Public Bikesharing in North America: Early Operator and User Understanding

MTI Report 11-26

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REPORT 11-26

PUBLIC BIKESHARING IN NORTH AMERICA: EARLY OPERATOR AND USER UNDERSTANDING

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16. Abstract

Public bikesharing—the shared use of a bicycle fleet—is an innovative transportation strategy that has recently emerged in major North American cities. Information technology (IT)-based bikesharing systems typically position bicycles throughout an urban environment, among a network of docking stations, for immediate access. Trips can be one-way, round-trip, or both, depending on the operator. Bikesharing can serve as both a first-and-last mile (connector to other modes) and a many-mile solution. As of January 2012, 15 IT-based, public bikesharing systems were operating in the United States, with a total of 172,070 users and 5,238 bicycles. Four IT-based programs in Canada had a total of 44,352 users and 6,235 bicycles.

This study evaluates public bikesharing in North America, reviewing the advances in technology and major events during its rapid expansion. We conducted 14 interviews with industry experts, public officials, and governmental agencies in the United States and Canada during summer 2011/spring 2012 and interviewed all 19 IT-based bikesharing organizations in the United States and Canada in spring 2012. Several bikesharing insurance experts were also consulted in spring 2012. Notable developments during this period include the emergence of a close partnership between vendor and operator and technological advances, such as mobile bike-docking stations that can be moved to different locations and real-time bike/station tracking to facilitate system rebalancing and provide user information.

During fall 2011 and early 2012, we also completed a user survey (n=10,661) to obtain information on four early IT-based systems: BIXI in Montreal; BIXI in Toronto; Capital Bikeshare in Washington, D.C.; and Nice Ride Minnesota in the Twin Cities (Minneapolis and Saint Paul). The survey found that the most common trip purpose for bikesharing is commuting to either work or school. Not surprisingly, respondents in all cities indicated that they increased bicycling as a result of bikesharing. Respondents in the denser cities generally stated that they walked and rode bus and rail less, while in the Twin Cities, respondents reported that they walked and rode rail more but rode the bus slightly less. These shifts may be a function of city size and density, as open-access bicycles can more quickly and easily serve riders on congested transportation networks. Respondents in all cities overwhelmingly indicated that they drive less as a result of bikesharing, indicating that it reduces vehicle miles/kilometers traveled and vehicle emissions.

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EXECUTIVE SUMMARY

Public bikesharing systems offer accessible shared bicycles for first-and-last mile trips, many-mile trips, or both in an urban environment. Bikesharing systems operate much like carsharing (short-term auto use) in that people join an organization to access the bicycles. While the majority of North American bikesharing operators charge for use (membership and fees), some community-based bikesharing organizations do not. This report highlights bikesharing activities in the United States and Canada.

Bikesharing systems typically permit both one-way trips and round-trips, as well as instant access (without a reservation) via a network of docking stations for retrieving and parking bikes. Thus, bikesharing can facilitate connections to and from public transit and provide a means to make local trips within the bikesharing network. IT-based bikesharing has grown rapidly in North America over the past three years.

This study evaluates public bikesharing from several angles, including current operational practices, business models, and environmental and social impacts in North America. Background information includes a worldwide perspective and a literature review of previous bikesharing research. As part of this study, we conducted interviews with 14 local government representatives and other bikesharing experts, as well as 19 bikesharing operators in the United States and Canada. Several bikesharing insurance experts were also consulted. In addition, we performed a survey of bikesharing users (early adopters) in Montreal, Toronto; the Twin Cities (Minneapolis and Saint Paul); and Washington, D.C.

The operator and stakeholder interviews documented the growth of public bikesharing in North America. Since 1994, there have been 32 program startups and nine program closures in the United States and eight program launches and two program closures in Canada. As of January 2012, there were 15 IT-based public bikesharing systems in the United States, with 172,070 members and 5,238 bicycles. By January 2012, Canada had four IT-based bikesharing organizations, with more than 44,352 members and 6,235 bicycles. The combined average member-to-bicycle ratio in the United States and Canada was 19:1, and the combined target average of bicycles to docking ports was 1:1.7. As of January 2012, the majority of bikesharing programs were non-profits. Seventeen additional programs are planned to launch in the United States and one in Canada in 2012.

> **As of January 2012, there were 15 IT-based bikesharing operators in the U.S. claiming 172,070 users sharing 5,238 bicycles. In Canada, there were 4 IT-based bikesharing programs with 44,352 users sharing 6,235 bicycles.**

North American programs support bikesharing operations through a combination of startup and operational funding sources, primarily sponsorships and user fees. Revenue-enhancing partnerships, partnerships with public transit, and collaboration with institutions to ensure equity and service access are also key to bikesharing success in these countries. One-half of reporting operators indicated that the optimum distance between stations is between 300 yards and a quarter of a mile. More than 40% of operators reported that the typical trip is a round-trip. Theft, vandalism, and accidents were reported to be relatively minor challenges. While the vast majority of programs employ similar technologies and have

been classified as "state-of-the-practice," five programs are categorized as "state-of-the-art." The principal distinguishing factor between state-of-the-art and state-of-the-practice programs is the deployment of global positioning systems (GPS) that support real-time tracking, real-time data integration with public transit, and system data dashboards.

