New **Mobility**

July 2016

August 2016 Update

WSP

Foreword

This report presents findings and research on the future of cities and new mobility, conducted by WSP Group on behalf of Metrolinx, the regional transportation authority for the Greater Toronto and Hamilton Area in Ontario, Canada. This work is intended to inform policy discussion around the role of new mobility as part of the Regional Transportation Plan update.

Given the uncertainty and dynamic nature of new mobility, a foresight and scenario generation approach was used to derive strategic directions and policy considerations for government and a wide range of new mobility stakeholders. Research was conducted on a broad range of global and regional trends, and future scenarios were developed in a structured framework to help identify potential opportunities, risks and implications that may arise from developments in new mobility. The findings of this research were validated through a panel of Thought Leaders who came from a wide cross-section of perspectives that span sectors and geography. These Thought Leaders are listed in the Acknowledgements section of the report. The project team is grateful for the richness and thoughtfulness of the advice received.

New mobility is a rapidly evolving topic. This report frames current thinking on the issues, opportunities and forces at play in the emergence of new mobility. Continued research and analysis will be needed as this field evolves and matures over the coming years.

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1. Introduction

The Changing Nature of Mobility

In the Greater Toronto and Hamilton Area (GTHA), a growing public desire for alternatives to travel by private car has led to new policy and financial support for transit, cycling and walking. After decades of underinvestment, public transit in the GTHA is receiving significant financial support from all orders of government. The overall scope, quality and integration of transit has improved significantly, and transit is now competitive in many areas where it has lagged for years. At the same time, a rapidly growing network of cycling and walking facilities is helping more people to use active modes for daily travel.

However, policy and infrastructure work slowly. It can take decades to feel the full effects of some policies, and years of planning, engineering, design and construction are needed before a rapid transit line can carry passengers. Change continues to unfold as those things happen, so while we plan for the short term we must also look farther ahead and consider trends that are only starting to emerge. A key role of Metrolinx is to watch for emerging trends, and to consider their potential impact on transportation in the GTHA.

Just as gas-powered cars reshaped cities in the 1900s, today's rapidly changing technologies seem likely to disrupt mobility in the GTHA. The great unknown is in which advances will have the greatest effect, and where they might lead us. The answer will depend on other social, economic and built environment trends that will both influence, and be influenced by, new technologies.

Figure 1.1 - Map of the Region

It is not just the technologies themselves that matter, but how they are applied, and how people interact with them. Already, new models of mobility are blurring the lines between public and private transportation, and changing the very definitions of different travel modes—but their ultimate impact will depend on the actions of government, the private sector and individual users. We cannot predict the future of mobility in the GTHA, but we can use our understanding of current trends to illuminate what might happen as they shift and evolve with time, perhaps as they weaken or strengthen, and even as they converge to take us in new and unexpected directions

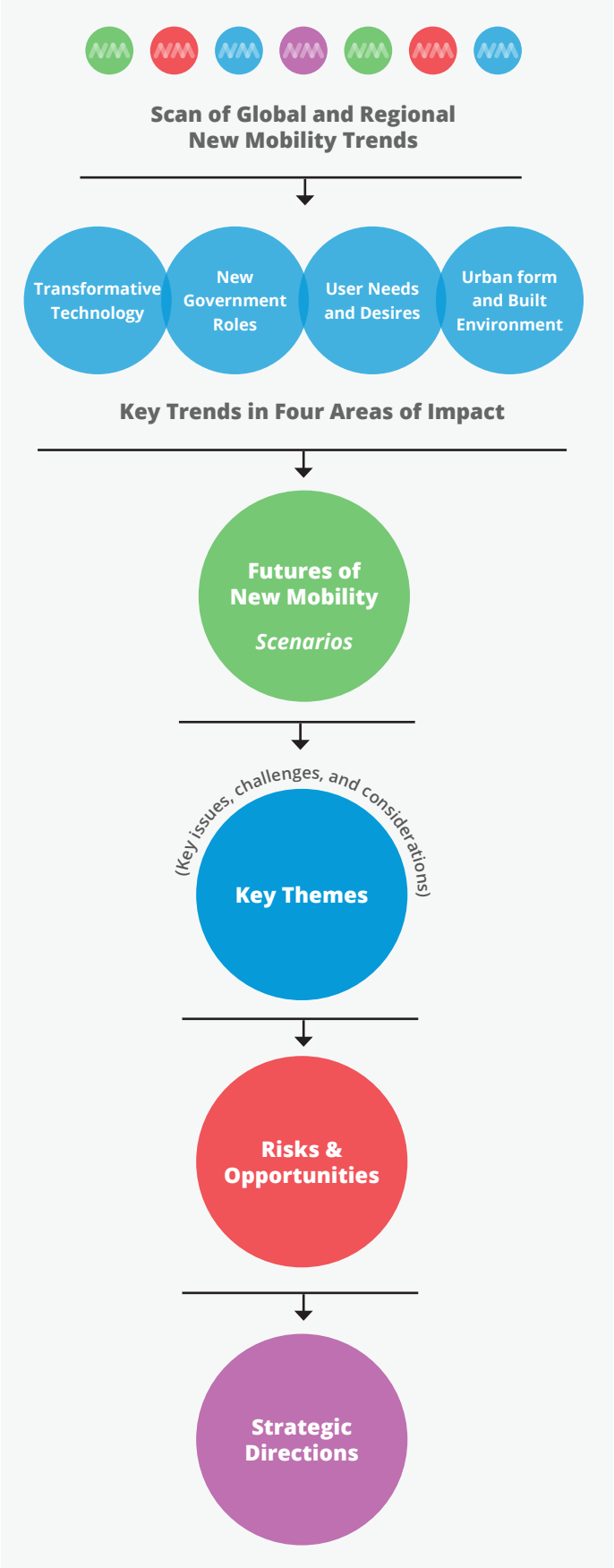

Figure 1.2 - Analysis Process

Overview of this Report

This report contributes to a growing discussion about how "new mobility" could impact the GTHA, and about ways to ensure that it benefits the region as a whole. It has been structured to mirror the analysis process used in developing this report, illustrated in the diagram to the left. Chapter 2—Key Trends explores major trends related to technology, government, individual users and the built environment, and their impacts so far. Chapter 3—The Futures of New Mobility identifies two radically different future scenarios and how they might emerge given the changing dynamics of the system. Chapter 4—Strategic Directions uses six key themes to suggest a number of ways the region can prepare for impending change. The report concludes with Chapter 5—Planning for Change, a discussion of how key actors in the GTHA can work together to create the mobility future they want to see.

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2. Key Trends

The term "new mobility" includes many forms of transportation arising both from changing needs and demands, and from new and emerging capabilities. While new mobility offers exciting opportunities to enhance the movement of people and goods in the GTHA, its effects seem likely to reach beyond transportation and impact our overall quality of life. This reality will challenge all levels of government to define an appropriate policy and planning response for the GTHA—something that must be based on a broad understanding of relevant trends.

This chapter identifies the global and regional trends most important to new mobility in four key areas: transformative technologies, new government roles, user needs and desires, and urban form and built environment. These are areas of significant—and in some cases imminent—change that will influence mobility and quality of life in the GTHA. Most of the trends discussed are interconnected, and have broad relevance across all four areas.

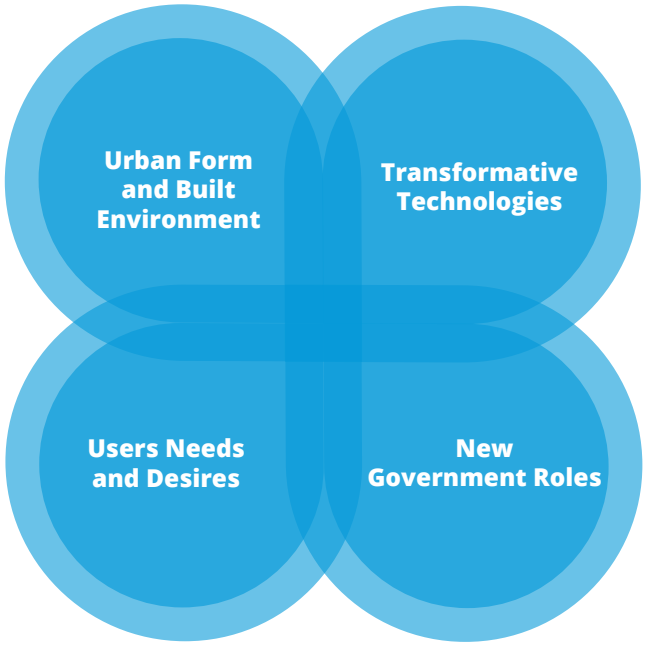


Figure 2.1 - Areas of Impact

Transformative Technologies

Technology-driven increases in automation, connectivity and information sharing have reached the realm of transportation infrastructure and services, making many aspects of life easier and more convenient. However, while they might enable us to use resources more efficiently, they could also have the opposite effect and encourage us to accelerate our consumption to unprecedented levels.

An increasingly connected and data driven world

The Internet of Things (IoT) and big data are two key technological trends that are enabling an increasingly connected and data-driven world. IoT technologies create "smart" systems of interacting sensors and devices that can operate with little human intervention, gathering rich data about the condition of a system and its use. The resulting large sets of data (big data) can be processed using advanced analytics for a variety of purposes in both public and private sectors; these include service planning, travel demand forecasting, long range planning, emergency response, customized goods and services, improved information provision, and targeted marketing.

Thanks to IoT technologies, transit users can actively track the location of their next bus through onboard GPS tracking. Beacons, which enable location-based communication, can provide geographically relevant content to users about nearby services and businesses. Electronic displays and smartphone applications give car drivers information on parking space availability that is gathered through parking bay sensors. Maintenance crews can be notified and deployed faster when infrastructure issues arise. Assets can be used more efficiently when certain roads and transit lines are under high demand

1 Cisco (July, 2013)
2 Canada's Big Data Consortium (October 2015)

Internet of Things (IoT)

Examples of consumer products that make use of IoT technologies include smart thermostats and wearable fitness devices. IoT applications in transportation include parking management systems that track vacant and occupied spaces in a facility, and many more are expected to emerge. Connected vehicles have yet to hit the market, but are expected to make roads safer using vehicle-to-vehicle and vehicle-to-infrastructure communication. The technology has similar objectives as autonomous vehicles, but is being developed separately in parallel. Cisco estimates that in 2012, there were about 8.7 billion connected objects globally. By 2013, this number exceeded 10.0 billion, and by 2020, it is estimated that the number of connected objects will reach up to 1.8 trillion.[1]

Big Data

Big data represents the information about our lives that is being collected in an unprecedented variety, richness and volume, and being processed with once-unimaginable speed. Datasets are generated from many sources including business transactions, sensors and social media. In the transportation sector, there is strong interest in analyzing this data to gain new insights into human behaviour and system performance. Important questions have arisen about personal data privacy, security and ownership. Many sectors will also have to contend with the issue of a skills gap. Canada's Big Data Consortium estimates that Canada has a skills gap of between 10,500 and 19,500 professionals with deep data and analytical skills, and a further gap of 150,000 professionals with solid data and analytical literacy. [2]

and travellers are redirected to less-congested routes, times and destinations. Connected vehicles, which are more aware of their surroundings, will contribute to a safer transportation system.

