Readiness for Shared Micromobility: Public Perceptions in Metro Vancouver

Recommendations from Case Studies

Summary Report Prepared for TransLink
July 2020

HUB Cycling:
Gavin Davidson, Lead Planner
Tim Davidson, Planner

With support from:
Cities, Health & Active Transportation Research (CHATR) Lab, Simon Fraser University:
Meghan Winters, PhD
Sarah Tremblay, MPP

With funding from:

TransLink New Mobility Research Grant Program

Mitacs

Your Cycling Connection

CHATR SFU

TRANSLINK Mitacs

Executive Summary

This report is complementary to the Readiness for Shared Micromobility Case Studies report and provides recommendations derived from the findings of case studies that were conducted between January and March 2020 by HUB Cycling with the support of the Cities, Health, and Active Transportation Research (CHATR) Lab. HUB Cycling has taken the findings from the case studies and compiled recommendations for the implementation of shared micromobility in Metro Vancouver and the responsible organizations.

Shared micromobility (SMM) is a catch-all phrase that is used to describe a growing variety of shared, publicly available, human and electric powered vehicles, the most common of which include bike share (dockless and station-based), electric bicycles and electric scooters. SMM, and shared e-scooters in particular, prior to COVID-19, were booming in cities all around the world, growing from 35 to 84 million trips annually between 2017 and 2018 (NACTO, 2018).

HUB Cycling and CHATR Lab examined SMM programs in Vancouver and at University of British Columbia, Calgary, Seattle, Portland, and Washington DC, to inform possible expansion of SMM in Metro Vancouver. Our research considers implications for established transportation systems and the role that SMM might play in supporting economic, social and environmental objectives identified in TransLink's Regional Transportation Strategy.

Those agencies that have embraced SMM are enthusiastic about the service, given that it:

- Offers limited emissions, low noise levels, and flexibility for integration with transit;
- Is generally popular and where available and accessible, SMM is well utilized;
- Tends to support reductions in motor vehicle kilometers travelled; and
- Has the potential to spur the development of infrastructure designed to serve bicycles and a growing range of low-speed vehicles.

In our research we distinguish between motivators and barriers associated with shared bikes, e-bikes and e-scooters. The technology is evolving rapidly, as are ownership, operating and pricing models. Some of these trends appear to be positive, yet they mask challenges facing the industry. For example reliance on corporate sponsorship and public subsidies are diminishing, but are being replaced by reliance on venture capital. Yet, so far as we are aware, there is no evidence to date that venture capital supported systems are profitable, thus putting into question their viability as well as the sustainability of pricing models that they tend to impose upon users (See Cost Pg 20).

There is also a trend away from docked and toward dockless SMM systems. Dockless systems are less costly and generally quicker to implement than station-based systems, yet dockless systems face challenges ensuring that bikes are not improperly parked within public right-of-ways, and are typically more difficult to access for those who do not own a cell phone.

When comparing the relative benefits of shared bikes and e-scooters, it's apparent that bikes and e-bikes facilitate active travel, are associated with lower injury rates than e-scooters, and are better suited to serve longer trips, thus offering an effective alternative to automobiles. Yet, e-scooters are very popular, small and versatile, enhancing their potential for integration with transit, particularly near crowded rapid transit stations within urban centers. Our recommendations offer means to mitigate risks and to accentuate benefits promised by SMM and suggest further research required to clarify SMM's potential to support regional transportation objectives.

In all markets we examined there appears to be a growing variety and diversity of micromobility vehicles, clouding distinctions between pedestrians, bicycles and motor vehicles, and leading more devices like e-scooters to gravitate toward use of dedicated cycling infrastructure. Yet, there is a risk of conflating micromobility infrastructure with bicycle infrastructure, since the focus on one particular mode may ultimately not reflect the diversity of users, potentially leading to ongoing disputes, conflicts and safety concerns.

Although the Society of Automotive Engineers has established a taxonomy and classification of powered micromobility devices (SAE International, 2019), this system has not been widely adopted, nor are there guidelines to govern the design of appropriate infrastructure. The province of BC has introduced enabling legislation that could set the stage for regulations governing low speed vehicles, yet local jurisdictions in Metro Vancouver have historically set their own, and sometimes conflicting rules, creating challenges for interoperability. Clearly a consistent and coordinated approach is required throughout Metro Vancouver.

A preliminary assessment of TransLink's Regional Transportation Strategy suggests that SMM could complement regional transit services, making a positive contribution toward regional economic, social and environmental objectives. Yet more information is needed to understand and evaluate the contribution that SMM can make. Further, the extent to which SMM can support regional goals will depend upon actions that TransLink and local governments take to support consistency and integration with regional transit services. We thus recommend that TransLink and local governments embrace and facilitate SMM pilot projects encouraged by the provincial government.

Through its Shared Micromobility Guidelines, TransLink has recommended a coordinated approach to enabling and managing SMM in local jurisdictions throughout Metro Vancouver. TransLink should go a step further, offering a common framework to assess, evaluate and confirm whether SMM has a role to play as part of a larger public transit service strategy and to quantify and define any public subsidy required to support that role.

In order to better support expansion of SMM services in Metro Vancouver we offer 30 recommendations under six headings including:

- Mitigating impacts on established transportation systems;
- Cost;
- Safety;
- Usage patterns;
- Transit integration; and
- Meeting regional objectives.

Table of Contents

Executive Summary 3

Introduction 6

- Research questions 6

Methods 6

- Logistics 6
- Recruitment 6

Background 8

Analysis 9

- Implications for established transportation systems 9
- Safety 16
- Cost 20
- Usage patterns 23
- Integration with Transit 26
- Meeting Municipal and Regional Goals 28

Conclusion and Recommendations 36

Appendix A 37

- Key Informant Interview Questions 37

Appendix B 39

- Consent Form 39

Appendix C 42

- Case Studies 42
  - Washington, DC 42
  - Portland, Oregon 42
  - Seattle, Washington 43
  - Calgary, Alberta 43
  - Metro Vancouver, British Columbia 43

References 45

Introduction

HUB Cycling, with the support of SFU's Cities, Health and Active Transportation Research (CHATR) Lab, undertook case studies to better understand the demographics of use, and perceived barriers and facilitators of shared micromobility (SMM). Case studies focused on jurisdictions where SMM systems are in place and where there has been substantial effort to characterize use and public perceptions of micromobility. The overarching goal was to identify what can be learned about implementation and usage patterns elsewhere, and then to extrapolate what this may imply for SMM in the context of Metro Vancouver.

Research questions

The overall project aim was to examine public perceptions of micromobility in Metro Vancouver, complemented with experiences here and in other jurisdictions, to better understand the potential for adoption and use of SMM solutions in the region. Using surveys, focus groups and case studies, we aimed to answer:

1. Who are the potential users of SMM, and how is this distributed regionally?
2. What are the barriers and facilitators for use of micromobility?
3. What is the potential for integration with transit services?

Methods

Logistics

The research team undertook case study analysis and key informant interviews between January and April 2020. In advance of interviews, publicly available documents relating to the cities' micromobility operations were examined and synthesized. Documents included reports on micromobility operations, local news stories, permitting and request for proposal documents, and local bylaws. Each key informant interview was one hour in length and facilitated by Gavin Davidson, of HUB Cycling using a semi-structured discussion guide (Appendix A). Consent forms were sent prior to the interview (Appendix B), and the facilitator verbally highlighted and confirmed understanding of key components of the consent including voluntary participation, anonymity, the right to refuse to answer questions and audio recording processes. A member of the research team took notes during the key informant interviews. Discussions were recorded and transcribed. All methods described here were detailed and approved by the SFU Office of Research Ethics, application #2019s0362.

Recruitment

The Team selected case study cities from agencies that have embraced SMM and which had made an effort to monitor and evaluate the impacts. Secondly, we chose jurisdictions that were comparable to Metro Vancouver in various ways, including for example, climate, demographics, and/or jurisdictional context. Appropriate agencies and staff contacts were identified through online searches, through literature reviews and by reaching out to academic, industry and agency contacts throughout North America. HUB Cycling's research team members contacted agency staff in case study jurisdictions by phone and email.

The following jurisdictions were selected:

- Seattle, WA and Portland, OR provide similar city and metropolitan regions for comparison, along with having similar climates;
- Washington DC has a long history with SMM, and a history of collaboration with the surrounding municipalities;.
- Calgary, AB provides a comparable Canadian city, currently engaged in SMM pilot initiatives;
- Metro Vancouver, BC to gain further insight into the Metro Vancouver context, several key contacts in the Metro Vancouver region were interviewed.

Key informant interviews were conducted with the following individuals:

Table 1: Case Study Interviewees

Title	City
Transportation Planner	Washington, DC
Transportation Policy	Washington, DC
Bike Share Program Manager	Seattle, Washington
E-Scooter Pilot Project Manager	Portland, Oregon
Bike Share and TDM Program Manager	Portland, Oregon
Shared Mobility Program Manager	Calgary, Alberta Via WATT Consulting Group
Active Transportation Projects Coordinator (Team Leader)	Calgary, Alberta Via WATT Consulting Group
General Manager, Vancouver Bike Share	Vancouver, British Columbia
Bike Share and Active Transportation Coordinator	University of British Columbia, British Columbia
Transportation Planner	University of British Columbia, British Columbia
Senior Planner, New Mobility	New Westminster, British Columbia
Planner, New Mobility	New Westminster, British Columbia

Background

Below Table 2 shows key facts drawn from key informant interviews as well as publicly available documents, reports and web searches. References and details concerning each case study are available in the Appendices.

