherwise treating differently any individual or group of customers based on how they choose to access the AV-PTC application and hire a ride. This includes (but is not limited to) charging different prices (including ‘surge’ prices) based on the application they choose to use to hire a ride, or determining their place in the queue in such a manner that could negatively impact their wait time compared to those who have ordered a ride by a different means.

3. Provide qualifying low-income customers with a reduced ride-share fare.

Autonomous vehicles offer a unique opportunity to assist low-income residents. The City of Toronto believes it is not unreasonable that in exchange for operating in Canada’s largest travel market, AV-PTCs provide a small concession to assist its most needy residents. This concession shall be available to those who qualify as low-income, as defined by Statistics Canada’s ‘Low-
Income Measure After Tax’. In 2016, 482,550 Torontonians qualified as low-income, and the City of Toronto shall regularly provide the complete current list of names and account numbers for all those who have applied and been approved to receive this concession.

The new City of Toronto-sponsored ‘Fair Pass’ program offers a 33 per cent reduction on adult single TTC fares to qualifying low-income residents (with qualification based on the same Statistics Canada metric). To encourage shared-ride trips, AV-PTC operators shall similarly provide a 33 per cent concession to qualifying low-income customers on all shared-ride services, from the prevailing market-rate fare at the time the shared ride is ordered (adjusted for any ‘surge’ pricing). The concession shall be linked to a user’s account and automatically applied, with users required to renew their qualifying low-income status annually.

AV-PTCs are prohibited from discriminating against or otherwise treating differently any individual or group of customers based on their qualification in this program. This includes (but is not limited to) limiting a qualifying individual’s ability to hire a shared ride, charging different prices (including ‘surge’ prices) based on qualification and/or participation in the program, or determining a qualifying customer’s place in the queue in such a manner that could negatively impact their wait time compared to those who are paying full price.

The City of Toronto believes surge pricing is a useful tool to help smooth traffic congestion; however, use of surge pricing must be based on travel demand, and shall not be used in any targeted manner to discourage low-income ridership. All AV-PTCs must provide the surge pricing charged for every ride requested or provided that begins or ends in Toronto. ML&S shall evaluate the surges as they relate to general traffic patterns and AV-PTC customer requests for service. Should it determine that AV-PTCs are imposing surge charges at times when low-income riders are more likely to travel when such increased fare is not merited based on overall demand, a financial penalty shall be imposed on the AV-PTC to be determined by ML&S; for subsequent offenses, the penalty shall increase and may result in the termination of the operating license in the City of Toronto. Penalties can be appealed and rescinded should an AV-PTC be able to illustrate to ML&S its surge pricing was based on demand rather than discrimination.

4. Provide a minimum level of service provision across all Toronto neighbourhoods.

The City of Toronto recognises 140 neighbourhoods, and believes citizens in each deserve similar access to transportation; however, the size and density of neighbourhoods vary, and it is impractical to expect wait times to be the same in a small community with a dense population and one with a small number of residents spread over a large area.

To address the conflict between spatial/demographic differences and a goal of comparable wait times, all AV-PTCs shall provide the City of Toronto with the length of time elapsing between the moment a passenger places a service request and the start of the trip, for all trips beginning inside city limits. This information shall be provided on a monthly basis. For a given AV-PTC, wait times shall be categorised based on neighbourhoods, and the average wait time for each neighbourhood shall be multiplied by the neighbourhood’s population density to provide a neighbourhood ‘wait score’. These scores shall be ranked, and the wait time score in the lowest-performing neighbourhood for that AV-PTC shall not be greater than 33 per cent above the score in the neighbourhood where wait times are shortest.