A more integrated and informed mobility system

IoT and big data are creating opportunities for a more integrated and informed transportation system. Mobile traveller information systems for smartphones and other mobile devices are increasingly used to share live information about the condition of the transportation system and to aid in trip planning and navigation. These applications give users better access to the transportation system as they are no longer limited by their own knowledge, and can encourage the use of certain modes by offering information and recommendations.

In some jurisdictions, mobile applications are being extended to incorporate new functions such as integrated fare payments for transportation service providers. Progress is also being made toward combining live and customized information with integrated fare payment through the use of personalized smart tokens and contactless digital payment. A logical next step would give users convenient, comprehensive access to information and payment options for different modes through a single portal. This would signal a shift from treating the transportation system as a set of discrete modes, towards treating it as a set of integrated mobility services. Some jurisdictions are coming close to this concept through the advancement of Mobility as a Service frameworks.

Contactless Payment

This technology has evolved from special purpose smart cards (e.g. the PRESTO farecard) to options enabled by bank and credit card companies. Technologies including radio-frequency identification (RFID) and near field communication (NFC) enable quick transactions and are suitable for transit environments. Contactless payment examples include Visa payWave™ and Mastercard Tap & Go™. In the United Kingdom, Transport for London allows fare payment for bus, underground, tram, light rail, cable car, river bus and overground train rides using contactless bank cards and credit cards.

An emerging generation of contactless payment relies on smartphones and other personal devices to act as personalized smart tokens, which adds an extra level of security. Personal devices allow individuals to authenticate their identity using a passcode or biometric authentication. Examples include Apple Pay and Android Pay, which use fingerprint identification technology built into many smartphones.

Mobile Traveller Information Systems

The earliest such systems were commissioned by government entities and transit operators, and generally offered users transit schedules, journey planning, and predictive travel times. Newer systems, including some private companies, have introduced dynamic route optimization capabilities, real-time transit and traveller information and multimodal trip planning. Since these applications are usually free, many companies are supported by investor funding with the eventual intent of monetizing the data collected through the system. Examples of these applications in the GTHA include Google Maps, Transit App, Moovit, CityMapper, and Metrolinx' own Triplinx.

Mobility as a Service (MaaS)

MaaS is a distribution model for mobility services. It integrates services offered by multiple independent providers (e.g. transit, taxi, bike share, car share) into one mobile application, allowing travellers to plan and pay for their mobility needs through a single portal. The goal of MaaS is to be more attractive than auto ownership. European research and industry activity around this model has been significant. A pilot project called UbiGo[3] was tested in Gothenburg Sweden, and more recently a solution called Whim was released in Helsinki, Finland.[4] The growth of MaaS could have a potentially strong impact in reducing auto ownership and use.

Personal transport without personal ownership

New technologies have enabled the practice of resource-sharing between people and/or businesses in many sectors, such as short-term rental of rooms and homes as casual travel accommodation. In transportation, the sharing economy has manifested itself in ridesharing, carsharing, bikesharing, and other on-demand mobility services such as ridesourcing through transport network companies (TNCs) such as Uber and Lyft.

Although carsharing and bikesharing have had only limited impact on the broader transportation system, emerging models are enabling steady growth. Between 2014 and 2015, the number of carsharing memberships in Canada grew by 50%, while fleets grew by 26%.[5] Many services are also shifting towards more convenient free-floating models, which allow vehicles, both cars and bikes, to be picked up and dropped off closer to where people actually need to be instead of being confined to station infrastructure, or needing to return the vehicle back to its origin. Growth within the sharing economy is also introducing peer-to-peer models of car and bike sharing, which will make the fleet of available vehicles even larger.

Government transportation agencies have historically been the biggest proponent of ridesharing, or carpooling, as a measure of transportation demand management (TDM). Conventional systems matched drivers to passengers ahead of time, usually by home and work location, to form fixed groupings of carpoolers. Though these programs have had some success in increasing per vehicle occupancy and reducing the number of trips and emissions produced at the workplace level, the lack of flexibility has made it challenging for application in a

3 UbiGO (2016)
4 MaaS Global (2016)
5 Transportation Sustainability Research Centre (2015)

Transportation network companies (TNCs)

TNCs use online applications to provide prearranged transportation services for paying passengers, connecting them with drivers who use their personal vehicles. International examples include Lyft, Uber, Didi Kuaidi and Haxi. The type of service provided by TNCs is usually referred to as ridesourcing, though other terms, such as ride-hailing, and e-hailing are also used. The City of Toronto has termed TNCs as Private Transportation Companies (PTCs).

broader context. Some TNCs have begun to enter the market of ridesharing as an extension of the on-demand ridesourcing services they provide. Using similar mobile platforms as those used in ridesourcing, both drivers and riders are being given the option of opening up their ride to other users looking to travel along a similar route in exchange for costs being shared. Though most ridesharing services provided by TNCs still require pre-matching, such systems are making the process of ridesharing more flexible and convenient. Ridesharing remains distinct from on-demand mobility.

Many of these services are becoming more flexible than conventional fixed-route transit services, and do not require users to own a car. Growing acceptance of these shared mobility models could reduce dependence on private automobiles, and could increase average vehicle occupancy.

Everything on-demand

On-demand services such as those provided by TNCs have expanded beyond ridesourcing to include a whole host of new services. This trend is empowering users with the ability to access anything they want, whenever they want it, right at their fingertips through their mobile devices. This trend is providing users with more options, and also changing user expectations.

In the movement of people, new permutations of mobility services include not only advanced ridesharing capabilities (such as UberPool and Lyft Line), but also services that look increasingly reminiscent of public transit. Microtransit services are an increasingly common sight for many cities, some of which are aimed at complementing existing transit by acting as the first-mile and last-mile leg of trips (as in the case of Bridj and

Autonomous Vehicles (AVs)

AVs (also referred to as driverless or self-driving cars) sense their environment using GPS, LIDAR and radar. They can navigate roads without human input and make intelligent decisions about interacting with other road users. AVs have the potential to improve safety, decrease the environmental impacts of vehicle use, increase mobility for seniors and youth, and reduce vehicle operating costs.

Although many researchers believe that driverless vehicles will not be ubiquitous in society until 2025 to 2040, the technology has been deployed in test-beds around the world.[6] In Queenstown, Singapore, SMART (Singapore-MIT Alliance for Research and Technology) has initiated testing of autonomous vehicles on a designated 6km route within a business park.[7] In the Netherlands, WEpods, a fully autonomous and electric vehicle, is being tested as a shuttle service between the train station in the town of Ede and the Wageningen University.[8] In Sion, Switzerland, the iconic PostBus service has partnered with a startup called BestMile for a two year pilot of autonomous buses called "SmartShuttles" that will service the city centre.[9] In addition to these examples, many other pilot projects aimed at testing this technology are being developed and initiated in cities around the world.

RideCo), while others serve as independent services on their own (such as UberHop and Chariot). Passenger comfort and convenience are often used as the major selling points of these services. These services often help to fill gaps that have been challenging for conventional transit to fill, yet there is also risk that these services could cannibalize ridership from the public transit network, making it less sustainable to operate public systems in the long run.

Changes brought about by on-demand services to the goods and services industry are even more drastic. Starting with on-demand restaurant food delivery (from services such as UberEats and Foodora) and fulfilment of personal errands (such as TaskRabbit), services are now moving in a direction of providing anything and everything that can be delivered on-demand. While users may benefit from an unprecedented level of convenience, widespread adoption may result in major implications for the transportation system. Whereas users today may trip-chain to save time when conducting their own shopping and errands, on-demand last-mile goods and services delivery might mean that the same user would be served by a number of different uncoordinated trips. This has the potential of greatly increasing the amount of trips taken, overall VKTs and transport related emissions.

6 Isaac, L (2016)
7 Singapore-MIT Alliance for Research and Technology (SMART)(2016)
8 Dutch Automated Vehicle Initiative (DAVI) (2016)
9 Post Bus (June 2016)

Automation is inescapable

Advancements in automation and robotics are making fully autonomous vehicles (AVs) a reality. While AVs are certainly coming, there remains some uncertainty over how they will be regulated and used, their acceptance by users and non-users, their timelines, and the exact mix of vehicles. Their adoption could result in dramatic changes to how people and goods are moved, and to the form of the integrated transportation and land use system. Vehicle automation might favour shared mobility over private ownership if vehicles in a shared fleet could deliver themselves to users.

Other trends in automation could impact the way manufacturing industries work, how freight is delivered and how land use patterns evolve. One impact of robotics and automation on the labour force will be to alter work-based travel patterns and goods movement.

From selling cars to selling mobility

The auto industry realizes the potential of new mobility to disrupt their conventional business models. To minimize the effects of a potential drop in vehicle ownership, many automakers are either joining forces with new mobility services, or developing their own. Ford Motors has partnered with Bridj in Kansas City to provide vehicles for a microtransit service, and General Motors has launched its own carsharing service called Maven.[10]

Transit and new mobility: downsides and upsides

New mobility technologies will have an impact on traditional transit operations, particularly those that offer coverage but low quality service. Bus operations in London, England have experienced a recent drop in passenger volumes, as have transit operators across Canada. While the causes are still being investigated, it is possible that some customers are shifting towards Uber due to its convenience and affordability (particularly of uberPOOL). On the other hand, Lyft claims that about 25% of their customers are travelling to or from transit stations—if so, then it demonstrates the potential of rideshare and transport network companies to provide convenient, cost-effective first-mile/last-mile solutions that support transit ridership.[11]

10 General Motors (GM) (January 2016)
11 Lyft (October 2015)

Rethinking the Public Interest

Conflicts can arise when the needs of new business models compete with the needs of other uses that have enjoyed long-standing protection under government regulations. As an example, Car2Go recently changed its policies to allow users to park on Toronto streets even though they had been generally limited to city-owned lots. The company thinks door-to-door access is fundamental to making carsharing work for the masses, and asked the City of Toronto for a residential parking pilot program in November 2015. However, Councillors felt the request would take too many parking spaces from residents who rely on street parking permits, and rejected the request. Faced with this challenging decision with difficult tradeoffs, officials chose to preserve the status quo, which prioritizes car-owning residents over carsharing residents. Car2Go now absorbs the cost of all parking infractions within its costs. As new business models such as carsharing become more pervasive, it will be even more important that regulations set out an environment that provides mobility options for all residents irrespective of how they prefer to access a vehicle.

New Government Roles

Successful companies seek out opportunities to disrupt and revolutionize existing business models. Now, disruptive forces in the transportation industry are pushing to reshape a sector that has been dominated by public infrastructure, services and regulation. Government involvement in some areas of transportation may be challenged, but services for some transportation consumers could improve. Governments will continue to prioritize and protect the public good, but will also have to accommodate changing consumer expectations and industry dynamics.

