Understanding Carsharing Patterns for Effective TDM Policymaking: A Study of Municipalities in Metro Vancouver

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Abstract

In the context of global climate change and the subsequent need for evolving mobility and smart transit patterns, carsharing (CS) has established itself as a method of individual transportation more sustainable, efficient, and cost-effective than personal automobile ownership. As such, cities worldwide are implementing a variety of policies intended to encourage CS access and utilization with the goal of improving urban planning and human health through transportation demand management (TDM) strategies. Among many potential TDM policies, municipalities have used sticks and carrots to engage developers in TDM through parking requirements and offsets when CS is provided. Many variants of these policies have been implemented throughout Metro Vancouver (MV) municipalities. This thesis provides an overview of the policies adopted by key MV municipalities and establishes a deeper understanding of CS utilization and membership patterns as exhibited through behavioural and policy-driven perspectives. Through two complementary studies, this research 1) identifies and substantiates CS membership and usage patterns as they relate to CS vehicle visibility and proximity to current and prospective members and 2) surveys which policy levers and marketing initiatives present throughout the Metro Vancouver region are effective at incentivizing widespread CS provisioning and use in concurrence with *Metro 2040* sustainability goals. Findings were analyzed to formulate a set of best practices guidelines informing thoughtful TDM policymaking for sustainability-focused cities worldwide.

Lay Summary

Carsharing (CS) is a method of individual transportation more sustainable, efficient, and cost-effective than personal automobile ownership. Cities worldwide are exploring policies intended to encourage CS access and utilization with the goal of improving urban planning and human health through transportation sustainability. There is a need to understand and explain CS usage patterns to improve existing municipal policies. This thesis surveys municipal policies for promotion of CS around Metro Vancouver. Relatedly, a broadly held perception has emphasized the importance of CS vehicle visibility as critical to recruitment of members and utilization of vehicles. This belief was tested against visibility metrics and found to neither explain recruitment patterns nor utilization rates. Additional data is gathered to partially explain observed patterns of CS membership recruitment patterns and vehicle utilization and their adoption as part of the menu of municipal policymaking for transportation demand management policy tools.

Preface

The research design of this study, as well as subsequent data exploration and analysis, was devised and conducted by the researcher with the continually thoughtful guidance, supervision, and invaluable feedback of supervisor Dr. Hadi Dowlatabadi. My committee members, Dr. Hadi Dowlatabadi, Dr. Alex Bigazzi and Dr. Jiaying Zhao provided pivotal input and guidance in narrowing the research scope and highlighting important conceptual details for my address. They also reviewed the final product and provided pivotal suggestions and edits. I collected the majority of the qualitative material garnered for this research, while Dr. Dowlatabadi facilitated the connections by which I obtained confidential datasets generously provided by Modo containing a range of anonymized membership and vehicle data. Data interpretation and analyses were conducted jointly by myself and Dr. Dowlatabadi with thoughtful contributions from both Dr. Jiaying Zhao and Rainer Lempert, a fellow research labmate who also assisted with statistical data analysis and visualization.

This thesis is the original, independent, and unpublished work of the author. Semi-structured interview research for the policy case study depicted in Chapter 2 was officially approved by the UBC Behavioural Research Ethics Board under certificate H17-02428.

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List of Terms, Abbreviations, and Acronyms

CS	Carsharing
CSV	Carsharing Vehicle
CSO	Carshare Operator
TDM	Transportation Demand Management
MV	Metro Vancouver
COV	City of Vancouver
On-Site	Located in a respective residential building
Off-Site	Located outside of a respective residential building
CoC	City of Coquitlam
EFL	East Fraser Lands

Acknowledgements

This research would not have been possible without each component of our carsharing research lab, and together this team intends to pioneer and guide carsharing research and thoughtful TDM policy formation worldwide.

Many thanks to Sylvain Celaire and Karen New at Modo, whose invaluable datasets and input from the CSO perspective made it possible to both understand and analyze detailed carsharing behaviours. Sylvain's input identified initiatives effective at stimulating CSO membership and growth, providing crucial material by which this research formulates best practices in TDM. Thanks also to all of the transportation planners and engineers whose interview responses rendered this research possible.

Thank you to all of the brilliant professors at IRES whose knowledge and thoughtful teaching fundamentally broadened my perspectives not only on resources, environment, and sustainability but how I view the world's natural processes and the actors operating within.

Thanks lastly to the Natural Sciences and Engineering Research Council of Canada for providing Engage grant funding that fueled the origins of my research.

1. Introduction & Survey of Pertinent Literature

1.1 Carsharing Context

A pioneering city with regard to the introduction, implementation, and widespread uptake of carsharing services, Vancouver is heralded as one of the most progressive carsharing cities in North America (Namazu & Dowlatabadi, 2018) and arguably the world. The City of Vancouver and Metro Vancouver have illustrated their embrace of the sharing economy through mobility business models (Fong et al. 2015). The sharing economy has and continues to transform countless industries worldwide as advanced societies progress, marking a full-circle nature of shared resource allocation and utilization. Among these industries, transportation has particularly benefitted from implementing a shared economy model throughout numerous methods of transit including carsharing (Cohen & Keitzmann, 2014) and subsequent improvements in transportation efficiency are poised to evolve and continually provide returns (Meijkamp 1998).

It is now an undisputed fact that carsharing provides profound improvements to the lasting detrimental health consequences accompanying widespread individual automobile ownership and use (Shaheen et al. 2010). These beneficial impacts of widespread carshare utilization are illustrated through their subsequent improvements on various sustainability metrics such as decreased personal vehicle ownership (Klincevicius et al. 2014); utilization of alternative transport modes or modal shift such as complementary public transit (Martin & Shaheen 2011); 8-13% reductions in greenhouse gases emissions from personal automobile travel (Namazu & Dowlatabadi 2015; Nijland et al. 2015; Lee et al. 2014); decreased vehicle congestion (Shaheen et al. 2004); refined urban planning and urban sprawl (Morency et al. 2012); reduced parking demand (Lane 2005; Stasko et al. 2013); reduced vehicle kilometers traveled, or VKT (Martin & Shaheen 2016) and reduced transportation costs (Litman 2000) that may instead be reallocated

towards other TDM initiatives and associated societal welfare improvement. This reallocation of capital to alternative investments improving transportation planning and efficiency poses benefits to collective human health on a community, city, and eventually countrywide scale. In this context, carsharing has established itself as an ideal means by which cities can achieve their respective sustainable transportation goals (City of Vancouver, 2016), fueling progress in aggregate global sustainability and the impetus to fight and impede the rate at which climate change threatens life worldwide (Rabbitt & Ghosh, 2013).

1.2 CS Prevalence

Thousands of drivers throughout the Americas enjoy a plethora of carsharing membership choices with over 45 carsharing programs available (Shaheen 2016). As of 2015, carsharing membership had grown to a whopping 1,517,145 members throughout the United States and Canada alone (Shaheen & Cohen 2015), a steadily increasing statistic illustrating the service's popularity. CS's high prevalence has prompted many cities' planning, transportation, and sustainability departments to examine its emerging role and utility as a TDM tool (Filosa 2006; Millard-Ball, 2005; City of San Francisco 2017) to decrease individual car ownership and its associated negative impacts (Cairns et al. 2008) such as subsequent parking demand (Metro Vancouver 2014) particularly in densely populated cities with spatially restricted urban cores such as Vancouver, BC or San Francisco, CA where distinctly limited space is at a cost premium.

1.3 CSV Location Optimization and User Demographics

Numerous efforts have been made to model ideal quantities and locations of shared mobility system vehicles such that the latter might be optimally apportioned to meet user demand distribution (Laporte et al. 2015; Balac & Ciari 2015; Barth &Todd, 1999) for both station-based

(2-way) and free-floating (FF) carsharing systems. Ideally, projected CS spatial availability should be optimized for user demand (Weikl & Bogenberger 2013; Rudel et al. 2013). A body of work has modeled spatial distributions of "optimal" CS parking placement. Some such studies employ GIS methods to identify ideal parking locations (Rickenberg et al. 2013) but either fail to consider the influence of vehicle visibility or intentionally exclude visibility from their models, dismissing it as a criterion of less consequence than urban centrality (Schwer & Timpf, 2016). Similarly, simulation results have predicted that in the case of round-trip carsharing services, demand imitates supply; it has been posited that round-trip CS vehicles introduced to unique locations may result in increased membership (Balac et al. 2015). The validity of this concept remains to be substantiated.

Other studies have developed or assessed algorithms intending to systematize optimal customer-based CS vehicle distribution (Gavalas et al. 2015) predicting potentially profitable CS parking locations based on CS membership and census data (Ciari et al. 2015). However, at present no existing studies identify a recruitment effect between round-trip CS vehicle placement and subsequent membership. In other words, no research has empirically illustrated whether the mere presence of a round-trip carsharing vehicle in a given location actually impels surrounding residents or passers-by to join the carsharing service. As such, this thesis empirically investigates utilization and membership patterns in order to clarify understanding vehicle utilization and member recruitment efforts.

Additionally, user demographic characteristics for both station-based (Kang et al. 2016; Namazu 2017; Namazu et al. 2018) and free-floating CS (De Lorimier & El-Geneidy 2013; Schmoller et al. 2015) patrons can provide useful insight by which CSOs can refine their business models. Identifying which user demographic attributes are associated with specific

vehicle fleet and usage preferences (Jian et al. 2017) can help CSOs determine which vehicle types to allocate in particular locales, such as utility vehicles in industrial or commercial areas. As one might expect from any well-maintained business model, CSOs are also interested in analyzing customer demand and usage patterns to determine whether respective round-trip carsharing vehicle locations are profitable or unprofitable such that CSOs should relocate underutilized vehicles (Boldrini et al. 2016). CSOs are naturally also interested in data identifying highly utilized vehicles in order to maximize investments (Alfian et al. 2014; Rhee et al 2014). These interests should motivate cooperative synergies between CSOs, developers, and municipalities/cities to improve CSV hub deployment choices.

1.4 Municipal Support

As with many municipal objectives, improved CS accessibility can and should originate in supportive municipal policy. These policies can be complemented by private sector initiatives to achieve optimal CS outcomes. The City of Vancouver is in the process of realizing its *Metro Vancouver 2040: Shaping our Future* regional growth plan, a region-wide effort to improve urban planning and sustainability through a number of improved planning venues including transportation and associated sustainability metrics such as decreased GHGs, overall VKT, and traffic congestion. This plan specifically prioritizes city efforts to encourage increased CS prevalence as an alternative to personal automobile use (City of Vancouver 2011). Because CS can help cities achieve their sustainable transportation goals, municipal governments can curate this type of public-private cooperative partnership to improve urban planning and land management. As such, this study intends to improve understanding of CS membership and utilization patterns for more efficient TDM policymaking not merely in the context of *Metro 2040* objectives but in the broader scope of sustainability planning worldwide.

The importance of sensible urban space management and thoughtful parking requirements are not a new phenomenon (Forinash et al. 2003). There is now an emphasis on the instrumental role of municipal and city governments to encourage or require CS provisioning policies (Schuster et al. 2005; IBI Group 2015; Shaheen et al. 2010) in residential or commercial developments (Dowling & Kent 2015). Numerous effective policy tools to this end exist like requiring TDM methods (Rye 2002) such as CS provisioning by residential developers, and parking requirement reduction ratios (Engel-Yan & Passmore 2013), one of the policy levers of prime investigation in this thesis.

Table 1 Municipal CS Policy Levers

Municipal Carsharing Policy Levers			
	Maximum Policy Support: Environmental Impacts	**Moderate Policy Support: Sustainability/Business Impacts**	**Minimum Policy Support: CSOs as Businesses**
Sanctioned CS Parking	Allow designation of CS parking stalls through informal case-by-case basis	Transition from informal to formalized CS parking stall allocation	Strict adherence to formal bylaws/CS parking variances
Limited CS Parking (Caps)	No limit to CS parking variances;	Can exercise caps on amount of designated CS parking city-wide	Flat cap on citywide CS parking;
Fee/Permit Allocation	Free or low-cost CS parking provided to CSOs	CS operating fees determined by cost recovery needs, or reduced to achieve environmental goals	CSO fees based on profit or cost-recovery methodology (admin fees, program fees, meter revenue differences)

Municipal Carsharing Policy Levers			
	Maximum Policy Support: Environmental Impacts	**Moderate Policy Support: Sustainability/Business Impacts**	**Minimum Policy Support: CSOs as Businesses**
Parking Enforcement	Enforcement by local police; CS parking violations high	Enforcement by local police	Enforcement by local police; CS parking violations equal to other parking violations
CS Parking Maintenance	City funds signage, installation, demarcating costs, and associated maintenance	City funds installation/parking indicators; CSO pays for actual signs/maintenance	CSO pays for all - signs, installation, parking demarcation, maintenance

Table 1 outlines a toolkit of potential city parking policies supportive of CS and identifies distinctions among the policy actions along a spectrum of support and involvement.
(Source: Adapted from Shaheen et al. 2010)

Recent research among Canadian provinces and municipalities has established the significance of environmental motivations behind traffic management strategies (Bigazzi & Mohamed 2017). The same motivation should inspire municipal governments to pursue TDM policies encouraging CS due to their portfolio of sustainability benefits, which can also reflect favorably upon city governments. For example, Flexcar in Seattle (co-founded in 1998 by the former director of King County Metro and eventually acquired by Boston's Zipcar) was the first CS service in the United States (Seattle Dept. of Transportation 2018); Flexcar eventually took over CarSharing Portland in 2000 and later partnered with American Forests to offset 100% of its vehicle emissions countrywide (Portland Office of Transportation, 2005) embodying the immense environmental benefits potentially realized by municipal CS policy support. Indeed, an impetus for municipal policy and financial support of CS services has been identified worldwide (Enoch & Taylor 2006) and some progressive cities such as Portland, Vancouver, Austin, and

Edinburgh have taken actions accordingly. A suite of TDM incentives and options referred to as a "TDM Menu of Options" is available to municipal planners and policymakers (City of San Francisco 2017) providing a variety of methods by which developers and planners can discourage personal vehicle ownership and encourage more multimodal transit methods such as CS.

Some studies build on the assumption that CSV visibility from the street, while walking or driving, leads to higher usage and should encourage city provisioning for designated on-street CSV parking (Osgood 2010). Naturally, one might assume that if a vehicle with a CSO's logo on it is highly visible from the street driving or walking by, that vehicle will be utilized more because local residents are aware of its presence and availability. In this respect, on-street CS vehicles with visible logos can serve as de-facto marketing tools for the CSO. Not only will members know there is a carsharing vehicle station at that respective location, but they know whether it is regularly *available* for their personal use if it is repeatedly observed in its station base (Lorimier & El-Geneidy, 2013). CSOs and planners in MV have contended that user perception of CSV availability is an important determinant of membership and utilization -- and thus policies sanctioning on-street CSV parking are encouraged in some cities such as the City of North Vancouver. In most downtown core areas of COV, however, CSVs are largely located in off-street locations.

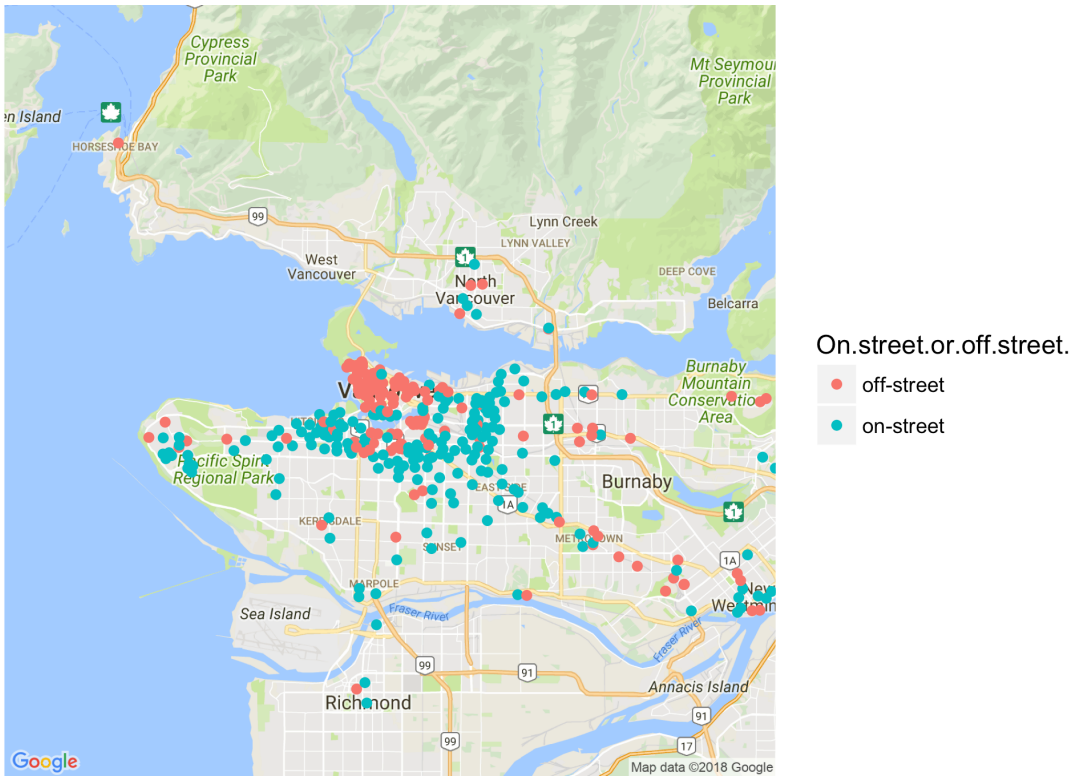


Figure 1 On-Street vs. Off-Street Parking Map for Modo CSVs:

High concentration of off-street CSVs in downtown core vs. outlying areas where there is more on-street availability for designated CSV parking hubs. High-volume residential developments are also more highly concentrated in the downtown urban core, necessitating more hidden/off-street CSV hub deployment. (Source: Adapted from data provided in Modo Vehicle Database)

A study conducted in the San Francisco Bay Area found that planners, developers, and service providers are all in favor of designated on-site carsharing vehicles provided that there are sensible policy incentive structures and regulatory demands in place, as well as efficient methods of stakeholder collaboration in this process which is often uncoordinated (Rivasplata et al. 2013). This thesis acknowledges these policy challenges as barriers to efficient carsharing vehicle implementation. There can also exist conflict between developers' desires to maintain CSVs within their own underground parking facilities as exclusive amenities for building residents, vis-a-vis CSO concerns regarding vehicle utilization and access for all CSO members residing

elsewhere (ibid.) While exclusivity of CSVs within a given residential complex may serve as a marketable amenity for potential residents, CSVs enclosed within secured parking facilities can prove inaccessible to CS members who do not reside within the building, potentially hindering utilization rates, membership inclusivity, and subsequent revenue. Thus, policymakers designing parking variances for developers should consider including CSV access design provisions outlined in Chapter II.