§ 546-120b. Urban form & street space.
In addition to better serving all Torontonians, self-driving vehicles enable new opportunities to rethink street space, with the goal of moving towards communities that prioritise pedestrians and cyclists. Autonomous vehicles can quite literally have transportation norms programmed into their trip-planning decisions. While the City of Toronto is working with the Ministry of Transportation to encourage such a shift for all vehicles operating on Ontario roads, it can directly regulate provisions for AV-PTCs that further such an objective. Specifically:

1. **AV-PTC vehicles shall only be allowed to park in designated PTC/taxi parking spaces.**

   The City of Toronto is working to reduce parking overall in order to reclaim street space for sidewalks, pocket parks, and other community amenities. Parking will be at a premium, and the City of Toronto does not want AV-PTC vehicles and private drivers competing for the same spaces. As such, the City of Toronto has established a number of designated AV-PTC spaces throughout the city.

   The number of spaces will change yearly based on the number of AV-PTCs and vehicles in operation, and will be evaluated to ensure vehicles are parked in such a way as to allow them to reduce deadheading and limit customer wait times as much as possible.

2. **AV-PTCs shall incorporate the City of Toronto’s road hierarchy classification into their trip-planning algorithms.**

   With the exception of public laneways, every street in Toronto has been given one of five classifications (from the 2013 City of Toronto Road Classification System):
   5. **Local Roads:** Provide access to properties with a minor role in carrying motorized traffic. Traffic volumes and speeds should be low. Over time, the City of Toronto shall move towards permitting all modes of travel throughout the right of way.
   6. **Collector Roads:** Collect and distribute traffic between local roads and arterial roads.
   7. **Major and Minor Arterial Roads:** Provide the major corridors for traffic (including surface transit) movement. Are also important for pedestrians and cyclists. As motor vehicle speeds and volumes are higher on these roads, special facilities such as bicycle lanes are necessary to ensure the safety of cyclists.
   8. **Expressways:** Carry high volumes of motor vehicle traffic at relatively high speeds, with no amenities for pedestrians and cyclists.

   The City of Toronto has assigned a point score to each street type:
   4. Expressways and Major Arterial Roads – 1 point
   5. Minor Arterial Roads – 2 points
   6. Collector Roads – 3 points
   6. Local Roads – 4 points

   Any vehicle travelling in Toronto will therefore have a ‘travel score’ for any given trip, calculated as follows:

   \[
   1 \times \text{(Expressway kilometres)} + 1 \times \text{(Major Arterial Road kilometres)} + 2 \times \text{(Minor Arterial Road kilometres)} + 3 \times \text{(Collector Road kilometres)} + 4 \times \text{(Local Road kilometres)}
   \]

   As an example, if a vehicle travelled on Dundas Street (a Major Arterial Road) for 0.25 kilometres, then on Sherbourne Street (a Minor Arterial Road) for 0.35 kilometres, then finally
on Linden Street (a Local Road) for 0.20 kilometres before arriving at its destination, its travel score would be:

\[ 1 \times (0.25) + 2 \times (0.35) + 4 \times (0.20) = 1.35 \]

The algorithms for route navigation for any AV-PTC vehicle operating on any City of Toronto road must be written such that any trip is within 20 per cent of the lowest travel score possible between the requested origin and destination. Effectively, as much as possible vehicles should remain on Expressways and Major Arterial Roads, only running on lower-order streets when departing from an origin point or nearing a destination.

The City of Toronto recognises this may add travel time to an AV-PTC journey, given that vehicles will need to travel along more congested corridors rather than taking smaller side streets; however, the purpose of the road classification system is, in part, to acknowledge the importance of different types of road users (pedestrians and cyclists, transit users, and motorists). The algorithm-based decision-making process employed by autonomous vehicles provides the City of Toronto with a unique opportunity to ensure the user hierarchy is respected.

As noted above, the City of Toronto is working with the Ministry of Transportation on a goal of eventually seeing all private and commercial autonomous vehicles employing a similar trip-planning algorithm.

3. **AV-PTC vehicles shall be required to pay a fixed-rate congestion charge when entering the downtown during ‘peak hours’.**

Given the predominance of public transit users, pedestrians, and cyclists in the downtown core, all efforts should be made to encourage these more efficient means of transportation. While the City of Toronto will be looking at different measures to encourage such use in the years to come, in the interim they are discouraging AV-PTCs inside the downtown boundary to make it easier and safer for commuters to choose public transit, walking, and cycling.