Adapting to new mobility service models

New mobility is difficult to define, and will be even more challenging to regulate because many emerging service models are fluid and evolve very quickly. They occupy a middle ground between traditional public and private transport services, avoiding neat categories that satisfy today's transport policies and regulations. Some service models have created conflicts in the transportation industry, as new players have either taken advantage of regulatory gaps or side-stepped existing rules altogether. The taxi industry, which is facing disruption from Uber, Lyft and other TNCs, was one of the first sectors to feel the impact of new mobility. Transit is also starting to see its effects, and will likely face greater competition over time. Government's role in operating transit services may diminish, but its role in ensuring safety, equitable access and the public good will be ever more critical.

Data—the new currency

In an increasingly connected world, data will become more valuable than ever. Smart systems are fueled by data, and new mobility services could thrive or fail on the richness of their

underlying datasets. In the technology sector, many emerging services (e.g. mobile traveller information systems) have deliberately opted to forgo short-term revenues and subsist on investor funds, in exchange for a larger market share and more user information that can be monetized in the long term. In managing transportation and land use systems, government has traditionally been the major collector and consumer of data. However, in a climate of immense competition over data ownership, government may not be able to keep pace. Loss of control over data collection will be a challenge, as government decisions should be informed by the best data available. The protection of user privacy is another key issue.

New approaches to managing transportation assets

Despite the possibility of a diminishing role for government in operating transportation services and collecting data, government will have continued oversight over the built environment. It will maintain its key role as the owner and caretaker of urban transportation infrastructure, and may need to change the ways that it manages those assets. One example would be if a rise in autonomous vehicles allows more efficient practices in road design and parking supply. Another example is the need for governments to reflect potential efficiencies arising from new mobility services in the business cases developed for new infrastructure projects. A third example is the need to monitor new mobility's impact on the consumption of transport infrastructure; the over-consumption of roads depletes both their condition and their quality of service, leading to greater maintenance costs and unwanted congestion and environmental impacts. Through its control over the infrastructure on which conventional and new mobility services operate, government can manage usage of the transportation system in a way that ensures overall sustainability.

User Needs and Desires

Users and consumers play a major role in shaping the future of our cities. Emerging technologies and services can enable new ways of doing things, but user uptake is what determines their true value and impact. Technological change presents new opportunities for the private sector, and at the same time introduces new challenges for the public sector—notably in protecting equitable access by all citizens to public services. In the transportation sector, a key question for government is how to distribute mobility resources in a way that meets the mobility expectations of users, while ensuring that all population segments can access those resources to meet their daily needs.

Higher and changing expectations

Consumers are diverse, and trends in other sectors reveal a growing consumer expectation to have this diversity catered to by services tailored to the needs of different population segments. The internet and mobile applications allow for even greater personalization of services, as an unprecedented wealth of information about goods and services is available online. Coupled with this is the rise of the sharing economy and an increased acceptance of foregoing exclusive ownership of some possessions. In transportation, there has been a rise in carsharing services that could lead to a decline in personal vehicle ownership.

A generation of mobile seniors, aging in place

Studies indicate that as baby boomers approach retirement, most expect to "age in place" and continue their historically high degree of mobility that relies largely on cars.[12] Freedom of movement has played an integral role in the life of that

12 Canadian Mortgage and Housing Corporation

generation, and will continue to influence their future lifestyle choices. Many baby boomers live in suburbs that are difficult to serve by public transit, raising the challenge of how to satisfy their mobility needs when driving is no longer an option due to health or income constraints. New mobility technologies and services could help satisfy their needs, but will be tested by the behaviours and preferences of this influential demographic. However, unlike previous generations of seniors, baby boomers are the first to age into retirement as connected internet users.[13] With approximately 80% of Canadian baby boomers currently online, it's possible that many new and emerging technologies and mobility services will be able to serve this cohort with little impediment.[14]

A connected culture

The “millennial” generation is at the forefront of a culture that expects constant online connectivity, real-time information and on-demand service. Consumers assume they can access information on transportation services via the internet as conveniently as they book restaurants and hotels, listen to music, share photos and communicate with friends and family. Mobile traveller information apps and on-demand mobility services cater to these expectations.

The connected culture has also raised expectations for customizable products and fast delivery. Consumers have tremendous power over where, when and whether to buy goods and services. With the growth in e-commerce, many

13 IPSOS (2012)
14 Statistics Canada (2014)

brick-and-mortar stores are evolving from points of sale into showcases for brand identities and products. These trends will impact freight movements and retail-related travel patterns, with real implications for land use.

On the flip side of the connected culture is a lack of connectivity experienced by some segments of the population due to the costs of being online, language barriers, or a lack of technical know-how. To ensure equitable access to mobility services in a highly connected paradigm, government will need to support population segments that have a reduced online presence.

Inequity of access and fragmented service

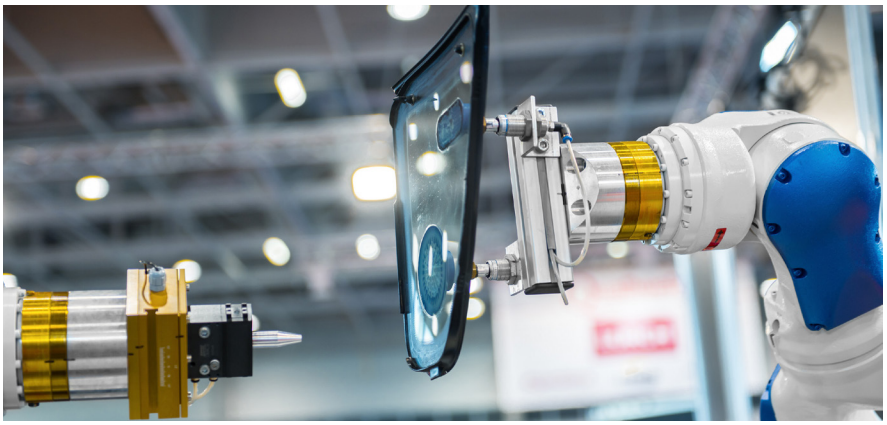
Rising inequity is a global trend to which the GTHA is not immune. A changing regional economy and rising housing costs are leading a majority of lower-income population clusters to locate outside Toronto's core, away from higher-order transit and other centralized resources. Ensuring access and mobility for these parts of the population will be a challenge, particularly as transit's farebox revenues face rising competition from new mobility services. High levels of personalized services could also lead to unsustainable transit ridership and a decline in service, resulting in a fragmented market. As private players in the market will eagerly respond to the needs of consumers who can pay, government will need to protect the interests of those who cannot.

Urban Form and Built Environment

Land use and transportation go hand-in-hand. New mobility trends are bound to have an impact on the built environment, and the reverse is also true. Mobility services and conditions have the power to alter the economics of location decisions and trip-making within industry as well as households. New development opportunities could also open up as mobility demands shift away from infrastructure centred around the private automobile.

Re-urbanization or re-suburbanization

Urban form could shift in very different directions, depending on how mobility markets develop and how governments regulate land use and transportation. Current trends reveal an interest from today's younger generation in a more urban lifestyle. On the other hand, the promise of a more productive suburban commute in self-driving vehicles could tempt many who struggle with the higher cost of living in urban centres. Longer car-based commutes could offer benefits for some, but would have negative impacts on society and the environment; the risk of increased urban sprawl is therefore a concern, and will need to be addressed in transportation and land use plans, policies and regulations.



Where robots go to work

The rise in robotics and automation, particularly in industry, will affect where businesses locate and what traffic they generate. In many areas, the loss of industrial employment due to robotics and automation has created lower employee densities, and at the same time reduced labour requirements have allowed industries to locate farther away from the cities and suburbs where potential employees live. More remote, lower-density

industrial workplaces are less likely to support efficient fixed-route transit services—but they could benefit from new mobility services that are more responsive to demand.

Parking unlocked

Shared mobility service models could decrease parking requirements in urban areas, particularly on streets and at major destinations. Users could be dropped off and picked up without the vehicles they use (particularly autonomous vehicles) sitting idle in the interim. This dynamic could unlock a significant amount of land now occupied by parking facilities. Parking lots and structures could be redeveloped, while on-street parking lanes could be reclaimed as spaces for walking, cycling, transit or motor vehicle movement. Governments will have to be proactive in protecting these reclaimed urban environments; in the meantime, the future value and repurposing potential of planned parking facilities should be considered through a new mobility lens.

Smart parking applications could provide an interim solution to the growth of existing parking demand. Applications like Rover[15] and WhereiPark[16] can help to unlock underused parking assets by connecting drivers requiring parking with other users who have parking spaces to offer. Fulfilment of demand using existing parking may delay the need for construction of expensive new parking facilities that will quickly become obsolete. However, opening up a new market of parking spaces in the interim may also lead to increased demand for driving as parking constraints have been seen as a limiting factor for drivers in the past.

15 Rover (n.d.)
16 WhereiPark (n.d.)

An electric future

One new mobility paradigm includes an electrified (or "decarbonized") future transportation system that would require very different infrastructure than today's petroleum-based cities. Because electric vehicles are typically charged at home, work and other destinations, the wide-scale adoption of electric vehicles would allow lands now occupied by service centres to be repurposed.

Emissions from transportation made up about 35% of all emissions in Ontario in 2013, the largest single source of greenhouse gas (GHG) emissions. More than 70% of the transportation-related emissions can be attributed to cars and trucks. A shift towards an electrified transportation system is expected to contribute significantly to the decrease in GHG emissions.

Expanding the use of electric vehicles

Ontario's Climate Change Action Plan identifies transportation as a major action area, and highlights a number of actions for the government to take in the transportation sector, many of which are related to creating an electric future. Actions include maintaining incentives for electric vehicles, providing free overnight vehicle charging, ensuring that charging infrastructure is widely available, and making electric vehicle-ready homes and workplaces a new requirement.

The Ontario Ministry of Transportation (MTO) has been an avid proponent of increased adoption of EVs in Ontario. In addition to education and awareness programs, the ministry has implemented an Electric Vehicle Incentive Program (EVIP) to counter the current price premium of EVs as compared to conventional gas-powered vehicles, and has also established an Electric Vehicle Chargers Ontario (EVCO) grant program to encourage the expansion of charging infrastructure across the province.

3

3. The Futures of New Mobility

What will the world look like by 2041? Where will people live, work and go to school? How will people and goods be transported? Will vehicles be able to roam autonomously? Would individuals still need to own their own vehicles?

While many futures are possible, the one that arrives will depend on the progression of key trends, and on the responses of government, the private sector and transportation system users. This chapter presents two scenarios developed to illustrate diverging outcomes of the new mobility paradigm. The first scenario envisions a future where governments take a strong stance in directing the evolution of new mobility. The second scenario envisions a future where governments allow new mobility trends to develop organically and with little direct regulation. Both scenarios take into account many different global and regional trends that were investigated for this report.

The goal of this chapter is not to choose a direction, but rather to explore two sets of outcomes that define the extremes of possible opportunities, risks and implications related to new mobility. In the following diagram the middle portion shows how various elements of new mobility are likely to interact in the future given their current trajectories while the panels on either side describe the network conditions that might arise out of two divergent response scenarios: a “highly managed” development scenario and an “organic” development scenario.