Table 2: Case Study Key Facts

	Washington DC	Seattle	Portland	Calgary	Metro Vancouver
Area	177 km2	368 km2	376 km2	825 km2	115 km2 (c) 2,879 km2 (m)
Population	700,000	750,000	580,000	1,240,000	630,000 (c) 2,460,000 (m)
Service Providers (at interview time)	Bird (s) Bolt (s) HelBiz (e) Jump (s, e) Lime (s) Lyft (s) Razor (s) Skip (s) Spin (s) Revel (m) Capital Bikeshare (b)	Jump (e) Lime (e)	Biketown (b) Bird (s) Lime (s) Razor (s) Spin (s) Shared (s)	Lime (e, s) Bird (s)	Vancouver Mobi (b) UBC HOPR (b) Richmond U-Bike (b)
Fleet Size (at time of interview)	E-Scooters : 5,235 Dockless EBikes: 5,000 Docked BS: 4,300+ bikes, 500+ stations	Variable fleet size by month Average 2019 fleet size: 6093	E-Scooters: 2500 total cap	Removed for winter months, Pilot: Ebikes: 500 E-Scooters: 1,500	Mobi (b) Appx 2200 HOPR (b) 175-200 U-Bike (b) 50 increasing to approx 80 Spring 2019
Estimated Trips per year	Dockless vehicles: 5.5 million/yr Docked: 3 million/yr	2.4 mil (2019)	Biketown: 400 k (2018) E-Scooters: 700 k trips (4 months, 2018)	Ebikes: 165 k per year (Oct18 - Oct 19) E-Scooters: 750 k trips (July - Oct19)	Mobi: 700 k trips (2018) HOPR: 34 k (Sept – Dec 2019) U-Bike: 1,850 trips (Nov 2018 - Oct 2019)
Rationale	Gateway to active modes	Aggressive mode shift goals; creative and convenient solutions	Convenience, small footprint	Increase cycling mode share, e-scooters to augment ridership	Mobility options; support increased cycling mode share

Funding Mechanism	Capital Bikeshare Public subsidy, fare receipts, and sponsorship of individual stns E-Scooters, Mopeds and Dockless bikes: Fare receipts, venture capital	Fare receipts, venture capital	Biketown: Public subsidy, fare receipts, sponsorship revenue E-Scooters: Fare receipts, venture capital	Fare receipts, venture capital	Mobi: Public subsidy, fare receipts, sponsorship revenue
Enforcement	Suspension, Removal, Revoke	Fine service providers, get them to pass on fines to users	Fine service providers, get them to pass on fines to users	Performance bonds, user fines	User fines
Equity	Discounts available to economically disadvantaged and mandated deployment across the city	Get providers to support traditionally underserved groups.	Mandated deployment in underserved areas	None	Discounted fare program
Injury Rates	Limited data	(Extrapolated data from pilot) 10 bike share related collisions per million trips	(Extrapolated from pilot data) 250 emergency room visits per 1 mil trips	(Extrapolated from pilot) 667 emergency room trips per 1 mil trips	2.5 injuries per 1 mil trips (Mobi) no data for HOPR or U-Bike

(s) = E-scooter, (b) = bicycle, (e) = E-bicycle (m) = Moped

Analysis

Implications for established transportation systems

Micromobility promises potential for improved urban mobility and many agencies are enthusiastic about welcoming SMM, given limited emissions, low noise levels, and flexibility for integration with transit. Yet experience in the jurisdictions that we examined warn of complications that can arise when new transport options are introduced into an established and crowded transportation system. Specifically, SMM may:

- Increase use and popularity of mobility devices that could undermine and diminish use of active modes;
- Exacerbate proliferation of motorized micromobility devices that are difficult to regulate and control;
- Add to congestion and conflicts on congested roadways, shared pathways, sidewalks and dedicated cycling facilities.

A number of recommendations are made to mitigate some of the risks and to accentuate benefits promised by SMM.

Discussion

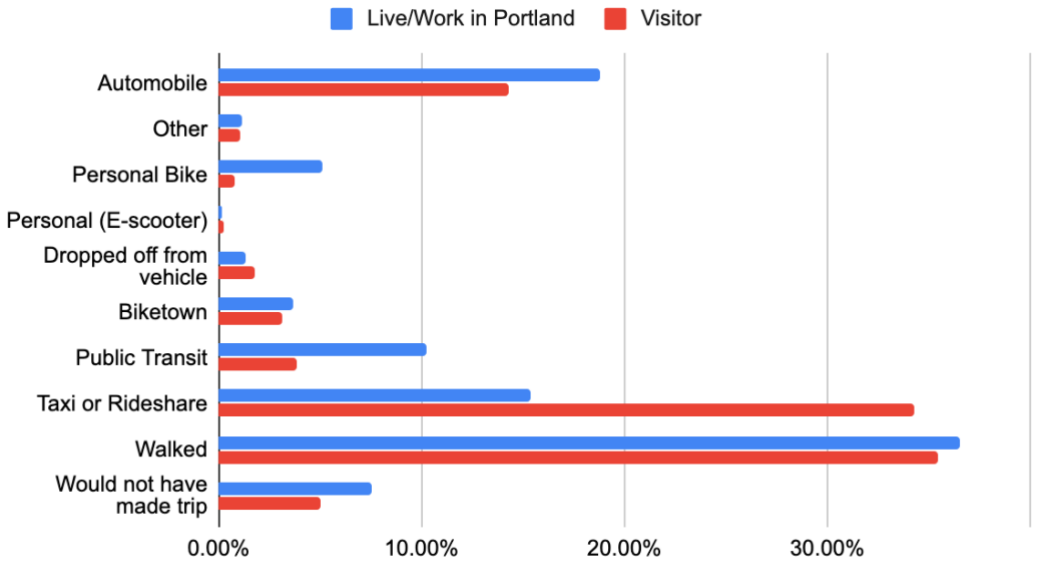
SMM is generally popular and where these vehicles are available and accessible they are well utilized. Available ridership statistics suggest that amongst available SMM options, e-scooters are most popular, followed by e-bikes and bikes. In Calgary for example, the SMM pilot began in October 2018 with the introduction of 500 e-bikes in Calgary. In the year from October 2018 to October 2019, there were 166,000 e-bike trips recorded. In July 2019, 1,500 shared e-scooters were introduced and between July and October 2019, there were 750,000 e-scooter trips recorded. Thus in one third of the time, daily demand for e-scooters outstripped e-bikes by over 50% (City of Calgary, 2019). Further, 85% of those using a shared device in Calgary reported preferring e-scooters over e-bikes (City of Calgary, 2019).

When users and non-users were asked how much they agree with the statement “shared electric scooters are a good option for Calgary’s changing transportation needs” (n=9,949), 72% agreed (strongly 52%) or (somewhat 20%) and only 25% disagreed (strongly 17%) or (somewhat 8%). Similar trends were evident in other case study cities. For example, in a representative citywide poll, 62% of all Portlanders viewed e-scooters positively at the end of the pilot. Support was even higher among Portlanders under 35 (71%), from people of colour (74%), and those with incomes below $30,000 (66%) (Portland Bureau of Transportation, 2019).

Shared e-scooters also appear to attract new demographics to use micromobility. For example in Portland, 74% of those using e-scooters reported never using a shared bike, despite the fact that shared bikes have been available in Portland since 2016. In addition, 42% reported never bicycling (Portland Bureau of Transportation, 2019).

All of the case studies provided evidence that SMM tends to help reduce reliance on automobiles, though to varying degrees. Figure 1 below shows findings from Portland (Portland Bureau of Transportation, 2019).

Figure 1: Portland E-Scooter Mode Replacement



In Calgary, about 65% would have used another sustainable mode including walking (55%), transit (6%), and riding one's own bike or a bikeshare bike (4%). Yet, 34% would have used an automobile, including those who would have driven their own car (18%), a taxi (12%), a car share (3%) or in a carpool or as a passenger (1%) (City of Calgary, 2019). In Washington DC bikeshare users reported driving on average 1,565 fewer miles each year, which equates to 9.9 million fewer miles driven by DC SMM users each year (LDA Consulting, 2017).

Given that there is evidence to suggest that shared e-scooters are popular, attract new demographics and help to reduce reliance on automobiles, there appears to be a strong argument for their adoption. Such findings are likely what prompted the BC government to encourage municipal SMM pilot projects.

Yet e-scooters are not a panacea, since those who replace a walking, bicycle or even a transit trip with an e-scooter trip (65% in some cases) are likely to get less exercise and experience higher transportation costs (City of Calgary, 2019). Further, there is evidence that shared e-scooter programs may not be significantly less resource intensive than automotive options given the short lifespan of e-scooters, and resources required to recharge and rebalance (Portland Bureau of Transportation, 2019).

Ideally, shared e-scooter programs should act as a gateway to a range of shared options, and in particular options that include shared bicycles and e-bikes which support active transportation and associated health benefits. Unfortunately, in the majority of jurisdictions examined, emphasis on, and use of shared bicycles is stagnant or diminishing. In Calgary for example, none of the SMM companies hoping to operate in 2020 are willing to provide shared bicycles or e-bikes as part of their fleet (Thivener, 2020). Yet, in Vancouver, UBC and Seattle where services are limited to shared bikes, demand is strong and the services are popular. In Vancouver public subsidies have allowed the government to influence fleet make-up, size, distribution, and pricing of SMM. In Calgary, by contrast, where there is no government subsidy, market forces tend to have a strong influence on service offerings and governments must compromise in order to balance interests of public and private entities. This situation raises the role of public subsidy in influencing service offerings and the mix of vehicles available for rent.

There is a growing number and variety of micromobility vehicles including those that are human powered, electrically assisted, electrically or gas powered, capable of different speeds and of varying weight. Under the authority of the Motor Vehicle Act (MVA), the Insurance Corporation of British Columbia (ICBC) dictates which kinds of vehicles are allowed on roads in the province, and whether insurance, registration and licensing is required. The following Table provides a brief overview.

Table 3: People powered and low-speed vehicles

Type	Typical Specs	Provincial Regulations	Permitted on: Major Roads Local Roads Bike Lane/Pathway Sidewalk	Insurance, Registration & Licensing Requirements
Skateboards and Longboards 	Weight: 4.5kg Dimensions: 0.2m x 0.8m Speed: 16kmph Powered: Active	No provincial rules, but many (though not all) municipalities have enacted bylaws regulating their use.	Major Roads - No Local Roads - Some Bike Lane/Pathway - Some Sidewalk - Some	None
E-skateboards (hover-boards, and electric unicycles) 	Weight: 10kgs Dimensions: 0.3m x 0.8m Speed: 25kmph Powered: Internal Battery	Considered a vehicle under BC MVA. Does not meet safety requirements for vehicles.	Major Roads - No Local Roads - No Bike Lane/Pathway - No Sidewalk - No	None
Push scooters 	Weight: 4.5kg Dimensions: 0.2m x 0.5m Speed: 15kmph Powered: Active	No provincial rules, but many (though not all) municipalities have enacted bylaws regulating their use.	Major Roads - No Local Roads - Some Bike Lane/Pathway - Some Sidewalk - Some	None
E-scooters and segways 	Weight: 12.5kg Dimensions: .4m x 1.2m Speed: 25kmph Powered: Integrated battery	Considered a vehicle under BC MVA. Does not meet safety requirements for vehicles. The province is in the process of drafting regulations to permit e-scooters to operate in BC	Major Roads - No Local Roads - No Bike Lane/Pathway - No Sidewalk - No	None
Motorized wheelchairs 	Weight: 100kg Dimensions: 0.6m x 1.2m Speed: 8kmph Powered: Multiple removable batteries	Treated similarly to pedestrians and can operate anywhere that pedestrians are permitted to walk	Major Roads - No Local Roads - No Bike Lane/Pathway - No Sidewalk - Yes	None
Bicycle 	Weight: 10kg Dimensions: 0.7m x 1.8m Speed: 20kmph Powered: Active	Not considered a vehicle but referenced within the BC MVA. Rider must be 16 years or older and wear a helmet.	Major Roads – Yes, with some exceptions Local Roads - Yes Bike Lane/Pathway – Yes Sidewalk - Some	None