Industry experts and public bikesharing operators indicated convenience, improved access, health benefits, increased mobility, positive environmental impacts, low cost, and space efficiency as the greatest bikesharing benefits. Experts reported that daily system rebalancing is one of the leading challenges and noted that some of the greatest inconveniences occur when bicycles are unavailable for check-out or docking stations are full at check-in. The operators and industry experts interviewed highlighted the need to increase public-transit linkages, as well as the need to improve bicycling infrastructure and safety. Public bikesharing insurance is also an important issue and policies vary considerably across the industry. In general, insurance premiums are influenced by: 1) geographic location, 2) limits and deductibles, and 3) system usage.

The user survey was performed in four cities (n=10,661) in fall 2011 and early 2012. It collected information on trip purpose, bikesharing perceptions, travel-behavior changes, commuting needs, demographics, and other factors. The survey results showed that the most common bikesharing trip purpose is work- or school-related in all four cities. In the two Canadian cities, 50% to 56% of the respondents reported that their most common trip purpose was for travel to work or school. The proportion was 38% in both of the American cities. The second and third most common trip purposes were social/entertainment and running errands. During the course of this study, the two participating American bikesharing operators released operational data to the public. These data, analyzed for 2011, showed that usage peaked during the fall. Both survey and operational data in these cities suggested that bikesharing is predominantly used for one-way, station-to-station travel. Information obtained from operator interviews in several other systems—particularly smaller ones—suggested that bikesharing is more likely to facilitate round-trips. The survey probed user perceptions about bikesharing and found that a majority in the surveyed cities felt that bikesharing was an enhancement to public transportation, improved connectivity to transit, and increased exercise.

Survey respondents were asked to self-assess how public bikesharing had changed their use of other transportation modes. The results suggest that bikesharing in many cases draws from all travel modes. Within the entire sample, 72% of the respondents increased their bicycling, 5% decreased it, and the remainder indicated no change. At the same time, 23% increased their walking, while 34% reduced it. On average, 9% increased and 43% decreased rail use, while 7% increased and 38% decreased bus use. This shift away from public transit was observed in the larger, more congested cities of Montreal, Toronto, and Washington, D.C. In the Twin Cities, which have lower density and more-limited public transit, more users increased than decreased their bicycling (71% increased, 3% decreased), walking (37% increased, 23% decreased), and rail use (15% increased, 3% decreased), while bus use declined slightly (14% increased, 17% decreased). The different results may be driven in part by the high congestion experienced on public transit in bigger cities. Users in all cities indicated a reduction in driving as a result of bikesharing (0% increased, 40% decreased) over the entire sample (for the Twin Cities, 53% reported a

driving decrease). Bikesharing was also found to contribute to a small reduction in vehicle ownership. A majority of respondents reported getting more exercise since becoming a user of bikesharing. Helmet use across cities was somewhat limited. Depending on the city, 43% to 62% of respondents reported never using a helmet while bikesharing. Finally, an analysis of commuting needs of survey respondents showed that bikesharing users generally live closer to work than do the rest of the population.

Broadly, these results indicate that in all cities evaluated, public bikesharing reduces driving and auto emissions. In larger cities, bikesharing appears to draw from public transit use, freeing up capacity and perhaps serving as a faster connection to intraurban locations than previously provided by bus and rail systems. At the same time, there is evidence that public bikesharing is improving urban travel connectivity, reducing driving and thus lowering vehicle emissions.

I. INTRODUCTION

Concerns about global climate change, congestion, and oil dependency have caused many decisionmakers and policy experts worldwide to examine the need for more sustainable transportation strategies. Public bikesharing—the shared use of a bicycle fleet by the public—is one strategy that could help address many of these concerns. Many consider it a form of public transit. Since 1965, bikesharing has grown across the globe in Europe, North America, South America, Asia, and Australia.[1] As of May 2012, there were approximately 184 bikesharing programs operating in an estimated 204 cities around the world, with about 368,600 bicycles at more than 13,600 stations on 5 continents and 36 countries.

The principle of public bikesharing is simple: Bikesharing users access bicycles on an as-needed basis. Bikesharing stations are typically unattended and concentrated in urban settings. They provide a variety of pickup and drop-off locations, enabling an on-demand, very low emission form of mobility. The majority of bikesharing programs cover the cost of bicycle maintenance, storage, and parking (similar to carsharing or short-term auto access). Trips can be point-to-point, round-trip, or both, allowing the bikes to be used for one-way transport and for multimodal connectivity (first-and-last mile trips, many-mile trips, or both). Generally, trips of less than 30 minutes are free. Users join the bikesharing organization on an annual, monthly, daily, or per-trip basis. Members can pick up a bike at any dock by using their credit card, membership card, or key, and/or a mobile phone. When they finish using the bike, they can return it to any dock (or the same dock in a round-trip service) where there is room and end their session.

By addressing the storage, maintenance, and parking aspects of bicycle ownership, bikesharing encourages cycling among users who may not otherwise use bicycles. Additionally, the availability of a large number of bicycles in multiple dense, nearby locations frequently creates a "network-effect," further encouraging cycling and, more specifically, the use of public bikesharing for regular trips (e.g., commuting, errands).