1.5 Diminishing Parking Minimums and Requirements

In the not too distant future, it is anticipated that municipalities and cities will move towards eliminating minimum parking requirements, which have proven to be quite costly to renters and individuals without personal vehicles (Gabbe & Pierce 2016) who can ultimately end up paying for parking spaces they do not require (Litman 2016). The MV region conducted an apartment parking assessment in 2012 to identify parking inefficiencies and potential municipal parking policy improvements. Key findings yielded that not only does parking supply significantly exceed actual vehicle parking demand across MV (Figure 3) but both strata-owned and market rental developments both vastly provide superfluous parking (Figure 2) with as high as an 18-35% oversupply in parking for residential strata-owned developments (Metro Vancouver 2012)

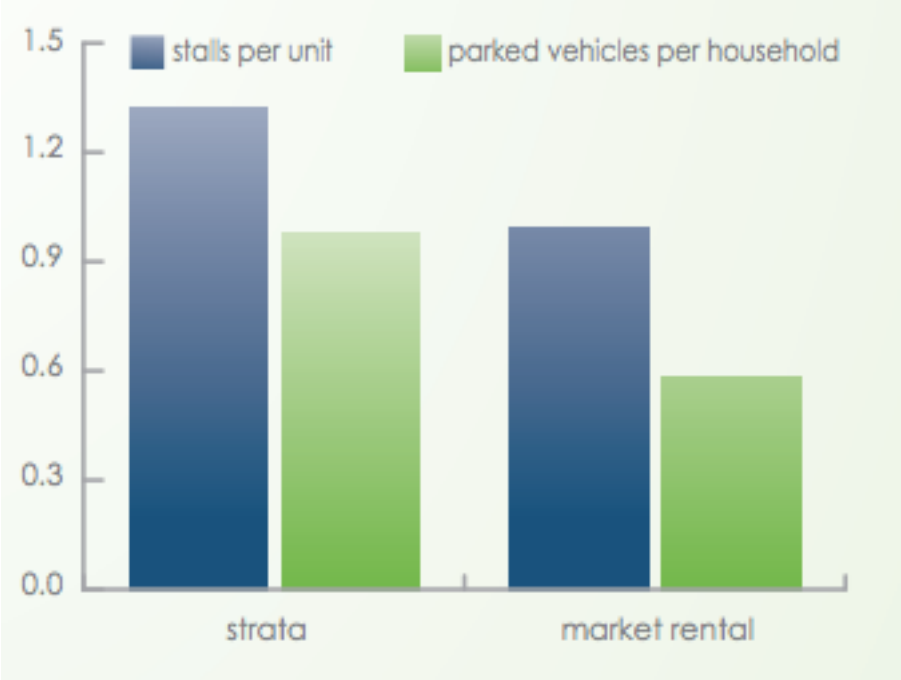


Figure 2 Strata Vs. Rental Housing Parking Supply & Demand

(Source: The Metro Vancouver Apartment Parking Study, 2014)

This significant oversupply in parking throughout the MV area is consistent among the municipalities. This statistic is of interest when considering the financially determined likelihood of whether developers will choose to sell parking stalls at market prices or invest in TDM parking variances.

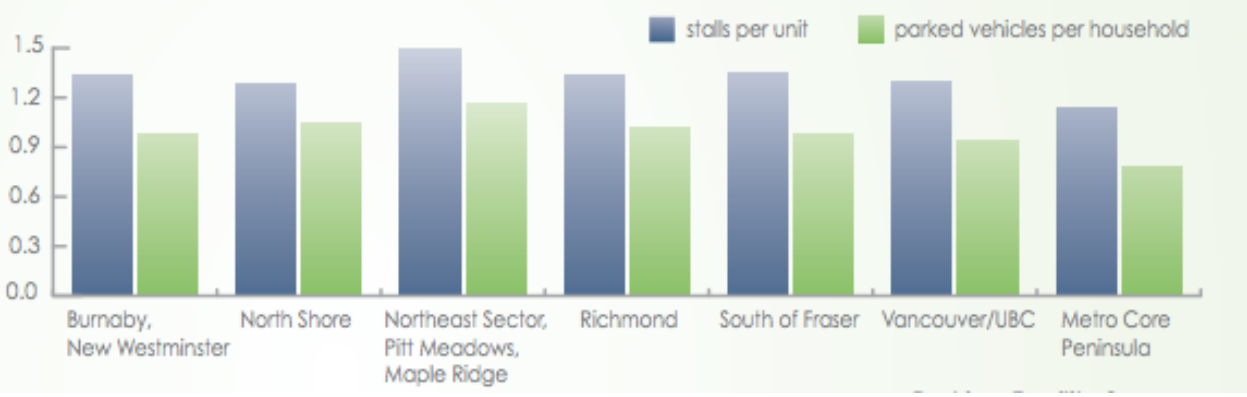


Figure 3 Parking Supply Exceeds Parking Demand Across MV.

(Source: The Metro Vancouver Apartment Parking Study, 2014)

In consideration of these findings the study encouraged several TDM policy recommendations such as incentivizing CS membership and accessibility where it is feasible to do so, decreasing minimum parking requirements throughout the MV municipalities from the current average of 1 stall per unit, and instituting parking maximums which currently only exist in the COV and the UBC Point Grey Campus (Ibid.)

1.6 Public Transportation Demand Management Policies

Given these circumstances, several burgeoning TDM policies with respect to CS in the MV area are of particular interest in this thesis and explored in the two case studies. They are ideally intended to further the impact and accessibility of CS and its associated sustainability impacts. One such TDM policy, examined among others in Chapter II, rewards parking variances (reprieves from legally binding minimum parking requirements) to residential developers who offer CS vehicle provisioning in their residential developments - a practice designed to reduce both personal vehicle ownership and associated parking spaces (Engel-Yan & Passmore 2013). A second TDM policy examined is one specifically designating on-street parking spaces for CS vehicles (City of Vancouver 2017) with the intent of increasing physical visibility and awareness of CS and potentially nudging surrounding residents and passerby to become members of CS services (Zhou & Kockelman 2011). The research presented in Chapter III originally sought to substantiate and verify the merit behind this hypothesis. However, findings illuminated the relatively more consequential actions that can be taken to expand a new notion of CS "visibility." This is of particular relevance to municipalities where residential density is rising and on-street parking will be constrained.

Research Questions and Objectives:

In consideration of the identified shortcomings in current CS and TDM policy research, this thesis specifically intends to confront the following research questions throughout two separate studies:

1. Which TDM policy elements are exercised by different municipalities in the Metro Vancouver region, and which of these policies effectively encourage CS provisioning and subsequent membership and utilization?
2. How does CSV visibility determine or relate to utilization and recruitment patterns?
3. What are the observed patterns of CS member recruitment and vehicle utilization, and which other explanatory factors could be responsible for them?

By addressing these questions, this thesis aggregates and analyzes an eclectic body of data to inform a set of best practices intended to guide TDM and zoning policy formation on behalf of municipal and city governments. This research provides a formerly unestablished understanding of the relationship between CS vehicle visibility and usage/membership patterns; this new understanding entails the immense potential to change public transportation behavior, resulting in decreased vehicle ownership and more multimodal transit behaviours.

2. Case Study A: Carsharing and TDM Policies: Heterogeneities Across Metro Vancouver

Abstract

This research identifies heterogeneities among carshare (CS) provisioning incentives and associated parking relief variances for residential developers across 8 municipalities in the Metro Vancouver (MV) region. The uptake and subsequent efficacy of each municipality's corresponding bylaws were clarified through zoning bylaw and document analyses, physical observation of parking and CS conditions across the region, and semi-structured interviews conducted with respective city planners, transportation engineers, and car share operators. Results identified which transportation demand management (TDM) bylaws and practices are currently in use across MV and which appear to function well. Findings were analyzed to develop a set of policy guidelines for city planners, residential developers, and CSOs worldwide to reference when designing and improving sustainable zoning, parking, and TDM policies as they relate to CS provisioning. Cities interested in supporting and expanding the many benefits CS entails can refer to these best practices for smoother policy implementation and sustainability planning in a rapidly transforming urban mobility future.

2.1 Introduction

Two-way carsharing is unequivocally acknowledged as a prominent and effective method of individual transportation more sustainable, efficient, and cost-effective than personal automobile ownership. It has been established that personal vehicles remain idle 95% of the time - a blaring statistic that implores the pragmatic search for a transportation solution effectively inducing fewer personally owned vehicles which have been established as often largely unnecessary. Carsharing provides this alternative, delivering a multitude of relative

improvements to human health and society across numerous venues. These benefits include decreased greenhouse gas (GHG) emissions from transportation averaging -.84t GHG/year per participating household in North America; more detailed research identifies household GHG/year reductions ranging from ~ 19-54% corresponding to specific CS use factors such as right-sizing and modal shifts, or ~ 45-55 percent per household; decreased VKT; increased consideration for the detrimental environmental impacts of owning and driving cars; less personal spending on car insurance and maintenance for vehicles that remain largely idle anyways; and, of particular interest in this research, more efficient use of limited city space that is currently wasted by inflated minimum vehicle parking allocation requirements established in urban zoning bylaws. It is in every city's interest to maximize urban space wisely, decrease GHGs from transportation and subsequently improve air quality and human health, and encourage CS use as a transition step towards the impending transformation of personal mobility.

Given this present context, city governments worldwide are slowly implementing a variety of policies crafted to encourage CS access and utilization. As with most societal improvements, there are various policy mechanisms to incentivize CS vehicle provisioning and use. This research conducted a thorough examination of these approaches as they are practiced throughout MV in order to identify which TDM bylaw practices are used – and which succeed or fail at achieving their desired policy outcomes. Findings inform a catalogue of strategies by which planners, developers, and CSOs can craft and implement more effective TDM measures leading to highly utilized CS vehicles replacing congestion causing, costly and emission-heavy individual cars.

2.2 Methods

2.2.1 Study Area

The first city in the world to reach 100,000 car2go memberships, Metro Vancouver's population (N = 2,463,431) exhibits one of the highest proportions of CS memberships in North America with 20% of residents enrolled in at least one of four available carsharing services including Zipcar, Daimler-owned Car2go, the BCAA operated Evo, and Modo, North America's first carsharing cooperative established in 1997 following Montreal's CommunAuto, Canada's first CS organization (Communauto). Metro Vancouver thus offers a variety of available CS choices ranging from free-floating one-way systems to station-based cooperative systems including Modo and Zipcar for more dedicated users. The region is comprised of 21 municipalities serviced by a fairly comprehensive public transit system maintained by TransLink, which CS users often complement with CS in multi-modal transit patterns (Translink 2017). Additionally, the costs of owning a vehicle in BC can range from $8,600 to a stellar $13,000 per year (Alini 2017). It is possible that this costly barrier to car ownership may partially explain why census data assessing commute mode share in the COV indicated a 6% decrease in personal motor vehicle transit to work from 2006 – 2011(Ibid.) – an encouraging statistic likely to continually decrease with growing CS availability and use.

The City of Vancouver (COV) is currently in the process of actualizing its broader *Greenest City Action Plan*, a comprehensive directive to achieve sustainability goals and targets by 2020 emphasizing greener transportation, building efficiency, and renewable electricity, among others. This directive is currently underway and complimented by the region's *Metro 2040* Regional Planning Strategy (Metro Vancouver 2011) which delineates aspirations for more sustainable transit modes through policy mechanisms such as zoning and related TDM practices; these are specifically examined in this research. Many of the surrounding municipalities have followed suit to the COV's *Greenest City* initiatives with similar sustainability objectives and

approaches. These collective characteristics render Metro Vancouver a prime location for this study.

2.3 Data Collection

The study area spanned 8 Metro Vancouver municipalities with additional supplementary input from practices and circumstances observed in the City of Toronto. MV municipalities surveyed included the following:

Table 2 MV Municipalities: Population Data

	Total Population	Population Density (Sq Km)
City of Vancouver	631,486	5,493
City of North Vancouver	52,898	4,465
City of Victoria	85,792	4,405
City of Coquitlam	139,284	1,139
District of North Vancouver	85,935	535
City of Richmond	198,309	1,534
City of Surrey	517,887	1,637
District of Saanich	114,148	1,099
Metro Vancouver Total	2,463,431	855

Source: Statistics garnered from Statistics Canada's Census of Canada 2016

In total 13 people were interviewed within a consecutive 9 month period from March 2017 – December 2017. Interviewees consisted of Modo employees and city planners from the municipalities represented in Table 2. Those interviewed had official titles representing varying forms of "transportation engineer" and "transportation planner". The 13 interviewees and their respective titles are provided in Appendix A. Interviewees were initially identified through city employee listings and snowball referencing exhibited through respective interviews. Semi-structured interviews were conducted by the researcher with respective transportation engineers, city planners, and Modo employees either in person or over the phone. Questions assessed TDM

policy formation, practices, and evaluation. The interview question template and structure are provided in Appendix D. Among the range of interviews conducted, all were performed solely by myself with the exception of two interviews (City of Coquitlam, Modo) in which my supervisor, Dr. Hadi Dowlatabadi, was also present to assist in conversation.

Responses were directly transcribed during the interviews in Microsoft Word and imported into NVivo 11.4.2. with which they were coded and analyzed for thematic frequency. Other methods employed included municipal zoning and parking bylaw document analysis and a review of pertinent literature on carsharing adoption, TDM measures, parking management and engineering standards. Data and analysis gleaned from these methods and planning considerations identified that most of these approaches are either formally codified in bylaws or informally observed throughout the 8 MV municipalities surveyed. These methods were identified, assessed, and evaluated for their effectiveness in encouraging CS provisioning and residential use.

2.4 Results

Information collected from interviews and document analyses identified the TDM practices in use, either formally or informally, in the respective municipalities. It was quickly apparent that parking variances associated with CS provisioning are present in all MV municipalities examined. Throughout these municipalities, parking reductions are awarded to multi-unit residential developers who provide sufficient TDM plans accepted through zoning application approvals. Additionally, the following themes, issues, concerns, and practices were repeatedly identified throughout interviews conducted; they are categorized thematically and discussed below. Results present prominent considerations in/obstacles to effective TDM

measures and incentives for developers, CSOs, and municipal governments – and subsequently inform how planners can include certain provisions when crafting TDM policies.

2.4.1 Official vs. Unofficial Bylaws

Explicit Parking Reduction Ratios

Among all municipalities surveyed, the COV exhibited the strictest parking variances for CS provisioning at a ratio of 5 required parking spots relieved per single CS vehicle provided, and a maximum of 1 CS vehicle space for every 50 building units. This reduction ratio is explicitly codified in the City's official zoning bylaws; it is referenced and informally adhered to throughout several other Metro Vancouver municipalities' planning departments. Relative to other cities in North America, this reduction ratio is relatively progressive and rewards developers handsomely for providing CS in residential buildings as a TDM planning tool. Forgoing provision of several required parking spaces saves a great deal of construction costs to developers – especially if this eliminates additional floor(s) of parking structure. Some of this saving can then be used by developers to promote CSO contracts, through purchasing CS vehicles, memberships and/or driving credits for residents. These practices are at present exercised between numerous MV developers and Modo and discussed further in Chapter IV. Waiving a proportion of minimum parking requirements also directly contributes to more efficient land and space management with the potential to deliver more benefits to urban planning and collective community health. For example, developers providing CS vehicles can dedicate parkade space otherwise reserved for unnecessary parking spaces - towards alternative TDM amenities encouraging alternative transit such as bike lockers and repair facilities or end-of-trip amenities in residential or professional/commercial developments including showers, drying racks, and changing rooms. Providing such amenities is a TDM practice observed

(usually informally) in Port Coquitlam, Surrey, Richmond, and facilities on UBC's Point Grey Campus.