E-bikes (bicycle-style) 	Weight: 30 kg Dimensions: .7m x 1.8m Speed: 32kmph Powered: Removable battery	Not considered a vehicle but referenced in the BC MVA. Classified as an electric assist bike (requiring pedaling for assist to engage) or as a limited speed motorcycle (with throttle operation). Rider must be 16 years or older and wear a helmet. Gas-powered cycles and electric cycles without attached pedals don't qualify	Major Roads – Yes, with some exceptions Local Roads - Yes Bike Lane/Pathway – Yes, with some exceptions Sidewalk - No	None
E-bikes (scooter-style) 	Weight: 95kg Dimensions: 0.9m x 2m Speed: 32kmph Powered: Internal battery	Considered a vehicle under BC MVA. Rider must be 16 years or older and wear a helmet. Gas powered scooters are prohibited in BC	Major Roads – Yes, with some exceptions Local Roads - Yes Bike Lane/Pathway – Yes, with some exceptions Sidewalk - No	None*
Limited speed motorcycles (mopeds & scooters) 	Weight: 95kg Dimensions: 0.8m x 1.9m Speed: 70kmph Powered: gas or electric	Considered a vehicle under BC MVA.	Major Roads - Yes Local Roads - Yes Bike Lane/Pathway – No Sidewalk - No	Must be registered and insured. Any license sufficient (except learner's)

Image sources: Panel survey images
* Recent ruling by BC has placed the legal standing of these devices in question (Zeidler, 2020)

One important distinction, expanding on the above Table, is whether or not an e-bike is electric assist (requiring pedaling for the electric assist to engage) or electric powered and controlled using a throttle. A recent Supreme Court ruling in BC has clarified the legal standing of electric powered e-bikes. Justice Robert W. Jenkins ruled that a scooter style electric powered e-bike "does not comply with the intent of the legislation" because the pedals are not required to be used for the electric motor to engage. As such, these electric powered e-bikes are defined as limited speed motorcycles and not as a bicycle, and those using such vehicles are required to have a license and insurance (Zeidler, 2020). HUB Cycling supports the position taken by the BC Supreme Court and notes that while scooter style e-bikes are generally throttled, that the same can be said of some bicycle style e-bikes. The ambiguity between electric assist and electric powered vehicles poses an ongoing challenge for enforcement and will require a legislative change should the provincial government, wish to permit a range of electric powered vehicles to operate more widely in BC.

Yet in practice, the variety of micromobility vehicles in operation is becoming increasingly diverse and the numbers are growing. On any given day in Metro Vancouver, one can encounter scooter style e-bikes, e-scooters, e-skateboards, hover-boards and electric unicycles operating on bikeways and streets throughout the region. Further, shared e-scooter companies are currently testing seated e-scooters, potentially further clouding the distinction between limited speed motorcycles and e-bikes (KATU Staff, 2019)

In Washington DC, a company has introduced scooter style e-bikes for shared use that can travel unassisted at speeds up to 40 kmh and weigh ~90kg. These vehicles are characterized as a motor driven cycle in the District and are not permitted on dedicated cycling facilities. Users are required to wear a helmet and to be licensed to drive, but do not require a license to operate a motorcycle or any special training (Revel Transit Inc, 2020). By contrast limited speed motorcycles can weigh up to 95 kg and can

have travel speeds on level ground of up to 70 kmh. Heavier and faster vehicles tend to pose a risk to the safety of cyclists and other vulnerable users, particularly if they are sharing pathways and dedicated cycling infrastructure with users that are travelling at much slower speeds. If it is difficult to distinguish between various classes of micromobility vehicles, enforcement is challenging.

In response to growing use and latent demand for various micromobility options, the provincial government has introduced enabling legislation that will set the stage for rules covering electric scooters, segways, hover-boards, electric skateboards and electric unicycles. Such rules should mirror the SAE micromobility classification system by including vehicle weight, size, speed and power source as part of the classification. Yet even with a robust and clear classification system in place, there is the possibility that local jurisdictions will enact unique rules, as evident in Table 3, creating challenges for interoperability throughout Metro Vancouver. In order to allow for interoperability of micromobility vehicles throughout Metro Vancouver, TransLink and municipal governments should consider developing consistent operating rules, enforcement and fast and effective means to identify different classes of micromobility vehicles.

Increasing popularity of micromobility vehicles poses a challenge for the design of the road right of way and allocation of space to different road users. There are currently no formal design guidelines for micromobility infrastructure at present. This has led agencies to improvise in order to accommodate SMM.

In Calgary, for example, shared e-scooters are permitted to use bike lanes and protected bike lanes, multi-use pathways, shared streets and sidewalks. Shared e-scooters are not permitted on roadways that do not include dedicated cycling infrastructure. While Calgarians appear to support use of shared e-scooters on multi-use paths, and on designated cycling infrastructure, there was a strong negative reaction to use of e-scooters on sidewalks. During the four-month shared e-scooter program, Calgary received over 351 calls (281) and emails (70) relating to shared e-scooters (City of Calgary, 2019). Of the 281 calls, 109 (39%) were complaints about sidewalk riding in general and specifically about e-scooter riders not yielding to pedestrians or passing too close. By contrast, between the launch of its shared e-bike program in October 2018 and the launch of e-scooters in July 2019, Calgary received a total of 14 complaints regarding shared e-bikes. This situation has prompted calls to prohibit e-scooters on sidewalks while providing new impetus for the expansion of cycling facilities in Calgary.

Yet, there is a risk in conflating micromobility infrastructure with bicycle infrastructure. While there is a common understanding of what constitutes cycling infrastructure, pavement markings and signage, the focus on one particular mode may not ultimately reflect the diversity of users. This approach may have safety implications if infrastructure design is predicated upon the operating characteristics of a single type of vehicle. Moreover, conflicts may arise if signage and iconography appear to confer a higher degree of ownership to a particular mode.

A number of agencies have begun to consider design guidance that would be appropriate for the growing diversity of micromobility vehicles. Portland, for example, has begun to use the term Lite Individual Transportation (LIT) to describe travel lanes that might accommodate a wide variety of vehicles that weigh less than a typical automobile and travel at slower speeds. Recently City of Vancouver passed a motion to establish 50 kilometers of slow streets on existing greenways and local streets where minor interventions can be used to reduce and slow down traffic so that people can walk and roll in the street with more comfort while improving physical distancing (Chan, 2020).

Other options to better accommodate a range of micromobity vehicles include:

- Circulation plans that reduce automobile traffic volumes;
- District-wide traffic speed reduction to 30 kmh or less; and

- Traffic calming and filtering which permit slow speed access to all neighbourhood destinations but which prevent automobiles from driving through a neighbourhood.

Regardless of the approach, design guidance should be appropriate to the range of vehicles sharing a facility, while offering the prospect of comfort and safety to the most vulnerable users.

Recommendations

Mitigating impacts on established transportation systems	
Recommendation	**Responsible Agencies**
Establish distinctions between classes of low speed vehicles based on weight, dimensions, power source and speed, and mandate means to make quick visual distinctions between classes in order to facilitate enforcement.	Lead: Province Support: TransLink and Municipal agencies
Develop facility design guidelines to accommodate different classes of micromobility vehicles.	Lead: Province Support: TransLink and Municipal agencies
Permit only those classes of micromobility vehicles that are compatible and consistent, to operate on dedicated bicycle and pedestrian facilities.	Lead: Municipal agencies Support: TransLink
Enable and enhance region-wide operability of micromobility devices, including common, region-wide rules, penalties and enforcement. Where exceptions are required, establish clear and consistent means to notify users.	Lead: Municipal agencies Support: TransLink
Take advantage of the broad appeal and popularity of SMM to expand cycling friendly infrastructure.	Lead: Municipal agencies Support: TransLink

Safety

In each of the case studies we examined, user safety was a point of discussion. Injury rates for those using shared e-scooters appear to be high relative to injury rates for bicycles, though further investigation is necessary. There are a number of factors that may account for higher rates of injury for shared e-scooters:

- The design of e-scooters may influence the risk of injury to users;
- E-scooters are unfamiliar to users, many have not used a scooter, let alone an e-scooter;
- Design and condition of municipal infrastructure;
- Challenges associated with establishing and enforcing regulatory controls.

Discussion

Methods to measure injury rates involving SMM differ significantly between case study jurisdictions. In Washington DC, for instance, the data is limited and only includes injuries that have been reported to the operating company. DDOT rarely receives injury reports through any other method and has not developed a way to track injuries through the hospital system. Calgary by contrast commissioned an academic study to understand who, how, when, where and why people are being injured on e-scooters. The study involved collecting data from SMM users who visited an emergency room in July, August and September of 2019. This study indicates that every 1,500 e-scooter trips results in at least one (1) emergency department visit. This equates to a rate of 678,000 injuries per 1 billion trips, or 678 injuries per million trips. This is significantly higher than injury rates (emergency department visits) reported from other recent studies as shown in Table 4 (OECD/ITF 2020, P27).

Another way to measure injury rates is based on the number of patients admitted to a hospital bed. In this case the data is also somewhat mixed. Based on the number of patients admitted to hospital beds, Calgary, Austin and Auckland showed injury rates of 10, 29 and 62 per million trips respectively, while not a single bicycle related study reported more than 10 cyclists admitted to hospital for every million trips.

Yet, no study of which we are aware, has compared the injury rates of those using e-scooters and bicycles based on a consistent protocol, over the same area and timeframe. Although the safety performance of standing e-scooters relative to other transport modes remains inconclusive, there appears to be enough evidence to suggest that injury rates are generally higher than for bicycles.

Table 4: Rider injury rates per billion trips

Ref	City, Time	Standing e-scooter	Bicycle	Powered two-wheeler
Injuries - Emergency Department visits per billion trips				
1	Calgary, Alberta, 2019	678,000		
2	Austin, Texas, 2018	203,000		
3	Baltimore, Maryland, 2018-19	87,000		
4	Portland, Oregon, 2018	251,000		
5	Auckland, New Zealand, 2018-19	200,000		
6	United States, 2009		110,000-180,000	
Injuries - Hospital admissions per billion trips				
1	Calgary, Alberta, 2019	10,000		
2	Austin, Texas, 2018	29,000		
5	Auckland, New Zealand, 2018-19	62,000		
7	Germany, 2008-2009		1,000 to 2,000	
8	Rhone, France, 2005-2006		4,000	28,000
9	Toronto, Canada		circa 1,000	
6	United States, 2009		5,000 to 9,000	
7	United States, 2008-2009		6,000 to 10,000	
8	Canada, 2006-2011		6,220 (95% CI 6,110 to 6,330	

[1] City of Calgary (2019) [2] Austin Public Health (2019); [3] Baltimore City (2019); [4] PBOT (2019); [5] Bekhit et al. (2020) [6] CDC WISQARS (2019); [7] Buehler and Pucher (2017); [8] Blaizot et al. (2013); [9] Bassil et al. (2015).