METHODOLOGY

This study documents the state of public bikesharing in the United States and Canada, as well as the transportation, environmental, land use, and social impacts associated with it, informing the following:

> 1. **Status of bikesharing operations in the U.S. and Canada;**
>
> 2. **Key attributes and business models of bikesharing operations in the U.S. and Canada;**
>
> 3. **Economics of bikesharing in the U.S. and Canada; and**
>
> 4. **Evolution of IT-Based bikesharing in the U.S. and Canada.**

In addition, the study documents a variety of public bikesharing impacts among early adopters in four cities, including:

> 1. **Impact of bikesharing on walking, bicycling, and public transit;**
>
> 2. **Purpose of bikesharing trips, bikesharing system use, and user perception;**
>
> 3. **Impact of public bikesharing on driving and vehicle ownership; and**
>
> 4. **Role of commute distance in public bikesharing use and travel pattern impacts.**

To answer these questions, the study team:

1. Completed an extensive literature review on the state of public bikesharing in North America and around the world;

2. Conducted interviews with all 19 operating IT-based public bikesharing organizations in the United States and Canada (as of April 2012);

3. Tracked 18 IT-based bikesharing programs in the United States and Canada planned to launch by the end of 2012;

4. Completed interviews with several bikesharing insurance experts in spring 2012;

5. Conducted 14 interviews with city and regional transportation personnel, public transit operators, policymakers, and community bike coordinators to gain a greater understanding of the benefits and challenges of public bikesharing from a variety of perspectives in summer 2011/spring 2012;

6. Completed an online survey with members of IT-based public bikesharing systems in Montreal; Toronto; Washington, D.C.; and the Twin Cities (Minneapolis and Saint Paul) in fall 2011 and early 2012. The survey focused on evaluating how members used the service and altered their travel modes and how vehicle ownership changed as a result of bikesharing; and

7. Analyzed operational data from two American operators for 2011.

Data were collected from May 2011 through June 2012.

ORGANIZATION OF THIS REPORT

Chapter II provides background on how public bikesharing has evolved and on developments worldwide, as well as an overview of studies regarding bikesharing impacts. Chapter III focuses on public bikesharing in the United States and Canada and presents a summary of interviews with operators and other experts in the field. This is followed in Chapter IV by a review of the user survey and the social and environmental impacts of public bikesharing in Montreal; Toronto; Washington, D.C.; and the Twin Cities.

Finally, Chapter V summarizes key results to provide policy guidance to local governments and transportation agencies that are considering the implementation of bikesharing in their regions.

II. BACKGROUND

Public bikesharing has been in existence for decades but has recently gained prominence due to the rapid expansion of bikesharing systems into new locations and the scale of their operations, based in large part on information technology (IT) that has improved communications and tracking. This chapter provides an overview of the way public bikesharing systems have evolved, a worldwide perspective, and a summary of key studies regarding the impacts of bikesharing.

EVOLUTION OF PUBLIC BIKESHARING

Over the past five decades, public bikesharing has been categorized into four key phases or generations:

- First generation: white bikes (free bikes);

- Second generation: coin-deposit systems;

- Third generation: IT-based systems; and

- Fourth generation: demand-responsive, multi-modal systems (the next generation of IT-based bikesharing).[2]

In first-generation systems, bicycles are typically painted one color, left unlocked, and placed randomly throughout an area for free use. First-generation systems do not use docking ports. In some of the systems, the bikes are locked; users must get a key from a participating local business and may also need to leave a credit card deposit, but actual bike use is still free. Many first-generation systems eventually ceased operations due to theft and bicycle vandalism, but some are still operating as community-based initiatives.

In second-generation systems, bicycles have designated docking stations/parking locations where they are locked, borrowed, and returned. A deposit, generally not more than $4, is required to unlock a bike. Although coin-deposit systems helped reduce theft and vandalism, the problem was not eliminated, in part because of user anonymity. Many second-generation systems are still in operation.

Third-generation, IT-based systems (the focus of this report) use electronic and wireless communications for bicycle pickup, drop-off, and tracking. User accountability has been improved through the use of credit or debit cards. Third-generation bikesharing includes docking stations, kiosks or user interface technology for check-in and check-out, and advanced technology (e.g., magnetic-stripe cards, smartcards, smart keys). Although these systems are more expensive than first- or second-generation systems, they offer substantial benefits because of the incorporation of innovative technologies. IT enables public bikesharing programs to track bicycles and access user information, improves system management, and deters bike theft. It is responsible for public bikesharing's recent expansion in both locations and scale.

Fourth-generation, demand-responsive, multi-modal systems build upon the technology of third-generation systems by implementing enhanced features that support better user metrics, such as flexible, clean docking stations or "dockless" bicycles; demand-responsive bicycle redistribution innovations to facilitate system rebalancing; value pricing to encourage self-rebalancing; multi-modal access; billing integration (e.g., sharing smartcards with public transit and carsharing); real-time transit integration and system data dashboards; and GPS tracking. For example, numerous B-cycle programs use GPS telematics for real-time tracking (e.g., systems in Boulder, CO; Broward County, FL; Denver, CO; Hawaii; Madison, WI; Omaha, NE; and San Antonio, TX). Fourth-generation bikesharing is an evolving concept that has yet to be fully deployed.

OVERVIEW OF PUBLIC BIKESHARING WORLDWIDE

Public bikesharing has developed around the world and across cultures as a low-cost, clean transportation option that can augment public transit and replace automobiles in some circumstances—as both a first-and-last mile and a many-mile solution. Public bikesharing also has expanded to more than 69 college/ university campuses throughout North America in recent years, with an additional 17 programs planned in 2012. However, this report does not include employer or college/university bikesharing programs, as they are typically not accessible by the general public.

