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GOVERNANCE PARTICIPATION STRATEGIES FOR MOBILITY AS A SERVICE

(Authors: Blair Underhill & Alec Knowles)

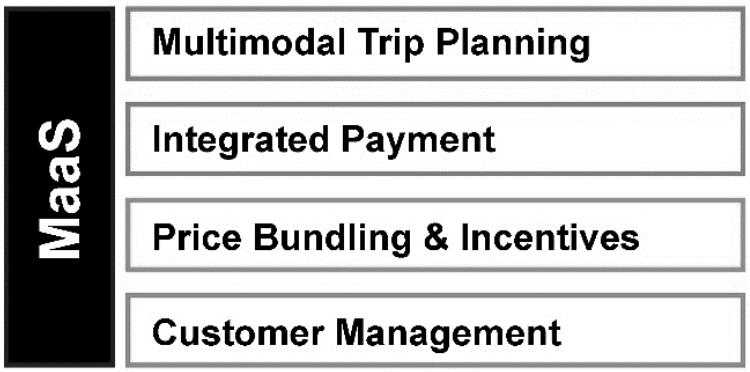
Overview of Mobility as a Service (MaaS)

New forms of mobility are transforming the transportation landscape globally. As the landscape evolves, it will become increasingly viable for travellers to meet most of their mobility needs through purchasing rides or seats, instead of the traditional purchasing of vehicles. The concept of selling mobility rather than vehicles is experiencing renewed interest, in part due to recent developments in digital technology that allow for greater levels of personalization and integration across multiple transport services. Noting this incipient trend in traveller attitudes and behaviour, government agencies have the opportunity to assess options for participation before the transition matures (Smith et al., 2019). The objective of this paper is to help governments define their role(s) as it pertains to Mobility as a Service (MaaS), the term used to describe an integrated platform for payment, multi-modal trip planning, and price bundling.

MaaS components and levels of integration

While there are many definitions of MaaS, for the purposes of this paper, we will focus on the intersection of four key elements: multimodal trip planning, integrated payment, price bundling & incentives, and customer management (TransLink, 2019). In other words, MaaS is an integrated framework that allows users to plan and make trips using a variety of modes using a single payment system, with price bundling to offer several tiers of service at different price points. Further, incentives can be used to promote certain modes at specific times and locations. Pricing is used as a key tool to influence customer behaviour, and innovations in pricing models can further influence traveller mode choice. While aspects of MaaS can be applied towards goods movement, this paper focuses on the movement of people.

Figure 1 Key components of MaaS (TransLink, 2019)



There are many definitions of MaaS and several common themes bubble to the surface, but few offer a complete picture (Jittrapirom et al., 2017). That said, there is a general consensus that development of MaaS is a process from limited service integration to near-complete integration with incentives to impact behavior.

Figure 2 Adapted MaaS topology of integration (Brenden et al., 2017)

Level 0 No Integration	Level 1 Information Integration	Level 2 Payment Integration	Level 3 Contractual Integration	Level 4 Policy Integration
Separate mobility services. Users have agreements and relationships with various transport service providers. Separate payment solutions.	Services are integrated at information level. Users have agreements and relationships with various transport service providers. Separate payment solutions.	Booking of and payment for services are integrated in a platform. No responsibility for travel services. Focus on individual journey A to B.	Offer alternatives to car ownership. Subscription or packaged. Responsibility for the entire service for customer and transport service provider. Combined payment for all services.	Incentives and instruments integrated in agreements and the service. The purpose is to steer towards public sector objectives. Conditions for resale of the public sector's services.