‘Peaks hours shall be defined as 7:00-18:00 from Monday to Friday, and 9:00-18:00 on Saturday. AV-PTCs shall be required to pay this charge for every trip that either begins or ends in the downtown (with boundaries defined in § 546-127). AV-PTCs shall only be charged once for any shared rides that begin or end in the downtown. This charge shall be set bi-annually by the City of Toronto based on congestion levels over the last six months, with the City of Toronto informing all AV-PTCs of the upcoming charge on January 1st and July 1st.

§ 546-121. General requirements.

A. An AV-PTC shall only permit passengers requesting transportation to submit a request for transportation through a software application.

B. Customers must be able to access and use this application and receive similar information through any of the following means, as they choose:
   a. On a smartphone;
   b. On a tablet;
   c. On a desktop or laptop computer; and
   d. Via a voice- or keypad-activated telephone line.

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7 Yellow highlights identify sections from Article 10-A that have been changed from similar provisions in Article 10.
C. An AV-PTC shall not permit or carry out hails or the solicitation of passengers, whether on the street or at a cabstand or in any other manner or at any other location.

D. An AV-PTC must permit customers to enrol in their system using a PRESTO card rather than a bank account. ML&S shall provide the computer code necessary to accommodate such a requirement, but in effect, all PRESTO card-registered customer accounts will be linked to a Metrolinx-managed bank account, rather than the bank accounts of these individuals directly. Details of this requirement are provided in § 546-120a.

E. No AV-PTC shall impose a mandatory arbitration clause on individuals accepting or making requests for service or require that the law of any jurisdiction other than Ontario be applied in relation to use of the AV-PTC platform in Toronto. To the extent that clauses contrary to this requirement are included in any AV-PTC agreement with individuals using its services in Toronto, such clauses are unenforceable.

§ 546-122. Application requirements and licence renewal process.

A. To apply for an AV-PTC licence, an AV-PTC shall submit to ML&S a licence application, in a form prescribed by the Executive Director, together with all applicable fees and in compliance with § 546-3.

B. The application submitted by an applicant for an AV-PTC licence shall be in the form prescribed by the Executive Director and require the AV-PTC to provide:
   1. The AV-PTC's registered business address in the Province of Ontario;
   2. The name, telephone, and email contact information for the person authorized to receive and respond on behalf of the AV-PTC to any and all communications from the City relating to the AV-PTC's licence or the AV-PTC's conduct of the business;
   3. An indemnity in favour of the City of Toronto from and against claims, demands, losses, costs, damages, actions, suits, or proceedings that arise out of, or are attributable to, the AV-PTC's business and services, which shall be in a form satisfactory to the City;
   4. A copy of the AV-PTC identifier that the AV-PTC is submitting for approval by the Executive Director;
   5. A copy of the AV-PTC's certificates of insurance, as required by § 546-124; and
   6. Information sufficient to describe or demonstrate:
      a. Where applicable, the legal relationship between any persons that, acting together, carry on the business of an AV-PTC;
      b. That the AV-PTC will have the ability to maintain and deliver data in the form and manner, and with the frequency, required by this chapter;
      c. That the AV-PTC has data security measures in place to protect the personal data collected by the AV-PTC relating to passengers and drivers;
      d. That the AV-PTC maintains records as required by this chapter and can provide regular daily or weekly updates to ML&S of this information, as required by the Executive Director; and
      e. That the AV-PTC maintains and can produce, in the form and with the frequency required, to ML&S or police, all data or records maintained in accordance with the requirements of this chapter.
C. When an AV-PTC licence is issued by ML&S, the AV-PTC shall be on probation for six months from the date of the new licence issuance. During this 6 month probationary period, ML&S may:
   1. Conduct random audits or investigations to evaluate compliance with this chapter; and
   2. Suspend or place conditions upon the licence, without a hearing, for up to 14 days, if the Executive Director has reasonable grounds to believe that the continued operation of the business poses an immediate danger to health or safety of any person or to property.