Box 2.1 COV TDM Bylaw: CSV Parking Variance

The Director of Planning and General Manager of Engineering Services, on conditions that are satisfactory to them, may allow the substitution of shared vehicles and shared-vehicle parking spaces for required parking spaces: Except as set out in subsections (b) and (c) at a 1:5 ratio, to a maximum of one shared vehicle and one shared parking space for each 50 dwelling units up to a maximum of two shared vehicles for each 100 dwelling units , rounded to the nearest whole number, or such greater substitution of shared vehicles and shared vehicle parking spaces at such ratio and for such number of dwelling units as they may consider appropriate with respect to the site; For secured market rental housing Downtown, at a 1:5 ratio, with no maximum number of shared vehicle parking spaces or shared parking spaces; For secured market rental housing not downtown, at a 1:5 ratio, to a maximum of 2 shared vehicles and 4 shared parking spaces for each 100 dwelling units

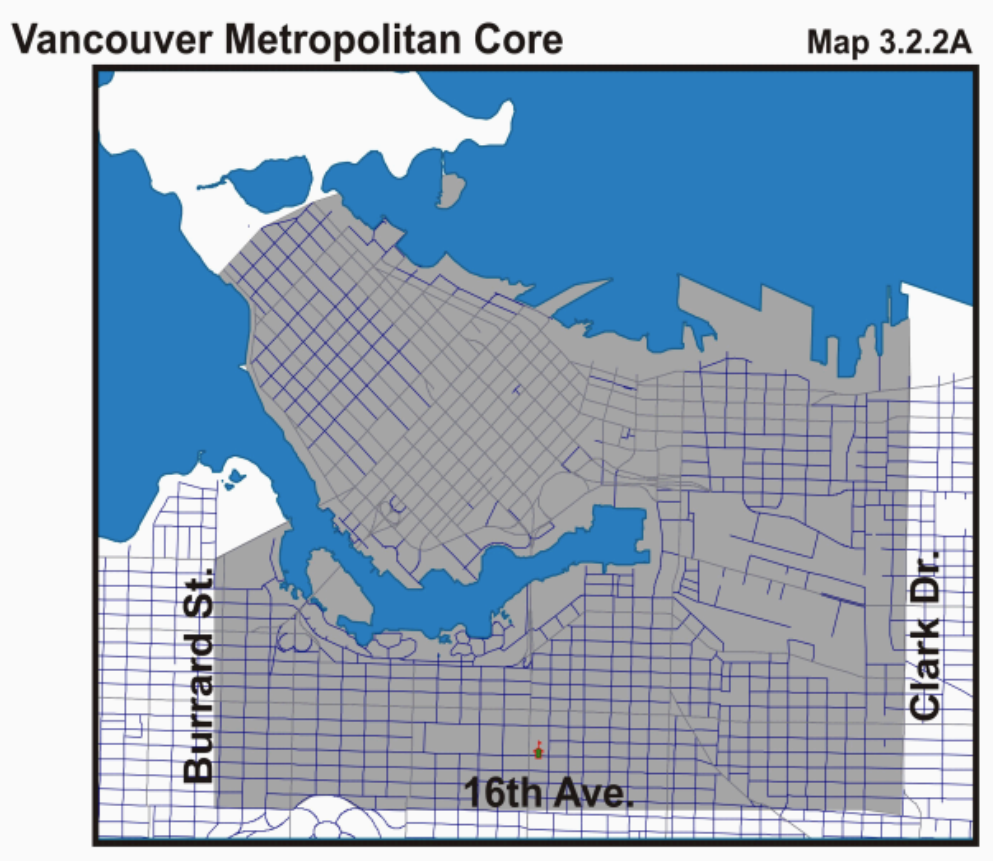
The COV TDM bylaw establishing parking variances for residential developers providing CSVs on-site also establishes a limit of one CSV per 50 dwelling units. This provision caps CSV provisioning to prevent developers from providing unsustainable amounts of cars simply to receive parking reliefs, potentially taking advantage of variances. (Source: City of Vancouver Parking By-Law, Section 3.2.2)

The COV's bylaw acknowledges an important distinction between the parking reliefs awarded among downtown core developments vis-à-vis non-downtown core areas as described in Figure 2.1 and illustrated in Figure 2.2. Parking reliefs awarded to developers providing CS vehicles in downtown core developments are unrestricted; developers are able to provide as many CS vehicles in developments as are feasible and are thus able to forgo providing considerable numbers of otherwise required parking spaces. This unrestricted parking variance is of immense financial benefit to developers considering that the COV's average market parking space has recently reached market values of $45,000 in some locations, signifying an additional consideration for developers (or complication for the city) regarding whether it makes more financial sense for them to invest in parking stalls for retail profit at these stellar levels, or to choose a TDM parking variance option relieving construction of a few stalls. Because parking construction costs for underground parkades is non-linear (providing additional garage floors at

further depths exponentially increases construction costs) parking variances may not necessarily appeal financially to developers or serve as an effective TDM incentive in some cases.

Other municipalities surveyed such as the Cities of Victoria, North Vancouver, Surrey, and the District of Saanich do not have officially codified bylaws sanctioning larger parking variances in core areas; however, in these municipalities planners usually determine case-by-case parking reductions considerate of development locations relative to urban cores and public transit access.

Table 3 COV Core vs. Outlying Area Map

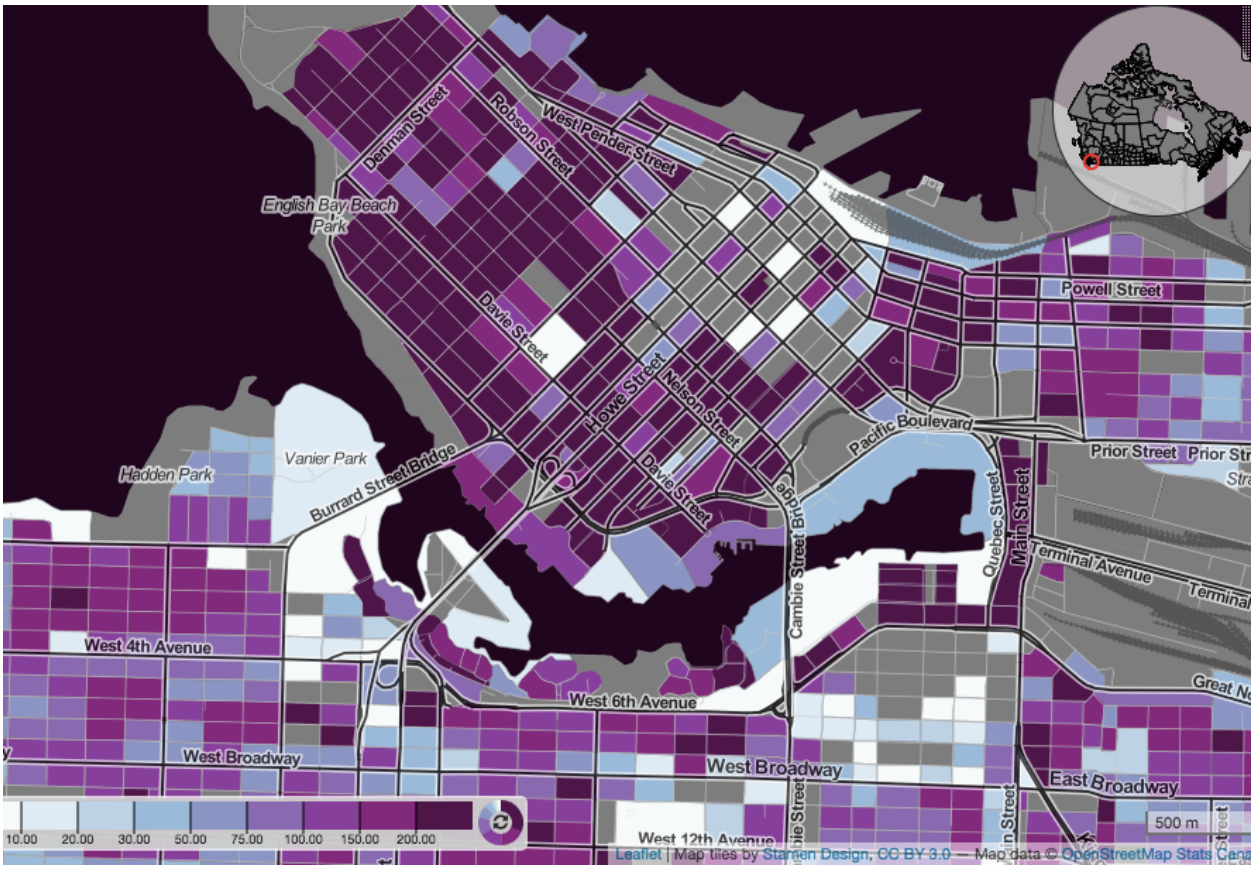


(**Source**: COV Parking Bylaw Section 3.2.2: Administration. http://bylaws.vancouver.ca/parking/sec03.pdf)

This map excerpted above from the COV's zoning bylaw pertaining to Section 3.2.2 delineates distinct core vs. non-core areas; as stated in the bylaw, core areas are exempt from CS parking variance limits for developers. Figure 4 below depicts block-by-block population density

data as established by Statistics Canada's 2016 Census. The significantly higher population density in the downtown core motivates the established unrestricted CS parking variances because the denser urban core naturally has less land available for vehicles and parking spaces.

Figure 4 COV Core Population Density by Block



(Source: Canada Census 2016: Population Density. https://censusmapper.ca/maps/591#14/49.2783/-123.1256)

In contrast, CS parking variances in non-downtown core areas are restricted to a maximum of 4 shared vehicles for every 100 residential units in a given residential building as set forth in Box 2.1. Parking relief variances are restricted in outlying areas because residents are more likely to require cars for work commutes, while variances are unrestricted downtown where space is significantly more limited and valuable. There is less practical demand for personal cars in downtown core areas due to geographical transit accommodation, walkability, and relatively

closer proximity of amenities available. This discerning model of restricted vs. unrestricted CS parking variances for residential developments considers the realities of urban societies reducing dependence on personal automobiles. As vehicle dependency gradually declines with improved public transit accommodation, more walkable and cycle-friendly urban infrastructure, and more prevalent ride hailing and autonomous taxi use, variance restrictions should correspondingly lift in non-core regions and allow local developers across the region to proceed with more CS provisioning and associated parking reliefs.

The City of Coquitlam is the only other MV municipality surveyed that explicitly practices official policy-driven consideration for TDM measures in its downtown core and shoulder areas around the Evergreen transit line (400m and 800m radii around the station area, respectively). Developers in the City Centre area are able to achieve an additional 5% reduction in minimum parking requirements should they wish to provide more payment-in-lieu, which is based at $20,000 per stall (50% of the current $40,000 market value). Coquitlam's TDM mitigation is thus entwined with this determined monetary value of parking stalls. Again, it is important to note that for developers, forgoing parking space provisions isn't necessarily appealing from a cost perspective; the value developers can realize from market prices of parking stalls can potentially deter them from pursuing parking variances or payment-in-lieu for parking stalls. As such, when considering TDM option uptake, planners and developers should consider:

- How much it costs to construct and provide the minimum parking requirements
- The marginal cost of providing additional stalls (perhaps requiring additional parkade floors which *significantly* increases construction costs)
- How much revenue additional stalls may deliver, relative to retail market price developers would receive for them.

The developer thus has to weigh the benefit of profits from developing and selling parking stalls at these stellar market prices vis-a-vis the cost savings they may benefit from if they are able to/choose to forgo construction of a few parking stalls and invest $20,000 in TDM measures instead – in addition to value that accompanies potential future residents whose decisions to buy into their developments are influenced by the convenience of an on-site CSV system. Based on these considerations, parking variances may not be the most effective mechanism for wider CS implementation and use. City planners should subsequently consider these developer perspectives when crafting and proposing CS TDM options involving parking variances.

Table 4 City of Coquitlam Allowances for TDM Variances

Burquitlam/Lougheed Neighbourhood	**City Centre Area (Under Review)**
5% for TDM methods	5% for TDM methods
5% reduction for payment-in-lieu	5% reduction for payment-in-lieu
	5% additional reduction for payment-in-lieu
10% Total Reduction	**15% Total Reduction**

Aside from the City of North Vancouver which adheres to a newly codified 1:4 CS parking reduction ratio, the other MV municipalities surveyed lack specified distinctions for CS parking variances in downtown core vs. non-core outlying areas in their codified bylaws. However, interview results exhibited that most MV planners consider these factors in case-by-case determinations of parking reductions awarded to developers. The planners interviewed generally support the ad-hoc nature of negotiated reductions rather than strict reduction ratios due to the wide array of varying building locations and circumstances.

2.4.2 Case-by-Case Reduction Determinations

Other municipalities determine CS parking reliefs on a case-by-case (or building-by-building) basis, seemingly not exceeding 1:6 anywhere in the region. Sizeable residential developments exhibit case-by-case needs and unique circumstances, rendering some construction prospects less feasible or costly and thus unappealing to developers. Such circumstances can include seismic obstacles to building foundations and underground parking facilities, as is occasionally the case in the Cities of Coquitlam and Surrey, cities in which some developers have reportedly cited depth challenges fundamentally preventing compliance with parking minimum requirements. These cities instead accept cash-in-lieu payments for a limited number of required parking stalls unmet as an alternative means of compliance.

Table 5 Factors Evaluated in Case-by-Case Parking Reductions

Planner Considerations: Parking Variance Negotiations	
1	Feasibility of variance size requested
2	Proximity to public transit
3	Likelihood of impending new public transit in area
4	Proximity to downtown core
5	Rental Vs. strata development
6	Demographic of residents
7	Walkability of neighborhood
8	CSO interest in providing on-site CSVs
9	Viability of CS success (Discussed with CSO)
10	Success of nearby on-site CSVs

It is possible that these common bespoke needs play a role in the unofficial nature by which parking variances are determined and awarded in most municipalities – because so many developments exhibit different construction needs, perhaps a codified precise ratio for parking variances could legally or logistically complicate bespoke negotiations between developers and city planners. This case-by-case negotiation process characterizes TDM and parking variances in the City of Victoria and to a lesser extent the Cities of North Vancouver and Surrey, which abide more strictly by a defined range of CS parking variances between 1-4 or 6 parking stalls

depending on building locations (i.e. proximity to downtown core/public transit and Skytrain stations. Based on interview responses, MV planners generally consider the 10 factors outlined in Table 5 when negotiating parking variances with developers. They collectively appeared to favor negotiated reductions as indicated in the responses below:

Box 2.2: Responses Regarding Negotiated Parking Reduction Ratios

Q: What's your assessment of the case-by-case negotiation process?

> **District of Saanich:** *I prefer a negotiated reduction, because things are changing so rapidly I wouldn't want to see parties locked into a fixed formula.*
>
> **City of Richmond:** *For larger major developments we usually require a parking study by a professional parking engineer, and they can propose TDM strategies through that which the city has to review and approve – it's an iterative process to identify which features can be enhanced like walking, cycling, et cetera to accommodate the parking reduction.*

The "fixed formula" referred to above is perceived as restrictive and inefficient to the quoted planner. According to this respondent, the dynamic nature of changing locational requirements and neighborhood transit circumstances are conducive to flexible reduction determinations.

2.4.3 City & Developer: Who Approaches Whom?

As discussed above, interview responses indicated that the zoning application process for residential developments often integrates building-by-building spatial considerations including spatial constraints or budgetary concerns, among others. Most established large-scale residential developers have in-house or contracted transportation teams familiar with local zoning processes and parking stall requirements. Large-scale residential zoning application processes in the Metro Vancouver region usually initiate with these developers or their planning/TDM teams approaching respective city planners with TDM plans and zoning concerns, exemption requests, or questions.

In the City of Surrey, CSOs have appealed to city planners for assistance securing agreements between CSO and developers in order to ensure contracted provision of CS vehicles in residential developers for predetermined amounts of time. Contract duration ideally spans several years to encourage long-term financial viability of the cars. In the City of Victoria developers often approach the city for parking variances associated with TDM and CS. Zoning applicants provide the city with parking studies for developments; city staff comment on consultant reports and city council decides whether to approve their desired parking variances. Planners are weary of not allowing large variances because parking undersupply can result in street parking congestion and overflow to neighboring areas which is problematic for residents. In most zoning approval processes in MV, area developers can appeal to the city with requests for construction waivers or present TDM alternatives to zoning requirements such as minimum parking requirements. It is common for developers in MV to exercise agency and approach city planners with detailed TDM plans as required in most zoning applications. MV planners indicated typical municipal processes with developers in response to the following interview question:

Q: Have you encouraged TDM methods in the burgeoning developments as they develop, such that developers are aware of and can realistically participate in these bylaws?
Surrey: *We inform them, the bigger developers with residential towers pack on a transportation consultant as part of development team, so the transportation planners in the private sector are aware of what surrey wants in mitigation standpoint, so they usually already know what we're looking for.*
Richmond: *As part of a preliminary application we identify that they have that as an option, but a lot of the developers are already familiar with bylaw requirements.*
CNV: *The way it normally happens is, the developer comes to us and we recommend that they provide one, and it generally comes down to the developer how much parking they want to deliver/what their market is. We don't force the developer to do it, we suggest they do. If a developer comes in with too many stalls and we suggest it as an alternative solution, that's usually when it's picked up.*
District of Saanich: *If the developers are familiar with CS as a TDM opportunity, they will sometimes bring it forward. In some neighborhoods there's a higher sensitivity to the*

congestion issue, and staff know this, so they'd say to the developer that since that neighborhood experiences X, we seriously recommend that you look at CS.
City of Victoria: *Applicants provide a parking study, staff comment on consultants' reports, council decides whether or not to support the variance. If the building is closer or in downtown, we'd be more supportive.*
District of North Vancouver*: If you want to propose decreased parking rates for multi-family developments, you provide a plan for how you'd do this. Developer x comes in and says hey we want to lower the parking requirements and do xyz, we review it and say yes or no and they move forward. We provide guidance for the lowest rates we're willing to allow in the TDM part of this proposal and we provide guidance as to the type of things they should consider. Developers with full reduction have to do more than smaller ones.*

These interview responses indicate a degree of cooperation and understanding between planners and developers. Developers are often aware of zoning processes and TDM opportunities available to them, and planners make it a point to inform them of TDM options they can potentially utilize given development circumstances. This type of collaboration is a good start for the drastically needed improvements in communication and collaboration among stakeholders – planners, developers, and CSOs – but particularly *among the municipalities* themselves, which should share information about which TDM policies work or fail and where, and how best to implement them. Sharing this information among municipalities would most likely result in more efficient TDM planning and policymaking.