The design of e-scooters, behaviour of users, regulation and enforcement, and municipal infrastructure have all been considered in efforts to improve safety for SMM users.

The design of e-scooters impacts safety performance. E-scooters tend to have small wheels (less than 15 centimetres or six inches in diameter), a narrow wheelbase (less than a metre or 3.3 feet) and are operated from a standing position. These factors make e-scooters less stable on uneven ground, at higher speeds, and when cornering. Operating companies have implemented, or are considering a number of design improvements to address such challenges including:

- Durable brakes that are designed for consistent braking;
- Automated braking to restrict top speeds to 25 km/h or less on downhill slopes;
- Reinforced hardware to prevent failure, even during heavy use;
- Requiring kick-start before the throttle can be engaged (to avoid unintentional or jerky acceleration);
- Non-slip standing surfaces and durable grips for secure riding;
- Front and rear lights configured to remain illuminated for at least 90 seconds after the rider has stopped, coupled with reflectors for extra visibility;
- Manual bells that can be used to alert other users on the road;
- Use of geofencing technology to cap the speed of e-scooters where necessary, such as on pedestrianized streets.

Other design changes recommended or under investigation include, for example:

- Increasing wheel diameter to 10-12" to reduce the threat of falls;
- Adding turn signals since it is hard to use hand signals without losing one's balance while riding a scooter;
- Improving geofencing to restrict speeds or use of SMM devices on sidewalks and other locations where they might be restricted or prohibited.

Design innovations that improve safety should ideally be adopted across the industry so that users benefit from operations and functionality is consistent and predictable.

Inexperienced users are much more likely to be injured. A 2019 study from the Austin Public Health Department and the Centre for Disease Control found that of patients surveyed, 30% of total injuries to SMM users occurred on a person's first ride. That same study found that the majority of injuries occur within the first 9 trips on a shared e-scooter (Austin Public Health, 2019). A number of steps have been taken to educate users and to warn them of safety risks, including for example:

- Clear and prominent labeling to reinforce responsible ridership rules (helmet recommended, no double riding, etc);
- A requirement in some jurisdictions for users to respond to a series of safety related questions before beginning a trip;
- Efforts to provide and to encourage use of helmets. Bird for example provides users with helmets free of charge;
- Outreach at locations that are frequented by people using SMM devices to offer education and incentives to reward safe usage.

Regulation and enforcement of SMM users adds costs and can be complicated for local jurisdictions. E-scooters are currently prohibited on all roads, bikeways, multi-use paths and sidewalks throughout British Columbia. In order to permit their use, provincial regulations and local bylaws are required. In Alberta, the provincial government issued an exemption to allow e-scooters to operate, and Calgary and Edmonton established bylaws (City of Calgary, 2020) to allow pilot programs to proceed. In Calgary, e-scooters can operate on dedicated bikeways, on multi-use paths and on sidewalks. In order to achieve consistency, the Province and TransLink should consider developing model bylaws in consultation with municipal governments.

In order to reduce the burden of enforcement, a number of local agencies that we studied levy fines and other penalties for user infractions against SMM operating companies. This approach has proven effective as a means of enlisting the support of operating companies in undertaking enforcement. In order to reduce the number of infractions and to support improved safety, Bird in Calgary:

- Ceases operations after midnight, when the risk to all road users tends to increase;
- Requires riders to confirm they are 18 years or older;
- Institutes and enforces through geofencing responsible speed limits for e-scooters;
- Enables direct reporting of irresponsible behaviour through an online app.

Typically enforcement is easier for SMM operators which can identify users and target them with warnings, fines and bans if they commit repeated or flagrant violations.

In Portland, a recent study of e-scooter users found that individuals ranked dedicated and segregated cycling infrastructure and streets with low traffic speeds (30kmh) as their most preferred facility types while sidewalks ranked last (Portland Bureau of Transportation, 2019) . Various studies (Santacreu, 2018; OECD, 2020; Deagan, 2018; NACTO, 2018) have shown that a variety of infrastructure improvements can improve safety for vulnerable road users, including but not limited to:

- Dedicated and protected facilities to serve micromobility users;
- Designated routes that avoid steep slopes wherever possible;
- Median barriers and other refuge islands that provide protection as vulnerable road users are crossing collector or arterial streets;
- Smoother pavement;
- Wider bike lanes to accommodate a broader range of micromobility users; and
- Designated parking for SMM devices.

Recommendations

Safety	
Recommendation	**Responsible Agencies**
Establish an effective and ongoing means to track and measure injuries to SMM users.	Lead: Health Authorities Support: Municipalities and medical researchers
Develop model bylaws to encourage consistency in regulations imposed upon SMM devices and users.	Lead: Province and TransLink Support: Municipal agencies
Consider minimum design and maintenance requirements for SMM devices.	Lead: Province Support: TransLink and municipal agencies
Adopt design innovations across the industry so that users benefit from ongoing innovation and so that functionality of devices is consistent and predictable.	Lead: SMM operators Support: Municipal and Provincial agencies and TransLink
Develop and deliver safety education and communications targeted at SMM users.	Lead: SMM operators Support: TransLink and municipal agencies
In order to reduce the burden of enforcement, levy fines and other penalties for user infractions against SMM operators.	Lead: Municipal agencies
Invest in infrastructure improvements and maintenance regimes that are demonstrated to enhance safety for micromobility users.	Lead: Municipal agencies Support: TransLink and the Province

Cost

Costs of using micromobility devices can often be more than a user expects. Companies charge a fee to unlock the devices, then charge at a per minute rate. While short trips remain somewhat affordable, longer trips quickly become relatively expensive. Using Calgary as an example; renting an e-scooter for an hour would cost a user between $18.70 and $21.80 an hour.

Discussion

Shared e-scooter's available for rent in Calgary use the following cost structure:

- Lime ($1 for first minute, 30 cents per minute after) (Lime, 2020)
- Bird ($1.15 for first minute, 35 cents per minute after) (Tucker, 2019)

Calgary's average trip distance is 1.85 km (City of Calgary, 2019), but no average time is given for this distance. Assuming that trips are taken at 85% of full speed (e-scooters are limited at 20 kmph), this trip would take about 7 minutes.

- Lime: $2.80
- Bird: $3.35.

Calgary's e-bike providers Lime, rented their bicycles at the same $1 for the first minute, 30 cents per minute after rate as their e-scooters. However, with a slightly higher top speed of 23.8 kmph, they would theoretically be able to complete their trip one minute faster, making the cost of a 1.85 km journey $2.50.

In Portland, e-scooters had the exact same average trip distance of 1.85 km, but they also provided an average trip time of 17 minutes (Portland Bureau of Transportation, 2019) . Using this 17 min time, the costs for an e-scooter trip in Calgary would be,

- Lime: $5.80
- Bird: $6.75.

Making comparisons to other modes is problematic, as they are designed for much different trip profiles than micromobility devices. However, these comparisons are helpful to show the order of magnitude difference in costs.

Calgary Transit currently operates on a single zone flat fare system, where use of bus, bus rapid transit, and light rapid transit is included. A single adult cash fare is $3.50, and allows full use of the system for 90 minutes. Daily and monthly passes are available at $11 and $109 respectively (Calgary Transit, 2020).

Calculating the cost of an average ride sharing trip is difficult, as costs increase with both time and distance. Currently Uber is the only company operating rideshare in Calgary, and their costs are as follows:

- $2.30 pick up cost,
- $0.90 per km travelled,
- $0.17 per minute travelled.

However their minimum charge, (regardless of time and distance) of $5.95 provides an absolute base level cost for comparison. Looking at Uber's trip estimator, in downtown Calgary, a 1.8 km trip would cost a user between $8 to $17 dollars, depending on the service and vehicle type vehicle requested (Uber, 2020) .

Table 5: Estimated Costs Per 1.8km trip (Calgary)

Vehicle	Estimated Cost (low)	Estimated Cost (high)	Estimated Time
Shared E-scooter	$2.80	$6.60	7-16 mins
Shared E-bike	$2.50	$5.80	6-16 mins
Public Transit*	$3.50		5-15 mins
Uber*	$8.00	*$17.00	5-7 mins
Walking	$0.00		18-22 mins

*Travel times are exclusive of any wait period as they will vary greatly dependent on location, time of day, traffic.
*Uber may also charge additional surcharges when the system is busy.

On the low end, micromobility costs are competitive with most modes, including transit, assuming the trip time is short. For the cheapest micromobility device (Lime), a trip shorter than 14 mins will be competitive with transit costs. Uber trips will likely be more expensive for the bulk of short trips, and will only become competitive over longer distances. See Table 5. Car share no longer exists in Calgary, following the exit of Car2Go from the North American market. A similar trip distance in Vancouver with car share company Evo would expect to cost between $3.30 and $5.60 (plus any subscription or registration fees).

Dockless systems will generally cost a user more than traditional docked systems, which often run on a subscription model. Vancouver's Mobi system costs an annual fee of $130 dollars for unlimited 30 minute rides (Vancouver Bike Share Inc, 2020). Use of the system on a consistent basis drives the per trip cost down, for example, a person using Mobi to commute to and from work (52 x 2 = 104 trips), their per trip cost would be $1.25. If they added one additional trip a week (156 trips per year), their per trip cost is about $0.86 cents. Further review should occur to examine possible links between the pricing models of micromobilty modes and injury. In short, does having a per minute cost associated with dockless modes incentivize the users to travel at higher speeds than they would under a subscription model, thus adding to the risk of injury?

Recommendations

Cost	
Recommendation	**Responsible Agencies**
Consider pricing models that include subsidies if SMM is determined to support Regional Transportation Strategy headline targets.	Lead: TransLink Support: Municipal agencies
Consider pricing models that are similar to transit, allowing deep discounts for regular users.	Lead: SMM operators Support: Municipal agencies and TransLink
Examine connections between pricing models and injury rates.	Lead: Municipal agencies Support: Health authorities and medical researchers
Adjust trip planning tools to support multimodal trips and to include a comparison of estimated travel costs.	Lead: TransLink

Usage patterns

While still a relatively new device, patterns are emerging that illustrate how SMM devices are used.

Discussion

In Portland, we see a slight uptick in usage on Fridays and Weekends, with about 10% more trips on weekends. Weekday use peaks around 3-6pm accounting for nearly 20% of pilot trips in this time frame, but not significant usage rates on weekday mornings. Weekend trip rates peak between 2-5pm (Portland Bureau of Transportation, 2019).