D. To renew an annual AV-PTC licence, an applicant shall complete a licence renewal application, in a form approved by the Executive Director and in compliance with § 546-3.
   1. When submitting a licence renewal application, an applicant shall provide documentation sufficient to satisfy the Executive Director that the applicant has met, and will continue to meet, the AV-PTC licence requirements applicable as at the date of the licence renewal application.
   2. At the time that an AV-PTC submits a licence renewal application, the AV-PTC shall be up to date in the payment of all applicable annual AV-PTC trip fees charged or collectible for periods prior to the renewal date under Chapter 441, Appendix C - Schedule 12, Municipal Licensing and Standards.
   3. Should an AV-PTC have failed to meet the minimum Neighbourhood Ratio Score requirements as outlined in § 546-120a in the year immediately prior to submitting its renewal application, the AV-PTC must provide information to the Executive Director as to how it intends to ensure it can meet the requirements in the forthcoming year. Should it fail to meet the requirements two years in a row, it may be subject to consequences up to and including termination of its license.

E. An AV-PTC shall ensure that the mailing address, e-mail address, and phone number provided to ML&S in the licence application or renewal process is up to date at all times. Any written communication to the AV-PTC by ML&S shall be deemed received by the AV-PTC when delivered to the mailing address or email address on file.

§ 546-123. AV-PTC vehicle requirements.

A. No AV-PTC shall operate or permit the operation of an AV-PTC vehicle unless that vehicle:
   1. Has four doors;
   2. Has a maximum seating capacity of seven passengers, plus the driver;
   3. Is no more than seven model years old;
   4. Displays an AV-PTC Identifier in a location approved by the Executive Director at all times when the vehicle is available to provide or is providing transportation to passengers;
   5. Is equipped with snow tires or all-weather tires from December 1 to April 30;
   6. Has no roof light or markings that have the effect of making the vehicle look like a taxicab or identify it to any person as being available for hire.
   7. Meets all requirements as determined by the Province of Ontario that permit an autonomous vehicle to operate on public roads; and
   8. Qualifies as a zero-emission vehicle as defined by the Province of Ontario.
B. All AV-PTC vehicles’ trip-planning algorithms must be designed to ensure every trip has the lowest possible ‘Travel Score’ (as outlined in § 546-120b). That is, it must use Local and Connector roads as little as possible, instead choosing Arterials and Expressways.

C. All AV-PTC vehicles classified at an SAE International autonomous Level 3 shall be required to have a functioning steering wheel and related controls, dashboard, and driver’s seat in good working order.

D. All AV-PTC vehicles classified at an SAE International autonomous Level 4 or 5 shall be prohibited from having any controls that could be used by a passenger to steer or otherwise control the vehicle.

E. The SAE International autonomous Level of a given vehicle shall be determined by the Ministry of Transportation of Ontario, either as a classification of vehicles or bestowed individually upon a vehicle in question. In the event the MTO has determined a given vehicle has a different Level classification than all other vehicles of the same make and model, the individual Level classification shall supersede the broader make and model classification.

§ 546-124. AV-PTC driver and monitor requirements.

L. Every AV-PTC vehicle classified at an SAE International autonomous Level 3 (hereafter referred to as Level 3 transportation services) shall be required, at all times when in operation and/or hosting passengers, to have a qualified AV-PTC driver employed by the AV-PTC that owns the vehicle at the wheel capable of taking over in the event of an emergency.

M. An AV-PTC vehicle classified at an SAE International autonomous Level 4 or 5 may, but is not required to, have a single monitor employed by the AV-PTC that owns the vehicle in the vehicle when transporting passengers.

N. Any driver providing Level 3 transportation services in Toronto must comply with all requirements as outlined in Highway Traffic Act (Ontario Regulation 306/15), Section 13 Driver’s Duties.

O. An AV-PTC driver or monitor shall:
   6. Be employed by the AV-PTC that owns the vehicle being driven and/or monitored by the AV-PTC driver or monitor;
   7. Be at least 18 years of age;
   8. Hold an unrestricted Class G, or higher, Ontario driver's licence;
   9. Be able to communicate in English.