2.4.4 Developer Uptake

COV engineers and planners reported that developers like parking reduction ratios accompanying CS provisioning. City planners generally classified this TDM practice as a "well-used opportunity" insomuch that developers regularly utilize this opportunity to forgo constructing a number of otherwise required parking stalls. One might surmise this predictable conclusion; reducing parking requirements is of immense financial benefit to developers who are able to easily negotiate and establish several year-long contracts with station-based CSOs. The

relatively little amounts of effort required by developers to establish these contracts deliver considerable monetary returns through the parking variances awarded.

The CSO also indicated that developers like to offer CS as a marketing amenity for prospective and current residents. Knowledge of CS service availability (and subsidized service, a "visibility" tool discussed in Chapter III) can also indicate to prospective development residents that they may not require a personal vehicle should they move into that building, which is also beneficial to the developer from a parking supply standpoint. None of the municipalities interviewed maintain records of developer uptake for reduction ratios; most citied lack of sufficient resources with which to do so. Doing this would allow planners to track, identify and analyze which development types or locations exhibit particular characteristics potentially more conducive to CS success. This would better inform planners on how and where to craft and push CS incentives, respectively – if planners know where and with whom these TDM measures are adopted, they can curate their approaches accordingly with developers and CSOs. For example: as indicated in the interview excerpt below, COV planners are aware that CS parking variances are effective; this evaluation can inform how they incentivize and negotiate with developers they know are interested in TDM options, or how they might communicate with developers constructing in a certain area of the city. In a different vein, the City of Coquitlam recently introduced CS parking variances as a TDM option for developers; as this unfolds, they can and should monitor and evaluate uptake for the purpose of anticipating developer uptake patterns and proceeding accordingly:

Q: Have you evaluated developer uptake of these variances?
COV - *We see a lot of uptake in terms of CSVs they want to put in buildings, they want to do it because they see it as an amenity for the building.,, They've been successful, a large portion of their vehicles downtown have been delivered through developments. 1:5*

relaxation of parking spaces is enticing for developers so we do see a lot of smaller projects taking this up as an option, especially rental developments.
Coquitlam – *It's still very new; only a handful of developers have taken up this TDM proposition, we really haven't had huge uptake/takers – only 2-4 developers or so.*

An inference I gleaned from these interviews was that the municipal transportation planning departments are understaffed and lack the resources needed to evaluate TDM policy uptake and efficacy. Most of the planners divulged that they have not evaluated carsharing-related TDM policies, and that the CSOs maintain this information in-house (and occasionally meet with planners in some cities). Because it would likely be impossible to assess policy successes, without a proper evaluation of their outcomes, it is recommended that city planners prioritize TDM policy evaluation to determine whether their policies or practices in place are actually achieving their desired policy objectives, which in these cases are increased CSV membership and utilization of frequently-booked CSVs, decreases in vehicle ownership, and lower parking demand.

2.4.5 Requiring CS for Zoning Approval

The COV is the only local municipality to consider and enact *requiring* CS vehicles in some recent developmental zoning applications. Though this progressive practice is new and its longitudinal effects are too premature to evaluate, it is a sensible and efficient way to increase CS presence, membership and use (particularly for urban zones in which residents needn't necessarily own cars, such as dense downtown cores with accessible amenities) while helping developers conserve premium space. This results in more funds redirected towards various forms of community betterment such as other TDM amenities or shared urban community spaces. Establishing zoning approval as contingent upon CS is a form of municipal command and

control that has the potential to effectively and efficiently increase the prevalence of well-utilized CS systems, reducing vehicle ownership, congestion, and GHG emissions.

A pilot example embodying this progressive notion of requiring CS provisioning for zoning approval was implemented in the City of Vancouver's East Fraser Lands district. The COV's East Fraser Lands (EFL) River District development is a 126 acre zone in Southeast Vancouver along the Fraser River. The development's original policy statement in 2004 required comprehensive TDM plans (City of Vancouver 2004) to minimize automobile use within the development (See Figure 4) while its official development plan published two years later promised parking requirement variances where carsharing was provided (City of Vancouver 2006). TDM initiatives eventually manifested in a required 30 CS vehicles within the development for zoning approval fulfilled by Modo. The policy required that all of Modo's 30 CS vehicles would be ensured by contract and deployed on the development's opening day for service onwards rather than gradually installed over time – mirroring resident arrivals. Their parking hub locations were selected for optimal spatial distribution and visibility across the development's residentially inhabited areas.

Numerous considerations must be addressed in determining CS requirements. The number, locations, visibility, implementation timing, and providers of CS vehicles must be determined prior to establishing the requirements necessary for zoning approval. Notable pitfalls to avoid are vehicle saturation and inopportune timing of vehicle deployment which would both lead to high initial costs and revenue losses, potentially discouraging CSOs from future contracts and deployments. This poor planning and subsequent underutilization would also defeat the purpose of CS and the sustainability benefits it delivers. When designing zoning bylaws for new large-scale development zones, planners should require detailed TDM plans incorporating CS

vehicle provisioning and facilitate stakeholder communication and planning between CSOs and developers. Ensuring CS in large-scale residential developments prior to launch will allow developers to market CS as an available amenity to prospective residents, signaling that they needn't require a car or associated parking spaces to live there conveniently. CS availability will also potentially allow developers to negotiate fewer minimum parking requirements with city planners in addition to the parking reduction ratios associated with CS vehicles, further reducing space otherwise dedicated to parking and liberating it for more beneficial community uses such as parks. This type of efficient and calculated pre-planning through TDM and zoning policy levers can present a win for all stakeholders involved – planners, developers, CSOs, development inhabitants, and the widespread populace - and should be common practice moving forward in urban planning. This approach is currently underway:

Q: Have you experimented with requiring CS in certain developments?
COV – *We do have new rezoning where we require CS. In some major rezoning projects, we will look for the provision of CSVs for the rezoning. Site-specific basis, not in bylaws – it's pretty recent. Olympic village is one, EFL is another.*

An excerpt of the zoning requirements for the aforementioned East Fraserlands development is provided below. These requirements explicitly identify CSV provisioning as discussed in the interview excerpt above and the section following it.

Box 2.4: EFL Area 2 Policy Report: Development & Building

14. Parking, Loading and Circulation Developments in EFL with 50 or more dwelling units are also required to provide shared vehicles, including off-street shared vehicle parking stalls. Conditions or enactment are included in Appendices I, K, and M to ensure the provision of shared vehicles and shared vehicle parking spaces.

Source: COV East Fraser Lands Official Development Plan, 2004.
Note that the zoning requirement specifies off-street shared vehicle parking stalls rather than on-street stalls. The implications of this descriptive provision are explored further in Chapter III.

Interview responses from Modo, the CSO tasked with providing the mandatory CSVs in the EFL development, confirmed that this approach is not effective, nor has it proved successful

for a variety of reasons: requiring 60 vehicles was arbitrary and never fated to match residential demand; the development's population distribution was not appropriately suited to the vehicle placement; and public transit access to and from the area was sparse with one bus accommodating the area every 15 minutes. CS is not a replacement for public transit; rather, it is a *complement* to public transit – and requiring bulk fleets of CSVs cannot effectively accommodate an underserviced transit area. This is also detrimental to the CSO because deploying underutilized vehicles is a guaranteed revenue loss.

In contrast, the UBC Properties Trust exercises a mandatory CSV provisioning policy model that has proven effective. Through the mandatory Residential Environmental Assessment Program applied to all Point Grey Campus developments, all developers must comply with Sustainable Sites requirements including the provision of a community CSV vehicle for every 100 residential units provided. The vehicles are not associated exclusively with or located in one single development; they are financed by the developers and provided for overall community access and use. Interviews confirmed that this model (unique to the UBC Properties Trust) has proven effective in terms of vehicle provisioning and utilization. As such, it is recommended that other municipalities and communities should emulate this policy model. The REAP Sustainable Sites CSV requirement is attached for reference in Appendix E.

2.4.6 CS Supportive Conditions

CSOs are businesses. Without sufficient CS vehicle use, vehicles become lost investments unviable to maintain - and CSO businesses lose revenue. The concept justifying these parking variances is that CS vehicles reduce dependency on personal vehicles and stimulate decreased vehicle ownership, contributing to more urban space and funds directed towards more productive societal improvements. As such, provisions ensuring adequate CS

vehicle utilization among residents and non-resident CS members should be required and codified for zoning approval in order to truly deliver an effective impact. Otherwise, the intention of maximizing CS benefits is not properly assured. If these supportive conditions are not established prior to zoning approval, it is highly unlikely that dedicated CS vehicles in respective buildings will remain long-term without enforcement mechanisms or terms. In these situations, CSOs will either remove financially unviable vehicles, or strata-owned CS vehicles and their former parking spaces will be sold for revenue back to developers, who initially pocketed money by complying with TDM variances with no intention of maintaining the vehicles' longitudinal utilization.

Various conditions determine the financial success and subsequent viability of a dedicated CS vehicle; ease of access for all members of that service (not simply residents of the development) is integral to their viability and success. In some instances CSOs have appealed to city planners to request that they play a role in contract negotiations between CSOs and developers to ensure that vehicle securities and terms are met prior to issuing zoning permits. Transportation planners are aware of the need for such provisions:

Q: What do you recommend through your experience looking at on-site CS as a TDM tool?
Metrolinx Toronto: *"Make zoning approval contingent on the applicant providing an agreement with a recognized CSO to provide one or more CSVs at the building for at least 3 years, ensuring dedicated CS vehicles are available to subscribers from outside the building"*

This interviewee indicated that his response was informed by past experience illustrating that if the proper provisions to ensure CSV use are not in place, the vehicle will likely sit for years and languish without proper utilization. His response also indicates support for the TDM initiative of requiring CSV provisioning in developments, discussed in the section preceding the present section. CSVs should not be abused by developers as simply an amenity or tool by which they

can forgo providing expensive parking stalls, but as a tool for all CS service members to utilize in the pursuit of improved transportation sustainability and urban planning. The UBC Properties Trust approach of requiring developer maintenance of 1 CSV per 100 units for community use addresses this potential policy pitfall.

2.4.7 Building Security and Member Access

CS vehicles are, theoretically, available to all members of that service; if so, the vehicles should be parked in spots accessible to anyone. When developers provide two-way CS in their buildings as a TDM method or residential amenity, security and access conflicts arise. Residential parkades are usually underground and restricted from access and/or inaccessible to the general public. When parkades are above-ground, they are often secured and equipped with access restricted to building residents only. This restricted entry poses obstacles for CSOs, as non-resident members are unable to access these vehicles and the vehicles often are underutilized, costing significant revenue to the CSO. Some planners have worked with the CSOs to address these issues barriers to entry through negotiations with developers. As indicated through interviews, the COV and Surrey have negotiated with stakeholders to ensure public access to some residentially stationed CS vehicles through several provisions outlined in Table 6.

Primary research in and around COV examined Modo parking locations within parking garages and residential parkades. Most enclosed vehicles were situated as closely as possible to main parkade entrances, such that patrons are able to walk inside the parkade and almost immediately identify the nearby CS vehicle. At the same time, a considerable number of vehicles are located within securely restricted residential development parkades underground. Access to vehicles within these restricted confinements proved confusing and time-consuming. These

restrictive circumstances can deter users from booking these vehicles and hinder vehicle utilization. A few interview responses discuss this consideration:

Q: Have you encountered CSV access issues in restricted residential parkades?
COV – *We establish that the CSV should be located on the highest floor of the parkade near entrance, not behind a parking gate, there are ways for people to access them after hours if needed, making sure public access is straightforward and well designed so people are able to get down there – there are concerns with residential building security, ensure CSV placement by secondary entrance access or stairway.*
Surrey: *Whenever there are CSVs in residential towers in parkades they're usually not utilized sufficiently, we've had cars die in there without use in months. We talk about locations about where we should accept CS, we do have dialogue with [the CSO}.*

It becomes clear that in addition to other factors that can lead to CSV neglect including inopportune deployment timing and poor location choice, CSV inaccessibility can challenge users and cause further underutilization. In consideration of these troublesome circumstances discussed throughout interviews with planners and Modo, the following provisions should be followed to ensure ease of access:

Table 6 Best Practices for CSV Parkade Access

• Highest floor of parkade
• Close proximity to parkade entrance
• Not restricted behind parking gate
• 24/7 or after-hours entry/access
• Well-designed, straight-forward public access, such as near stairs
• Key fob access codes available to all members through app

Rather than confining vehicles to a lifespan of costly underuse, stakeholders should design and establish parking spaces more conducive to vehicle ease of access and high utilization. There is thus a need to understand CSV utilization on a more detailed level for improved business and planning decisions; this need for understanding should impel research identifying what should inform best practices in CSV visibility and deployment. The need to close these gaps of missing information birthed the case study following this research's findings.

Originally I thought that CS visibility provisions would justify installing hubs in areas with high foot traffic levels to instill the most awareness of vehicle presence and accessibility as is possible. On the contrary, the research findings discussed in Chapter III disprove the commonly believed relationship between CS vehicle visibility and utilization, instead materializing in a different set of recommendations. In many instances, it is not feasible for a CSO to deploy a vehicle anywhere *but* within an enclosed residential or commercial parkade due to zoning bylaws and parking space availability constraints on surrounding streets. In these instances, it is crucial that the CSO ensure ease of access to the vehicle enclosed within these confined garages, considering visibility upon entrance as well as ease of accessibility after hours. These unexpected results implore the need for research to identify best practices in CS policymaking moving forward.

2.4.8 Eliminating Parking Minimum Requirements

An urban future with significantly reduced minimum parking requirements is potentially on the distant horizon. As more people turn to more readily available public transit, carsharing, walking and biking paths, ridesharing, and eventually shared autonomous vehicles, newer creative forms of mobility has the potential to slowly reduce the number of conventional personal vehicles on the road. As the toxic effects of vehicle use – wasted space, congestion, GHGs and poor air quality, among many others - become more pronounced and widely acknowledged, some progressive cities such as Portland, Oregon are taking steps towards decreasing (and in some cases eliminating) minimum parking requirements for developments within a designated proximity to public transit, for example (City of Portland). This movement, likely initiating most prevalently in downtown urban centres with higher incidences of congestion and availability of amenities, may slowly decrease the prevalence of and need for

personal vehicles, rendering it inconvenient and unfeasible to own a car for lack of space and practicality. These results are of consequence for CS use and CS-related transportation planning. Several municipalities in Metro Vancouver acknowledge this impending urban planning shift as depicted in Table 7 below:

Table 7 Reducing/Eliminating Parking Minimums in MV

Comparison of Four Municipal Minimum Parking Requirements for New Developments				
	City of Surrey	**City of N. Van**	**City of Vancouver**	**City of Victoria**
Current Policy (Minimum Parking/ Residential Unit)	(1-1.5/RU)	(1-1.5/RU)	(.5/RU)	(.7-1/RU)
Near Future	no plan to reduce	plan to reduce to m/hh	Test with 0/hh for buildings close to rapid transit	exploring reduction to zero in downtown core
Medium term	Will only explore when there is frequent transit	Test with 0/hh for buildings close to rapid transit	Adoption for some rental developments	Some residential zones have no parking minima
Longer term Prospects	Perhaps in 20 years	Expand to all buildings close to rapid transit amenities		Planning a car-free downtown and elimination of parking

The future of transit-oriented and autonomous mobility may require far fewer parking spaces than are currently mandated by most cities' minimum parking requirements. Cities should take pragmatic steps towards reducing and eventually eliminating minimum parking requirements as exhibited by the four MV municipalities above, which could provide immediate benefits by nudging drivers to pursue alternate methods of transportation such as CS. Drivers may consequently save money on vehicles and insurance, adapt to and better utilize transit tools available to them such as CS, and subsequently reduce GHGs from transportation. This trend is

present in the current dialogue among MV transportation planners, as discussed in the interview excerpts below.