> **Public bikesharing has developed around the world and across cultures as a low-cost, clean transportation option that can augment public transit and replace automobiles in some circumstances—as both a first-and-last mile and many-mile solution.**

Europe

Early European public bikesharing systems were small-scale non-profits with an environmental emphasis. The earliest of these first-generation programs was the Provos' White Bike plan, which began operation in July 1965 in Amsterdam. Fifty bicycles were painted white, left unlocked, and placed throughout the urban core for free public use. The program quickly failed because of theft and bicycle damage.[3] Other early European free bike systems include Vélos Jaunes in La Rochelle, France, begun in 1974, and the Green Bike scheme in Cambridge, United Kingdom, started in 1993.

> **The failures of early free bike systems led to the development of coin-deposit (second-generation) systems in Europe, which had designated docking stations where bikes could be locked after being returned, requiring a small coin deposit for the next user to unlock them.**

The failures of early free bike systems led to the development of coin-deposit (second-generation) systems in Europe, which had designated docking stations where bikes could be locked after being returned, requiring a small coin deposit for the next user to unlock them. The first system was Bycyklen in Copenhagen, Denmark, in 1995, followed by programs in Sandnes, Norway, in 1996; Helsinki, Finland, in 2000; and Arhus, Denmark, in 2005. Although amounts vary, coin-deposit fees are generally around US$4.

Figure 1.   Vélib' in Paris

France has been a hub of IT-based (third-generation) public bikesharing activity. The first IT-based system launched in Rennes, France, in 1998. This program, called Smart Bike (also known as Vélo à la Carte), was managed by Clear Channel Communications, Inc. and provided free access for up to three hours for users who had completed an application and received a smartcard. The program was part of a street-furniture contract to provide bus shelters. It ceased operation in 2009 when the contract expired and was replaced by LE Vélo STAR, which is operated by Keolis, the largest private sector French transport group.[4] In 2005, JCDecaux launched Velo'v, in Lyon. In 2006, the Vélos Jaunes program in La Rochelle was replaced with Yélo, an automated IT-based system. The city of Paris launched Vélib', one of the world's largest public bikesharing programs, in 2007 (Figure 1). Vélib' operates more than 20,000 bicycles and averages 80,000 to 120,000 trips daily.[5,6]

At present, the following 25 European countries have public bikesharing.

Austria	**Latvia**
Belgium	**Luxembourg**
Cyprus	**Monaco**
Czech	**Netherlands**
** Republic**	**Norway**
Denmark	**Poland**
France	**Romania**
Finland	**Slovenia**
Germany	**Spain**
Georgia	**Sweden**
Greece	**Switzerland**
Italy	**Turkey**
Ireland	**United Kingdom**

Asia and Australia

At present, China, South Korea, Taiwan, and Japan constitute the world's fastest-growing market for public bikesharing.

The first IT-based public bikesharing program to launch in Asia was Smart Bike (later renamed TownBike) in Singapore, which operated from 1999 to 2007. The Taito Bikesharing Experiment, a pilot program in Taito, Japan, ran briefly from 2002 through 2003.

Figure 2.   Xinfeida Public Bicycle, Wuhan, China

In 2008, South Korea launched its first IT-based public bikesharing program, Nubija, in Changwon. Also in 2008, Hangzhou, China, launched Hangzhou Public Bicycle, the first IT-based program in Mainland China and one of the world's largest bikesharing programs, with nearly 61,000 bicycles and approximately 2,400 bike stations. In 2012, the city of Wuhan, China, launched Xinfeida Public Bicycle, which has surpassed the Hangzhou system in size, operating 70,000 bicycles (Figure 2).[7]

The only bikesharing program in Australia is Melbourne Bike Share, of which PBSC Urban Solutions is the equipment provider. The program has received some attention in the bikesharing community for its local helmet laws.

North and South America

At present, there are public bikesharing systems in Argentina, Brazil, Canada, Chile, Mexico, and the United States, and Colombia is exploring pilot bikesharing programs. Although bikesharing has been in operation in North America only since the mid-1990s, the systems have evolved rapidly. The first North American bikesharing program, called the Yellow Bike Project, was launched in 1994 in Portland, OR, with 60 bicycles.[8] The program was free of charge and operated until 2001. It was followed in 1995 with the launch of the Green Bike Program in Boulder, CO, which was maintained by high school volunteers and made 130 bicycles available free of charge. Both of these first-generation systems eventually stopped operating because of bicycle theft.

Figure 3.   Tulsa Townies Bike Docking Station

In 1995, the Twin Cities launched North America's first second-generation system, the Yellow Bike Program, with 150 bicycles. This program had greater oversight, requiring a one-time refundable US$10 deposit. Following the launch of the program, a number of other coin-deposit bikesharing programs were launched throughout the United States (e.g., in Austin, TX; Decatur, GA; Madison, WI; and Princeton, NJ). Community-based first- and second-generation bikesharing systems are still operating in the United States.

Table 1.   Public Bikesharing in the U.S. and Canada as of January 2012

	United States	Canada
Number of programs	15	4
Number of users	172,070	44,352
Number of bicycles	5,238	6,235

North America's first IT-based bikesharing system, Tulsa Townies, started operating in 2007 in Tulsa, OK (Figure 3). Tulsa Townies was the first solar-powered, fully automated docking-based system in the world, and it provides its service free of charge. As of January 2012, 15 IT-based public bikesharing systems had begun operating in the United States, with a total of 172,070 users and 5,238 bicycles (Table 1).