HIGHLY MANAGED DEVELOPMENT

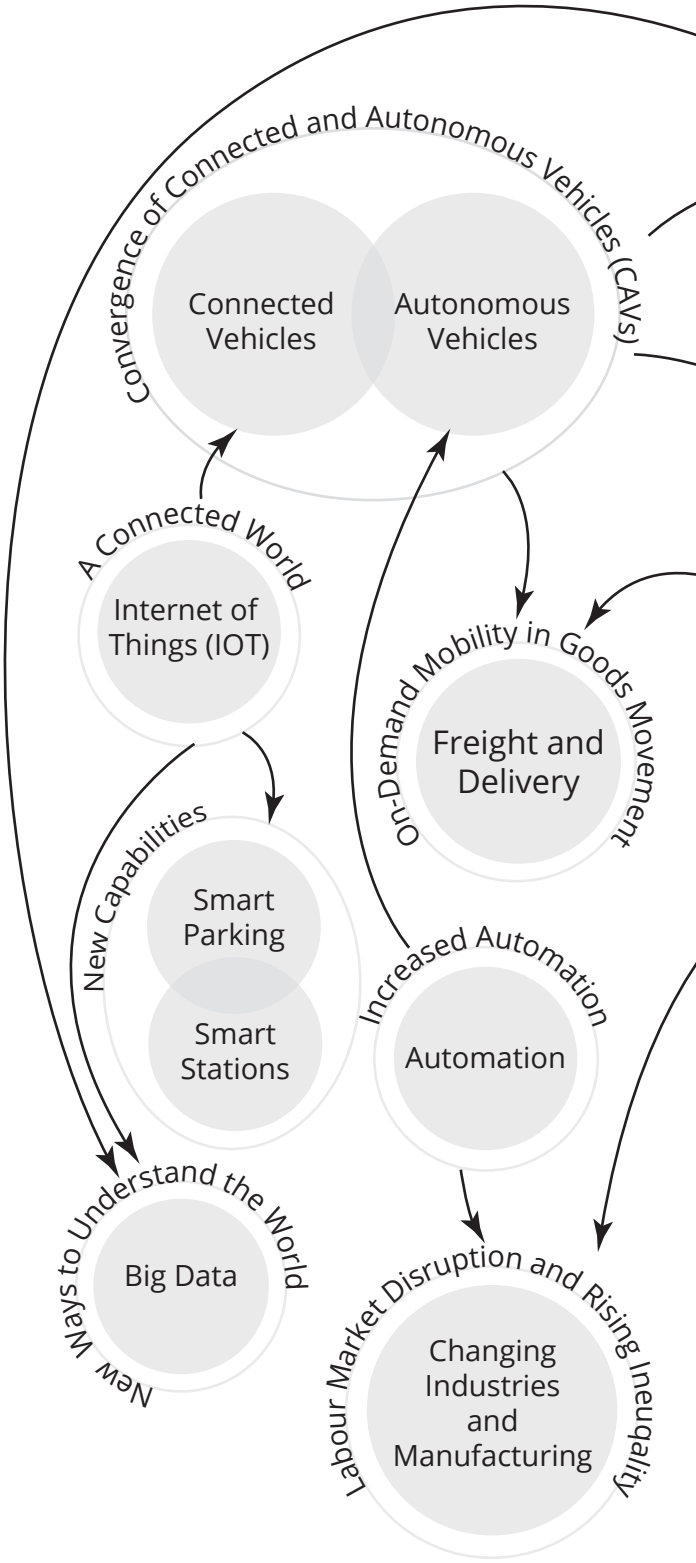
Shared/on-demand mobility services would be limited to only those services that complement public transit in a first-mile/last-mile function, increase per vehicle occupancy, or satisfy demand in areas that are difficult to serve with transit. However, the banning of all other shared/on-demand services would be difficult to enforce, and some may continue to operate outside of regulations. Service providers that partner with government would have to enter formal contractual relationships with government to operate, making it a challenge for many service providers, especially smaller ones. Long procurement processes for retaining services would make solutions outdated by the time they are implemented, limiting innovation.

Public transit would continue to provide broad network coverage, with higher-order or frequent service parts of the network acting as the backbone. Certain elements of shared/on-demand services would be incorporated into the public transit service offering, such as through microtransit in areas that have lower demand.

Mobility management would be a central part of government's role within transportation. Service pricing, road user charges, and taxes would play a fundamental part in motivating desirable people and goods movement behaviour. Government may consider taking a one-window approach for personal mobility, by integrating all pricing on one platform, but may face challenges in operating and maintaining such a system.

The built environment would continue to be shaped by policies that encourage higher densities. Mobility management mechanisms would contribute to discouraging widespread acceptance of longer commutes as a result of CAVs. With the expectation of increased first-mile last-mile and autonomous services, stations would be re-developed to address the diminished need for parking at stations.

Divergent to Imminent

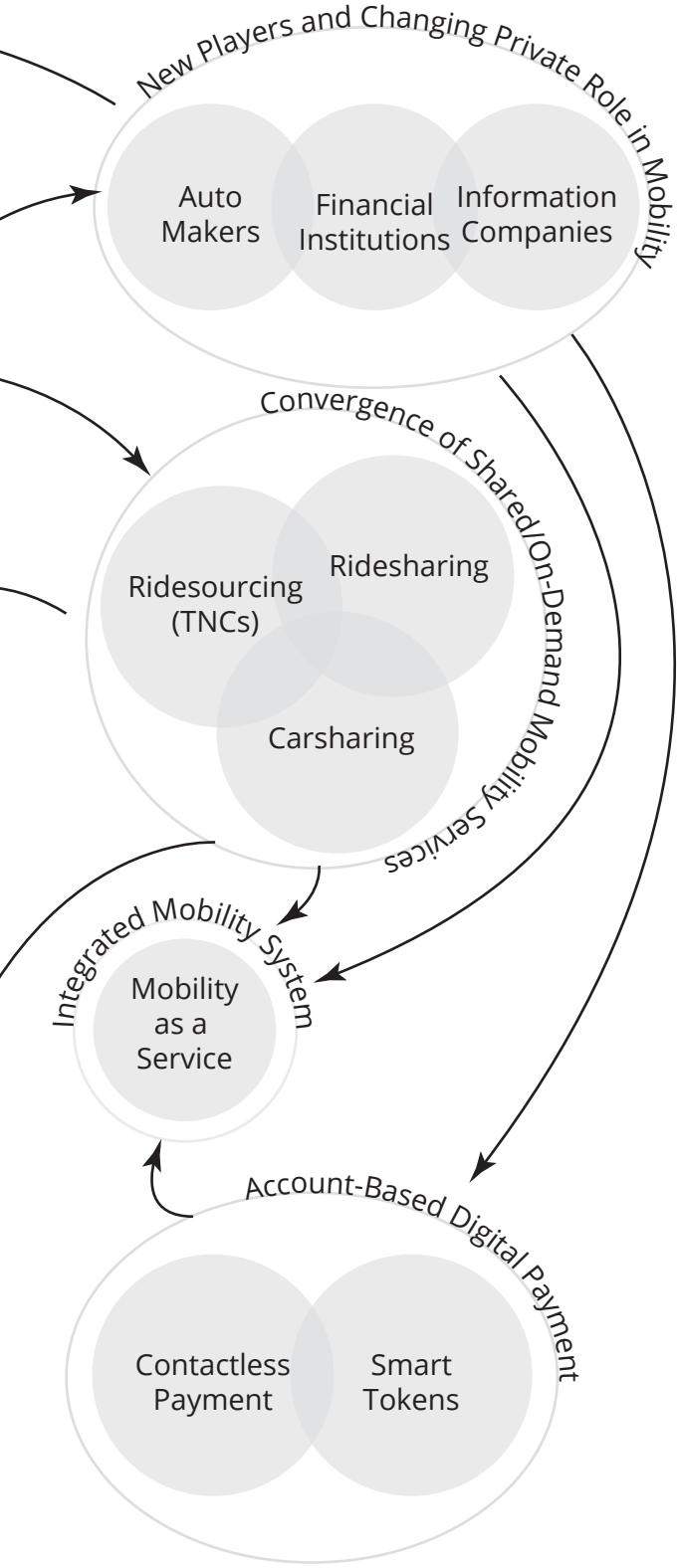


Drivers of Change

Evolving Economy

Changing Environment

Responses an Future



ORGANIC DEVELOPMENT

Shared/on-demand mobility services would be allowed to operate freely with little oversight. With automation, no driver will be needed, so even individuals would be able to put their privately owned CAVs up for sharing, which could introduce concerns around safety, security and liability. Driven by profit, pricing may motivate single-occupant vehicles, and longer travel distances, resulting in more driving overall.

Public transit would only remain in corridors where transit is much more competitive in travel time and convenience, or where intense demand results in autonomous vehicle congestion. Other parts of the network, particularly those with low levels of service, would have ridership cannibalized by emerging modes that are more demand responsive.

Mobility management would be difficult to coordinate with low government oversight. Pricing of services would be based purely on competition, with little regard for network, or societal impact. Modes and services that generate the most profit would be motivated, while low-impact modes such as transit, walking and cycling would be less emphasized.

The built environment would return to a trajectory of sprawl as CAVs would enable commuters to travel longer distances without the stress from driving and lost productivity. Transit station parking would largely become obsolete as most riders will be dropped off by CAVs, but without a plan for how to deal with these structures, many will sit vacant. Similarly, without plans to accommodate the increase in drop-offs at stations, station access will be a challenge, and perhaps a deterrent to transit use.

4

4. Strategic Directions

From the analysis of key trends and future scenarios, it is evident that the arrival of new mobility will bring about major changes to the transportation system and the region as a whole. Although many aspects of this coming paradigm remain uncertain, this change will happen quickly and all levels of government in the GTHA must be prepared to respond.

This chapter highlights opportunities and risks associated with the arrival of the new mobility paradigm and identifies strategic directions that government should consider. The intent of these strategic directions is not to prescribe an appropriate response, but rather to garner greater consideration for the implications of new mobility at all levels.

The opportunities, risks and strategic directions have been organized under six major themes that correspond to core areas of action. These themes have been listed below alongside the key diagram which is used throughout this section.

1 **Theme 1:**
Government Re-Imagined

2 **Theme 2:**
New Mobility is the New Transit

3 **Theme 3:**
The User is King

4 **Theme 4:**
Driving the Cities We Want

5 **Theme 5:**
All About the Data

6 **Theme 6:**
Plan for the "Known Unknowns"

Theme 1: Government Re-imagined

The Challenge

In this era of technology and innovation, the private sector has become increasingly involved in what were, until recently, government services. For several decades, transit in the GTHA has been managed by municipal and provincial governments, and used as an instrument of social policy. Government now needs to re-examine its role and purpose in providing mobility, an effort that could fundamentally alter the current model of government as transit operator. It could lead government toward a role more focused on mobility policy and management, with more limited, strategic choices about the markets it will serve directly.

Today, transit systems operate in sparsely populated, low-demand areas of the GTHA to ensure a basic level of access and mobility for all citizens. These services often require a substantial operating subsidy that is funded by property taxes and transit fare revenues on higher-ridership routes. However, advanced technologies and data analytics have allowed the private sector to deploy potentially more attractive and financially sustainable transportation services in these markets. Recognizing this, what is government's role in delivering access and mobility? Answering this question may require us to redraw the line between public and private, re-imagining the government space.