Q: Are you looking into eliminating minimum parking requirements at all?
City of Victoria: *In a way it's already happening, we've proposed lower parking rates downtown than other areas. 3 new areas – downtown core, large villages, outlying areas – the previous bylaw didn't, just had a rate for residential parking buildings across the board. In some areas, there are no parking requirements for certain residential zones; this allows the market to decide the value of parking spaces as a result, so it's already happening. As for the revenue question the city will adapt over time to different streams of revenue in a gradual shift.*
CNV: *We're also processing some zero-parking buildings at the moment, so we're open to that if it's close to transit/amenities.*
District of Saanich: *The playing field is changing and it always is. Now the city is investigating new parking standards. For a long time parking has been a requirement for every development. As we urbanize and become more aware of the negative impacts of vehicle use, the requirement for parking becomes toxic. How do we break that relationship? Downtown urban areas looking at ways to eliminate or reduce the parking requirements. The message is if you want to shop downtown, you gotta get here in a sustainable way or park in a parking garage. Parking provisions are diminishing.*
Surrey*: In Surrey we're not in the position to do that because people still rely on cars for jobs/amenities. We don't have a good transit-oriented development, maybe one day within city center, but in suburban areas of Surrey it would be impossible to eliminate minimum parking requirements period at least in 20-30 years. One day we'll get there with improved transit.*

2.4.9 Evaluation of Subsequent CS Utilization Rates

All stakeholders involved are invested in well-utilized on-site CS vehicles for monetary or planning/sustainability benefits. CSOs have no interest in maintaining unprofitable vehicles and their associated costs. Modo regularly evaluates utilization rates of their actively deployed vehicles to assess whether they are profitable and thus viable for continued operation. As such it is the CSOs who evaluate the usage frequency of their vehicles; this research did not identify any developers or city governments that actively monitor or assess CS vehicle usage in residential developments. CSOs have the most at stake among all parties involved in these arrangements because their revenue is directly determined by vehicle utilization and subsequent profits.

Developers naturally like to secure CS vehicle contracts with CSOs as required to receive a respective city's parking variance allocation as is practiced in COV. However, following the verified establishment of initial CSO contracts and associated parking variance awards, bylaws do not necessarily require that developers evaluate or maintain CS vehicle usage among development inhabitants. Without proper longitudinal evaluations of CS efficacy in the respective municipalities, there can be discrepancies between what they think works and what is actually or not effective. Cities should maintain records of developer TDM bylaw uptake in order to track which development type or location characteristics are more conducive to CS success. This would better inform planners on how and where to incentivize CS. No MV municipality surveyed has a system in place for evaluating CS usage after parking variances are awarded but instead defers to the CSOs for this analysis if needed.

2.4.10 TDM Menu of Options

Several MV transportation planners interviewed were familiar with a "Transportation Demand Management Menu of Options" which lists and summarizes an array of potential urban TDM strategies. Some municipalities such as the City of Coquitlam have pulled TDM methods directly from The City of San Francisco's TDM Menu of Options to integrate into their own proposed TDM plans. These menus allow developers to choose from options including providing public transit credits; car share vehicles, memberships, and driving credits; real-time transit information displays; bicycle repair services; and end-of-cycling amenities such as showers and lockers, among other options. Some of these TDM menu approaches integrate a point system by which respective TDM measures correspond with an allocation of points for the developer, with a minimum threshold of points required for municipal zoning approval. This approach allows flexibility with which developers can achieve TDM varieties and goals.

Of the municipalities surveyed, Coquitlam's sophisticated TDM plan allows residential developers the most flexibility in choosing how they wish to fulfill TDM requirements. This plan heavily references the City of San Francisco's TDM Menu of Options and delineates numerous TDM provisions for developers to choose from, each of which is assigned a monetary value and reduces parking stall requirements (valued at $20,000 per stall) by the corresponding amount. Coquitlam's plan also proposes progressive elements not included in SF's TDM Menu of Options. One such example is the option of providing monetary contributions to a local TDM monitoring fund, which the City will use to assess the efficacy of TDM measures through surveys, studies, and other assessments. Contributions are limited according to the following specifications:

Box 2.5: Coquitlam's TDM Monitoring Fund

G) Contributions to TDM monitoring fund

- Monitoring is essential to assess the effectiveness of TDM measures. Developers have the option of providing **contributions to a TDM monitoring fund** that will be used by the City to conduct sampled surveys and studies on the effectiveness of TDM measures for developments.
- This option is only available if the development is proposing other TDM measures to offset a minimum reduction of 10 required parking stalls. The maximum permitted fund contribution is increased by $20,000 (equivalent to 1 stall credit) for every successive reduction of 10 required parking stalls from the provision of other TDM measures:

Reduction in required parking stalls through other TDM measures	Maximum permitted contribution to TDM monitoring fund
0-9	$0
10-19	$20,000 (1 additional stall credit)
20-29	$40,000 (2 additional stall credits)
30-39	$60,000 (3 additional stall credits)
Every next 10 reduced stalls	Increase of $20,000 to maximum contribution cap

Coquitlam's proposed TDM plan also includes a "transportation options move-in package and personal travel planning" option for residential developers to offer and curate individualized transportation plans for residents' unique transportation needs. To provide this service, developers must hire a marketing or TDM professional to engage one-on-one with residents and

inform them about transit options available within the vicinity. The specialist will help residents formulate subsequent individualized transportation plans. This unique TDM option is a wise way to ensure efficient utilization of the many transit options available in the urban setting, encouraging multi-modal trips. MV's TransLink public transit system offers a similar initiative referred to as *TravelSmart,* its TDM program that helps individuals, businesses, and schools plan travel methods as needed for respective circumstances. The program includes online workshops, business site audits and assessments, and shared knowledge of best practices, among other services. The *TravelSmart* program works with local municipalities and has partnerships with local transit-oriented businesses.

Some municipalities allow cash-in-lieu payments for developers unable to provide minimum parking requirements established in respective zoning bylaws. This allows developers failing to meet minimum parking requirements to pay the city a determined value for each of the unmet parking stalls, sometimes in addition to accommodating parking reductions through additional alternative TDM measures. This alternative is used in both the Cities of Surrey and Coquitlam, where geological depth issues render compliance with underground parking requirements unfeasible in some geographical areas. In this instance the city's flexibility is positive given inalterable circumstances; the cash-in-lieu might provide more utility if repurposed towards other TDM opportunities for residents such as transit passes, CS driving credits, or contributions to community CSV provisioning initiatives. This comparatively more efficient use of limited urban space and capital would allow residential developers to save money otherwise allocated towards constructing unnecessary parking spaces; this capital can be invested in other beneficial amenities and TDM measures such as transit passes, bicycle parking, or CS memberships and driving credits for residents – all means to encourage multimodal transit,

increased space efficiency, improved urban planning, and tighter urban sprawl. These funds could also be redirected to community improvement funds, a practice currently observed in various locales including Coquitlam and the UBC Properties Trust.

Q: Have you engaged in any Inter-Municipal Collaboration for TDM planning?
COV - *We have had some conversations –Vancouver has the lion's share of CS vehicles in the city, we've shared the legal document that developers enter into us with others for ideas/a template, that's the extent.*
Surrey: *We worked on our parking rate review so some of our staff did touch base with other municipalities so we do know some of their parking practices, not so much TDM, but more about commercial parking rates. We look t our peers to see if we're out of line in terms of requirements, other municipalities have contacted me very similar to what you're doing in terms of finding out what our parking rates are, not so much COV, but Burnaby, Coquitlam, we've had discussions because our demographics and transit patterns are quite similar. We don't meet reg. but we do contact.*

Interview responses indicated that there is a slight degree of inter-municipal information-sharing on occasion. Planners from the City of Surrey meet "regularly" with CSOs to evaluate whether CS-related TDM policies are working well. The City of Vancouver shared that they provided CSO-developer contracts to other municipalities for reference. Coquitlam planners shared that they were approached by transportation planners from Burnaby for advice on formulating parking requirements; and, lastly, a Surrey planner indicated that he has appealed to other municipalities to discuss their approaches to parking requirements.

2.5 Discussion

Information gleaned from the municipalities surveyed revealed commonalities and disparities in TDM practices and planning. These insights identified which official and unofficial TDM practices are effective at achieving their desired outcomes of decreased dependency on personal automobiles and increased utilization of multi-modal or alternative transit options. The findings and analysis from this research inform best practices in TDM policy implementation in

several respects. In some cases these findings highlight which policy levers work, and in most cases illuminate the policy levers that fail to achieve their intended ends – and often aren't even identified or acknowledged as having failed due to a lack of established longitudinal policy assessment or evaluation – or inter-municipal communication. There is a considerable lack of planning coordination among the MV municipalities resulting in an inefficient trial and error process for designing and implementing parking and TDM bylaws within each city. The municipalities' explicit demographic, travel, and development similarities should encourage planners to pursue inter-municipal TDM discussion and coordination, benefitting from tried and true policy outcomes – what has worked well, what has missed the mark. Best practices should be informed by tried and true policies exercised in respective municipalities and cities. There is a clear need to learn from the broad heterogeneity of TDM policies currently in use across the MV region, understand which policies are effective or ineffective, and share these findings among the municipalities for better collaborative planning and improved transportation sustainability.

Through analyzing interview responses from both the planners' and CSO perspectives, I was able to identify the TDM practices understood by both stakeholders (planners, CSO) to be the most effective at inspiring CSV provisioning, membership and utilization. Among the practices exercised, **parking variances** are effective at achieving this end with the caveat that they are negotiated *thoughtfully* and in consideration of the CSO's needs and preferences as a business. Interview responses (particularly with the CSO) revealed that developers often use parking variances for CS provisioning as a tool merely for their financial benefit relative to construction costs, with no genuine interest in improving urban or transportation sustainability. It became apparent through interviews that some developers view parking variances as a *trade* to save capital rather than a means to improve societal health – and a corresponding lack of concern

whether the CSVs are sufficiently used can sometimes accompany this attitude, rendering some CSVs relatively unused and "dead" in parkades. Results suggested that parking variances for CSVs appear to work well when they are located in optimal building locations and the CSO 1) has considerable leverage in determining hub circumstances; 2) works with the developer to clearly demarcate CSVs in the respective parkade; and 3) the developer and CSO collaborate in concerted marketing efforts to inform and incentivize residents in and around the respective hubs regarding the service. These methods and their efficacy are discussed in more detail in Chapter 3.

Interviews and utilization data analyses indicated the efficacy of 2 other TDM practices exercised in some of the municipalities examined. These practices consist of 1) requiring CSV provisioning for zoning approval in *some* cases; and 2) requiring that developers financially contribute to a collective community fleet of CSV provisioning. These practices are exhibited in COV and the UBC Properties Trust as discussed above. Relative to these two approaches, the other CS-related TDM practices exercised are not as efficient at achieving increased CSV provisioning and use.

2.6 Conclusion

The many insights gleaned through the semi-structured stakeholder interviews conducted in this study illuminate best practices in TDM policy formation as it pertains to carsharing. These informed policy formation approaches apply not merely to municipalities in the Metro Vancouver region but are generalizable to cities worldwide interested in improving transportation diversity and efficiency – and subsequently energy efficiency beneficial to all. This research indicates that well-crafted TDM policies can conceptually materialize as effective incentives and zoning requirement provisions in any city's municipal toolkit. After analyzing

interview responses and themes, TDM best practices as they relate to CS (determined by the results of the two case studies comprising this research) are presented in Chapter IV.

3. Case Study B. Carsharing and Visibility: Understanding Utilization & Recruitment Patterns

Abstract

The correspondence between CS vehicle visibility and its subsequent usage effects are at present unillustrated. Understanding the reality of this relationship is of utmost consequence to CSOs, city planners, residential developers, and stakeholders with a human interest in improving transportation efficiency and reducing transportation-related GHGs on an earth compromised by climate change. This research examines the relationship between on/off-street CS vehicle visibility and accessibility - and associated CS membership recruitment effects and vehicle utilization as exhibited by members of a cooperative CS service in Vancouver, Canada. Primary observation research, statistical analyses, and semi-structured interviews were conducted to classify CS vehicle visibility and analyze its relationship with vehicles' respective utilization and new member recruitment effects. Results found that relative vehicle visibility is unrelated to both vehicle utilization and new member recruitment; more determinative explanatory factors are exhibited by developers' marketing efforts and incentives for residential CS use. Stakeholders interested in the sustainability and planning benefits CS delivers can refer to these findings for effective CS implementation guidelines and TDM policy design.

3.1 Introduction

Many governments, businesses, and marketers operate on the assumption that the more visible a marketed item of interest is, the better. Through this lens, more visually apparent an object or message appears, the more effective it is at rendering public cognizance and stimulating a desired thought or action. Such logic is ubiquitous within the transportation industry

throughout innumerable respects, from corporate logos emblazoned on airplanes to taxi cab rooftop lamps. In the interest of improving transportation efficiency and sustainability this research investigates various conceptions of CS vehicle and service "visibility" with respect to CS utilization and new member recruitment. In conjunction with logo details on their vehicles, the conceptual understanding of physical visibility as marketing tool is manifest among CS services in the following respect: if a CS vehicle is clearly visible to surrounding vehicle and pedestrian foot traffic, it will stimulate increased awareness of its presence among local residents and consequently encourage new members to both join the service and consciously utilize that vehicle more than it would have been had it been obfuscated from on-street exposure – because potential users will be aware of its reliable presence in that respective parking hub and its subsequent availability for regular bookings.

The dogma or "visibility assumption" discussed here is maintained by CSOs and planners - and seemingly rooted in common-sense psychological principles, yet unsubstantiated by data in current academic discussions. Despite this dearth of evidence, it is believed that if city governments sanction CS vehicle placement in on-street and highly visible parking stations, these vehicles will exhibit recruitment effects leading to higher levels of widespread CS utilization – more widely allocating the vehicles' benefits. This assumption has led major cities like Vancouver, Seattle, Portland, and Washington D.C. to enact policies establishing on-street 1-way and 2-way CSV parking hubs (Zhou & Kockelman 2011; City of Portland 2016). As such, this research explores the viability of this assumption and provides substantive findings illuminating the relationships present among vehicle visibility, CSO and developer outreach initiatives, and user awareness of CS as they relate to new CS member recruitment and vehicle utilization.

The initial queries of this study intended to address the following:

1. Is there a statistically significant association between higher visibility and higher vehicle utilization?
2. Is there a statistically significant relationship between visibility and recruitment of new members?
3. Which vehicle visibility/deployment characteristics and strategies are demonstrably effective at promoting CS membership recruitment and vehicle utilization?

Delving a step deeper, the study also examines:

4. How does a CSO's understanding and classification of its own vehicles' visibility criteria (and their supposedly stimulating effects on utilization and new membership) influence new vehicle location and deployment decisions?

Inconsistent and inconclusive results redirected the research query behind Question 3 towards alternative conceptions of vehicle and service visibility that have proved more consequential in stimulating CS utilization and membership than merely physical vehicle visibility. For these purposes, the term "visibility" evolved to encapsulate both physical and figurative conceptions of CS visibility to potential new CSO members. As such, the study turned towards the following revised research Question 3:

3. Which explanatory factors and marketing efforts to improve Modo "visibility" and service awareness are most instrumental in stimulating utilization and new member recruitment patterns?

This expanded notion of "visibility" refers to what this research establishes as the more crucial determinants of CS vehicle utilization and membership recruitment potential. This conception of visibility encompasses how "visible" CS services are to prospective new members in terms of their knowledge and consideration of membership and use. This pertains to the general prevalence of and extent to which effectual marketing efforts, membership and utilization incentives are established and maintained to spread awareness and accessibility of CS services in given residential developments or neighborhoods. As such, this research establishes a new "visibility" taxonomy and TDM toolkit for stakeholders to reference in conjunction with that established in Chapter II for best practices in TDM & CS policy formation and implementation.