In Canada, the first IT-based public bikesharing system, BIXI (BIcycle-TaXI), began operating in 2009 in Montreal. Since then, BIXI has expanded to Ottawa and Toronto. Another system, Golden Community Bikeshare, was launched in British Columbia in 2011. As of January 2012, there were four IT-based public bikesharing systems in Canada, with 44,352 users and 6,235 bicycles. A more in-depth analysis of IT-based bikesharing in the United States and Canada is presented in Chapter III.

In February 2010, Mexico City launched EcoBici, which offers users 1,200 bicycles at 90 stations for an annual membership of approximately US$25 per year. The program is planning two major expansions in June 2012 and anticipates that membership will increase to 100,000 users. According to Mexico City's government, the number of bicycle trips has increased by 40%, with about 100,000 trips made daily by more than 30,000 cyclists.[9] To

manage the high demand for bikesharing services, EcoBici established a waiting list (the wait currently averages six weeks) for those wishing to apply for membership.[10]

Figure 4 provides a timeline of first-, second-, and third-generation program launches in the United States and Canada from 1994 through May 2012.

										Capital Bikeshare			
										Chicago B-cycle			
										Denver B-cycle			
								Bike Schuylkill		Des Moines B-cycle		Houston B-cycle	
								Collingswood Bike Share		Nashville GreenBikes		RightBike	
Green Bike Program			Yellow Bike Project	BikeShare			People's Pedal		SmartBike D.C.	Nice Ride MN		Spokies	
Yellow Bike Program													
1994	**1995**	**1996**	**1997**	**1998**	**2001**	**2002**	**2005**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Yellow Bike Project		Orange Bike Project		Freewheels		Decatur Yellow Bikes		Tulsa Townies		BIXI Montreal		BIXI Toronto	
		Olympia Community Bikes										Boulder B-cycle	
		Red Bike Project										Broward B-cycle	
												Capital BIXI	
												Community Access Bicycles	
												DecoBike	
												Golden Community Bike Share	
												Hawaii B-cycle	
												Madison B-cycle	
												New Balance Hubway	
												Omaha B-cycle	
												San Antonio B-cycle	
												Simsbury Free Bike	
												Spartanburg B-cycle	
												ValloCycle	

Figure 4.   Launches of United States and Canadian Public Bikesharing Systems

Argentina, Brazil, and Chile currently have fully operational programs, and Colombia has a pilot program. Chile began one of South America's first bikesharing programs, B'easy, in Santiago in December 2008. In December 2010, a new operator took over. B'easy has approximately 150 bicycles and 15 stations.[11] Santiago city officials are exploring the possibility of a citywide expansion. In January 2009, Rio de Janeiro, Brazil, launched Samba, a pilot program. In the first eight months, the program's users logged 4,316 trips. In November 2011, Samba relaunched as BikeRio, with 600 bicycles and 60 stations. BikeRio users must use mobile-phone technology to access bicycles. In Argentina, Santa Fe launched Subite a la Bici in December 2010. As of March 2012, the program operated 135 bicycles at eight stations.

SOCIAL AND ENVIRONMENTAL IMPACTS OF PUBLIC BIKESHARING

Public bikesharing offers a number of environmental, social, and transportation-related benefits. It provides a low-carbon solution for the first-and-last mile of a short-distance trip, providing a link for trips between home and public transit and/or transit stations and the workplace that are too far to walk to, as well as a many-mile solution. Bikesharing has the potential to play an important role in bridging the gaps in existing transportation networks, as well as encouraging individuals to use multiple transportation modes. Potential bikesharing benefits include: 1) increased mobility; 2) cost savings from modal shifts; 3) lower implementation and operational costs (e.g., in contrast to shuttle services); 4) reduced traffic congestion; 5) reduced fuel use; 6) increased use of public transit and alternative modes (e.g., rail, buses, taxis, carsharing, ridesharing); 7) increased health benefits; and 8) greater environmental awareness.[12] The ultimate goal of public bikesharing is to expand and integrate cycling into transportation systems, so that it can more readily become a daily transportation mode (for commuting, personal trips, and recreation).

Although before-and-after studies documenting public bikesharing benefits are limited, a few programs have conducted user surveys to record program impact. Table 2 presents a summary of trips, distance traveled, and estimated carbon dioxide (CO_2) reductions. The emission-reduction estimates vary substantially across studies due to different assumptions about user behavior, trip distribution, and trip substitution. Key assumptions that influence CO_2 reduction estimates pertain to public bikesharing trips that displace automobile trips.