Figure 2 Portland E-scooter Trip Starts by Hour

Trip Start Time	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Grand Total
12 AM	1280	765	723	786	720	840	1470	6584
1 AM	989	517	475	518	545	575	1010	4629
2 AM	704	348	361	392	412	475	723	3415
3 AM	361	233	202	228	215	192	316	1747
4 AM	261	230	196	179	186	229	256	1537
5 AM	281	298	355	361	374	401	331	2401
6 AM	495	791	980	964	986	910	591	5717
7 AM	860	1839	2218	2354	2451	2187	950	12859
8 AM	1781	2942	3377	3640	3665	3430	2038	20873
9 AM	3515	3208	3408	3342	3579	3602	3730	24384
10 AM	5806	3746	3431	3552	3674	4110	5897	30216
11 AM	7935	5591	5188	5285	5611	6242	8081	43933
12 PM	9564	6958	6690	6654	7027	8058	9644	54595
1 PM	10584	7345	6614	6669	6952	8097	11120	57381
2 PM	10698	7731	7132	6796	6994	8726	12278	60355
3 PM	10754	8149	7855	7191	8204	9612	12175	63940
4 PM	10129	8677	8813	8532	8956	10125	11773	67005
5 PM	8485	8855	9235	9599	9468	9816	10165	65623
6 PM	6834	7477	7928	7923	8366	8516	8294	55338
7 PM	5303	5795	6231	6278	6709	7410	6474	44200
8 PM	4246	4526	4978	4838	5196	6330	5212	35326
9 PM	2112	2252	2439	2402	2539	3189	2579	17512
10 PM	1480	1478	1576	1510	1594	2124	1995	11757
11 PM	1007	1162	1110	1094	1299	1750	1620	9042
TOTAL	105464	90913	91515	91087	95722	106946	118722	700369

(Portland Bureau of Transportation, 2019)

Daily riders (and more than daily riders) account for only about 2.5% of riders. The bulk (41%) fall into the occasional category of riders (less than once a week) (Portland Bureau of Transportation, 2019).

Calgary showed a later weekday peak (4-7pm), with minimal usages rates in the mornings (City of Calgary, 2019). Survey respondents ranked commuting as the second most likely trip type, after errands/appointments. In an engagement survey near the end of the pilot, 66% of respondents indicated they have tried a shared e-scooter. Of those who have tried it, the same 66% ratio have used it 15 times or less. Only 20% responded that they used the devices more than 15 times, indicating that e-scooters have had limited use as a daily commuting option (City of Calgary, 2019) .

However, SMM devices are primarily used as a transportation option. In Portland, 71% of e-scooter trips were to reach a destination, while 29% were used for recreation/exercise (Portland Bureau of Transportation, 2019). In Calgary, the top two trip purposes were “shopping/errands” (25%), and “to and from work” (~17%) (City of Calgary, 2019). For DC bike share users, 65% said commuting to/from work was primary trip type (LDA Consulting, 2017), and in Seattle, only 6.8% of respondents listed “exercise and recreation” as their only use of bike share (Seattle Department of Transportation, 2018). Generally, shared bicycles have seen greater use as a commuting mode than e-scooters, with scooters being used more often on discretionary trips such as errands and shopping. Neither mode showed a tremendous use as a recreation/exercise device.

Average trip distances suggest that e-scooters tend to replace walking more often than shared bicycles. Calgary and Portland e-scooters for example had an average trip distance of 1.85km, whereas

Vancouver Bike Share and Seattle Shared Bikes have average trip distances of 2.3km and 3.5km respectively. Longer average trip distances suggest that shared bikes are more likely to be used as an alternative to a trip by automobile or transit.

Use by tourists of SMM can be dramatically different from how they are used by locals. For example in Portland, e-scooters replaced a vehicle trip 34% of the time, for visitors nearly half of e-scooter trips replaced a vehicle trip (48%) (Portland Bureau of Transportation, 2019). In Portland, bike share saw a sizable decrease in summer revenue which PBOT staff attribute to a shift in visitor and recreational trips from Biketown to e-scooters. Obviously there are also different reasons and destinations that are favoured by tourists as well. In Portland, tourists use SMM for sightseeing, restaurant, and recreational trips more often than locals (Portland Bureau of Transportation, 2018).

Use by tourists also reinforces the need for education about rules and regulations. In Portland, visitors indicated that they learned e-scooter rules from the app (50%) or off the device itself (20%). Twenty-two percent (22%) did not learn any of Portland's e-scooter laws. This is compared to local riders, only 6.5% of whom did not know Portland's e-scooter laws (Portland Bureau of Transportation, 2018).

One the more positive outcomes for SMM has been its effect on auto trips. In Portland and Calgary, e-scooters replaced an auto trip about 34% and 33% of the time respectively. With respect to active modes Portlanders reported replacing active modes with an e-scooter trip 42% of the time (37% walking, and 5% personal bicycle). Meanwhile in Calgary, ~55% of micromobility trips would otherwise have been completed by walking (City of Calgary, 2019). Portland has also noted a slight decline in auto ownership with the introduction of micromobility devices. 6% of respondents indicated that they got rid of their personal vehicle due to e-scooters, with another 16% indicating they were considering it (Portland Bureau of Transportation, 2019).

In DC, Capital Bike Share members increased the number of the cycling trips they made upon becoming a member. In their 2016 member survey, 82% of respondents indicate they increased their bike trips after joining, with 49% saying they cycled "much more often". Members indicated less trips by every other travel mode, suggesting at least some of these trips were captured by cycling. Capital Bike Share members also noted reductions in their annual motor vehicle miles travelled; 20% said they reduced the amount of miles they drove compared to the previous year, with 9% noting a reduction of greater than 1000 miles (~1600 km) (LDA Consulting, 2017).

Recommendations

Usage Patterns	
Recommendations	**Responsible Agencies**
Consider pricing, availability and other means to influence the extent to which SMM is used as part of a commute trip during peak periods.	Lead: Municipal agencies Support: TransLink
Consider means to reach and educate users and in particular visitors who might be more highly prone to injury due to their lack of familiarity with SMM and local geography.	Lead: SMM operators Support: Municipal agencies
Consider pricing, availability, and network service area as means to leverage increased use of SMM as an alternative to a trip in a motor vehicle.	Lead: Municipal agencies Support: SMM operators and TransLink

Integration with Transit

SMM offers an effective means to complement regional transit services. In this section we consider steps that TransLink and member agencies can take to support and enhance integration.

Discussion

In Seattle, nearly 75% of users had used bike share to access transit, with 33% of respondents saying they *regularly* used shared bikes for this purpose. And, 60% of respondents said they would be more likely to use shared bikes more often if connections to transit were easy and reliable (Seattle Department of Transportation, 2018). In Calgary, over 70% of respondents agreed with the statement, "Shared mobility can make connecting to Calgary Transit easier". Yet survey data suggests only 5% of trips on the devices were for this purpose (City of Calgary, 2019). In DC, seven in ten (71%) respondents used Capital Bikeshare at least occasionally to access a bus, Metrorail, or commuter rail; 18% used bikeshare six or more times per month for this purpose. One in 10 said having additional stations near transit would encourage greater use (LDA Consulting, 2017). For Portland, nearly 40% of e-scooter riders had used the device to access transit (Portland Bureau of Transportation, 2018).

Including docking stations or designated parking areas near transit hubs becomes essential to the combined use of SMM and transit. Since most users see micromobility devices as useful for serving the first and last mile trips to/from transit, it becomes imperative that users can make that connection as seamlessly as possible. However, transit hubs can quickly become overwhelmed with devices, if areas to park lack capacity and/or are not clearly defined. In Portland, major concerns were raised by disability groups that these improperly parked devices were blocking ADA access to transit facilities or access to ADA parking spots (Portland Bureau of Transportation, 2019). Seattle, while not focused explicitly on transit, ran three separate studies on the parking of dockless bikeshare, and found

between 4% and 10% of devices blocked or impeded movement on public sidewalks (Seattle Department of Transportation, 2018).

Despite the clear synergies that micromobility devices and transit have, the responses of transit agencies were primarily reactive. Only after parking of the devices around transit stops or hubs became problematic, with devices littering the landscape or blocking access, did cities or transit providers begin to address the issue. Being proactive on the likely impacts these devices may have on transit is imperative to achieving effective integration between SMM and transit.

Considerations should be made to include distribution of devices around transit hubs. If the devices are expected to be used as a complement to mass transit, then access needs to be made as easy as possible at these locations. For example, UBC requires providers to have a certain number of devices within 100m of the main UBC bus exchange in the mornings to facilitate students using the service to complement transit (UBC Transportation Planner, 2020).

Differences between visitor use and local use in regards to accessing transit is quite stark. In Portland, nearly 40% of local users had used scooters to access local transit options. For visitors, that rate is less than half at ~18% (Portland Bureau of Transportation, 2018).

One theme we heard from our Vancouver interviews was the concept of fare integration being important to the success of the system. Despite having bike share equipment that is produced by the same company, there is no integration between Vancouver and UBC's bike share systems. As a result, Mobi members cannot use their memberships to ride Hopr bikes, nor can Hopr members use the Mobi system.[1] This lack of integration could limit the success and interoperability of micromobilty systems, as Metro Vancouver consists of 21 member municipalities, an electoral area, and a treaty first nation, all with slightly different rules and requirements. Individual systems with limited service areas are destined to be minor players in the regional transportation system. TransLink however has taken a number of steps to facilitate regional integration. For example, TransLink developed the *Shared Micromobility Guidelines* document to help standardize services and data collection in the region. Moreover, TransLink has begun to trial fare integration through their B2B pilot program, in which TransLink's Compass cards can be used to access transit, bike share, and certain car share providers (TransLink, 2020).

[1] Members of the UBC community are eligible for discounted Mobi Memberships.

Recommendations

Transit Integration	
Recommendation	**Responsible Agencies**
Consider means to improve integration between SMM and regional transit services, including: ● Pricing, availability, and network service areas that leverage SMM as a complement to regional transit; ● Identifying designated areas where micromobility parking (or docking) will occur around transit stations and hubs before pilot programs are implemented; ● Placing restrictions on where devices can park and operate in order to maintain access to and circulation within rapid transit stations and exchanges; ● Establishing quotas for the number of SMM devices that must be stationed adjacent to transit hubs at particular times to support commuting, and other multimodal trips; ● Considering opportunities for fare integration in order to facilitate and incentivize complementary use of transit and SMM.	Lead: TransLink Support: Municipal agencies

Meeting Municipal and Regional Goals

Metro Vancouver has established a consistent vision for livability in the region which involves a series of compact urban centres supported and reinforced by a multi-modal transportation system. To realize this vision, TransLink and member municipalities have embraced objectives called “headline targets” to guide their actions in managing the regional transportation system.