Private delivery of public services is not new, and in fact many of the earliest transit services in Ontario were privately operated. However, government must be aware of the risks, opportunities and implications of a private-sector resurgence in mobility, and be proactive in clearly defining its role and position. An added challenge is the pace at which new technologies and service models are emerging and evolving. Governments will be challenged to keep pace with the private sector unless they adopt a more nimble and responsive approach.

One of government's core goals is to optimize value for society as a whole. In the case of transportation, the public sector has done this by providing services when the private sector was not engaged or did not have appropriate business models. However, now that the private sector can provide competitive services (or better) to at least some markets, some public-sector services may have difficulty competing. The public sector needs to reassess its service offerings and consider how new service models can be complementary and contribute to a broader vision for the GTHA.

Opportunities

- **Rapid innovation.** The private sector, with its more limited mandate and stakeholders, can often innovate more rapidly than the public sector. Involvement of the private sector in conventional public services could inject innovation and create opportunities for more creative and effective service delivery.
- **Improved service.** Emerging service models focus on greater convenience and optimized routing, which can make them more desirable for users. But rather than competing with transit, new mobility could provide a complementary solution to the first-mile/last-mile challenge and provide quality connecting services.
- **Reduced draw on government resources.** If the private sector provides some mobility services, public operating costs could decline. Scarce resources could then be reallocated to other services that offer greater returns.

Risks

- **Sub-optimal societal outcomes.** The private sector does not have a mandate to achieve optimal societal outcomes, and sometimes the goals of business may conflict with the public good. For example, an excessive dependence on privately supplied on-demand services could have undesirable impacts such as increased congestion, emissions and energy use.
- **Loss of control.** Government may lose control and oversight over critical parts of the transportation system, as the private sector adopts a greater role in data collection, system monitoring and service delivery.
- **Lack of internal capability.** Governments may not have the internal skills and resources to manage a transportation system that is increasingly driven by technologies and data.
- **Revenue shock.** Private mobility services could lead to lower transit revenue, particularly where they target high-ridership routes and leave government running inefficient routes that could also lose ridership.

[1.1] Picking a lane

The private sector can find ways of providing better mobility outcomes to individual users, but government must be mindful how this could impact its ability to achieve its vision and goals for the GTHA. The public sector must lead—doing nothing is not an option, because the private sector will look to government for a policy and regulatory framework and a statement of government's role. Inaction will encourage the private sector to exploit grey areas of policy or regulation. There may be no exact parallels of a paradigm of innovation challenging government so fundamentally, but it may help to consider cases where business has adopted responsibilities in other sectors such as telecommunications, health care and social services.

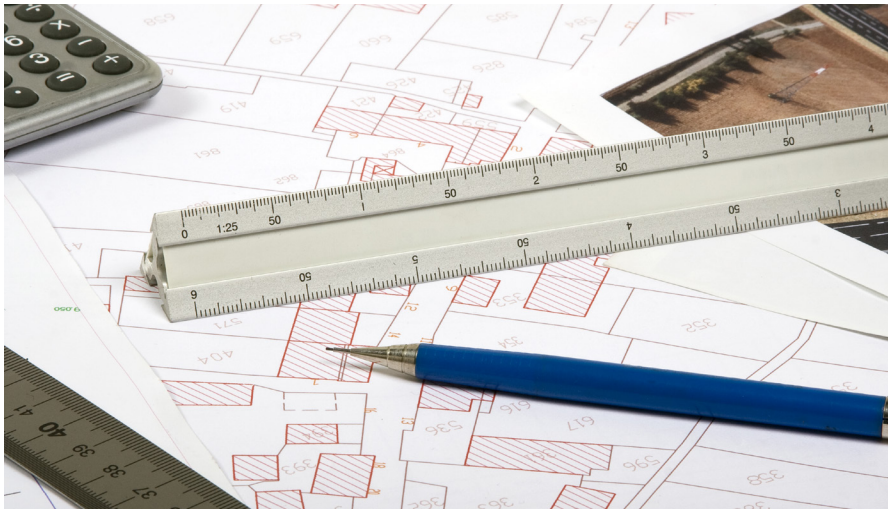
Government must be clear in its role and vision for the future, extending beyond mobility to address many aspects of life in the GTHA including land use, health, environment and the economy. The current review of the Growth Plan for the Greater Golden Horseshoe and the review of the Regional Transportation Plan offer perfect opportunities for the provincial government to set a clear direction for the coming decades.

[1.2] Regulating a fast-moving target

Regulatory approaches for emerging modes and services vary greatly from jurisdiction to jurisdiction, as governments grapple with how to balance risks and opportunities. While ridesharing has long been welcomed by many transportation agencies as a way to increase vehicle occupancy, transport network companies such as Uber and Lyft seem to challenge governments due to their fluid ability to provide both

ridesourcing and ridesharing services through a single platform. Many jurisdictions are still contending with issues around driver insurance, safety and security, accessibility for people with disabilities, and competition with other modes such as taxis, transit, walking and cycling.

Senior levels of government can play a role in regulation. Countries such as Brazil, Spain and Italy have prohibited transport network companies outright. In Canada, where municipalities have been generally unwilling to advance regulation and fill gaps in roles and responsibilities, provinces could provide guiding frameworks. For example, British Columbia has temporarily banned transportation network companies while it develops guidance and potential regulation.



[1.3] Planning versus licensing

New mobility discussions in Canadian municipalities have revolved around government's licensing role. This is needed, but government's important planning function has often received scant attention. Regulations must advance in sync with planning and mobility management functions. For example, Toronto recently opened the door for transportation network companies such as Uber to operate in the city, but requires the companies to share basic data such as the origins and destinations of trips. This represents progress, but the data will be used for licensing purposes; it will not provide the information needed to manage an efficient urban mobility system. Beyond licensing and operations, new mobility discussions need to take place within the context of a long-term transportation vision as its impacts will be lasting and pervasive.

Progress in Toronto

The City of Toronto recently developed a new Vehicle-for-Hire by-law that includes a new licensing category for private transportation companies (PTCs). The by-law sets requirements for basic data sharing, and regulates taxicabs, limousines and PTCs in a way that enhances public safety and consumer protection while providing opportunities for competition and innovation.[17]

17 City of Toronto (2016)

[1.4] Moving from operator to enabler

The public sector will need to rethink its role in transit provision as the private sector's market share grows. While GTHA governments may be able to step back from certain aspects of transit service, they must continue to shape and direct them to ensure positive outcomes for the entire region. One way to do this is to set regulatory parameters within which all service providers must operate, ensuring that the framework protects the public interest without stifling innovation. The framework should also be aligned across provincial, regional and local governments, because inconsistencies across boundaries or between areas could complicate GTHA-wide services or create inefficiencies. All levels of government should be open to emerging opportunities, and should not rely on past practices to guide future approaches.

[1.5] Creating new skillsets, processes and partnerships

To succeed in an increasingly technology- and data-driven landscape, governments will need a workforce development plan to transition from obsolete skillsets to new capabilities. Partnerships with the private sector will be critical in areas where governments lack the experience or resources to deliver services directly; this will require more flexible and responsive procurement processes that encourage private-sector innovation.

[1.6] Experimenting with confidence

Rapid change means there will often be insufficient information or experience to confidently evaluate options before implementation. Experimentation, and a willingness to either succeed or fail, will be essential. Time-limited pilot projects are a good way to evaluate the impacts of new services or regulations before adopting more lasting changes. Pilot projects should consider how a permanent solution would be established if they succeed, and how lessons learned will be captured if they fail.

[1.7] Innovating through pricing

While the private sector may increasingly deliver mobility services, the infrastructure those services use will still be owned and maintained by government. Pricing of infrastructure is a key tool in government's toolbox, and enables mobility management opportunities that could prevent unacceptable congestion and environmental impacts. Pricing incentives and disincentives can encourage positive behaviors such as carpooling, active transportation, teleworking and time shifting. Furthermore, private-sector involvement will likely move mobility pricing from a fixed-price regime to more value-based pricing. Government will need to make its pricing practices more flexible and responsive to market conditions.

Pilot-testing innovative access to GO stations

GO Transit conducted a pilot test with RideCo to provide convenient, on-demand first-mile/last-mile access to the Milton GO station using on-demand "personalized mass transit." Unlike Uber and Lyft, RideCo sourced rides through established transportation services such as shuttles, taxis and limousine services to help commuters reach GO train and bus services. The pilot has concluded, and while successful, there is no clear direction on how it might become permanent.[18] RideCo currently operates as a TNC in Kitchener-Waterloo where the company is based. From the lessons learned out of this pilot, Metrolinx is looking further into how on-demand services can be used in coordination with existing transit services.

Road testing

The United Kingdom's Centre for Connected and Autonomous Vehicles has allocated £100 million towards an intelligent mobility fund. Part of the funding will go towards trials of connected and autonomous vehicles so the government can learn the implications of the technology, and to identify regulations needed to ensure the technology's deployment in a manner that benefits the UK. [19]

18 Milton Transit (2016)
19 Government of UK (2015)

Theme 2: New Mobility is the New Transit

The Challenge

Emerging technologies, the sharing economy and innovative business models are likely to have disruptive impacts on public transit, but also present opportunities to improve transit elements such as traveller information systems and demand-responsive services. Transit can continue to flourish if it embraces change and adopts new business practices. However, because benefits for individuals can come at the expense of broader societal benefits, transit systems will need to consider how new mobility service models can be successfully integrated.

The sharing economy and on-demand services have already begun to change the GTHA's mobility landscape. Transportation network companies (TNCs) integrate both of these elements, and their rapid success has disrupted the taxi industry. TNCs have been able to undercut the cost of traditional taxis while providing more effective matching of drivers and passengers, user-friendly mobile apps, advanced algorithms, improved traveller information and streamlined payment mechanisms. Some TNCs are operating semi-fixed route services during peak periods, and enabling users to open up their rides to others. These services are increasingly encroaching on the realm of public transit, but with a more dynamic and convenient offer. While public transit may risk losing ridership to emerging services in certain markets, this shift in service provision provides an opportunity for transit agencies to focus transit in areas where it is most effective. Autonomous vehicles are expected to further accelerate the impact of TNCs on transit, as new operating models expand the range of geographies and customer volumes that can be served profitably.

TNCs may be capable of replacing conventional transit in some markets, particularly low-density areas where inadequate demand makes fixed routes costly and ineffective. However, in denser areas where public transit thrives, broad use of on-demand services could be detrimental. When regulating TNCs and other new mobility service models, government must carefully consider their possible range of impacts on quality of life.

Opportunities

- **Safety for all users.** The most immediate benefit of autonomous vehicles and related driver-assistance technologies is improved safety for motorists and other street users. This change could make on-road cycling more comfortable for a broader demographic to use it regularly.
- **Improved traveller information.** Dynamic traveller information systems can keep users updated about transportation conditions.
- **Optimized travel patterns.** Advanced data analytics and route assignment or service deployment algorithms have the potential to help optimize travel patterns. Instead of all users striving for individually optimal solutions, coordination could permit a more system-optimal outcome.
- **First-mile/last-mile access.** New mobility models can fill market gaps that transit has found difficult to serve. First-mile/last-mile trips have been a particular challenge for conventional transit services in lower-density areas. The flexibility of on-demand feeder services makes them an excellent complement to conventional transit.