Table 2.   Impacts of Public Bikesharing

	Year of Data	Trips per Day	Km per Day	CO_2 Reduction (kg per Day)	Before/After Modal Share	Respondents Using an Automobile Less
Bicing (Barcelona)	2008				0.75%/1.76%[a]	
BIXI Montreal	2011	20,000[b]				
Hangzhou Public Bicycle Program	2009	172,000[c]	1,032,000[c]	191,000[c]		
Vélib' (Paris)	2009	78,000[d]				
	2007				1%/2.5%[e]	28%[e]
	Year of Data	**Trips per Year**	**Km per Year**	**CO_2 Reduction (kg per Year)**	**Before/After Modal Share**	**Replaced/Forgone Vehicle Trips**
Boulder B-cycle	2011	18,500[f]		47,174[f]		
Denver B-cycle	2011	202,731[g]	694,942[g]	280,339[g]		
New Balance Hubway (Boston)	2011	140,000[h]				
Madison B-cycle	2011	18,500[i]		46,805[i]		
San Antonio B-cycle	2011	22,709[j]		38,575[j]		
Velo'v (Lyon)	2011	25,000[k]		150,000[k]		7%[l]

a) Romero, Carlos. "SpiCycles – in Barcelona." Presented at the Final Conference of the Chamber of Commerce & Industry of Romania, Bucharest, Romania, 19 December 2008.

b) Houle, Marie-Hélène. 2011. "4 174 917 déplacements en BIXI en 2011 - BIXI atteint le seuil des 40 000 membres." http://www.newswire.ca/fr/story/880423/4-174-917-deplacements-en-bixi-en-2011-bixi-atteint-le-seuil-des-40-000-membres.

c) Data obtained in a 2009 phone interview with Hangzhou program manager.

d) The Globe and Mail. 2009. "Paris's pedal power sets free uncivilized behaviour." http://veloptimum.net velonouvelles/9/ART/6juin/GlobeMail20.htm

e) DeMaio, Paul. 2009. "Bike-sharing: history, impacts, models of provision, and future." *Journal of Public Transportation* 14-4 (2009): 41–56.

f) Boulder B-cycle. 2011. "2011 Annual Report". http://boulder.bcycle.com/LinkClick.aspx?fileticket=wrmQ L2GXgI%3D&tabid=429h

g) Denver B-cycle. 2011. "2011 Season Results". http://denver.bcycle.com/News.aspx?itemid=185

h) Hinds, Kate. 2011. "In Its First Season, Boston Bike Share Exceeds Projections; Will Expand Next Spring." http://transportationnation.org/2011/11/29/in-its-first-season-boston-bike-share-exceeds-projections-will-expand-next-spring/

i) Madison B-cycle. 2012. "2011 Overview."http://legistar.cityofmadison.com/attachments/85a6af7b-3bb3-40bb-b5ab-d91e9720f0cc.pdf

j) San Antonio Office of Environmental Policy. "San Antonio Bikes." Presented at the Texas Trails and Active Transportation Conference, San Antonio, TX, February 1-3, 2012. http://www.slideshare.net/biketexas/b-cycle-bike-share

k) Slimani, Keroum. "Vélo'v: bike hiring self-service." http://www.fedarene.org/documents/projects/Climact/Best-Practices/027_Velov_.pdf

l) Bührmann, S. 2007. New Seamless Mobility Services: Public Bicycles.

In addition to studies that have demonstrated reduced CO_2 emissions and a modal shift toward bicycle use, evaluations indicate an increased public awareness of bikesharing as a viable transportation mode. A 2008 study found that 89% of Vélib' users said the program made it easier to travel through Paris. Fifty-nine percent of Nice Ride Minnesoa users said that they liked convenience most about

> **Fifty-nine percent of Nice Ride Minnesota users in the U.S. noted that they liked convenience most about their program. Denver B-cycle achieved a 30% increase in riders and a 97% increase in the number of rides taken in 2011.**

their program.[13] Denver B-cycle achieved a 30% increase in riders and a 97% increase in the number of rides taken in 2011.[14] These studies and anecdotal evidence suggest that public bikesharing programs have a positive impact on the public perception of bicycling as a viable transportation mode. Our user survey (reported in Chapter IV) examines the impacts of public bikesharing from both a social and an environmental perspective.

III. PUBLIC BIKESHARING OPERATIONS IN NORTH AMERICA

We conducted 38 interviews with experts in public bikesharing during the course of this study. Fourteen interviews with city and regional transportation professionals, public transit agencies, community bike coordinators, policymakers, community bike organizers, and vendors were completed in summer 2011 and spring 2012. These interviews provided valuable background and expertise for designing the user survey, which was conducted among members of four bikesharing organizations (two in the United States and two in Canada) during fall 2011 and early 2012. Results of the user survey are presented in Chapter IV. In spring 2012, we conducted 19 interviews with representatives from each of the 15 U.S. and four Canadian IT-based bikesharing organizations that were operational in April 2012. The interview results provide valuable insight into the current state of public bikesharing in the United States and Canada during a period of rapid expansion. Finally, we completed five interviews with brokers, underwriters, and attorneys in the bikesharing insurance industry in June 2012.

Two of the 15 U.S. programs—Des Moines B-cycle and Hawaii B-cycle—were pilot programs. The information obtained from the experts we interviewed was used to develop strategic recommendations for increasing public bikesharing benefits. Interview questions were designed to gain information about bikesharing operations; technology; the role of supportive infrastructure (e.g., bike lanes, bike parking); insurance, accidents, vandalism, theft; partnerships (e.g., bike-transit connections, universal smartcards); and policy. Most of the interviews lasted an hour or more and were conducted via telephone. An email option was made available for experts who preferred to respond in writing. The interview questionnaire for operators and stakeholders is reproduced in Appendix A. The expert stakeholders worked on public bikesharing policy and/or program planning and implementation at their respective organizations. They included representatives from the following organizations.