The levels of MaaS integration will be an effective measuring stick as platforms and services are expanded. Several multi-modal trip planners exist (or are being developed) that indicate that Level 1 integration is already maturing. Moovit, TomTom, and Microsoft recently announced a partnership to introduce a comprehensive multi-modal trip planner that will incorporate driving, parking and transit options in a single package (Moovit, 2019). Level 2 Payment Integration and Level 3 Contractual Integration are also being explored, and in some regions are

being deployed at a small scale (Masabi, 2018). An example of this is provided by Whim, which has developed subscription plans in Helsinki, Finland to provide discounted use of taxi, car-share, and ride-source services along with unlimited transit access, as a method of steering travellers away from vehicle ownership (MaaS Global, 2016). Level 4 Policy Integration is the currently envisioned 'final frontier' for governments and private entities working together to achieve regional goals through incentives and discounts, resulting in more shared and sustainable travel and fewer private vehicles on the road (Sarasini, Sochor, & Arby, 2017).

This paper focuses on how government agencies can participate in transitioning MaaS beyond Level 0 and 1, to a more integrated state that maximizes traveller experience and meets public objectives.

MaaS intersections with urban, suburban, and rural form

For geographical context, it is currently assumed that MaaS will be simpler to implement and be most efficient and attractive in urban areas where there is critical mass to develop a wide offering of services (Aapaoja et al., 2017). MaaS has the potential to reduce congestion and demand for parking, and make mobility more affordable by providing more and better alternatives to private vehicle ownership. In urban areas, it is important for MaaS to offer mobility modes that are competitive with private car ownership from an affordability and convenience perspective, and to offer a range of business models for a wide range of population segments. While there are barriers to entry in suburban and rural areas, MaaS will help to address first- and last-mile challenges and enable greater accessibility, and by extension spur economic development in suburban and rural areas. In rural areas where population and service densities are lower and public transport is limited, MaaS provides an opportunity to make publicly-available mobility options more efficient and better utilized, while satisfying various user purposes.

MaaS intersections with current and future modes

As suggested in Figures 1 and 2 above, a key component to MaaS is multi-modal integration, from information and trip planning, to payment, and eventually development of incentives and discounts to go along with this integration. Early pilots as well as policy developments in the field of MaaS recognize the importance of keeping transit as a backbone to service provision. As urban centres grow, cost of car ownership, congestion, limited parking availability, and environmental pressures continue to spur the need to focus on leveraging high-density and energy-efficient forms of transportation, particularly mass transport and shared mobility.

MaaS may present opportunities for transit service providers to test and implement innovative solutions through right-sizing fleet deployment with dynamic services in certain areas. Shared micro-mobility services (e.g. bike-share or scooter-share) could also allow for effective first- and last-mile transport for travellers that use transit as the primary mode of a trip. This is even more relevant with the steep increase in electric personal mobility devices from both a shared and owned perspective (Guidon et al., 2019).

MaaS is primarily discussed with respect to passenger transportation: though there are some aspects which could be applicable to goods movement, some of these functions already exist and are incorporated into third-party logistics (3PL) services. Automation of 3PL is likely to converge towards a freight-relevant concept of MaaS, and eventually the distinction in terms may be one of nomenclature more than substance. Furthermore, a shared approach to urban consolidation centres, and the transition of modes for first- and last- mile services may be another prominent area for an open operator system of MaaS to be deployed with regards to freight and goods movement in an urban setting.

Looking forwards, integration of connected and automated vehicle (CAV) technology with MaaS will have significant potential to redefine MaaS operations and governance (Arby, Curtis, & Vanacore, 2018). Automated MaaS has the potential to become cheaper than the conventional alternative. Affordable ride-buying will decrease the focus of vehicle ownership, and automation will make it feasible for individuals without a driver's license to complete single-occupancy auto trips. Connectivity will create benefits related to vehicle sharing and utilization, while also improving network capacity. The major challenge of CAVs with relation to MaaS is to determine how decreased vehicle operating costs may increase vehicle mode choice, and discourage the use of mass transit. Pricing through MaaS could be an effective way to address this challenge.

Why Should Government Participate in MaaS?

Transportation is moving from a vehicle-buying market to a ride-buying market. If governments ignore this trend, private platform operators will shape the landscape to their own benefit. If governments take an active role in managing and/or actively participating in MaaS, there is an opportunity to guide development of the system, anticipate and address market failures, and align MaaS with public goals.