Risks

- **Lack of influence over algorithms.** Algorithms will drive new mobility service models. Without input into how algorithms are written, it will be difficult for government to maximize the chances of socially optimal outcomes.
- **Lack of influence over data.** A wealth of data will be collected by private entities involved in new mobility. Not owning this data means that government will need to work hard to access it and influence how it is used.
- **More driving.** More direct and convenient car-based mobility options (e.g. TNCs and automated vehicles) that draw travel demand away from transit, walking and cycling could increase overall vehicle-kilometres travelled.
- **Workforce impacts.** Government workforces may not possess the skills to integrate and leverage new mobility data analytics, algorithms and operating models. TNCs have already impacted jobs in the taxi industry by relying on casual and affordable labour, and autonomous vehicles would dramatically change the role of vehicle operators.

[2.1] Keeping a network perspective

Door-to-door transport is undeniably attractive from a user standpoint, but must also be viewed through the lens of how it will impact the GTHA's transportation network and quality of life. A proliferation of new mobility services will require all levels of government to adopt a strong role in managing the overall network while harnessing technology and innovation, and to find ways of integrating new models of service into the transportation system. Walking, cycling and public transit will remain crucial to alleviating congestion and keeping the region a desirable place for people to live and work.

[2.2] Supporting the transit backbone

New mobility service models could disrupt and even replace elements of the public transit system, but could also complement and be integrated with existing transit services to make the transportation system better. It is crucial that existing higher-order transit services continue their role as the backbone of the transportation system, and that new mobility services focus on acting as first-mile/last-mile feeders. Fixed-route rapid transit will likely remain the most efficient and sustainable transport option for densely populated areas, but highly subsidized transit services in lower-density areas will be less able to compete with new mobility services once they are adopted more broadly. In those areas, government will have to decide how dynamic on-demand services can be incorporated, either by working with new mobility businesses or developing their own.

Bridging the gap with first-mile/last-mile services

There are numerous examples of on-demand services being pilot tested by government agencies in partnership with private companies.

In the United States, Lyft has partnerships with a number of transportation authorities. California's Metropolitan Transportation Commission delivers carpooling services through Lyft's Carpool mode which (unlike its better-known ridesourcing services) helps commuters find carpool partners with similar routes, and allows individuals to use online cost-sharing for their trip.[20]

In Kansas City, Ford Motors and Bridj have partnered to provide an on-demand microtransit service that complements other forms of transportation. The service has designated pick-up drop-off locations near Kansas City Transit stops and bike-share stations, making it easy for riders to seamlessly continue their trip.[21]

20 Lyft (2016)
21 Ford Motor Company (2016)

[2.3] Making a business case for transit

From a pure cost-recovery perspective, some transit investments may not seem viable. However, transit's social benefits must be accounted for in business case appraisals, which should consider carbon costs, health benefits, community resilience, road safety and congestion relief.

[2.4] Adapting the workforce

The emergence of TNCs has already had labour impacts on the taxi industry and automation has resulted in many waves of job-loss across North American labour markets.[22] With the onset of on-demand transit services and autonomous vehicles there will undoubtedly be some impact to the public transit industry, with vehicle operators likely to be the most affected. In the GTHA, guided rail systems will likely be the first to feel the impact of automation with the implementation of Automatic Train Control in the Toronto Transit Commission (TTC) subway system. To minimize the resulting disruption, transit systems should seek opportunities for their workforces to acquire new capabilities that will support the evolution of transit. Customer service, maintenance, emergency response, and other areas that are more challenging to address with preemptive solutions will likely remain within the jurisdiction of the human labour force.

22 Ticoll, D (2015)

[2.5] Avoiding zero-occupant vehicles

Average vehicle occupancy has remained low for decades, as single-occupant vehicles have become the norm. The emergence of autonomous vehicles could further exacerbate this by introducing zero-occupant (i.e. driverless and riderless) vehicles, which in theory could roam the streets continuously. Widespread private ownership of autonomous vehicles could be a major contributor to this threat, particularly in areas like downtown Toronto where drivers might (if the law permits) allow their vehicles to roam the streets rather than pay high parking prices. In contrast, the use of autonomous vehicles in a shared and integrated mobility model would have predictably more beneficial outcomes for the GTHA, and should be supported over a private ownership model through regulatory mechanisms. Demand management mechanisms that have been used to curb single-occupant vehicle use under the current paradigm will have to be re-evaluated to ensure their continued effectiveness as autonomous vehicles enter the market.

Mobility as a Service (MaaS) in action

A pilot MaaS system called UbiGo was tested over six months in Gothenburg, Sweden. The service provided 70 paying households with access to public transit, carshare, car rental, taxi and bikeshare all through a single platform, for a package price. At the end of testing, no household had dropped out of the pilot, and many wanted to continue using the service.[23]

[2.6] Providing one-window access

Integration between existing public transit and new mobility services will be crucial to making a shared transportation system function effectively. To reinforce the seamlessness of the network, government should take on a leadership role in developing a strategy for coordinated pricing and operation among various service providers, administered through a single portal. One approach could be to develop a Mobility as a Service (MaaS) platform that integrates a range of mobility options and gives users a single point of coordinated access. Developing and operating a MaaS platform would be a different role for government, but would allow it to retain influence over the pricing and management of regional mobility. As with any shift towards unfamiliar territory, development of IT solutions such as a MaaS platform internally comes with certain risks that government will have to contend with. As more becomes known of MaaS platforms and the changing labour profile within the public sector, government will be able to better assess how to best balance between influence over the system and risks associated with managing the unknown.

23 UbiGo (2016)

Theme 3: The User is King

The Challenge

Transit systems are adapting to a new world of rising consumer expectations, accelerating product personalization, ubiquitous mobile devices, and internet-enabled real-time information. They are increasingly focused on the user experience, and rely on marketing and engagement strategies to attract and retain customers. Alternative transit services (whether publicly or privately delivered) are filling gaps where conventional services are not meeting customer needs and desires.

Users' diverse mobility preferences are also shifting due to technological, economic and demographic trends. Today's young adults own fewer cars than previous generations have and are generally more concerned with their connectivity to the internet.[24] In response, on-demand ridesourcing and carsharing have emerged as convenient and affordable alternatives that keep users connected physically with the help of digital connectivity.

Even as these changes take place, access to and affordability of mobility services remain key priorities for users. Individuals that are unable to drive, such as older adults, youth and people with disabilities, remain disadvantaged from a mobility perspective; this is particularly true in suburban and rural areas with lower levels of transit service. The need for all residents to have mobility options, regardless of their location, income, age or ability, will continue—however, increased market segmentation and service personalization bring with them the risk that certain market segments could see less service, rather than more. Some disadvantaged groups, such as seniors, could be impacted more than others.

24 Environics Analytics (2015)

Opportunities

- **Openness to shared mobility.** Current trends in various sectors point to a general openness towards the adoption of shared mobility.
- **Personalization of service offerings.** New technologies and mobility service models are well suited to provide desirable types and qualities of services, and to compete with privately owned cars.
- **Improved network coverage and geographic equity.** Dynamic services could reach a broader user base, including those who live in areas of the region that have been more difficult to serve effectively with public transit.
- **Access to user data.** Users have been open to sharing some personal data, which is critical to the success of dynamic on-demand services.

Risks

- **Personal versus societal benefits.** The personal benefits of on-demand mobility services could challenge the societal benefits of a more coordinated and balanced mobility system.
- **Marginalization of "offline" individuals.** With most new mobility service interactions occurring through the internet using mobile devices, there is a risk that parts of the population that are poorly connected may have reduced access to transport services.
- **Inequitable access to services.** More convenient on-demand services may come at a higher cost to users. While this may be an attractive trade-off for many users, some will likely be priced out of vital transport services unless a subsidy is provided.
- **Lack of consideration for universal access.** Preserving accessibility for seniors and people with disabilities may not be a priority for private operators.

[3.1] Focusing on users

How travellers respond to change, and whether government improves its understanding of user behaviours and sentiments, will help shape the emergence of new mobility models. Data-enabled mobility services could lead to more refined market segmentation and the emergence of more tailored solutions with the potential to improve service across various groups and demographics. While many indicators point towards consumer acceptance of shared and on-demand mobility services, this could change with environmental or socio-economic shifts. Public support for a regional transportation vision will also be important to ensure that sustainable mobility remains a top priority even in changing political climates; it is critical for users to be informed about the implications of their mobility choices. It will be particularly challenging to build user awareness of these broader implications, even as the attractiveness of new services grows.

[3.2] Ensuring equitable access

Even though government's role in providing mobility may evolve, it should continue to play a role in mobility pricing and targeted service provision to support an equitable distribution of benefits for travellers regardless of their demographic, location or trip timing. Emerging new mobility service models should provide the tools to make equitable access a reality, but that objective is not a natural priority of profit-driven companies. The adoption of autonomous vehicles will make equitable access across geography and time easier to accomplish, but individuals without reliable internet connectivity or online skills will be excluded. The ability to access mobility services without the internet should remain.

[3.3] Designing for universal access

New technologies have the potential to remove mobility barriers for the elderly and people with disabilities, and should be designed into delivery solutions. From driverless vehicles to accessible smart stations, an array of solutions could improve universal access.

[3.4] Striving for personal mobility

The convenience of cars is difficult to match, but personalized mobility could help break our long-held attachment to the personal automobile. Diverse consumer needs require diverse, nimble and adaptable services, and emerging technologies make it possible for transportation to be a much more personal experience. The use of personal identifiers (e.g. smartphones or smart tokens) over an integrated platform (e.g. MaaS) will give travellers access to a mix of mobility options that are tailored to their needs. From a social standpoint, account-based personal mobility also provides a mechanism for government to provide targeted subsidies to individuals who are in need, without compromising the cost-recovery potential of the greater network.

Theme 4: Driving the Cities We Want

The Challenge

How people travel is strongly influenced by aspects of the built environment such as land use patterns and transportation infrastructure. While the GTHA's post-war growth was characterized by low-density, automobile-oriented development, in recent years planners have emphasized active and sustainable modes of transportation such as walking, cycling and public transit. Approaches to physical planning such as transit-oriented development (TOD) and complete streets have been successful in facilitating more walking, cycling and transit use, as well as allowing public transit to be provided more efficiently.

Changes in transportation technology and user preferences that will accompany new mobility are expected to create opportunities for changing our urban, suburban and rural built environments. Emerging travel options such as carsharing, ridesharing, on-demand services and autonomous vehicles may require new or adapted infrastructure. Convenient on-demand services could lead fewer people to drive alone and park their car at their destination, reducing parking demands at rapid transit stations and travel destinations, and permitting a new view of the urban realm. At the same time, more buildings may need convenient pick-up and drop-off areas. Automated vehicles may enable more efficient use of road space and greater road safety, allowing improved walking and cycling facilities and more shared use spaces. Freight movement could also be impacted, leading to changes in the nature, design and location of goods movement infrastructure.