3.2 Study Area & Data Collection

Field research and analyses were conducted in the City of Vancouver in British Columbia, Canada. Researchers worked exclusively with Modo vehicles and various Modo databases maintaining descriptive details regarding vehicle deployment dates, locations, and characteristics; utilization data; and fully anonymized membership data. All confidential data utilized was provided by Modo under the protection of official non-disclosure agreements upheld with each member of the research team. Modo vehicle booking data, membership characteristics, and vehicle locations were provided by the CSO. Specifically, databases provided included the following:

Table 8 CSO Data Analyzed

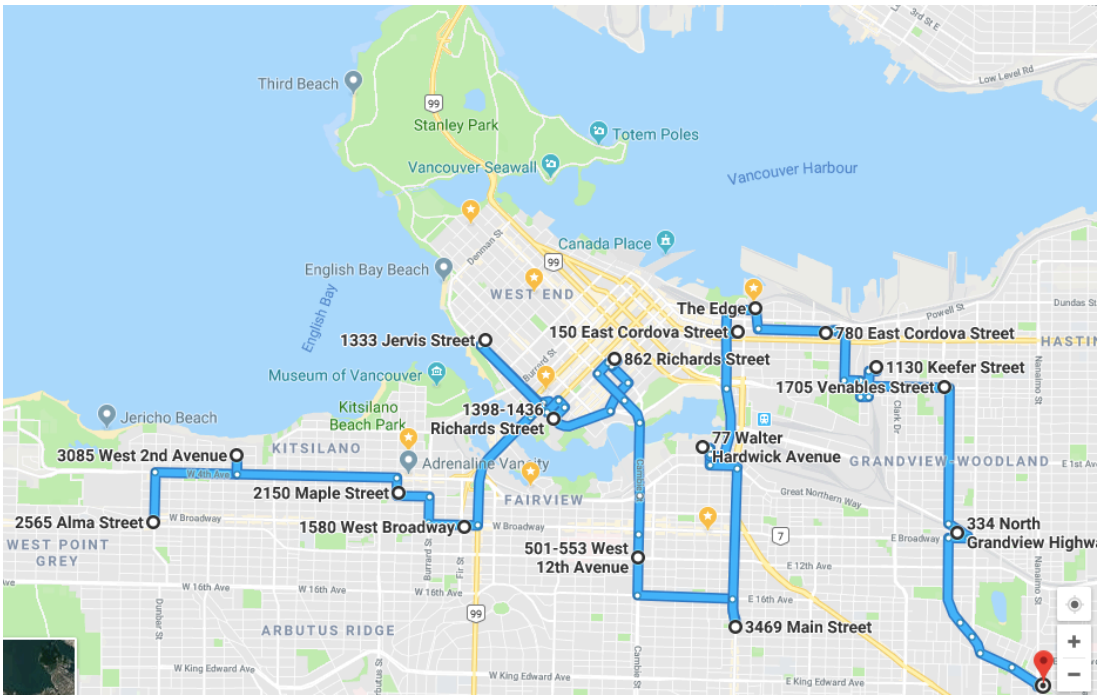
	Vehicle Hub Deployments	**Membership Recruitment**	**Vehicle Utilization Bookings**	**Vehicle Visibility Classification**
Data Provided from CSO	GPS Coordinates	Anonymized Member GPS Coordinates	All Bookings Within Past 2 Years	CSO's Visibility Classification For Each Fleet Vehicle
	Deployment Dates	Date Members Joined Service	Member Hash Codes for Bookings	5 Category Nominal Scale Ranging from "Invisible" to "Highly Visible"

3.3 Data Analysis & Methods

A variety of qualitative and quantitative data analysis methods were conducted to statistically characterize and analyze the above data. All statistical analyses of Modo data were conducted and graphically depicted in the R Statistical Computing Environment; these methods are described in more detail as they correspond to the statistical visualizations below. Descriptive field observations regarding Modo CSVs were orally, textually, and visually recorded on a smartphone camera. Observed vehicles and locations were selected from a Modo database detailing actively deployed vehicles, their descriptive visibility characteristics, and respective GPS coordinates. All vehicle hub locations observed (N = 20) were individually selected based on their spatial distribution throughout the COV's geographical area in order to represent a heterogeneity of socioeconomic and demographic conditions. A disproportionately high representation of Modo vehicle hubs stationed on the Point Grey campus of The University of British Columbia were also observed due to their convenient accessibility to the research team; these university hubs were observed first. The researchers drove and/or walked on foot to each consecutive vehicle hub over a duration of two days to 1) observe and depict their individual

physical visibility characteristics and 2) assess the latter with respect to the CSO's own classification system for vehicle visibility. On site, vehicles and their respective visibility characteristics as interpreted by the researchers were vocally described and recorded in brief videos on a smartphone camera.

Figure 5 COV Modo Vehicle Hubs Observed



(Source: RouteXL Map of CSV field visits - respective COV vehicle hubs moving eastward.)

3.4 Results and Discussion

Visibility Classification Discrepancies

We initially defined visibility as the ease with which a CSV is seen by the public in typical urban settings; for example, a CSV is highly visible if it is parked on a busy, well-trafficked street with high volumes of surrounding vehicle and foot traffic. In order to compare researchers' perceptions of hub visibility with the CSO's visibility taxonomy through regression, respective visibility classifications ranging from "invisible" to "highly visible" were assigned

values on a Likert scale ranging from -2 to +2 as depicted in Table 9. Both the researchers' and CSO's hub classifications were assigned corresponding Likert values and contrasted. Following inconclusive data analysis results, semi-structured interviews regarding the efficacy of membership and utilization incentives were conducted in person with Modo employees in charge of business development and information systems/intelligence. Interview responses were recorded and later analyzed in conjunction with membership and utilization databases.

Table 9 Visibility Classification

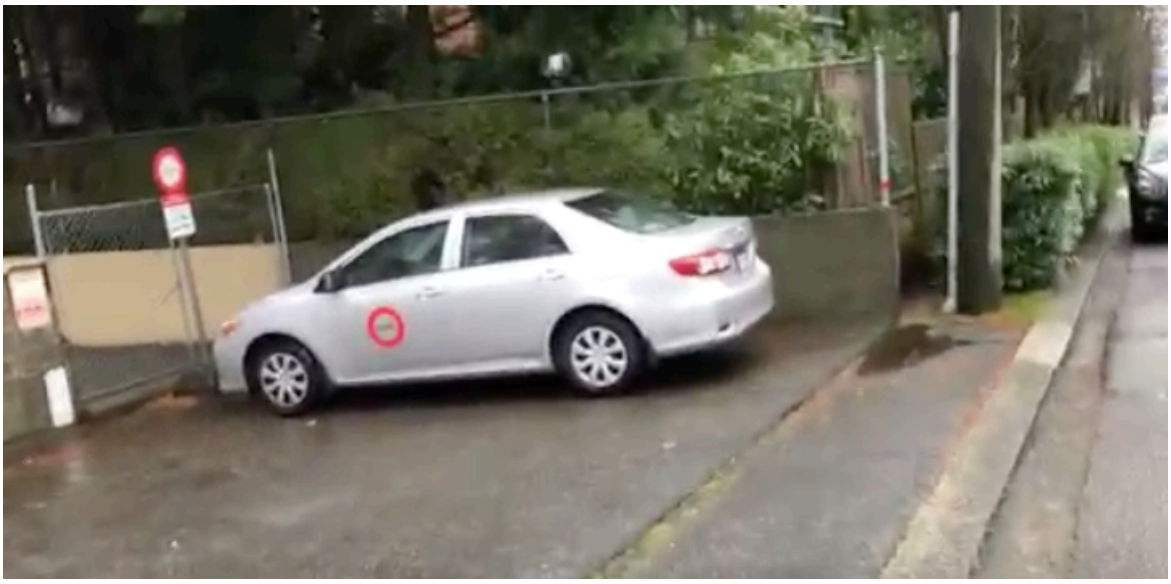
Invisible	Hidden	Visible	Very Visible	Highly Visible
-2	-1	0	1	2

Results yielded that visibility characteristics of the observed vehicles did not concur with the CSO's documented visibility taxonomy. Results also presented a broad range of subjective differences between the CSO's and researchers' determinations of visibility criteria. Upon field observation it became clear that the CSO classifies vehicle visibility based merely on the degree to which a vehicle is "visible" from a physical viewpoint directly in front of it rather than from all orientations. CSO classifications also did not appear to consider hub exposure to local foot traffic levels or lack thereof. Some hub locations with little to no pedestrian foot traffic were classified as "highly visible" but in reality are not as apparent to as many people as one might assume based on the classification.

Several of the hubs examined included vehicles classified as "very visible" or "highly visible" despite situating cars against concrete walls, fences, buildings, or barriers obfuscating visibility from pedestrian traffic. For example, the CSO classified the vehicle depicted in Figure 6 below as "highly visible" despite 1) hub location far removed from pedestrian foot traffic and vehicle thoroughfares in the area; 2) a nearly invisible CSO brand logo and hub sign; and 3) the

fact that the vehicle is only visible from one side and entirely obfuscated to the opposing side by a brick wall. Determining where to deploy new vehicle hubs based on this inaccurate assessment and classification of "visibility" arguably does not optimize prospective utilization and membership – particularly if a vehicle isn't truly "visible" to many passersby at all.

Figure 6 West End Vehicle



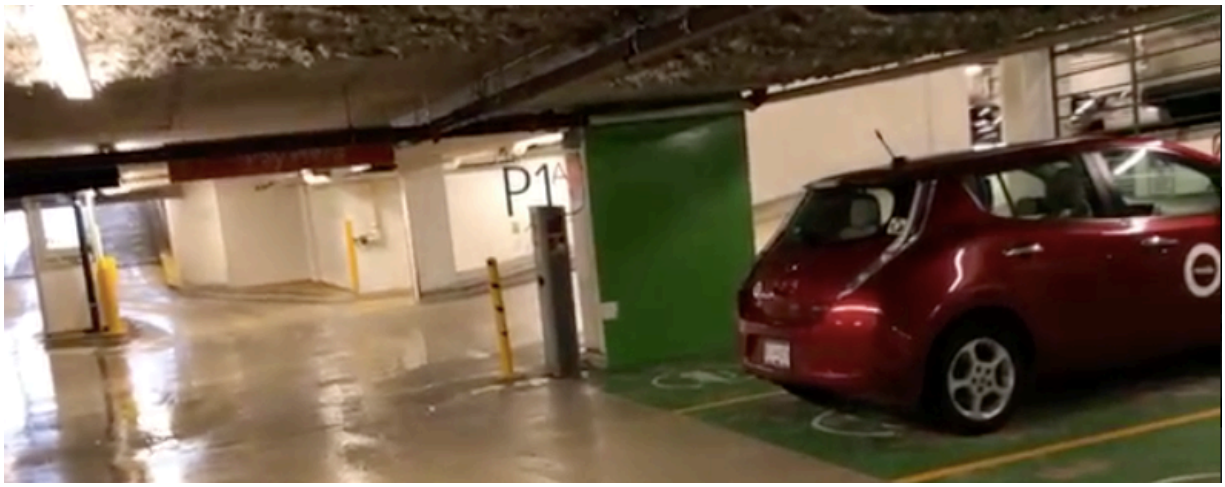
This Modo vehicle stationed in Vancouver's West End neighborhood was classified by the CSO as "Highly Visible" despite minimal surrounding foot traffic and its complete obfuscation to one side, rendering it invisible to eastward-directed vehicle and pedestrian traffic. Visibility-related membership recruitment potential of this vehicle is thus minimal.

As such, the CSO's prioritization of establishing "highly visible" vehicle hubs is rendered moot because in reality many of these hubs are not visible to many passerby at all. Because this study's findings dispel assumptions regarding the influence physical visibility determines in utilization and member recruitment, CSOs should instead dedicate booking and recruitment efforts towards initiatives proven to stimulate utilization and membership as exhibited by Modo members. These initiatives are discussed in the "Marketing Efforts" section below.

Geographical and construction circumstances characterizing dense urban settings necessitate deploying CS vehicles within enclosed residential parkades either above-ground or

underground. Many of the Modo hubs examined were indeed situated in such parkades. However, a number of these hubs were curated to attract as much attention as possible as depicted in Figure 7 below. Not only is the CSV located as closely to the parkade entrance as is possible, but it is 1) immediately visible upon entry; 2) painted an attention-grabbing red with a contrasting white Modo logo; and 3) situated in a hub painted vibrant green to attract attention and signify that the associated parking spaces represent vehicles serving a distinct purpose. These design traits reflect thoughtful planning on behalf of the CSO and developer and should be included in the CSO-developer contracts required by city planners to better encourage resident awareness of services.

Figure 7 CSV Parkade Best Practices, Embodied



This designated CSV exhibits characteristics embodying best practices for CSVs located in a parkade: Open, uninhibited access to parkade; placement directly in front of parkade entrance; clear signage; vibrant green paint to signify privileged or special vehicle parking; distinct red vehicle colour with contrasting white CSO logo.

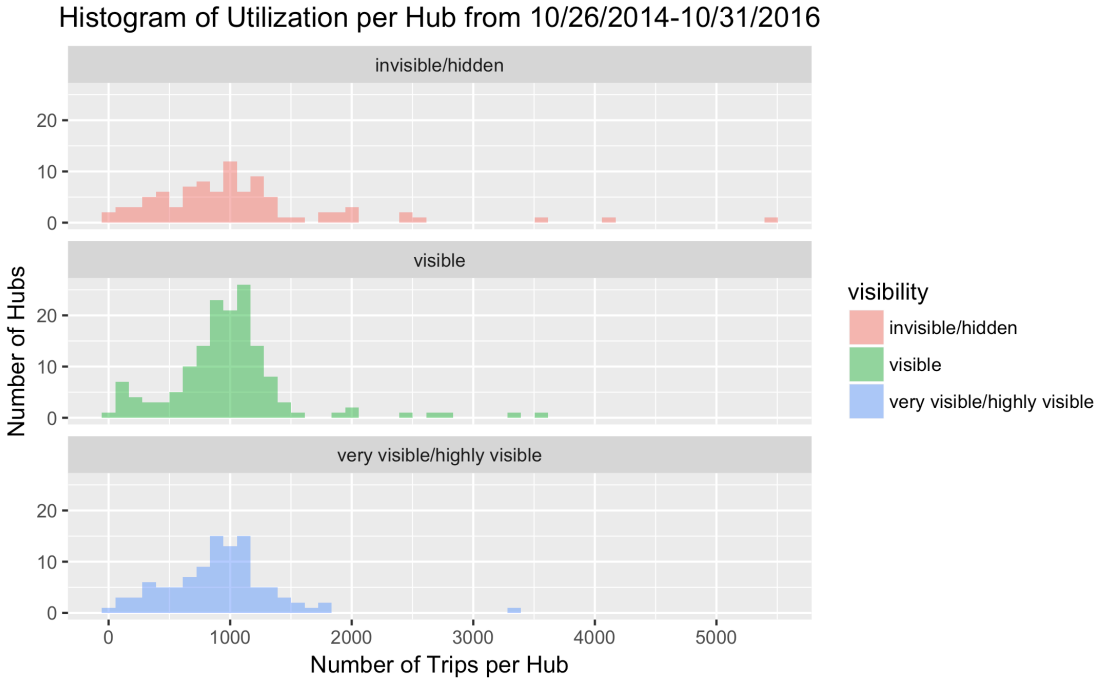
3.5 Visibility and Utilization/Recruitment

Visibility Vs. Utilization: Dismissing the Relationship

CSOs assign great weight to CSV visibility; they operate on the premise that it leads to greater membership recruitment and utilization, and integrate it in their deployment calculus and

negotiations with municipal governments. As such, I wanted to assess whether this premise is valid. CSO vehicle visibility classifications and booking data for each respective vehicle between 10/2014 and 10/2016 were analyzed in R yielding no statistically significant correlation between vehicle visibility and utilization rates: $R^2 = 0.07015$. In other words, vehicles classified as "highly visible" were not utilized more throughout this two-year time period than vehicles considered less visible. Alternatively, vehicles classified as "hidden" were not utilized less frequently than vehicles considered relatively more visible (See Figure 8 below).

Figure 8 CSV Utilization vs. Visibility



Findings indicated that despite the initial hypothesis and consensus maintained by most CSOs, user data illustrated that high on-street vehicle visibility as classified by the CSO is *not* a statistically significant determinant of high vehicle utilization. Contrary to expectations, higher on-street visibility did not impact or correspond with higher utilization levels; nor did lesser on-street visibility correspond with lower utilization rates. The descriptive characteristic of being on-street and/or highly visible is thus an insufficient determinant of vehicle utilization. This

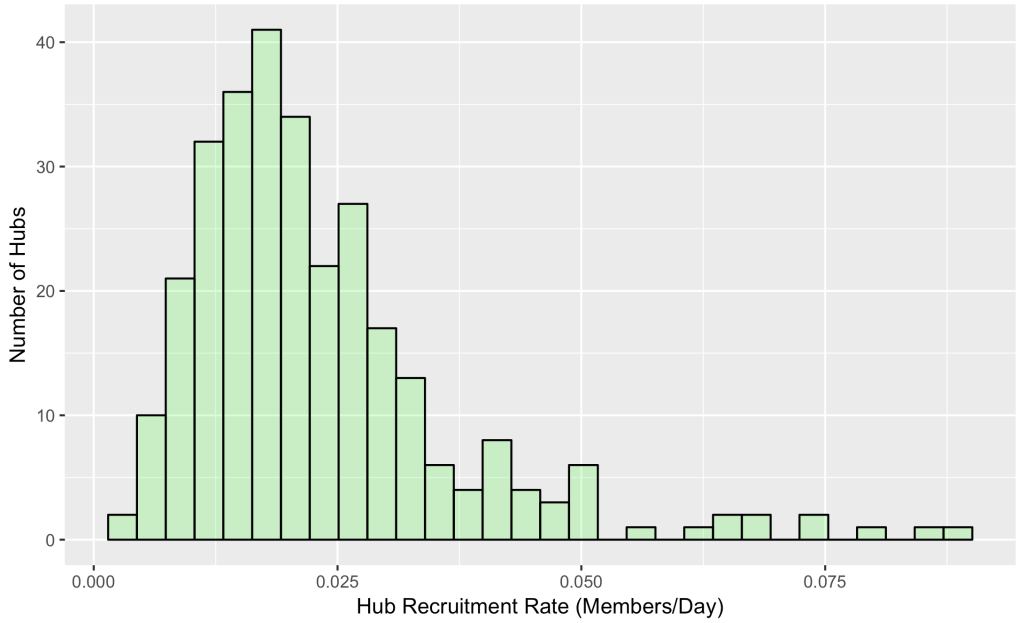
conclusion is likely explained by the nature and logistics of CS service mobile apps. Because all available vehicles and their parking locations are necessarily identified and reserved on the mobile app required to use the service, it is logical to assume that respective on-street visibility is unlikely to induce utilization as users must consult the app interface to virtually identify and select bookings rather than designate cars they've seen in person and inefficiently peruse the app for them. As these results debunked the correlation between CSV visibility and utilization, we then examined the potential correlation between CSV visibility and membership recruitment.