Expert Stakeholder Organizations
Bike Nation
City of Boston, Bicycle Programs
City of Minneapolis
City of Minneapolis, Public Works
Devinci Cycles
eBike
Kona
Portland Bureau of Transportation
San Francisco Municipal Transportation Agency (SFMTA)
SandVault
Social Bicycles (SoBi)
Tracetel
Trek Bicycle
8D Technologies

The operators interviewed included representatives from all of the operational North American IT-based public bikesharing systems, listed below.

United States (n=15)

Boulder B-cycle

Broward B-cycle

Capital Bikeshare, Washington, D.C. and
 Arlington, VA

Chicago B-cycle

DecoBike, Miami Beach

Denver B-cycle

Des Moines B-cycle

Hawaii B-cycle

New Balance Hubway, Boston

Madison B-cycle

Nice Ride Minnesota, Twin Cities

Omaha B-cycle

San Antonio B-cycle

Spartanburg B-cycle

Tulsa Townies

Canada (n=4)

BIXI Montreal

BIXI Toronto

Capital BIXI, Ottawa

Golden Community Bike Share

The interviews covered eight key aspects of public bikesharing, listed below.

1) **Organization information (e.g., number of bicycles, docking stations)**

2) **Membership and operations**

3) **Bikesharing equipment, technology, and associated costs**

4) **Safety, insurance, vandalism, and theft**

5) **Communications (e.g., radio frequency identification (RFID), global positioning system (GPS))**

6) **System rebalancing and integration**

7) **Bikesharing economics**

8) **Policy**

The bikesharing interviews, business models, bikesharing economics, partnerships, land use and infrastructure, operations, and technology are summarized below. Conclusions and policy recommendations resulting from the interviews are presented in Chapter V.

SUMMARY OF PUBLIC BIKESHARING ACTIVITY IN THE UNITED STATES AND CANADA

As noted in Chapter II, public bikesharing in North America began in 1994 with the launch of the Yellow Bike Project in Portland, OR. Over the next five years, similar bikesharing programs emerged, all of which were modeled after either white-bike systems, also known as free bike systems or coin-deposit systems. In June 2007, Tulsa Townies launched, marking the beginning of the IT-based bikesharing program renaissance in North America.

Figure 5 summarizes program launches and closures in the United States and Canada from 1994 through May 2012. Since 1994, there have been 32 program startups and nine program closures in the United States and eight program launches and two program closures in Canada. Only one of the nine program closures in the United States was an IT-based pilot program. (We gathered the most comprehensive information possible on first- and second-generation programs, but due to the informal nature of many of these programs, the data may not be representative of all of them.)
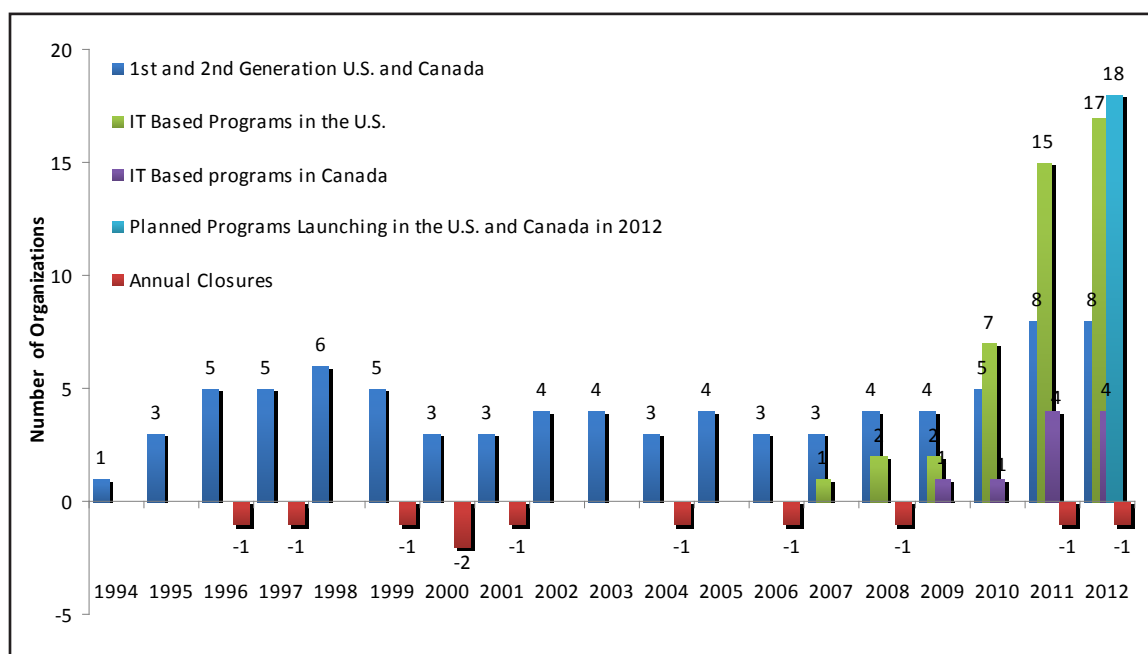

Figure 5.   Public Bikesharing Startup and Closure Activity in the United States and Canada, 1994 through May 2012

Table 3 lists all the first-generation, second-generation, and IT-based bikesharing programs that launched in North America as of May 2012. Figure 6 shows all active bikesharing programs in the United States and Canada as of May 2012.