P. AV-PTC drivers and monitors shall only provide transportation services in response to requests for service received through a licensed AV-PTC and via the AV-PTC's software application.

Q. AV-PTC drivers and monitors shall not pick up passengers at a cabstand or in response to a street hail.

R. AV-PTC drivers and monitors shall not solicit rides in any manner.

S. AV-PTC drivers and monitors shall carry and, upon request, produce to ML&S:
   6. Their Ontario driver's licence;
   7. Proof of employment by the AV-PTC that owns the vehicle being driven or monitored by the driver or monitor;
   8. Proof of applicable vehicle insurance; and
9. A copy of the most recent mechanical safety inspection certificate issued for the AV-PTC vehicle.

§ 546-124. Insurance requirements.

A. Policy of insurance; certificate
   1. An AV-PTC shall ensure that each AV-PTC vehicle affiliated or registered with it is insured under a policy of automobile insurance for $2,000,000 (exclusive of interest and costs) or more to provide coverage for:
      a. Loss or damage resulting from bodily injury to or the death of one or more persons;
      b. Loss or damage to property resulting from an accident; and
      c. Third-party liability.
   2. The AV-PTC shall deposit a certificate of any applicable automobile insurance policy with ML&S.
   3. Any applicable automobile insurance policy shall be endorsed to give ML&S at least 30 days' prior notice in writing of any cancellation, expiration or variation in the amount of the policy.

B. For each trip, the applicable automobile insurance policy for an AV-PTC vehicle shall provide coverage from and including the point in time that a request for transportation is accepted and until the AV-PTC vehicle has completed the trip.

C. AV-PTCs shall have an automobile liability insurance policy in place that provides at least equivalent insurance coverage that meets or exceeds all of the insurance requirements for AV-PTC Vehicles required for this by-law.

D. When the AV-PTC has an automobile insurance policy in place to satisfy the insurance requirements of this chapter, the AV-PTC shall provide a certificate of the policy to ML&S.

E. An AV-PTC shall have commercial general liability business insurance coverage of at least $5,000,000.

F. The insurance policy referred to in Subsection F shall contain a term or endorsement requiring that ML&S shall receive at least 30 days prior notice in writing from the insurer of any cancellation, expiration or variation in the amount of the policy.

G. ML&S may immediately suspend the licence of an AV-PTC and AV-PTC vehicle, without a hearing, if an AV-PTC or AV-PTC vehicle fails to comply with any or all of the insurance requirements of this chapter at any time, until the automobile liability insurance or commercial general liability insurance policy, as applicable, is reinstated or renewed or an equivalent replacement insurance policy is in place.

§ 546-115. AV-PTC Fares.

A. For each trip, an AV-PTC shall remit to ML&S the AV-PTC trip fee charged under Chapter 441, Appendix C - Schedule 12, Municipal Licensing and Standards.

B. All AV-PTCs shall offer a concession to qualifying customers (as defined in § 546-120a) of 33 per cent on any shared ride, from the prevailing market-rate fare at the time the shared ride is ordered (including any ‘surge’ pricing). The concession shall be linked to a user’s account and automatically applied. AV-PTCs shall be entitled to no compensation for such concessions. Details of this requirement are provided in § 546-120a.
C. An AV-PTC shall, prior to the start of a trip, clearly communicate to each passenger:
   1. The rate to be charged, including concession for qualifying customers;
   2. The provincial licence plate, make, and model of the AV-PTC vehicle providing transportation to the passenger.
E. An AV-PTC shall ensure a record is maintained confirming that the passenger accepted the rate prior to the start of the trip.
F. The AV-PTC vehicle identified by the AV-PTC to the passenger immediately prior to the commencement of the trip shall be the AV-PTC vehicle that provides the transportation.
G. At the conclusion of every trip, an AV-PTC shall provide a receipt to the passenger. A receipt may be in an electronic or paper format and shall include information on:
   1. All rates, fees and/or surcharges charged for the trip;
   2. Total fare amount paid;
   3. Date and time of trip;
   4. Location at which the passenger was picked up and location to which the passenger was driven;
   5. Total time and distance of trip.