Benefits from participating in MaaS

The speed at which technology and mobility patterns are evolving is forcing all mobility industry participants, including car manufacturers, transit agencies, vehicles-for-hire, etc., to make strategic decisions more quickly than what is typically observed in times of gradual industry evolution. MaaS is emerging in parallel with a multitude of other New Mobility trends, such as vehicle connectivity, automation, electrification, mobility pricing, and broader adoption of the sharing economy. These trends, in conjunction with MaaS, are likely to proceed in most jurisdictions with or without guiding legislation and regulation. Many jurisdictions around the world are therefore in the process of updating transportation legislation, policies, and strategies to accommodate MaaS (and other New Mobility trends) to take advantage of the opportunities.

The opportunities presented by MaaS include highlighting the role of public transit as the backbone of a MaaS network to drive transit ridership; reducing low-occupancy and 'unnecessary' vehicle trips; providing better accessibility and social inclusion; increasing transportation system efficiency; and meeting public objectives related to congestion reduction, environmental sustainability, economic development, and affordable mobility (Hoadley, 2017).

There is also an argument for aiming to establish international consistency through technology. This is something that is already being accomplished by private transportation operators such as Uber and Lyft, with the ability to open an application and have transport options available regardless of whether you are in your home location, or somewhere else in the world. A similar opportunity exists with MaaS applications that would be able to source local information (through location-based services) to provide a wide range of mobility options to travellers. This of course is dependent on the regulatory environment that exists and whether third party applications are able to source all available transport options.

Finland's updated regulatory environment allows for the development and operation of MaaS

A limited number of jurisdictions have developed legislation to prepare for MaaS. Finland's federal government, for example, recently passed an update to their Act on Transport Services to promote new service models that better meet the needs of users.

- The Act eliminates obstacles to market access, and facilitates the offering of new service concepts based on digital information, taking into account customer needs by regulating accessibility and user friendliness of services.
- The Act promotes the interoperability of different parts of the transportation system.
- **The Act integrates the transport authority payment system and accounts with other service providers to ensure the operability of a single-payment structure.**

This legislation is ground-breaking as it obliges industry participants to coordinate services to improve system efficiency and the customer experience (Ministry of Transport and Communications, 2017).

Risks of government participating in MaaS

Government participation risks can generally be categorized into risks of over-involvement and risks of under-involvement. Over-involvement risks include excessive regulation, limited industry participation, and limited innovation. Under-involvement risks include opportunity costs, as well as market failures (Docherty, Marsden, & Anable, 2018), and solutions which fail to maximize public well-being.

Risks of Government Over-involvement

- If government builds an underused or redundant MaaS platform, or if new mobility choices are underutilized, government money and resources may be used inefficiently, reducing opportunity to invest elsewhere. By extension, if MaaS performs poorly within an agency's jurisdiction, the agency's reputation and credibility, as well as the demand and political leverage for MaaS as a form of mobility, would be compromised.
- Excessive regulation could disincentivize private companies from entering the MaaS space, stifling private sector participation, competition, and innovation.
- As an agency becomes more involved in operating and governing MaaS, their duty of care for data security, privacy, and general performance will increase commensurately.
- While there are trends that display a transition from vehicle ownership towards a ride-buying model, this transition is not guaranteed. If this transition does occur, proper timing will be key to in order to have a significant impact on the uptake rate of MaaS.