Widespread use of autonomous vehicles could hinder urban intensification, which is a provincially directed policy goal of governments across the GTHA. Access to driverless cars could increase the acceptability of long car commutes, and thus encourage more development outside major centres; it could also undermine efforts to increase land use densities around rapid transit stations.

Opportunities

- **Improved geographical access.** On-demand transportation services could improve transit service in low-density areas of the GTHA.
- **Reclaimed space for redevelopment.** Autonomous vehicles and on-demand services may reduce parking demand, allowing redevelopment of parking areas into more people-oriented environments.
- **Less cluttered streets.** Automated vehicles could reduce the need for car infrastructure, opening up new opportunities for multimodal facilities and shared use spaces.

Risks

- **Increased sprawl from acceptance of longer commutes.** Autonomous vehicles may increase commuters' willingness to travel long distances, leading to greater emissions and infrastructure costs.
- **Mismatch of land use policies and emerging infrastructure needs.** Existing land use policies, if unchanged, may constrain innovation and adaptation to new transportation technology.
- **Competing demands over reclaimed space.** Conflicts could arise among different user groups in competing for limited funding and physical space.
- **Obsolescence of current plans.** Today's planned infrastructure investments will be made over the next decade, at the same time that emerging new mobility models might indicate different or conflicting needs.
- **Impacts to human health.** The convenience of automated and on-demand mobility may detract from healthy and active modes of transport such as walking and cycling.

[4.1] Planning proactively with a clear vision

To address the opportunities and risks presented above, GTHA governments need to proactively anticipate how the movement of people and goods might change in the future. A vision for planning should leverage technological change, rather than being subjected to it. For example, policies should address the possibility that developable land could be freed up by reduced parking demands.

[4.2] Reclaiming space for active and sustainable modes

If reduced demands for on-street parking make some road space available for other uses, municipal governments should make it a priority to reclaim this space for active and sustainable modes, or urban space, instead of releasing it as additional road space for cars.

Implementing a vision

Street layout, residential density, and the location of services were carefully planned for the new community of Hammarby Sjöstad in Stockholm, Sweden. Now nearing completion, the development will be home to 24,000 people and 4,000 jobs, and has already met the target for 80% of trips to be made by non-car modes.[25]

Return to a human scale

Freiburg, Germany has maintained a clear vision that includes human-scale development, community participation and priority for public transportation since the city was rebuilt following World War II. As a result, the city is now recognized as one of the most livable and sustainable in the world. [26]

[4.3] Integrating land use and transportation policy

While optimizing transportation efficiency and maintaining mobility choice should remain future priorities, it will also be necessary to preserve public safety, build people-oriented places, and protect the natural environment. Transportation and land use will need to be considered as an integrated system. For example, an appropriate combination of incentives and disincentives may be needed to minimize sprawl and congestion resulting from the adoption of automated vehicles.

25 Passenger Transport Executive Group (2011)
26 International Making Cities Livable (n.d.)

Planned obsolescence for parking

With the expansion of the GO rail service, there has been a dramatic increase in parking demand at GO Stations. As stations become increasingly space-constrained, more and more structured parking has been built. In recent years, 2,800 parking spaces have been built per year at an approximate cost of almost $5,600 per surface parking space and $33,800 per structured parking space.[27] As new mobility changes how people get to stations, this investment will need to be carefully reviewed to ensure value for money and that built structures will be designed for dissassembly or adaptive reuse in the future.

[4.4] "Futureproofing" infrastructure

Future government projects and plans should be assessed through the lens of new mobility to minimize the risk that major investments (e.g. freeways or rapid transit lines) could be rendered obsolete. This "futureproofing" of infrastructure may raise the bar for projects to be considered worthy of implementation, may require stronger links to land use planning to ensure ridership supports the investment, and may require more flexible transit station designs that can be adapted to the shifting circulation and parking needs of emerging access modes. It will also be important for design standards and zoning (e.g. for parking and freight loading facilities) to be regularly reviewed to reflect changing conditions.

27 (Metrolinx, 2015)

Theme 5: All About the Data

The Challenge

New mobility systems will give transportation practitioners and service providers a higher volume of detailed data for planning, analysis and overall decision making. Big data fuels these processes, and while its use will also demand new skills, the insights it provides is well worth the effort. By allowing more refined analysis and market segmentation it will permit more tailored solutions that better meet the needs of various customer groups.

Smartphones represent a significant tool for responding to mobility issues. They allow users to share services, crowd-source information on collisions and service interruptions, and plan and modify trips based on real-time information. Today's critical mass of smartphone users has allowed transit systems and private companies to offer on-demand services as an alternative to fixed-route, fixed-schedule transit routes.

The quantity and nature of mobility data being generated, stored and processed have brought increased attention to the field of data management. Concerns have been raised around personal privacy and safety related to data security. In many areas, the ownership and treatment of data are poorly defined, as is the role of government in managing key processes and databases.

Opportunities

- **Better decision making.** Big data will provide broader, more detailed data to inform planning decisions and support more tailored solutions that benefit users regardless of income, geography and lifestyle.
- **Dynamic services.** Live information feeds to travellers and service providers will allow transportation systems to be more flexible and adaptive.
- **Usage-based strategies.** Data generation and monitoring will enable new policy tools for transportation demand management such as mileage-based car insurance premiums or incentive programs for active transportation.

Risks

- **Loss of access to data.** Privatization of some mobility services could result in governments losing control of and access to data.
- **Increasingly complex data management.** The volume and multiple streams of data could make it difficult to manage effectively.
- **Disconnects with historical data.** As technologies advance, continuity may be lost between older and newer datasets.
- **Privacy and security vulnerabilities.** New vulnerabilities may emerge related to data security and public safety, particularly where there is a mix of publicly- and privately-held data.

[5.1] Adopting a data stewardship role

The source, format and ownership of mobility-related data will likely continue to change as new services and technologies emerge. By acting as stewards of mobility-related data, GTHA governments can work to maintain the integrity, security and openness of mobility-related data.

Open data

Government bodies around the world have created open data portals to enable public access to government data. In the United Kingdom, Transport for London (TfL) has an open data policy and shares traffic, incident and public transport data. It encourages software developers to use the data to provide travel information in innovative ways that benefit road and public transport users. TfL also stewards the data by establishing terms and conditions of use that developers must adhere to.

Ontario has taken a first step towards enabling open data with the Open Data Directive.[28] However, more work needs to be done. With so many ministries and municipalities in the province, coordination between all data generators and users will be required. The province must take a leadership role.

[5.2] Seeking data partnerships

Although government has traditionally played a major role in the collection of transportation data, the private sector has now surpassed it. With the mobile devices of platform users acting as probes and sensors, companies have been able to collect a rich assortment of data about transportation system users. This data is invaluable to government in informing decisions and future plans, and all levels of government should seek access to it through partnership agreements.

28 Government of Ontario (2016)

[5.3] Transforming government information and analytics

With the ability to openly access or exchange data, public- and private-sector mobility service providers can offer tailored solutions to different user groups. Government should make use of mobility-related data to inform its plans and decisions, and should ensure that affordable and accessible options remain available to disadvantaged groups. With great uncertainty around how transportation will take shape in the future, government can also leverage the available data to make better use of scenario planning techniques and improve understanding of longer-term planning and operational impacts.

A wealth of data

Mobile traveller information applications such as Waze, Transit App, Moovit and Citymapper collect data actively through user interactions, and passively as users go about their travel. Waze, in particular, gathers up-to-date traffic information through data points generated by users' smartphones to provide up-to-date traffic and navigation information to the broader network. The Waze Connected Citizens Program provides a mechanism for government agencies to partner with Waze to exchange data.[29]

29 Waze (n.d.)

Theme 6: Plan for the "Known Unknowns"

The Challenge

Global economic and political uncertainties, climate change, technological advances and generational shifts all guarantee that change will be constant. Governments are likely to be increasingly challenged by these disruptive trends, and transportation systems need to be flexible and responsive if they are to prove resilient.

Societal changes will place new demands on the transportation system. As our population ages, the mobility needs of many people will shift. Rising income disparity is another factor broadening the range of services and lifestyles that different groups need, want or can afford.

In recent years, stronger consensus around environmental degradation and climate change has increased the priority of emission reductions and other "green" strategies. Support for environmental sustainability is particularly strong where synergies exist with public health and quality of life, such as in the potential of active transportation to reduce emissions and fight chronic illness. As a low-tech solution, active transportation is also perceived as more resilient than motorized modes that rely on external energy sources and advanced communications.

Opportunities

- **Flexibility and responsiveness.** Through vigilant monitoring, government can identify ways to take advantage of new or shifting trends as they emerge.
- **Sharing and learning.** Changes in mobility are being felt across Canada, and especially in large communities. There is an opportunity for Metrolinx to share concerns, strategies and experiences with other major planning and transit authorities across Canada including Montréal's Agence métropolitaine de transport (AMT) and Vancouver's TransLink.

Risks

- **Inability to keep pace in a changing world.** The inertia of existing processes could challenge government's ability to keep pace in a rapidly changing environment.
- **Obsolescence of current infrastructure.** Changes in the mobility and environmental landscapes may render current infrastructure obsolete.
- **Network vulnerabilities to disruption.** Disruptions are possible from both natural and human sources such as severe weather, network outages and cyberattacks.

[6.1] Steering into the wind

In the face of uncertain conditions, a strong sense of direction for mobility-related objectives can help support the GTHA's economic, social and environmental aspirations. There is a need for government to retain control of vital policy tools such as financial incentives and disincentives, and to apply them in meeting objectives. New technologies and service models should be evaluated critically in terms of their support for the regional mobility vision and be linked to strategic objectives. As new directions are taken, government should ensure that regulations and public sector skillsets are updated. Similarly, policies should not be so specific that they only capture the current landscape, and should be broad enough to accommodate new developments. Assumptions and standards should be reviewed periodically and adjusted according to the latest conditions and outlooks.

[6.2] Addressing climate change

Urban form and mobility must be put in the context of climate change, which is the most significant strategic risk facing Ontario and its inhabitants. Mitigation is one priority, and involves taking steps to achieve provincial emission reduction targets. Adaptation is a second priority, and involves preparing for a warmer climate that will bring more frequent and severe weather events, and place extra burden on many aspects of our infrastructure. Many related decisions will have to revolve not around what people want their mobility system to be, but what they need it to be.

[6.3] Raising the bar for new infrastructure and services

Planning for the unexpected does not require prescience, but it does need a cautious attitude and flexibility in anticipating change. Major infrastructure investments should be considered carefully in light of emerging trends. Where possible, infrastructure should be designed keeping adaptation to future technologies and service models in mind.

[6.4] Creating redundancy

A more diverse offering of modes could help keep the GTHA moving when disruptions occur. The broad efforts of various governments to reduce reliance on private cars and fossil fuels will help, but it is also important to consider the resiliency of the other modes that will attract new users. Policies that support complete streets and active transportation should be strengthened, because human-powered modes are as adaptable as they are beneficial. As ridership grows, redundancy should be built into the transit network to protect its access to energy and communications.

[6.5] Planning to keep the region moving

New mobility, by design, is dependent on technology and constant internet connectivity. This represents a vulnerability to cyber attacks and electricity blackouts, among other threats. These risks need to be mitigated. Governments must work with service providers to ensure that backup systems and improved cyber-security will guarantee robustness.