3.6 Visibility Vs. Recruitment: No Relationship

We then analyzed the potential correlation between visibility and new membership recruitment using membership data ranging from the service's founding in 1996 to the present. In order to determine potential typography of recruitment rate, each Modo member was assigned to the vehicle hub identified as closest in proximity to the individual's registered address (indicated by GPS coordinates). Each member was assigned to only the closest hub in order to avoid potentially double-counting member quantities. Each member had to have been located within 400 meters of the assigned hub - and had to have joined Modo *following* the date the hub was installed in order to assess whether hub deployment stimulates new member growth. Each member's location in the datasets provided was randomized by 50 meters to maintain member privacy. This assumption poses a potential limitation to this study because it is impossible to verify whether members indeed joined the service respective of the hub closest to them. Additionally, we assumed that members using vehicles within or outside of the designated 400 meter range serve as a proxy for whether they have to enter a building externally or have access to a car internally within their residences. The number of members each hub has potentially

recruited was then divided by the amount of time each hub has been active in order to calculate the average number of members recruited per day per hub. This calculation determined daily recruitment rates per hub (See Figure 9). Following this, a linear regression was conducted to determine whether visibility is an explanatory variable that could determine recruitment rates or explain a relationship between the two.

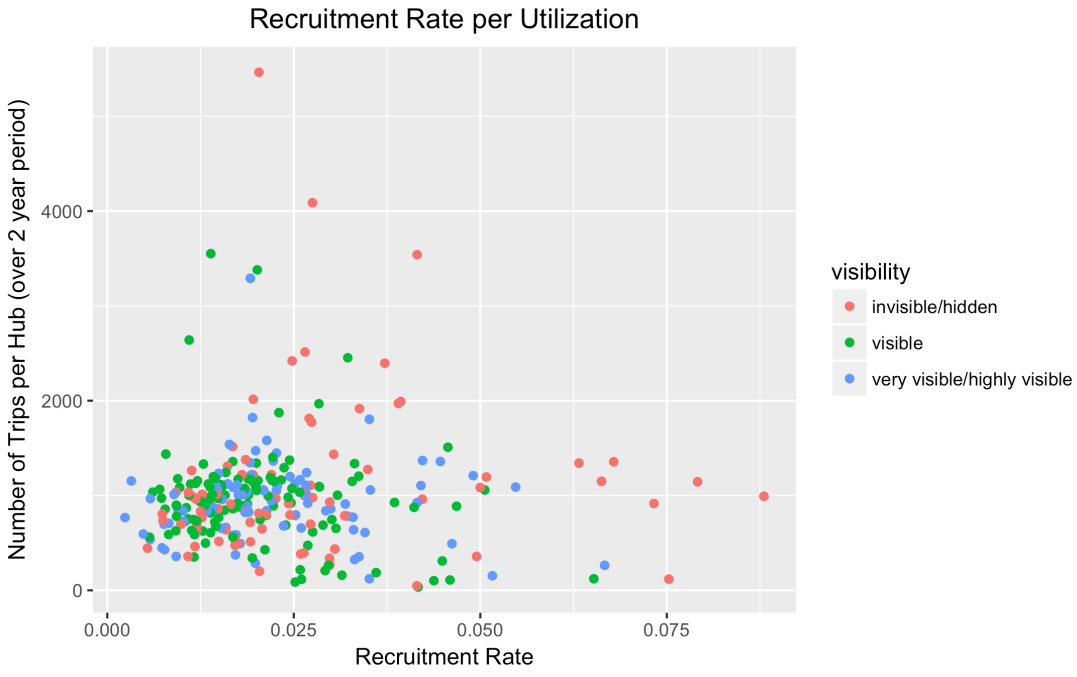
Figure 9 Daily Recruitment Rates Per Hub



A possibility considered upon initiating this study was that more densely populated areas may exhibit relatively higher instances of foot traffic around visible vehicles leading to higher recruitment rates. Analyses then addressed the possibility that said variance in population density could potentially serve as a confounding variable dwarfing a potent determinative effect visibility may have as an explanatory variable for utilization and member recruitment. Results indicated that this is not the case. In order to accommodate population variance, detailed block-by-block population density data was obtained from the 2016 Vancouver census. Each Modo hub

was assigned to a particular block with a known population and area. To account for scarcity within the census population data (i.e. some blocks had a listed population of zero), population and area of directly adjacent blocks were added to each hub's assigned values. Each hub's recruitment rate was then divided by its respective block's population density to normalize its recruitment effects. Another regression was conducted to determine if visibility is an explanatory variable for recruitment rate divided by population density; results yielded that it is not with an adjusted R^2= -0.002551. After normalizing for population density there was still little to no correlation identified between visibility and recruitment rates, further substantiating that Modo's visibility taxonomy is not determinant of explanatory independent variables. Results indicated that recruitment is not homogenous nor is it determined by CSV visibility; contrary to the visibility assumption, CS parking hubs with most recruitment utility are those classified as invisible or hidden from the street.

Figure 10 Visibility, Utilization, and Recruitment Power



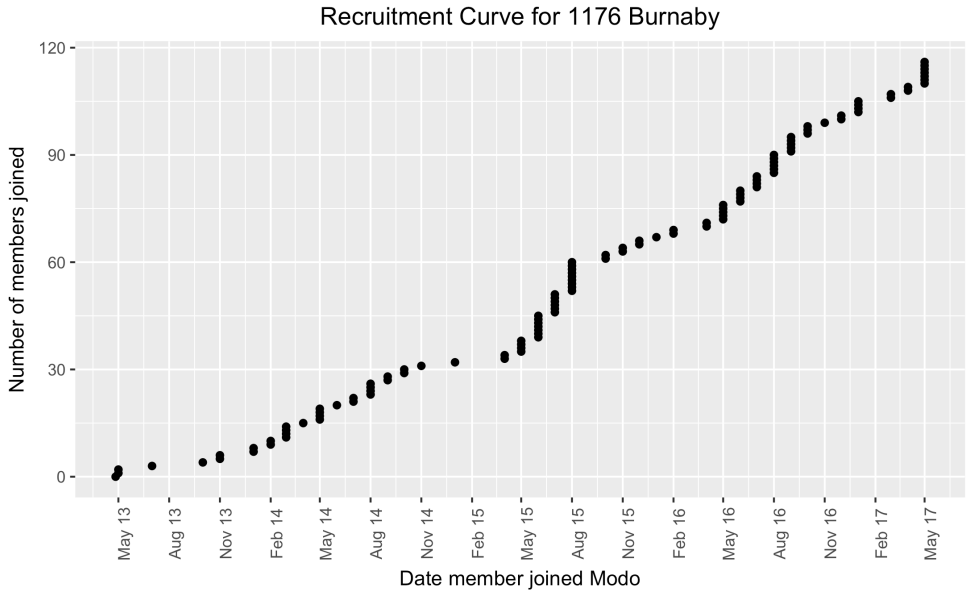
We found that visibility is not a sufficient explanatory variable for new member recruitment, with an adjusted $R^2 = 0.015439$. In fact, results yielded a slightly negative slope of $m = -0.0011985$. This finding exhibits very little to no relationship or between the variables. On the contrary, 10 vehicles characterized by the CSO as "invisible" actually yielded significantly higher recruitment power than many "highly visible" vehicles. These "outliers" are represented by the 10 red "invisible/hidden" scatterpoints in Figure 10 above; their detailed locations and characteristics are identified in Table 10 below.

Table 10 Outlying Hubs Exhibiting Strong Recruitment Curves

Index_Hub <int>	Location_Hub <chr>	Days_Open <dbl>	Members_Recruited <dbl>	Recruitment_Rate <dbl>	visibility <fctr>	Number_Trips <int>
116	Howard Johnson	693	61	0.08802309	invisible/hidden	992
225	1176 Burnaby	1466	116	0.07912688	invisible/hidden	1145
58	1333 Jervis	279	21	0.07526882	invisible/hidden	118
238	Villa Cardello	1583	116	0.07327858	invisible/hidden	915
100	Neon	545	37	0.06788991	invisible/hidden	1356
187	Burrard Bridge	1117	74	0.06624888	invisible/hidden	1150
111	New West SkyTrain	601	38	0.06322795	invisible/hidden	1342
165	The Lauren	963	40	0.04153686	invisible/hidden	3540
435	Wall Centre Downtown	4255	117	0.02749706	invisible/hidden	4088
285	Capitol Residences	2312	47	0.02032872	invisible/hidden	5464

New membership rates for *individual* hubs exhibiting strong recruitment effects were then graphically depicted in R (see example in Figure10). Upon initial hub installation, most growth curves exhibited exponential initial membership growth which usually tapered off. Some hubs reached membership saturation while some exhibited multiple sigmoidal new membership curves similar to that depicted in Figure 11 indicating unknown occurrences or efforts set forth to catalyze each sigmoid's initial growth spurt. We then interviewed Modo's business development representative to identify which outreach efforts or incentives may have occurred at the respective hubs to explain the sharp instances of membership growth. Evidential results from this particular research query inform the TDM best practices established in Section 5.

Figure 11 1176 Burnaby Recruitment Curve



Which potential interventions or circumstances could explain each sigmoid or spurt in recruitment? Interviews with the CSO revealed explanatory member recruitment initiatives as discussed in Section 3.3.

3.7 Marketing Efforts, Developer Incentives & Recruitment Patterns

Interviews with Modo's business development team overlaying their recruitment initiatives with membership data analysis identified corresponding explanatory variables for recruitment patterns – and subsequently which factors or outreach tools are most instrumental in substantively recruiting significant numbers of new members to CSO services. Interview results illuminated two actions they understand to be the most effective "visibility" tool: residential developers can provide monetary credits to residents for use towards driving time, membership fees, or driving infractions they may have incurred in CSVs, allowing users agency in how they allocate their developer-provided credits. Residents can be informed of these benefits upon completion of developments or initial move-in dates (these may coincide with building completion or moving in at later dates). This freedom of choice for residents is appealing and effective according to the CSO. If CS memberships are not explicitly provided by the developer,

residents can dedicate driving credit funds towards paying for their initial memberships. This may simplify the process by which residents are recruited.

The CSO identified its adherence to a second effective recruitment initiative: deploying clusters of *three* visible CSVs in a given neighborhood. The concept of three CSVs is understood as a "sweet spot" or seemingly a tipping point in member recruitment; it is thought that local residents or passerby will acknowledge the availability and reliability of three CSVs for their use and ultimately decide to become a member. Because this research disproves the potential relationship between CSV visibility and subsequent recruitment effects, the study turned towards examining which tools influence recruitment patterns so CSOs, cities, and developers can integrate them in policy formation.

Interviews with the CSO pertaining to the 10 hubs/outliers revealed marketing incentives and initiatives to educate residents about CS services available to them on-site or nearby that proved effective in spurring new membership. Successful initiatives have included Modo marketing campaigns, developer and CSO efforts to inform residents about the service and nearby (or on-site) vehicles provided, residential education packages regarding available TDM options, and monetary incentives such as monetary membership or driving credits provided to development residents. These actions embody the evolved notion of "visibility" referred to throughout this study. They were actively communicated to residents through vibrant marketing and outreach materials informing them of 1) their free memberships and driving credit values provided by the developer; 2) driving rates for vehicles; 3) CSVs available on-site for use, and 4) vehicles available off-site but within walking distance of their residence. This collaborative "visibility" effort and membership/monetary incentive on behalf of the CSO and developer

proved effective in stimulating significant recruitment curves. These visible marketing materials are provided in the Appendix.

3.8 Summary

Study results and key findings can be summarized as the following:

1. There is no statistically significant association between higher CSV visibility and higher CSV utilization patterns. Nor is there a statistically significant relationship between lower CSV visibility and lower CSV utilization patterns. The variables are not associated.
2. There is no statistically significant relationship between CSV visibility and recruitment patterns. The variables are not associated.
3. The CSO's criteria for determining CSV visibility characterizations are not systematic and can result in misclassified vehicle visibility determinations. As interviews established that these visibility classifications are factored into vehicle deployment calculus, altering CSV visibility classification criteria to more accurately reflect vehicle visibility and pedestrian exposure would better inform deployment decision-making on behalf of both the CSO and the city, particularly in TDM policymaking decisions.
4. Explanatory factors and marketing efforts to improve CSV "visibility" and service awareness are more instrumental in stimulating CS utilization and membership recruitment than is mere vehicle visibility. Demonstrably effective "visibility" tactics have consisted of the following:
    - Educational and marketing materials provided to new residents upon moving in to the development;
    - Consistent communication regarding CSO presence and service, such as through email or marketing materials in residential lobbies;

- Waiving portions of membership fees;
- Providing incentives such as free driving credits or monetary credits towards membership fees or vehicle infraction charges.

3.9 Policy Implications

These findings should collectively provide formerly unestablished insight that CSOs, city planners, and developers can consider in CS planning and implementation processes. Findings substantiate various circumstances conducive to CS success and should inform, of foremost importance, CS-related municipal TDM policymaking – followed by CSO and developer initiatives. TDM policies should require developer-CSO marketing efforts to promote residential awareness of CS services as much as possible. If users are unaware of exclusive CSV availability in their own buildings, they most likely will not join or utilize a service conveniently available to them.

It is also important to understand that vehicle inaccessibility characterized many of the CS vehicles visited on-site. This inaccessibility defeats the purpose of maximizing CS sustainability metrics already established as beneficial to urban planning and sustainability. In order to orchestrate effective CS prevalence and widespread use, city governments should craft CS-related TDM policies ensuring inclusion of policy levers conducive to sensible vehicle placement and access for the most potential members possible; municipal support for new hubs can now be justified by substantiated user data provided by this research. Findings from Case Study A regarding community CSV funds (as a replacement for or supplement to parking variances for on-site CSV provisioning) should also be factored into TDM policy formation. TDM policies establishing these variances should require contracts between the CSO and

developer establishing feasible lengths of vehicle deployment to ensure consistent reliability for existing and new members; variances should be contingent upon proof of contract to better ensure longitudinal efficacy. As discussed, these contracts should include provisions ensuring that vehicles are easily accessible and there no complex barriers exist to impair ease of user access at all times. Such contract terms might include vehicle location requirements near entrances or stairs or providing non-resident CS members key fobs for secure parkade access, among others. These policies should also include city-determined provisions ensuring ease for developers and CSOs, the crucial stakeholders working synergistically to maximize CS benefits. The latter recommendations are summarized in the Best Practices Table provided following the conclusion below.

3.10 Conclusion

This research establishes that CSOs can improve their vehicle visibility criteria for more accurate and consistent visibility classifications. This can contribute to a more accurate interpretation of the influence vehicle visibility serves for recruitment. Findings dispel the commonly held belief that CS vehicle visibility corresponds with increased utilization; results identify and substantiate the efficacy of targeted marketing and policy initiatives that, if exercised by CSOs and incorporated in city and municipal TDM CS policies, can significantly increase the depth and breadth of CS services and the many benefits it entails. These efforts are demonstrably more effective at stimulating CS use and membership than vehicle visibility alone. Visibility has thus evolved in understanding as a mechanism of promotion activities intended to spread awareness to potential and current members about new possibilities for CS mobility. This substantiated knowledge should inform TDM policy formation and the contractual provisions between CSOs and developers required for parking variance approval. In conjunction with

findings established in Chapter II of this thesis, study results further inform best practices in thoughtful CS-related TDM policy formation.

4. Aggregate Summary of Findings

- There is a heterogeneity of TDM methods and policies exercised across the MV region.
    - Many of these are informal and inexplicit practices rather than codified bylaws.
    - It is apparent that the most commonly utilized TDM tools among developers are parking reduction ratios are awarded to those who provide CSVs on-site.
    - Municipalities should refine and codify their TDM menu of options.
    - The most effective CS-related TDM policies currently exercised consist of:
        - Thoughtfully crafted parking variances that include detailed discussions and negotiations with the CSO regarding their location, deployment, and contract preferences;
        - Requiring developers to finance and provide CSVs for broader community use rather than tying the CSVs exclusively to their developments.
- Municipalities are not intimately familiar with developer preferences/considerations when considering TDM uptake. Understanding developer considerations and market implications of parking spaces will better inform planners in crafting TDM policies and corresponding negotiations with developers.
- There is a striking lack of coordination among the municipalities in TDM planning.
- There is a bottleneck of TDM consultants available to developers and the municipal planners. This circumstance should be utilized for more efficient coordination among stakeholders and improved TDM policymaking informed by experience.

- The municipalities aspire to achieve more/better planning than they are equipped and resourced to do – further coordination and utilization of TDM consultants could streamline more efficient TDM policymaking region-wide.
- Despite commonly held assumptions, CSV visibility has no statistically significant influence on vehicle utilization or membership recruitment.
- CSO classifications of CSV visibility characteristics can be improved to better reflect vehicle circumstances and locations, leading to more effective hub deployment and more successfully utilized CSVs.
- Marketing efforts towards increasing and maintaining CSO service "visibility" is more effective than vehicle visibility and thus exhibits more utility in membership recruitment efforts.

The conclusions garnered from these findings should impel MV municipal planners, developers, and CSOs to pursue greater collaboration informed by a wider range of experience. This will streamline more efficient and tried-and-true TDM policymaking and subsequent CS provisioning/planning regionwide, improving transportation efficiency and sustainability for all of the region's inhabitants to enjoy.