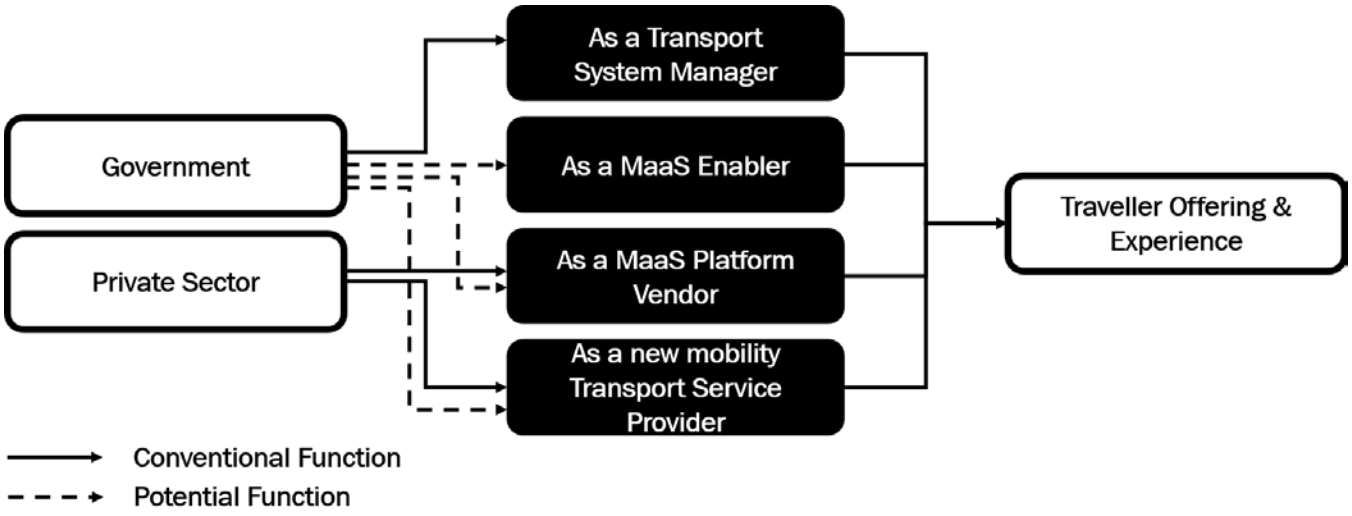
Risks of Government Under-involvement

- If agencies do not involve themselves sufficiently to respond to the evolution and manifestations of MaaS, there may be a lost opportunity to shape MaaS services and performance, and by extension the government's ability to deploy travel-demand measures over time would diminish.
- Failing to regulate storage and monetization of data by the private sector could lead to insufficiently robust security and privacy.
- If MaaS transport services are poorly coordinated, consumers may see themselves among several 'walled gardens' – that is, private companies operating MaaS platforms exclusive to only their services (Zipper, 2018), which would hamper direct price competition and result in inefficient service provision.
- MaaS platforms could be challenged by private economically driven agendas that limit services to certain geographies, limiting the extent to which MaaS provides societal benefits.
- MaaS platforms that lack coordination, competition, and/or innovation could lead to limited progress environmentally, resulting in the underachievement of public objectives.
- One opportunity cost of being under-involved would include loss of potential to be better-informed by the lack of detailed travel demand data when planning transportation systems.

How Should Government Participate in MaaS?

There are four primary roles where government can participate in MaaS, and within each are different roles that are articulated further in this paper. Government can participate in MaaS as a Transport System Manager (TSM), as a MaaS Enabler, as a MaaS Platform Vendor, and as a New Mobility Transport Service Provider. These roles are identified along with their relationship to private sector participation and traveller offerings and experiences in Figure 3 below. It should be noted that these roles are not mutually exclusive and approaches from each can be drawn upon to maximize participation where appropriate. Depending on organizational capacity, partnerships, and existing legislation, different government agencies may be better (or less well) positioned to participate in MaaS. This paper focuses on identified opportunities for participation, but does not prescribe what agency is most appropriately positioned to act.

Figure 3 Government Opportunities in New Mobility Management and Participation of MaaS.



Government participation as a transport system manager

There are several roles that government can play within the role as a TSM. While many of these exist today, they may require an expansion of mandate to navigate new modes, and the integration of services that are part of the MaaS package. From a MaaS perspective, a TSM will need to effectively apply regulation to both MaaS platform vendors and transport service providers in order to maximize traveller experience and achieve public objectives.