A. AV-PTC vehicles shall only be permitted to park in designated PTC/taxi parking spaces, as defined by ML&S, with a list distributed to all AV-PTCs at the beginning of the fiscal year. (Any changes to this list shall be provided to AV-PTCs as soon as possible after a change has been approved.)
B. AV-PTC vehicles shall be required to pay a per-trip congestion charge when entering the downtown core, defined as the area bound by but exclusive of Bloor Street to the north, the Don Valley Parkway to the east, the Gardiner Expressway to the south and Bathurst Street to the west, during peak hours, defined as 7:00-18:00 Monday to Friday and 9:00-18:00 Saturday, excluding holidays.

§ 546-127. AV-PTC record keeping and disclosure requirements.

A. Unless otherwise specified or approved, all information provided by an AV-PTC to ML&S shall be provided electronically and in a format prescribed or approved by the Executive Director.
B. An AV-PTC shall maintain business records that include, at a minimum, the following information in relation to transportation commencing or terminating in Toronto:
   1. For trips involving one passenger or one fare:
      a. Pick up location and the destination (by reference to the intersection);
      b. Date and time the trip started and terminated;
      c. Route taken by the AV-PTC vehicle including a list of every road on which the AV-PTC vehicle travelled and the exact distance the AV-PTC travelled, which shall be used by the Executive Director to determine the AV-PTC’s annual ‘Neighbourhood Ratio Score’ (as described in § 546-120b) and to audit their Travel Scores; and
      d. The market-rate fare charged, including surge pricing;
      e. Length of time elapsing between the passenger's service request and start of the trip.
2. For trips involving more than one passenger or for which multiple fares were charged:
   a. Total number of passengers paying separate fares;
   b. Pick up location(s) and destination(s) (by reference to the intersection) for each trip;
   c. Dates and times the trips started and terminated;
   d. Length of time that elapsed between the time the passenger(s) requested service and the trip started for each passenger;
   e. The market-rate fare and the actual fare(s) paid for the trip; and
   f. Number of trips involving multiple passengers paying separate fares.

C. An AV-PTC shall maintain business records that include, at a minimum, the following information in relation to transportation requested in Toronto that was not provided due to the cancellation or rejection of the request:
   1. Pick-up location and, if provided, destination (by reference to the intersection); and
   2. Date and time the trip was requested.

D. An AV-PTC shall maintain records that include, at a minimum, the following information in relation to AV-PTC Vehicles providing transportation commencing in Toronto:
   1. Information provided by the AV-PTC to passengers in their receipt;
   2. AV-PTC vehicle licence plate number;
   3. Type of service provided, if the AV-PTC offers different categories or tiers of service;
   4. Total time (measured in hours and minutes for each calendar day) that the AV-PTC vehicle was available to provide transportation services through the Platform; and
   5. Total time (measured in hours and minutes for each calendar day) that the AV-PTC vehicle was available to provide transportation services through the Platform categorized according to the following:
      a. Period 1: total time an AV-PTC vehicle was available on the AV-PTC Platform to receive or accept requests to provide passenger transportation service;
      b. Period 2: total time elapsing between the time a passenger request for transportation is accepted by an AV-PTC vehicle and the arrival of the AV-PTC vehicle at the passenger’s pick up location; and
      c. Period 3: total time elapsing between the time an AV-PTC vehicle picks up a passenger(s) until the passenger(s) has arrived at their destination(s).

E. The AV-PTC will report on accessible service delivery, including information on average wait times of accessible AV-PTC vehicles, in a frequency prescribed, and in a form approved, by the Executive Director.

F. The records an AV-PTC is required to maintain under the provisions of this chapter shall be maintained for a minimum of three years.

§ 546-128. ML&S audit and investigative authority.

A. ML&S may audit all records an AV-PTC is required to maintain under this chapter for the purpose of investigating compliance with the requirements of this chapter and an AV-PTC shall comply with directions given by ML&S related to such an audit.
B. An AV-PTC shall be required, if requested by ML&S, to create passenger accounts for use by ML&S to investigate compliance with this chapter. An AV-PTC shall not obstruct, in any manner, access to any accounts established for use by ML&S to investigate compliance with this chapter.