SMM has emerged as a transportation option driven by private interests, but with the potential to complement public transit services. Public agencies have reacted in various ways, some by resisting, some by tolerating and regulating and others by actively supporting and even subsidizing such services. Through case studies of SMM services, we consider the extent to which SMM might:

- Support and reinforce regional objectives, and
- Be worthy of public subsidy.

Discussion

The following section considers headline targets listed in the Regional Transportation Strategy, identifying whether or not evidence from the case studies supports, is neutral or unsupportive to achieving these regional objectives.

Table 6: Preliminary assessment of TransLink's RTS headline targets

Target	Supports 😊 Neutral 😐 Unsupportive ☹	Notes
Increasing trips made by sustainable modes including walking, cycling and transit		Calgary: SMM replaced an auto trip ~34% of the time [1] Portland: E-scooter trips replaced car trips 34% of the time. Higher replacement among tourists: 48% replaced an auto trip. [3] DC: 82% of bike share members increased their cycling [4]
Reducing the distance people drive		DC: 20% of bikeshare members drove less, reducing annual VKMT by 9.9 million miles. [4] Portland: 6% got rid of a car due to availability of e-scooters [3]
Making travel time more reliable		Portland: 46% of users indicated e-scooters were the fastest and most reliable method of travel for certain trips [5]
Increasing transportation options		Each case study city indicated that SMM increased transportation options
Making it easier and less stressful to get to work and school		Calgary: ~80% indicated SMM makes it easier/faster to get to work and school [2]
Giving us more time to do the things we love		Portland: 28% indicated they use e-scooters primarily for fun/recreation [2] Portland: 46% of users indicated e-scooters were the fastest and most reliable method of travel for certain trips [5]
Ensuring businesses continue to prosper with better access to more workers and more markets		Calgary: Over 50% of SMM trips ended in a BIA or BRZ and many commented that it offers an effective way to explore the city [1]

Making living, working and doing business in this region more affordable	?	Affordability is relative to the mode replaced and predicated on the value of time for users.
Giving people better access to more jobs and more opportunities		Portland: During their four-month pilot, companies reported working with 1,533 independent contractors (primarily rechargers) and paying $643,000 in total wagers to contractors. [3]
Making our roads safer	?	Calgary: Some evidence that injury rates are significantly higher than for those using privately owned bicycles.[3] More evidence needed to understand overall impacts on transport safety
Helping us live healthier and more active lives, reducing the burden on the healthcare system		Overall level of impact on active living and costs to the healthcare system are unclear. There are some indications e-scooters replace walking trips thus undermining their health benefit
Helping us get out on the sidewalk to meet our neighbours and deter crime		Inconclusive evidence concerning the impacts on crime rates and positive interactions with other street users
Making the air we breath cleaner		As shared e-scooters are powered by electricity they add minimally to local air pollution
Protecting our climate by reducing our greenhouse gas emissions		Portland: E-scooters were likely a less polluting option, but more evidence regarding overall energy consumption, operations and lifecycle costs are needed. [3]

[1](City of Calgary, 2019) [2](City of Calgary, 2019) [3](Portland Bureau of Transportation, 2018) [4](LDA Consulting, 2017) [5](Portland Bureau of Transportation, 2018)

Based on the limited evidence available, SMM appears to make a positive contribution to at least 9 of the 14 headline targets that Metro Vancouver has identified. Evidence from the case studies suggests that impacts (both positive and negative) can be influenced by a number of factors including, but not limited to, the size and make-up of the fleet and the extent of the service area. More research is thus needed to confirm our findings, particularly within the local context.

One area that TransLink targets only touch on, but which was a popular topic of discussion amongst case study jurisdictions is the issue of equity. Three aspects of equity were raised, including access for:

- People with disabilities and other communities with special needs (both in terms of access to, and public right-of-ways unencumbered by, SMM vehicles);
- Those without access to a cell phone;
- Under-banked households, low income users; and
- Economically disadvantaged neighbourhoods.

Our sense is that these issues are best understood within a local context and through dialogue with affected communities. We thus recommend that a comprehensive examination of equity be added as a headline target for explicit consideration through pilots that take place within Metro Vancouver.

TransLink and member municipalities that have, or are planning to implement SMM pilots, are well situated to evaluate the contribution that such programs might make to headline targets and what public subsidy, if any, would be appropriate to leverage that contribution.

How SMM operations are awarded and governed can impact their ability to influence local and regional objectives. The right to operate a SMM operation is typically awarded through:

- A request for proposal (RFP), which involves a competitive procurement process to select a firm (or firms) best qualified to provide a service;
- A permit process, in which any number of firms may provide a service, so long as they meet minimum qualifications;
- Open access, through which any firm may enter the market without restriction.

More recently a combination between permit and RFP processes have been used to award operating licenses. Those companies which meet certain criteria are allowed to enter the market. Then a competitive process based on operating history and capacity is used to apportion the overall fleet amongst those permitted to operate. Permitting a variety of operators creates an environment in which competition for customers and fleet size provides incentives for operators to strive for continual improvement. Such processes can also be used to set performance standards that may be used to regulate the behaviour of SMM operators. Open access by contrast is not recommended since it offers little or no opportunity for government agencies to clarify or enforce their expectations.

Once SMM operators are permitted access to a market, measures beyond competition amongst operators have proven necessary to induce operators to meet expectations of licensing agencies. Municipal agencies have thus come up with a range of enforcement tools to encourage compliance. These include for example:

- Performance bonds, which require the operator to set aside a sum of money that the regulator can draw upon through agreed fines if the operator does not meet its contractual obligations;
- Non-financial rewards and penalties such as an option to increase or requirement to decrease a fleet size; and ultimately
- The ability to revoke an operating permit.

Having an escalating range of financial and non-financial rewards and penalties have proven an effective means to achieve compliance. However, given that none of the SMM operators supported by venture capital are profitable, such controls must be used judiciously in order to encourage and support a thriving SMM sector (Shulman, 2019).

Recommendations

Meeting Regional Objectives	
Recommendations	**Responsible agencies**
Support shared SMM pilot projects, but undertake further research to confirm whether SMM should be embraced as part of a larger public transit service strategy.	Lead: TransLink Support: Municipal agencies
Consider a process for granting pilot operating licenses that involves a hybrid between a permit and request for proposals process in order to allow multiple operators the opportunity to access local markets while allowing those operators with superior capacity and operating history to supply a higher proportion of the overall fleet.	Lead: Municipal agencies
Consider contract enforcement tools that offer a range of positive and negative reinforcement including, but not limited to, performance bonds, non-financial rewards and penalties, and the ability to revoke operating permits. Use these powers judiciously in order to support a thriving SMM industry.	Lead: Municipal agencies
Identify, collect and analyze data required to understand the potential for SMM to contribute to achieving local and regional transportation strategy objectives.	Lead: TransLink and municipal agencies Support: The Province
Consider the role and responsibility of public agencies in influencing the size and make-up of SMM fleets in order to maximize use of active transportation, sustainable modes and to support other agency objectives.	Lead: TransLink and Municipal agencies Support: The Province
Consider what level of public subsidy, if any, would be required to allow SMM to fully support local, regional and provincial transportation strategy objectives.	Lead: TransLink and municipal agencies Support: The Province

Mitigating impacts on established transportation systems	
Establish distinctions between classes of low speed vehicles based on weight, dimensions, power source and speed, and mandate means to make quick visual distinctions between classes in order to facilitate enforcement.	Lead: Province Support: TransLink and Municipal agencies
Develop facility design guidelines to accommodate different classes of micromobility vehicles.	Lead: Province Support: TransLink and Municipal agencies
Permit only those classes of micromobility vehicles that are compatible and consistent, to operate on dedicated bicycle and pedestrian facilities.	Lead: Municipal agencies Support: TransLink
Enable and enhance region-wide operability of micromobility devices, including common, region-wide rules, penalties and enforcement. Where exceptions are required, establish clear and consistent means to notify users.	Lead: Municipal agencies Support: TransLink
Take advantage of the broad appeal and popularity of SMM to expand cycling friendly infrastructure.	Lead: Municipal agencies Support: TransLink

Safety	
Recommendation	**Responsible agencies**
Establish an effective and ongoing means to track and measure injuries to SMM users.	Lead: Health authorities Support: Municipal agencies and medical researchers
Develop model bylaws to encourage consistency in regulations imposed upon SMM devices and users.	Lead: Province and TransLink Support: Municipal agencies
Consider minimum design and maintenance requirements for SMM devices.	Lead: Province Support: TransLink and municipal agencies
Adopt design innovations across the industry so that users benefit from ongoing innovation and so that functionality of devices is consistent and predictable.	Lead: SMM operators Support: Municipal and Provincial agencies and TransLink
Develop and deliver safety education and communications targeted at SMM users.	Lead: SMM operators Support: TransLink and municipal agencies
In order to reduce the burden of enforcement, levy fines and other penalties for user infractions against SMM operators.	Lead: Municipal agencies
Invest in infrastructure improvements and maintenance regimes that are demonstrated to enhance safety for micromobility users.	Lead: Municipal agencies Support: TransLink and the Province

Cost	
Consider pricing models that include subsidies if SMM is determined to support Regional Transportation Strategy headline targets.	Lead: TransLink Support: Municipal agencies
Consider pricing models that are similar to transit, allowing deep discounts for regular users.	Lead: SMM operators Support: Municipal agencies and TransLink
Examine connections between pricing models and injury rates.	Lead: Municipal agencies Support: Health authorities and medical researchers
Adjust trip planning tools to support multimodal trips and to include a comparison of estimated travel costs.	Lead: TransLink
Usage Patterns	
Consider pricing, availability and other means to influence the extent to which SMM is used as part of a commute trip during peak periods.	Lead: Municipal agencies Support: TransLink
Consider means to reach and educate users and in particular visitors who might be more highly prone to injury due to their lack of familiarity with SMM and local geography.	Lead: SMM operators Support: Municipal agencies
Consider pricing, availability, and network service area as means to leverage increased use of SMM as an alternative to a trip in a motor vehicle.	Lead: Municipal agencies Support: SMM operators and TransLink

Transit Integration	
Consider means to improve integration between SMM and regional transit services, including: ● Pricing, availability, and network service areas that leverage SMM as a complement to regional transit; ● Identifying designated areas where micromobility parking (or docking) will occur around transit stations and hubs before pilot programs are implemented; ● Placing restrictions on where devices can park and operate in order to maintain access to and circulation within rapid transit stations and exchanges; ● Establishing quotas for the number of SMM devices that must be stationed adjacent to transit hubs at particular times to support commuting, and other multimodal trips; ● Considering opportunities for fare integration in order to facilitate and incentivize complementary use of transit and SMM.	Lead: TransLink Support: Municipal agencies

Conclusion and Recommendations

Considering SMM in light of regional transportation principles and the case studies we examined, it is apparent that SMM has the capacity to add to resiliency, offering redundancy and complementing transit services, particularly within highly urbanized areas. There is potential too that services can function seamlessly with existing transportation services, yet none of the case studies examined made a concerted effort to integrate SMM with public transit, nor adjusted transportation networks to comfortably and effectively accommodate the service.