The following are some areas for regulation, though by no means is this an exhaustive list:

- Governments can manage what and where mobility services and platform vendors operate;
- Governments can manage curbside space;
- Governments can regulate how much riders pay for mobility services and packages;
- Governments can establish performance standards, both for transport services and for platform vendors. Performance standards could be tied to incentives to promote high-occupancy transport.

Regulation and system management come with challenges and opportunities outlined above. Generally speaking, government over-involvement as a TSM may result in stifled innovation of the private sector, reduced participation, and potentially a poor service-offering for travellers. Government under-involvement in this field could result in a flood of services in select parts of a region, lack of affordable transportation, low-quality service offerings, and a lack of alignment with public objectives.

There is an opportunity for government to assume the role of a TSM, but it is currently unclear what degree of participation is appropriate since MaaS is still in its infancy. Continued observation of efforts around the world will allow for effective responses in this field.

Government participation as a MaaS enabler

In the role of MaaS Enabler, governments have an opportunity to develop tools and share these resources with private sector platform vendors and transport service providers to access travel, route, and/or capacity data, as well as timely and accurate network data. Beyond the provision of real-time data, there is also an opportunity for government to leverage and share real-time information of the transport network, in order to maximize throughput of people on a network and avoid bottlenecks. An example of this would be the ability to push notifications to platform vendors that a certain transit line in a city is stalled. This would enable vendors to prompt travellers in the area to use a different form of transport during the delay window. Consequently, this may result in higher use of shared ride-sourcing, to move travellers to another part of the rapid transit network with limited impact to their commute time.

Some of these tools are already being deployed by governments across Canada, while other tools are under development or being considered for a later point in time. There remains some debate around appropriate ways to approach integrated payment across multiple modes and providers.

Currently, most major metropolitan areas in Canada (e.g. Toronto, Montreal, Vancouver) have card-based systems where traveller account information is stored on and read from a smart-card. Complexity and functionalities are limited to the available space on the smart-card. In some cases, multiple devices can be connected to an account (e.g. TransLink is piloting wristbands for additional accessibility), but generally it is limited to a single medium. This unfortunately provides additional limitations when looking at multi-modal trips. For example, if a traveller is looking to take a ride-sourced service from home to the nearest rapid transit station, and then also take a bike-share for the end of their trip after taking transit, there are three transactions that need to occur. Currently this requires three different mediums. A Montreal example would be booking a ride-sourced trip via Téo Taxi, then paying transit fare via an Opus card, then using a BIXI key to unlock a bike. While some bike-share options are available to unlock via a smart phone, there are still some systems that do not offer this functionality. Similarly, transit services in most Canadian metropolitan areas require a smart-card or credit card to tap on (and off in some cases) to clear fare gates.

There are a few ways to overcome the lack of current payment integration. In order to ensure public transit services remain a backbone to the system, significant upgrades may be required to transition from a smart-card account to an account-based system. Barring privacy and security logistics, this would allow traveller account information to be stored in a remote database that could be accessed online by any approved service that is part of the trip-chain (e.g. Uber for ride-sourcing or Dropbike for bike-sharing). Transitioning to an account-based system is an essential requirement to further MaaS integration in order to access information on the entire trip chain in real-time, for payment integration, and to leverage incentives and discounts to maximize public goals and the traveller experience. While there are other options (such as integrating NFC or contactless credit card payment into transit gates and boarding technology), most limitations in the system are currently within the public transit realm. As previously stated, most ride-sourcing applications purely exist on smart phones, and this is similar with many car-sharing options and bike-sharing options. Providing similar functionality for transit is essential particularly in urban areas where use of public transit is of utmost importance for macro-level traveller modes.