5. Conclusion of Case Studies

The two case studies comprising this research work in synergy to identify best practices in municipal TDM policymaking. By substantiating the merits of CS policy elements proven to work (or in some cases fail) through a synergy of interviews, document analysis, field observation, and statistical analyses & visualization, these studies identify 1) which TDM and CS policy elements are actively exercised in the MV region; 2) a lack of substantial evidence that

CSV visibility plays a role in utilization and membership recruitment; 3) which "visibility" actions are effective at stimulating the latter; and subsequently 4) the policy elements that can be taken on behalf of CSOs, developers, and city planners in order to most effectively create an environment by which CS use can flourish, contributing to decreased urban sprawl, improved urban planning and space management, capital flow directed towards community betterment and green initiatives, decreased individual vehicle ownership as well as associated GHG emissions and air quality; and improved transit efficiency and capital management. Those whose govern and shape the transportation systems in which millions of MV inhabitants flourish should use the resources and knowledge available to them from their own policymaking endeavours and those of their fellow MV planners to curate the healthiest, happiest, most well-designed environment they possibly can – and this can be achieved by learning from the data and practices available on our doorsteps.

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Appendices

Appendix A: Interviewees & Respective Affiliations

List of Interviewees & Respective Municipalities		
Municipality	**Interviewee**	**Title**
City of North Vancouver	Daniel Watson	Transportation Planner
City of Coquitlam	Kathy Ho	Senior Transportation Engineer
City of Coquitlam	Glen Chua	Transportation Planning Technologist
City of Victoria	Lucina Baryluk	Planner
City of Victoria	Steve Hutchinson	Transportation Planner, Planning
District of Saanich	Pam Hartling	Community Planner
District of North Vancouver	Ingrid Weisenbach	Transportation Planner, Planning
City of Richmond	Sonali Hingorani	Transportation Engineer
City of Surrey	Jeff Pang	Transportation Engineer
City of Vancouver	John Turecki	Senior Development Review Engineer
City of Vancouver	Rosemarie Draskovic	Transportation Development Engineer
Metrolinx (Toronto)	Joshua Engel-Yan	Director, Research and Planning
Modo (Vancouver CSO)	Sylvain Celaire	Business Development Manager

Appendix B: Modo & Developer Worksheet

modo.

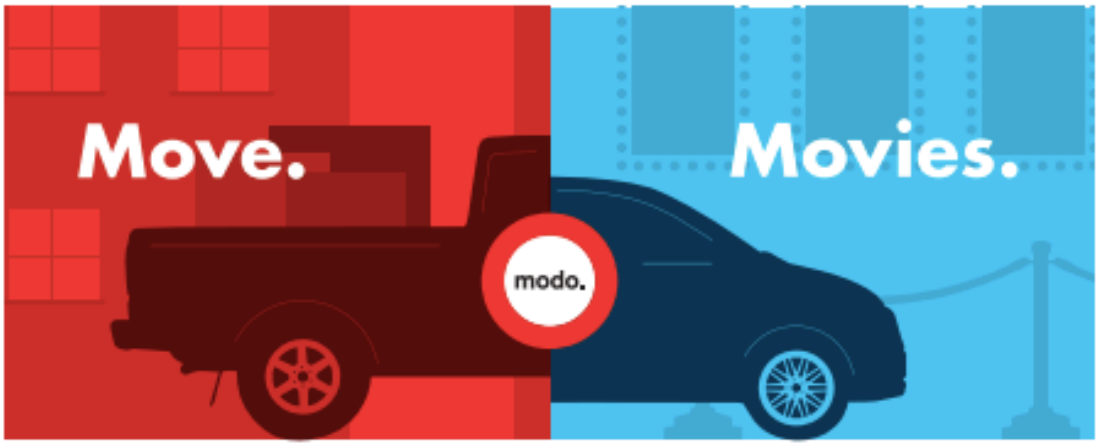
DEVELOPER WORKSHEET

Thanks for reading our 8-Step Guide to Maximizing the Benefits of Parking Relaxations. With this insight, you're well on your way to realizing the program's potential.

Next, you'll need to be able to answer the eight questions below – which we're more than happy to help you with. Send your partially completed, or blank worksheet, to our Business Development Manager at sylvain.celaire@modo.coop

1. How many carshare vehicles can my development support?
2. What's the maximum parking relaxation I can get and what are the municipal requirements to get them?
3. What's the right number of carshare vehicles to maximize profitability, consumer appeal and long-term value?
4. Where should the carshare stall(s) be located to minimize construction costs, avoid security concerns and maximize flexibility of vehicle choice?
5. What vehicle types and carshare incentives will most appeal to prospective buyers and future residents?
6. How soon is soon enough to define my carshare program and confirm the agreement?
7. How can we leverage carsharing as an amenity in our sales and marketing strategies?
8. What's the best way to bring my sales and marketing team up to speed on the benefits of carsharing, in order for them to use it in their sales pitches?

Appendix C: Modo Informational Marketing Pamphlet – 1333 Jervis St.



Carsharing at 1333 Jervis is easier with $100 in value from Modo!

As a special offer, residents at 1333 Jervis receive **a one year free membership* and $30 free drive time when joining as a Monthly member.**
Simply redeem your welcome offer by signing up online at **www.modo.coop** and using the promo code **JERVIS.**

Prefer more drive time? Join as a Modo Plus member and use the code **JERVISPLUS** to get $100 free drive time.

Already a Modo member? Call or email our team to redeem your $100 free drive time at info@modo.coop or 604.685.1393.

With **500 cars across the Lower Mainland and Victoria**, we'll get you moved in or just out to the movies hassle-free! We're driven by people like you – not profits – and look forward to having you join our growing community of 17,000 members!

	Modo Plus	Monthly member
HOURLY RATE	$4 per hour $40 per 24 hours	$8 per hour $64 per 24 hours
OVERNIGHTS	$12 max between 7pm–9am	$24 max between 7pm–9am
OVERSIZED & PREMIUM VEHICLES	$8/hour $80 per 24 hours	$12/hour $96 per 24 hours
KILOMETRES PER BOOKING	40¢ for the first 40km 20¢ thereafter	200km included per trip 25¢ thereafter
TO START	$500 refundable share purchase	$10 registration *$5 monthly admin (waived for 1 year for 1333 Jervis residents)

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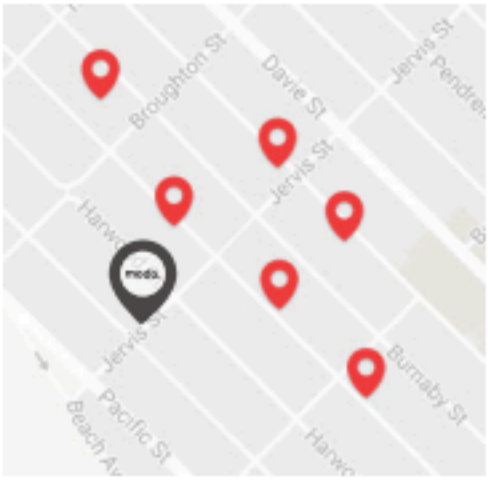
Modo right at your doorstep

With **two vehicles at your doorstep** and 8 cars (and a cargo van!) right in your neighbourhood, you have the right vehicle for every trip. Plus, your membership gets you access to **our entire fleet of 500 vehicles** in the Lower Mainland and

Modo at 1333 Jervis

- Honda Fit #817

- Toyota RAV4 Hybrid #818



Modo in your neighbourhood

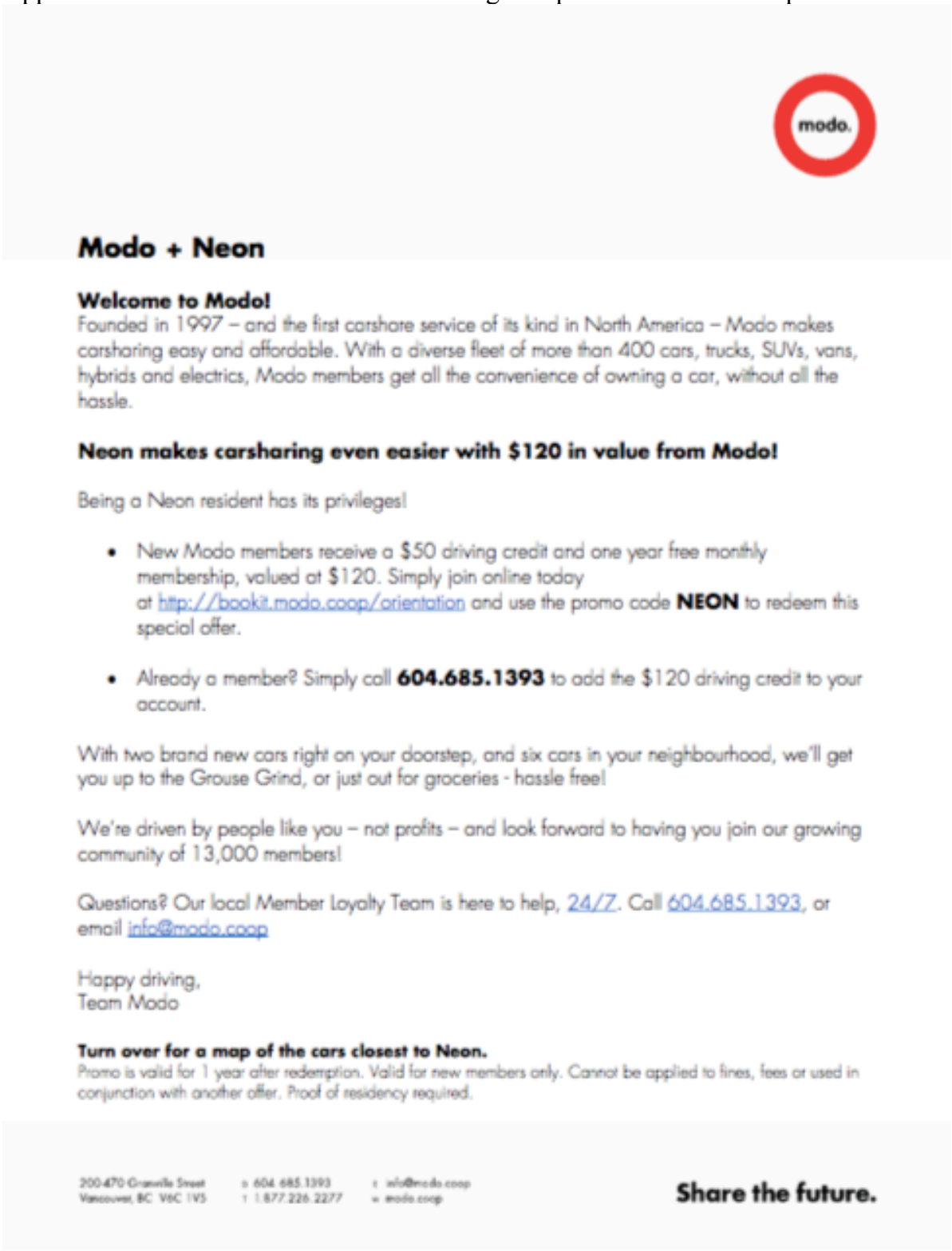
Harwood Street & Jervis Street
#374 Silver Toyota Corolla

Burnaby Street & Bute Street
#450 Blue Nissan Juke
#460 White Nissan NV200 Cargo Van

Burnaby Street & Bute Street
#500 Orange Fiat 500

www.modo.coop

Appendix D: Modo Informational Marketing Pamphlet – Neon Development



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Modo + Neon

Welcome to Modo!
Founded in 1997 – and the first carshare service of its kind in North America – Modo makes carsharing easy and affordable. With a diverse fleet of more than 400 cars, trucks, SUVs, vans, hybrids and electrics, Modo members get all the convenience of owning a car, without all the hassle.

Neon makes carsharing even easier with $120 in value from Modo!

Being a Neon resident has its privileges!

- New Modo members receive a $50 driving credit and one year free monthly membership, valued at $120. Simply join online today at http://bookit.modo.coop/orientation and use the promo code **NEON** to redeem this special offer.

- Already a member? Simply call **604.685.1393** to add the $120 driving credit to your account.

With two brand new cars right on your doorstep, and six cars in your neighbourhood, we'll get you up to the Grouse Grind, or just out for groceries - hassle free!

We're driven by people like you – not profits – and look forward to having you join our growing community of 13,000 members!

Questions? Our local Member Loyalty Team is here to help, 24/7. Call 604.685.1393, or email info@modo.coop

Happy driving,
Team Modo

Turn over for a map of the cars closest to Neon.
Promo is valid for 1 year after redemption. Valid for new members only. Cannot be applied to fines, fees or used in conjunction with another offer. Proof of residency required.

200-470 Granville Street
Vancouver, BC V6C 1V5

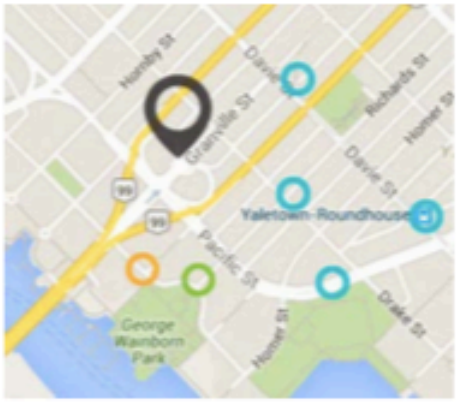
o 604.685.1393
t 1.877.226.2277

e info@modo.coop
w modo.coop

Share the future.

Modo right at your doorstep:

- **Scion FRS** – 2 Door Sport Coupe
- **Kia Soul** – 5 Door Versatile Hatchback



Modo in your neighborhood:

- Beach Crescent and Seymour Mews
  Honda Insight **#270**
- Beach Crescent & Richards Street
  Chevrolet Orlando **#526**
- Richards Street & Drake Street
  Nissan Versa Note **#652**
- Drake Street & Pacific Boulevard
  Fiat 500 **#312**
- Davie Street and Granville Street
  Nissan Micra **#663**
- Yaletown Roundhouse Station
  Mazda 3 Sport **#655**

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Vancouver, BC V6C 1V5

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e info@modo.coop
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Share the future.

Appendix E: UBC Properties Trust Residential Environmental Assessment Program

UBC REAP 3.0 CHECKLIST

Performance Category: Sustainable Sites (SS)		
The intention of the Sustainable Sites category is to reduce the negative impacts of development, maintain the natural landscape, vegetation and environmental attributes of the site and provide new landscaping that enhances the microclimate.		
SS MANDATORY		
SS M1 – StormWater Management		**M**
Develop a plan that integrates the on-site storm water management system with the neighbourhood-wide storm water management principles and strategies, including controlling of rate and/or quantity of run-off as required.		
SS M2 – Adapted and Ecologically Sound Planting		**M**
Demonstrate that landscape design has minimized the need for pesticides and irrigation through the selection of adaptive and drought-tolerant plants and consideration of the principles of Integrated Pest Management and xeriscaping.		
SS M3 – Bicycle Parking		**M**
Provide shot term and long term covered storage facilities for securing bicycles in accordance with the *UBC Development Handbook*.		
SS M4 – Contribution to Community Car Sharing		**M**
Contribute to the development of a community car-sharing network by funding the equivalent of one community vehicle per 100 residential units.		
SS M5 – Light Pollution Reduction		**M**
Do not exceed Illuminating Engineering Society of North America (IESNA) illuminance requirements as stated in the *Recommended Practice Manual: Lighting for Exterior Environments*.		
SS M6 –Recycling Collection		**M**
Provide for collection of domestic paper, plastic, glass and metal recyclables by contracting with a waste management company for the service. Recycling storage space shall be designed in accordance with Metro Vancouver's *Technical Specifications for Recycling Amenities*.		
SS M7 – Compost Collection		**M**
Provide a space in the building for the collection compost and provide for the compost collection through a contract with UBC Waste Management or another waste management service provider. Design the space in the building in accordance with Metro Vancouver's *Technical Specifications for Recycling Amenities*.		

Appendix F: Semi-Structured Interview Question Template

Open-Ended Interview Questions – TDM Interviews

BEGIN SCRIPT:
Thank you so much for agreeing to speak with me today about TDM policies and practices in (insert municipality name here) for my thesis research. I will proceed to ask you a few open-ended interview questions. You can elaborate as you please, or refuse to answer any questions as you please. If you are ready, I will begin.

1. From what I understand, in (insert municipality name here) the parking reduction ratio for carshare vehicles provided is X. Is this still the case?

OR, if there is no **official** reduction ratio bylaw:

1. From what I understand, in (insert municipality name here) parking reduction ratios for provided carshare vehicles in residential developments is performed on an ad-hoc basis. Is this still the case, and can you elaborate?
2. How is this TDM or reduction ratio system applied/working, and what are the results? Do you/the department want to change the current practices?
3. Has there been an evaluation of carsharing patterns and efficacy?
4. Have you encouraged TDM methods in the burgeoning developments as they develop, such that developers are aware of and can realistically participate in these bylaws?
5. Have you ever had Stratas appeal to the developers or the city for having too few parking spots?
6. For the owners buying into apartments – are there mechanisms for them to shape the policy?
7. Are the apartments in which these TDM bylaws or practices been implemented fully occupied/lived in, or mostly rented out/empty? (This is consequential for initial parking demand)

END QUESTIONS
Thank you again for your time today, your insight is valuable for my research and analysis. If you are interested, I can send you a copy of my final product as was indicated on the consent form you signed. Thank you and I will be in touch!