Currently, there is not enough evidence to indicate whether SMM should be embraced as part of a broader public transit service strategy. In order to effectively assess the role of SMM in Metro Vancouver, TransLink has taken an important step by recommending robust data collection as part of its Shared Micromobility Guidelines. In addition, TransLink should consider and support means to evaluate SMM programs to assess their potential to contribute to the headline targets laid out in the Regional Transportation Strategy. Any such assessment should explicitly consider what level of public subsidy would be appropriate, should SMM prove to be an effective and efficient means to meet regional objectives.

Appendix A

Key Informant Interview Questions

1. What is your current role/position? What is your experience with micromobility and SMM?
2. Can you very briefly describe how SMM was introduced to your community and what it looks like now?

BENEFITS & CHALLENGES (10 min)

3. What have the biggest benefits or advantages of SMM been in your area?
4. What are the top challenges associated with SMM options in your city/area of jurisdiction?

PUBLIC ENGAGEMENT/EDUCATION (5 min)

5. What public and/or stakeholder engagement and/or education has been undertaken or is planned in support of SMM program?

SAFETY (5min)

6. Have there been many collisions and/or injuries involving those using SMM? If yes, can you describe any patterns that have been observed?
7. What actions, if any, have you taken to mitigate safety concerns involving SMM? Have these actions impacted rates and severity of collisions and injuries affecting those using SMM?

POLICIES, LEGISLATION & PROCESS (10 min)

8. What policies, regulations and enforcement (if any) currently exist or are planned to moderate the use of e-bikes and e-scooters in your city/area of jurisdiction?
9. Have policies, regulations or enforcement been effective in influencing behaviour and outcomes?

IMPACT on CURRENT MODES/TRANSPORTATION SYSTEMS (10 min)

10. Does your jurisdiction have information on how use of SMM has impacted travel patterns and modes? (e.g. transit, car share, personal car use, pedestrians).
11. Does your agency see such perceived impacts as problematic? Do you plan to take action to address perceived impacts?
12. Specifically, with regard to public transit. Have there been any challenges or opportunities that have emerged in achieving integration between SMM and public transit?

FACILITY DESIGN/NETWORK DESIGN (5 min)

13. Have you or do you plan to adjust your transportation facility or network design to better accommodate SMM or micromobility in general? (If so, can you please describe any specific changes that you have made/plan to make to your transportation infrastructure?)

MOVING FORWARD (5 min)

14. Micromobility (including SMM) seem to be evolving rapidly and there is trepidation and excitement about future innovations. What trajectory do you see for micromobility in your city?

15. If you could give any advice to transportation planners and policymakers in Vancouver regarding supporting, implementing, monitoring and controlling micromobility options to ensure best use, and strong public support, what would it be? Who else do you recommend we speak to? (in your jurisdiction…other areas or cities)?

Additional, if time allows:

- Specifically with regard to partnerships with vendors…What advice do you have for Metro Vancouver that would assist us in our dealings with SMM providers - RFP processes, administrative arrangements, data sharing and management, cooperation and compliance…

Appendix B

Consent Form

READINESS FOR SHARED MICROMOBILITY:
PUBLIC PERCEPTIONS IN METRO VANCOUVER
Key Informant Interviews Letter of Information & Consent

1. Invitation and study purpose

We are inviting key informants (e.g. municipal government or local transit staff) from cities that are piloting or championing new and shared micromobility systems (e.g. shared e-bikes, e-scooters) in their respective regions to participate in interviews. The purpose of the interviews is to understand key learnings as to how to best introduce, integrate and manage such new transportation technologies. The outcomes from this project will provide locally-relevant data which can help to inform a coordinated, context-aware approach toward policy that supports a smoother transition toward shared micromobility services in Metro Vancouver. You are being invited to participate because you have been identified as a key-knowledge and implementation expert in your identified city.

2. Who is conducting this study?

This study is being conducted by Dr. Meghan Winters at Simon Fraser University (SFU) (Faculty of Health Sciences, 778-782-9325) in partnership with HUB (Gavin Davidson, 604-220-0949) and is funded by the Translink's New Mobility Research Grant Program and MITACS.

3. Who can participate in this study?

You can participate if a 1) You are age 18 years or older; 2) You can read and speak English well enough to understand this consent form and respond verbally to questions provided in English. 3) You have expert-knowledge and experience in the area of micromobility systems in your region. You cannot participate if you do not fit the above criteria.

4. What will your participation involve?

Your participation is voluntary. Should you choose to participate in the interview, you can expect the interview to last approximately 30-60 minutes. The sessions will include a main interviewer and potentially an additional note-taker. The discussion will be audio taped and some notes will be taken about the things said. You do not have to answer any questions during the session if you are not comfortable with them.

5. What are the risks of participation?

We do not think there are any major risks to participating in this study. No data will be gathered about you as an individual. Findings will be based on overall themes from the interviews across North America and will not be attributed to any specific individual.

With your permission, we may list your name as a participant in reports. However, since you are considered an expert in your field and your views may be known within your community, it may be possible for your identity to be inferred even if you decide not to be listed by name as a participant.

All consent forms containing participant names will be stored in a locked drawer in a secure office belonging to the research team. Once transcribed, audio recordings will be permanently deleted. Transcripts and any other electronic documents related to the interview (such as notes or electronic consent forms) will be stored as password-protected files on SFU Vault and retained for up to 5 years. Non-Canadian participants should note that data from their interview will be stored outside their home country in Canada only. Only team members will have access to the data. In any presentation of data findings identifying information will be removed.

6. How will the results be used?

The results of your interview will be reported in scientific meetings, journal articles, and a graduate thesis. We will analyze interviews to summarize learnings on implementation and usage patterns elsewhere, and then extrapolate implications for shared micromobility in the context of Metro Vancouver. Our report will be a summary of common themes across 5-10 interviews with expert informants; this will be shared with our funders at Translink. Your name will never be revealed in these reports. Data collected will be stored securely on SFU servers and used for transportation-related studies by the Dr. Winters' research group. Aggregated results will also be posted on chatrlab.ca when the study is complete.

7. You can participate or not. You can stop at any time without giving reason.

Your participation is voluntary, and you may withdraw at any time during or after the interview. Your data can be removed from the study upon your request to the interviewer or by contacting Dr. Winters.

8. Who to contact if you have questions or complaints about the study:

If you have any questions or would like to receive copies of the final results you may contact Dr. Meghan Winters (778-782-9325).

If you have any concerns about your rights or experiences as a research participant in this study, you may contact Dr. Jeffrey Toward, at the SFU Office of Research Ethics (jtoward@sfu.ca, 778-782-6593).

Participant Consent

Taking part in this study is up to you. You have the right to not participate. If you decide to take part, you may choose to pull out of the study at any time without giving reason.

□ Yes I consent to participate in this study
□ Yes I have received a copy of this consent letter for my own records

_____ _____ _____

Printed name of participant Signature Date

It is optional to have your name listed as a participant in these interviews.

□ Yes, I consent to have my name listed as a participant
□ I would not like to be listed as a participant in research findings and/or dissemination

_____ _____ _____
Printed name of participant Signature Date

In addition, if you would like to have a copy of the final results emailed to you, please provide your email contact below (this is optional);

Email:_____

Appendix C

Case Studies

Below key findings and context are highlighted using information from the key informant interviews as well as publicly available documents, reports and web searches.

Washington, DC

Washington, DC has a varied history and one of the widest range of micromobility rental options in the United States. Capital BikeShare, the first bike share in the United States, launched in 2008 using a docked model, and today two private micromobility companies operate bicycles and eight private micromobility companies operate electric scooters. As one of District Department of Transportation (DDOT)'s long-term plans is 30% active transportation mode share, DDOT believes micromobility contributes to these goals and is a "gateway to active modes of transportation" because those who are not interested in biking or walking may feel more comfortable with what micromobility modes have to offer. In addition, having different modes available offers greater flexibility when commuting.

Dockless vehicles and fleet sizes in Washington, DC are governed under permit periods set by DDOT. This allows DDOT to control the number of operators, but interviewees noted that enforcement is the biggest challenge when it comes to micromobility. To date, Washington, DC focused their efforts on strong working relationships with operators to educate and promote good behaviour and have avoided having to directly fine the user. This means that should problems arise DDOT can only suspend operations, remove devices and revoke permits should problems arise.

Washington, DC takes a reactive approach to enforcement and largely allows the free market to operate shared micromobility in the region with equity provisions.

Portland, Oregon

Portland first established a publicly funded docked bike share system, BIKETOWN, in Summer 2016 after eight years of preparation. E-scooters arrived in summer 2018, with Portland Bureau of Transportation (PBOT) following a 120-day e-scooter pilot. With the introduction of e-scooters, demand dropped for bike share for non-members and casual users. In 2019, PBOT began a second, 18-month pilot, which is currently underway.

PBOT sees e-scooters as a key support for their aggressive mode shift and climate emergency goals. PBOT conducted thorough engagement with communities before, during and after the pilots. Over the first pilot period, 700,369 trips covered 801,887 miles on 2,043 e-scooters. PBOT used a permit-based system, recognizing the difficulties that arise when regulations are written into law. Five companies applied to operate in the pilot; three were granted licenses. PBOT has enforced regulations by fining companies and requiring that fines are passed onto users, but does not see this as the most effective process since since companies do not always pass them on to users. In the future, PBOT would like operators to pass on all fines, as a financial disincentive that will discourage prohibited and anti-social behaviour by users.

Evaluation of the first pilot found that e-scooters drew in new users to active transportation: 74% had never used BIKETOWN, 34% said they would have otherwise taken a car or taxi and 6% said they got rid of their personal vehicle due to e-scooters. In addition, a city-wide poll showed that 62% of respondents had a positive impression of shared e-scooters at the end of the first pilot period.

Seattle, Washington

Seattle Department of Transportation (SDOT) launched one of the first dockless bike share programs in the United States in 2017 as a one year pilot program. This is the city's only shared micromobility program, and they perceive that it has been very successful. SDOT recognizes the impact shared micromobility can have on the "fabric of society"; so while e-scooter implementation is near they are first addressing challenges associated with bike share. Seattle feels that equity is key to include in the design of programs.