Moving beyond disruption

Heavy reliance on digital services and internet connectivity has made the possibility of network outages a concern in many sectors. As mobility is increasingly internet-enabled, contingency plans must ensure that the GTHA can keep moving in face of such disruptions. For example, many services dependent on the cloud computing division of Amazon experienced a recent outage due to severe weather in Australia. The affected services ranged from food delivery to ticket selling to carsharing service.[30]

30 BBC News (2016)

5

5. Planning for Change

This report frames current thinking on the issues, opportunities and forces at play in the emergence of new mobility. By looking forward at how different trends and scenarios could evolve, it identifies broad strategic directions that are of interest to a wide range of new mobility stakeholders.

To support the update of the GTHA's Regional Transportation Plan, this concluding chapter highlights several high priority areas where future work could bridge gaps in current research or otherwise inform government transportation policy.

Protecting the Public Interest

The changing mobility landscape will have implications for public policy and supporting research including the following key areas.

Regional policy and regulation

An ownership model of new mobility-continuing and expanding the current model based on private vehicle ownership–would have major implications for the GTHA's transportation system and policy framework. In this model, vehicle owners and service providers would play a key role in shaping travel patterns and their impacts, especially changes in the amount of motor vehicle travel and government's ability to shape outcomes for the

benefit of society. Research is needed to understand how the effectiveness of different policy levers would change depending on the model and mix of ownership.

For example, mobility pricing is a key policy tool but government's influence could diminish with a greater range of private-sector mobility offerings that compete with transit and are market priced. Data ownership, access, sharing and security are key areas of research that must span the public and private realms. Research is also needed on where and how government can best invest its limited resources to influence industry practices—for example, in the area of travel planning the role of government could range from creating its own tools to creating frameworks and standards that guide the work of others. Research could also explore policy models for Mobility as a Service (MaaS), addressing issues such as organizational roles and priority strategies to ensure effectiveness.

Rapid transit network planning

New mobility trends highlight the need for new tools and approaches for rapid transit network planning. Dynamic and uncertain circumstances call for scenario planning tools that can quickly assess policy and infrastructure options, both for strategic purposes and to monitor the plan's progress and shifting context. At a project level, evaluation tools and business cases will need to consider how new rapid transit lines, transit stations and parking structures can respond to a changing environment, and what role is played by factors such as the level of of public acceptance of on-demand mobility services and autonomous vehicles, and how it impacts the degree and timing of possible uptake. Financial models will need to be sensitive to a range of revenue and service approaches, including disruptive ones. Similarly, traditional transportation models will need upgrading to more accurately assess the impacts of new mobility choices and services on individual behaviours and the broader transportation system.

Operations and business models

Underpinning the Regional Transportation Plan will be the need for a better understanding of new mobility practices and business models. While international experience is highly varied, work can be done to bring together good examples of new mobility offerings and lessons learned, such as the Milton GO Connect service, Kutsuplus in Helsinki or Bridj in Kansas City, Boston and Washington, D.C. Government will also need to monitor trends in the automotive, financial and information technology sectors to ensure the ongoing relevance of plans.

Mobility pricing

The integration of transit fares across the region, to create a unified and logical fare structure for transit trips regardless of the operating agency, has become an increasingly urgent priority. The discussion has become more complex with the arrival of new mobility. Government policies around transit fares must continue to balance social, economic and environmental objectives, while also considering new market forces. Research is needed to build a better understanding of mobility pricing across modes and operators (e.g. bikeshare, parking), advanced transportation modelling, and private-sector business models for public mobility. Work is also required to decouple social and transportation policy objectives so that both can be pursued in an integrated and effective manner. For example, technology now allows for a consistent approach to fares, while concessions to different user groups can be applied to qualifying individuals. These subsidies can then be explicitly accounted for in the appropriate operating budget.

Next-generation transportation demand management

TDM tools such as road or cordon charges have the potential to be a key lever of mobility policy in limiting the growth in vehicle-kilometres travelled that could result from new technology and service models. Work is needed to explore new ways of managing demand and their potential effectiveness.

Parking management

Parking is an area that faces significant potential disruption from new mobility, both in terms of pricing and in the nature and extent of required infrastructure at GO stations and across the region. Within the broader topic of mobility pricing, parking pricing could be a key policy lever in managing demand. Areas of research could include how on-demand mobility services and autonomous vehicles could impact parking demands and operations; of particular interest might be the impacts of a mixed vehicle fleet on the timing, layout and possible repurposing of transit stations, parking structures and access streets.

Urban freight

The automation of urban freight and the possible convergence of goods movement with personal mobility could raise a host of policy issues. Monitoring developments in the freight industry will be increasingly important to regional modelling and policy frameworks.

Active transportation and safer, more complete streets

New mobility has the potential to reshape how public rights-of-way are used, and could lead to the reallocation of road space. Policy consideration should be given to how to best use road space, and how to repurpose roads over time in a way that balances public and private mobility with wider civic needs. Understanding the changing context of safety will also be important to street design and operations.

Working Together in New Ways

A key finding of this report is the emergence of a wide range of new players in the mobility field, and the changing balance of public- and private-sector roles. There is an urgent need for cultural change in how government views its role in mobility and how it engages with external stakeholders. There is a need for greater collaboration among different levels of government, between government and the private sector, and even within the private sector.

Government collaboration

New mobility is disruptive, and the response of government so far has been fragmented and unfocused leading to a range of strategies. Canada's federal and provincial governments have been more active in the realm of autonomous vehicles, while the impacts of transportation network companies have largely been met by wildly different approaches of municipal governments. There is an opportunity to share initiatives and collaborate in research and policy development; in particular, Montréal's Agence métropolitaine de transport (AMT) and Vancouver's TransLink have mandates and experiences that support their continued engagement with Metrolinx. Other municipalities, regions and provinces can also engage on the topic, with scope for a greater provincial role and more coordinated action across municipalities. This could include identifying areas of research and policy development, and clarifying the appropriate roles of different jurisdictions in areas such as road safety, data analytics and security, and new transit business models. Of particular concern are inconsistent approaches across boundaries or between jurisdictions that could create inefficiencies or complicate GTHA-wide services.

Partnering with the private sector

Government's role in mobility is changing rapidly and a new approach to engaging with the private sector will be needed in areas ranging from procurement processes to the coordination and delivery of different services. Research is needed on different partnership models, their successes and failures, and lessons learned. Government will need to better understand industry dynamics in the mobility space and to monitor the evolution of business models and strategies, particularly in the automotive, financial, information and logistics sectors.

A culture shift

In the context of the Regional Transportation Plan, re-imagining the role of government when it comes to innovative approaches such as Mobility as a Service (MaaS) means regulating service providers in a way that protects the public interest without stifling innovation. For transit operators, it means moving from their traditional role as train and bus operators into a new role as mobility managers and enablers. It will be important for government to be strategic in where it engages, and to maintain a clear policy direction on what factors it wishes to influence or control. Critically, this will in turn require corporate support and accountability within different areas of each organization.

A fundamental shift in government culture is needed, and the public sector will need to rethink its role in transit as private sector services grow along with their market share. While many governments have acknowledged the arrival of new mobility, few recognize the extent to which it will change the industry, and fewer still have worked to understand the pragmatic implications for today. Immediately after World War II, few planners foresaw the massive transformation of mobility and cities that took place over the next two decades; today, planners are in a similar situation and inertia must not restrain their ability to leap (sometimes uncomfortably) into a new future for mobility in the GTHA.

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Thought Leader Panelists

Anthony Perl, Simon Fraser University, Canada

Barrie Kirk, Canadian Automated Vehicles Centre of Excellence, Canada

Bob Oliver, Pollution Probe, Canada

Caroline Cerfontaine, Union internationale des transports publics (UITP), Belgium

Catherine Kargas, Marcon, Canada

Cherise Burda, Ryerson City Building Institute, Canada

David McKeown, Medical Officer of Health, City of Toronto, Canada

Gunnar Söderholm, City of Stockholm, Sweden

Jake Sion, TransitApp, Canada

John Stanley, University of Sydney, Australia

Jörg Beckmann, Mobility Academy & World Collaborative Mobility Congress (wocomoco), Switzerland

Kalina Soltys, Transport for London, UK

Kevin McLaughlin, mMobility, Canada

Laurent Chevrot, Réseau de transport de Longueuil, Canada

Lea Hoyer, Stadtwerke Osnabrück, Germany

Marlene Connor, Mobility Management Committee, American Public Transportation Association (APTA), USA

Matti Siemiatycki, University of Toronto, Canada

Michael Glotz Richter, City of Bremen, Germany

Michael Lichtenegger, Neue Urbane Mobilität, Wiener Stadtwerke, Austria

Robert Stüssi, Urban Logistics, Portugal

Sandra Phillips, Movmi, Canada/Switzerland

Sharon Doyle, York Region Transit, Canada

Sunil Johal, Mowat Centre, Canada

Susan Zielinski, Sustainable Mobility & Accessibility Research & Transformation (SMART), University of Michigan, USA

Tim Savoie, South Coast British Columbia Transportation Authority (TransLink), Canada

Wendy Reuter, Canadian Urban Transit Association (CUTA), Canada

Thought Leader Facilitation

Michael Roschlau, Toronto, Canada

Metrolinx Advisors

Antoine Belaieff, Director, Regional Planning, Metrolinx, Toronto Canada

Kyle Kellam, Transportation Analyst, Systems Planning, Metrolinx, Toronto, Canada

Lisa Salsberg, Senior Manager, Systems Planning, Metrolinx, Toronto, Canada

Josh Tzventarny, Senior Advisor, Sustainability, Metrolinx, Toronto, Canada

Naren Garg, Advisor, Hub and Station Planning, Metrolinx, Toronto, Canada

Lisa Orchard, Senior Advisor, Systems Planning, Metrolinx, Toronto, Canada

Eric Peterson, Senior Advisor, Systems Planning, Metrolinx, Toronto, Canada

Jennifer Niece, Senior Advisor, Strategic Planning, Metrolinx, Toronto, Canada

External Advisors

Michael Urban, Mowat Centre, University of Toronto, Toronto, Canada

Consulting Team

Daniel Haufschild, Project Lead, WSP, Toronto, Canada

Kitty Chiu, Research/Author, WSP, Toronto, Canada

Lauren Isaac, Advisor, WSP, San Francisco, USA

Gianluca Barletta, Advisor, WSP, London, UK

Andrew Potter, Advisor, WSP, London, UK

Harold Sich, Advisor, WSP, Toronto, Canada

Rachel Zack, Research, WSP, San Francisco, USA

Cian O'Neill, Research, WSP, Toronto, Canada

Sonya Terek, Research, WSP Toronto, Canada

Steve Cassidy, Advisor, Viaqqo, Edinburgh, UK

Beth Garner, Advisor and Research, Viaqqo, Edinburgh, UK

Alan Woodland, Advisor, Red Team, Vancouver, Canada

Geoff Noxon, Editor/Advisor, Noxon Associates, Ottawa, Canada

Layout and Graphics

Ratnak Vann, WSP, Toronto, Canada

Figure and Image Credits

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