For further provision of secure mediums, open authorization (OAuth) payment systems are seen as an opportunity to progress MaaS evolution and improve the traveller experience (but are not necessarily a requirement). This refers to the idea of opening a payment platform owned and managed by a regional transportation authority (e.g. PRESTO via Metrolinx, or Compass via TransLink) and allowing it to be used by MaaS platform vendors and new mobility transportation service providers. While some vendors and service providers may opt for their own payment system and integrate transit through the account-based transition outlined above, there may be MaaS vendors that would appreciate the opportunity to leverage a payment system that already exists, and could be seen as a way to encourage more participation in this space. OAuth is something we're all familiar with, regardless of the namesake; it is often provided through platform applications and other mediums for login account information. Rather than requiring the user to create a new login, the user can leverage existing login credential from Facebook or Google. It would be similar application in the transport medium, but would include options such as "login with PRESTO" (Kalogirou et al., 2018).

These components will come with challenges and negotiation. The payment and account systems in place in major regions across Canada are complex and will likely need to be updated in ways that will have significant financial implications. There will also need to be a clear understanding of transfer to risk and security if there is movement towards sharing these services with private operators.

Government participation as a MaaS platform vendor

To date, most government participation has come from the enabling or regulating (TSM) perspective. As a relatively new field of study and application, there is merit of discussing whether government could effectively position itself as a MaaS platform vendor alongside the private sector.

In the examples provided above, many regional transportation agencies already have the tools and data that would be required to deliver a MaaS platform. While government is traditionally less flexible compared to the private

sector when it comes to developing technical applications, there is still opportunity to co-develop a solution, driven by maximizing traveller experience, while also striving towards delivering on public objectives (such as decreasing congestion, improving air quality, increasing transport affordability).

As a platform vendor and operator, regional transportation authorities are well positioned with the ability to leverage existing payment platforms, a massive traveller database (of existing transit users), and other competencies, such as an expansive and experienced customer service operation. The challenge with creating a publicly owned MaaS platform, aside from financial viability and potentially slow innovation with respect to the private sector, is the need to partner with private sector transportation service providers who may not be interested in linking their services to a public agency's platform. While some municipally owned services may see this as a great opportunity (e.g. a bike-share operation), global ride-sourcing companies may be hesitant if trip planning algorithms are out of their control. Of course, a MaaS platform will not succeed if transport service providers do not participate and reach a critical mass.

Developing a multi-modal transportation service offering is an essential component to delivering a high-quality traveller experience. As outlined above, some countries are mandating that an open ecosystem exist to maximize traveller experience. This can also be achieved through brokered partnerships with transportation service providers. Lastly, there is the challenge that as a MaaS platform vendor, there may be issues that arise if the brand is attached to services that do not provide a good experience. For example, a ride from a private transportation network company (TNC) could arrive late, or could have an unsafe driver that would reflect poorly on the public agency who is at the forefront of the platform itself.

Government participation as a new mobility transport service provider

Regional transportation authorities have primarily focused on mass transport solutions for regions as well as providing accessible services for those in need of specialized assistance. There are also examples of partnerships between public agencies and private transport service providers to create subsidized trips instead of implementing complete mass transit solutions (Li, 2019).

Regional transportation authorities in Canada can explore micro-transit solutions that mimic private sector ride-sourcing services. While this service is currently being deployed by private TNCs and taxi companies across Canada, it is an area that regional transportation authorities may need to consider at some point in time. This specifically ties to MaaS government participation as a platform vendor, if regulation does not require private transport service providers to participate and if no brokered agreements can be reached for partnership. To fill the void of service in this scenario, public authorities could consider expanding service to deliver a completely integrated system.

This effort would require significant financial and political capital and would be a substantial organizational undertaking, but could be an expansion of conventional services to provide a complete mobility package for all users in a region, with oversight on public objectives as well. A centralized system would likely be the most effective way to incentivize users to travel by different modes or at different times through discounts. This expansion of service combined with government as a MaaS platform vendor could also create the opportunity of servicing all geographies and demographics in a region, beyond those overlooked by private transport service providers where less of a profit may exist. A major risk to this service is if it creates redundancy and is poorly used by travellers who opt to travel with private companies instead, making the investment difficult to justify. This role would be worthwhile to consider if market failures exist with private sector leadership.