Seattle sees shared micromobility as a convenient, small, and low footprint transportation option. They felt that dockless systems are key to increasing ridership; the 468,976 trips were taken in the pilot period – almost ten times more trips taken than their previous docked system which had approximately 500 bikes in its fleet. Over 60% of respondents to a population survey indicated they would use bike share more if connections to transit were made easy and reliable.

Seattle takes a goal-oriented approach to enforcement and permitting. SDOT issues a limited number of permits through a transparent application and scoring process (similar to Request for Proposals). Operators must meet a minimum number of qualifications to move into the scoring phase. Once permitted, the onus of responsibility rests on operators to provide education to remove unwanted behaviour, and ensure their customers avoid fines. SDOT holds the right to revoke permits for non-compliance and redistribute to competitors, a process that works only when competition is strong.

Calgary, Alberta

Calgary sought to implement bike share as an action item from the 2012 Cycling Plan but was constrained by options for several years given council did not allocate any tax dollars for the initiative . As dockless providers began to offer services not requiring municipal subsidies, Calgary embarked on micromobility. Calgary's e-bike share pilot program began in 2018, with Lime supplying 500 e-bikes. Over one year, 165, 000 e-bike trips were recorded. Lime removed their bikes from Calgary in December 2019.

Soon after the beginning of the bike share pilot,1,500 e-scooters were introduced in Calgary. In four months, there were 750,000 trips on e-scooters; surveys indicated that 1/3 of riders said they would have otherwise driven. Calgary imposed caps of 1000 e-scooters per operator, which has become a point of contention as operators feel they can better serve communities with bigger fleets.

Unlike e-bikes, which are regulated and permitted under existing provincial regulations, e-scooters are prohibited from operating in the public right of way. In order to legally operate, Lime and Bird were given an exemption under the Alberta Traffic Safety Act and permitted to operate e-scooters where designated by the city of Calgary. Calgary's bylaws were updated to permit shared e-scooters to operate on sidewalks, bike lanes and on pathways, although personal e-scooters are limited to operation on pathways and private property. In addition, operators were required to pay a performance bond which was used as a 'stick' to encourage compliance.

Interviewees noted that e-scooters have acted as a gateway to more favorable attitudes towards cycling in Calgary and has resulted in cycling network expansions and modifications.

Metro Vancouver, British Columbia

Metro Vancouver's policy context is a unique landscape for shared micromobility. To date, there are a number of bike share systems operating throughout Metro Vancouver at the discretion of municipal governments; however, regulatory environments set by the provincial government in addition to

concerns over curb and road space management, have prevented many municipalities from moving forward with shared micromobility. The provincial government opened a window of opportunity, launching a program to enable select shared micromobility pilots for interested municipalities in Summer 2020. TransLink has offered municipalities a coordinated approach to implementation by producing Shared Micromobility Guidelines (released July 2019) but has not taken any steps to introduce shared micromobility regionally.

Richmond, Port Coquitlam and Port Moody have established small dockless bike share systems run by U-bicycle. Since 2016, the City of Vancouver has hosted the Mobi by Shaw Go bike share. The system now has 200 docking stations. Mobi by Shaw Go has been heavily subsidized, and there is fear that the introduction of electric devices (bikes or e-scooters) could impact its ridership significantly. The University of British Columbia (UBC) has a dockless bike share program, HOPR, a subsidiary of Cyclehop. Over 80 designated bike share hubs have been installed across campus to make it easier for users to locate shared bicycles, and free up bike racks for cyclists on personal bicycles. The HOPR system is currently operating approximately 200 bikes. Mobi by Shaw Go and HOPR, while owned by the same company, are unable to be used interchangeably due to inconsistencies in the technologies. Users can be fined for not wearing a helmet, leaving the service area or incorrectly parking devices.

References

Austin Public Health. (2019). *Dockless Electric Scooter-Related Injuries Study.* Austin: Austin Public Health. https://www.austintexas.gov/sites/default/files/files/Health/Epidemiology/APH_Dockless_Electric_Scooter_Study_5-2-19.pdf

Baltimore City (2019), Dockless Vehicle Pilot Program Evaluation Report, Department of Transportation, Baltimore City, https://transportation.baltimorecity.gov (accessed on XXX?).

Bassil, K. et al. (2015) "Pedestrian and Cyclist Safety in Toronto" https://www.researchgate.net/publication/280576352_Pedestrian_and_Cyclist_Safety_in_Toronto (accessed on XX).

Bekhit, M. N. Z., J. Le Fevre, C. J. Bergin (2020), Regional healthcare costs and burden of injury associated with electric scooters, Injury, Volume 51, Issue 2, 2020, https://doi.org/10.1016/j.injury.2019.10.026.

Blaizot, S. et al. (2012) "Accidentalité à Vélo et Exposition au Risque (AVER) - Risque de traumatismes routiers selon quatre types d'usagers" HAL Id: hal-00768484, https://hal.archives-ouvertes.fr/hal-00768484 (accessed XX).

Buehler, R. and J. Pucher (2017) "Trends in walking and cycling safety: Recent evidence from high income countries with a focus on the United States and Germany" American Journal of Public Health¨ Vol. 107/2, pp. 281-287: 10.2105/AJPH.2016.303546.

Calgary Transit. (2020, March 31). *Fares and Passes*. Retrieved from Calgary Transit: https://www.calgarytransit.com/fares-passes

CDC WISQARS (2019), Web-based Injury Statistics Query and Reporting System,https://www.cdc.gov/injury/wisqars/index.html

Chan, K. (2020, May 14) "City of Vancouver proposes 50 km of "slow streets" for pedestrians and cyclists" retrieved from Daily Hive: Vancouver Urbanized https://dailyhive.com/vancouver/vancouver-slow-streets-coronavirus

City of Calgary. (2019). *Electric Scooter Share Pilot Stakeholder Report Back: What we Heard.* Calgary: City of Calgary.

City of Calgary. (2019, Dec 18). *SPC ON TRANSPORTATION AND TRANSIT.* Retrieved from https://pub-calgary.escribemeetings.com/FileStream.ashx?DocumentId=117277

City of Calgary. (2020). *BYLAW NUMBER 26M96.* Retrieved from Bylaws and permits related to street-use: http://publicaccess.calgary.ca/lldm01/livelink.exe?func=ccpa.general&msgID=SyAccKqKqW&msgAction=Download

Deegan, B. (2018), "Light Protection of Cycle Lanes: Best Practices", Discussion Paper, International Transport Forum, Paris, https://www.itf-oecd.org/sites/default/files/docs/light-protection-cyclelanes_2.pdf.

Gilligan, M. (2020, April 22). *E-scooters return to Calgary in spring 2020: Here's what's changed*. Retrieved from Global News: https://globalnews.ca/news/6639675/e-scooters-calgary-2020-new-rules/

ITDP (2020) "Where can micromobility go?" https://www.itdp.org/2020/03/24/as-the-impacts-of-coronavirus-grow-micromobility-fills-in-the-gaps/

KATU Staff. (2019, June 14). *2 companies bringing seated e-scooters to Portland's pilot program.* Retrieved from KATU: https://katu.com/news/local/2-companies-bringing-shared-seated-e-scooters-to-portlands-pilot-program

LDA Consulting. (2017). *2016 Capital BikeshareMember Survey Report .* Washington: LDA Consulting.

Lime. (2020, Feburary 8). *Your ride in Calgary*. Retrieved from Lime: https://www.li.me/locations/calgary

NACTO (2018), "NACTO Policy 2018: Guidelines for the Regulation and Management of Shared Active Transportation", National Association of City Transportation Officials, https://nacto.org/wp-content/uploads/2018/07/NACTO-Shared-Active-Transportation-Guidelines.pdf

OECD/ITF (2020), Safe Micromobility, OECD Publishing, Paris, https://www.itf-oecd.org/sites/default/files/docs/safe-micromobility_1.pdf (accessed on 03 April, 2020)

Portland Bureau of Transportation. (2018). *2018 E-SCOOTER PILOT User Survey Results.* Portland: PBOT.

Portland Bureau of Transportation. (2019). *2018 Biketown Annual Report.* Portland.

Portland Bureau of Transportation. (2019). *2018 E-Scooter Findings Report.* Portland: PBOT.

Revel Transit Inc. (2020, March 18). *Washington DC*. Retrieved from Go Revel: https://gorevel.com/washington-dc/

SAE Society of Automotive Engineers. (2019). SAE J3194: Taxonomy & Classification of Powered Micromobility Vehicles. Retrieved from https://www.sae.org/binaries/content/assets/cm/content/topics/micromobility/sae-j3194-summary---2019-11.pdf

Santacreu, A. (2018), "Cycling Safety", International Transport Forum, Paris, https://www.itfoecd.org/sites/default/files/docs/cycling-safety-roundtable-summary_0.pdf.

Seattle Department of Transportation. (2018). *2017 FREE-FLOATING BIKE SHARE PILOT EVALUATION REPORT.* Seattle. Retrieved from https://www.seattle.gov/Documents/Departments/SDOT/BikeProgram/2017_BikeShare_Evaluation_Report_113018.pdf

Seattle Department of Transportation. (2018). *APPENDIX D - SDOT Citywide Survey Report.* Seattle: SDOT.

Shulman, Sophie. (2019, June 19). *Scooter-Sharing Companies Don't Make Money, They Grow*. Retrieved from CTECH: https://www.calcalistech.com/ctech/articles/0,7340,L-3764203,00.html

The University of British Columbia. (2019). *Campus Bike Share Pilot Survey Summary Report.* Vancouver: UBC.

TransLink. (2020, 02 25). *Pilot and Demonstration Projects*. Retrieved from TransLink: https://www.translink.ca/Plans-and-Projects/TransLink-Tomorrow/Pilot-and-Demonstration-Projects.aspx

TransLink Tomorrow. (2019). *Shared Micromobility GUIDELINES.* New Westminster: TransLink.

Tucker, A. (2019, July 30). *We tried both Calgary e-scooter brands Lime and Bird — here's how they compare*. Retrieved from The Star: https://www.thestar.com/calgary/2019/07/29/we-tried-both-calgary-e-scooter-brands-lime-and-bird-heres-how-they-compare.html

Uber. (2020, April 10). *Uber Price Estimator*. Retrieved from Uber: https://www.uber.com/ca/en/price-estimate/

Vancouver Bike Share Inc. (2020, April 10). *Offers*. Retrieved from Mobi by ShawGo: https://www.mobibikes.ca/en/offers-subscription

Washington State Transportation Center. (2018). *APPENDIX BTDC Bike Share Evaluation Report.* Seattle: SDOT.

Zeidler, M. (2020, May 10). *E-bike users, sellers dismayed by B.C. Supreme Court decision.* Retrieved from CBC News: https://www.cbc.ca/news/canada/british-columbia/e-bike-users-sellers-dismayed-by-b-c-supreme-court-decision-1.5563450