C. With respect to any AV-PTC information or records required by the police for use in any investigation of potential breaches of the law, an AV-PTC shall provide the requested records directly to the requesting authority within 24 hours of its receipt of the request.

D. With respect to any AV-PTC information or records requested by ML&S for investigative or audit purposes, an AV-PTC shall provide the requested records, or any reports based on the information requested in a format approved by the Executive Director, within 30 days of the receipt of the request, unless the Executive Director requires the records or reports within 24 hours.

§ 546-129. Public disclosure required by AV-PTC.

A. An AV-PTC shall disclose to the public on its Platform and through its website:
   1. Rates to be charged;
   2. The criteria applied to AV-PTC Vehicles providing service through the Platform;
   3. Information on the categories of services available to passengers through the Platform and the distinctions between these categories or types of service, if any;
   4. A plain-language explanation of their insurance coverage, including detailed information on how to initiate a claim;
   5. Information on the obligatory travel assistance program offered to qualifying low-income individuals, including:
      a. How the system works;
      b. Pertinent information on variable fares (i.e. that ‘surge’ pricing still applies even to qualifying participants);
      c. How customers can assess whether they qualify; and
      d. How to apply for the service.
   6. Notification that personal information collected by the AV-PTC may be disclosed to the City for the purposes of licensing enforcement when the passenger obtains transportation services in Toronto.

§ 546-130. Accessible vehicle service to be offered by AV-PTCs.

A. Any AV-PTC with more than 500 AV-PTC vehicles licensed by ML&S shall provide wheelchair accessible service to the public.

B. Providing wheelchair accessible service to the public requires an AV-PTC to:
   1. Ensure wheelchair accessible vehicles are available when requested by a passenger through the AV-PTC’s platform within the average wait time for non-accessible taxicab services; and
   2. Charge fares for accessible vehicles that are the same or less than, the fare charged by that AV-PTC for its lowest cost non-accessible service.

C. The average wait time for non-accessible service shall be determined yearly by the Executive Director and calculated based on the average time that elapses between a passenger's request for non-accessible taxicab service provided to passengers in Toronto and the arrival of a taxicab at the passenger's location.
This is to certify that:

**Benjamin Marshall Gillies-Podgorecki**

Has completed the following CITI Program:

- **Social & Behavioral Research Investigators** (Curriculum Group)
- **Social & Behavioral Research Investigators** (Course Learner Group)
- **1 - Basic Course** (Stage)

Under requirements set by:

- **Harvard University**

Verify at [www.citiprogram.org/verify/?wb305934d-3f8e-456b-8bad-38bcfc4ba69-25361960](http://www.citiprogram.org/verify/?wb305934d-3f8e-456b-8bad-38bcfc4ba69-25361960)
The above-referenced protocol is considered exempt after review by the Committee on the Use of Humans as Experimental Subjects pursuant to Federal regulations, 45 CFR Part 46.101(b)(2).

This part of the federal regulations requires that the information be recorded by investigators in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects. It is necessary that the information obtained not be such that if disclosed outside the research, it could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

If the research involves collaboration with another institution, then the research cannot commence until COUHES receives written notification of approval from the collaborating institution's IRB.

Unless informed consent is waived by the IRB, use only the most recent, IRB approved and stamped copies of the consent form(s).

**Adverse Events:** Any serious or unexpected adverse event must be reported to COUHES within 48 hours. All other adverse events should be reported in writing within 10 working days.

**Amendments:** Any changes to the protocol, including changes in experimental design, equipment, personnel or funding, must be approved by COUHES before they can be initiated, except when necessary to eliminate apparent immediate hazards to the subject.

Human subjects training is required for all study personnel and must be updated every 3 years.

You must maintain a research file for at least 3 years after completion of the study. This file should include all correspondence with COUHES, original signed consent forms, and study data.
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