Roles for different levels of government

It is currently unclear which levels of government should act, and more so, which levels of government are best positioned to lead in which way. Through recent discussions with public servants, WSP has developed the following table which provides a general approach to the Canadian context of existing jurisdiction and appropriate roles at the Municipal, Regional, and Provincial/Federal levels. While there are clear areas of overlap, it is likely that these roles will be poorly defined prior to further movement in the field of MaaS, and that adjustments to government roles will vary over time. In parts of the country where regional transit authorities (e.g. TransLink, Metrolinx) do not exist, these roles would likely best be provided at the Provincial level.

Table 1: Roles for Different Levels of Government with regards to MaaS

Municipal	Regional	Provincial/Federal
Enforcement: ensure local bylaws and regulations are adhered to.	**Coordination:** Convene private sector and local stakeholders to overcome issues.	**Rulemaking:** laws, regulations, standards, policies.
Enablement: Ensure necessary technology, modes, service providers and platforms exist.	**Leadership**: provide local direction to meet regional transport goals and objectives. Arrange pilots to display efficacy.	**Oversight**: issuing licenses, certificates, permits; conducting audits and inspections; taking action where rules are broken.
Outreach: promoting and educating public to increase awareness of services.	**Enablement**: Ensure necessary technology, modes, service providers and platforms exist.	**Outreach:** promoting and educating public to increase awareness of services.

At the municipal level, enforcement is a clear area that will be required with regards to MaaS. This is particularly evident with the recent onset of TNCs, and the lack of appropriate infrastructure for pick up and drop off services. Municipal curbside management will evolve to better accommodate these needs, but there will be an ongoing need to enforce these activities to limit illegal stopping and parking manoeuvres. Municipalities will also be a key conduit to ensure their respective constituencies understand the concept of MaaS and the operators and modes available. This will be particularly important with the ongoing sustainable transportation initiatives that exist in major cities, as a way to incentivize travellers to opt for transit and active modes, through improved coordination that is offered by MaaS.

At a regional level, coordination will be one of the key roles. Many commuters travel across municipal boundaries, and as such, will require a coordinated and consistent approach to MaaS to undertake their trip in a non-disruptive way. Beyond the opportunities presented above for regional authorities to participate in MaaS, there will also be a role for these governments to provide advice to provincial and federal authorities, to ensure that policy that is developed meets the requirements of respective regions. Dependent on the participation strategy that is taken, there may also be an opportunity for regional authorities to develop incentives for sustainable travel.

Provincial and Federal governments will be tasked with the difficult requirement of developing policy, laws, and regulations to ensure that MaaS is rolled out in a way that allows for safe, efficient, and sustainable travel, while also meeting the needs of businesses that wish to participate as a MaaS operator or vendor. Based on other emerging mobility solutions (e.g. ride-sourcing, micro-mobility), it is likely that provinces will take on the issuing of licenses, permits, audits and inspections. These government bodies will be responsible for reviewing analysis that comes from regional authorities and municipalities to adjust policy and laws so that MaaS is deployed in a way that is fair to businesses and provides necessary social and environmental benefits for our travel patterns.

Concluding Remarks

MaaS is still in its infancy with on-the-ground examples around the world. It is worth considering the opportunities for government participation early to set the wheels in motion for a high-quality product that maximizes the traveller experience. In order to achieve this high quality traveller experience while also striving toward public goals, the following could be considered:

- Agencies will require strategic objectives that enable a simple, convenient, affordable, and open MaaS platform for all mobility service offerings, for all travellers across their regional jurisdiction.
- While public agency involvement in MaaS can resolve a number of potential challenges, there are risks of both over- and under-involvement when it comes to participating in MaaS.
- There will be certain roles that can be played more effectively by government, and other roles that private sector will excel at. Hence, cooperation between the public and private realm will be essential to developing and operating a functioning MaaS platform.
- There are still many unanswered questions regarding the evolution of MaaS and how different levels of government can participate; therefore, a stepwise approach would be wise for governments to follow.

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