Table 3.   Public Bikesharing Programs in the United States and Canada as of May 2012 (n=40)

Country	Program	Year Launched	Operational Status	Location	Generation	Business Model
Canadian Programs						
	BikeShare	2001	Canceled (2006)	Toronto, ON	2nd Generation	Non-Profit
	People's Pedal	2005	Canceled (2008)	Edmonton, AB	2nd Generation	Non-Profit
	BIXI Montreal	2009	Ongoing	Montreal, QC	IT-based	Non-Profit
	BIXI Toronto	2011	Ongoing	Toronto, ON	IT-based	Privately Owned/Operated
	Capital BIXI	2011	Ongoing	National Capital Region (Gatineau, QC; Ottawa, ON)	IT-based	Publicly Owned/ Contractor Operated
	Community Access Bicycles	2011	Ongoing	Kitchener, ON	2nd Generation	Non-Profit
	Golden Community Bike Share	2011	Ongoing	Golden, BC	IT-based	Publicly Owned/Operated
	RightBike	2012	Ongoing	Ottawa, ON	2nd Generation	Non-Profit
U.S. Programs						
	Yellow Bike Project	1994	Canceled (2001)	Portland, OR	1st Generation	Non-Profit
	Green Bike Program	1995	Canceled (2000)	Boulder, CO	1st Generation	Non-Profit
	Yellow Bike Program	1995	Canceled (2000)	Twin Cities (Minneapolis, MN; St.	1st Generation	Non-Profit
	Olympia Community Bikes (Pink Bikes)	1996	Canceled (1997)	Olympia, WA	1st Generation	Non-Profit
	Orange Bike Project	1996	Canceled (1996)	Tuscon, AZ	1st Generation	Non-Profit
	Red Bike Project	1996	Ongoing	Madison, WI	2nd Generation	Non-Profit
	Yellow Bike Project	1997	Canceled (2012)	Austin, TX	1st Generation	Non-Profit
	Freewheels	1998	Canceled (Est. 1999)	Princeton, NJ	1st Generation	Non-Profit
	Decatur Yellow Bikes	2002	Canceled (Est. 2004)	Decatur, GA	2nd Generation	Non-Profit
	Tulsa Townies	2007	Ongoing	Tulsa, OK	IT-based	Non-Profit
	Bike Schuylkill	2008	Ongoing	Schuylkill River Heritage Area (Hamburg, PA; Phoenixville, PA; Pottstown, PA)	1st Generation	Non-Profit
	Collingswood Bike Share	2008	Ongoing	Collingswood, NJ	1st Generation	Publicly Owned/Operated
	SmartBike D.C.	2008	Canceled (2011)	Washington, D.C.	IT-based	Street Furniture Contract
	Capital Bikeshare	2010	Ongoing	Washington Metropolitan Area (Washington, D.C.; Arlington, VA)	IT-based	Publicly Owned/ Contractor Operated
	Chicago B-cycle	2010	Ongoing	Chicago, IL	IT-based	Privately Owned/Operated
	Denver B-cycle	2010	Ongoing	Denver, CO	IT-based	Non-Profit
	Des Moines B-cycle	2010	Ongoing	Des Moines, IA	IT-based	Non-Profit
	Nashville GreenBikes	2010	Ongoing	Nashville, TN	2nd Generation	Non-Profit
	Nice Ride Minnesota	2010	Ongoing	Twin Cities (Minneapolis, MN; St.	IT-based	Non-Profit
	Boulder B-cycle	2011	Ongoing	Boulder, CO	IT-based	Non-Profit
	Broward B-cycle	2011	Ongoing	Broward County, FL	IT-based	Non-Profit
	DecoBike	2011	Ongoing	Miami Beach, FL	IT-based	Privately Owned/Operated
	Hawaii B-cycle	2011	Ongoing	Kailua, HI	IT-based	Privately Owned/Operated
	Madison B-cycle	2011	Ongoing	Madison, WI	IT-based	Non-Profit
	New Balance Hubway	2011	Ongoing	Boston, MA	IT-based	Publicly Owned/ Contractor Operated
	Omaha B-cycle	2011	Ongoing	Omaha, NE	IT-based	Non-Profit
	San Antonio B-cycle	2011	Ongoing	San Antonio, TX	IT-based	Non-Profit
	Simsbury Free Bike	2011	Ongoing	Simsbury, CT	1st Generation	Non-Profit
	Spartanburg B-cycle	2011	Ongoing	Spartanburg, SC	IT-based	Non-Profit
	ValloCycle	2011	Ongoing	Montevallo, AL	2nd Generation	Non-Profit
	Houston B-cycle	2012	Ongoing	Houston, TX	IT-based	Non-Profit
	Spokies	2012	Ongoing	Oklahoma, OK	IT-based	Publicly Owned/ Contractor Operated

Figure 6.   Locations of Public Bikesharing Programs in United States and Canada as of May 2012 (n=29)

While there were only two instances of operators competing within the same geographic region as of spring 2012, increased competition among bikesharing operators within geographic regions is likely. While the discussion thus far includes first- and second-generation public bikesharing systems, the remainder of the report focuses on IT-based systems.

IT-Based Public Bikesharing in the United States and Canada

The first IT-based bikesharing system in North America, Tulsa Townies, began with 96 bikes and four fully automated docking stations. The program's emphasis on IT-based services distinguishes it from first- and second-generation systems. Today, it operates with 24 bicycles and three docking stations. Unlike other IT-based public bikesharing systems in North America, Tulsa Townies operates free of charge.

SmartBike (Washington, D.C.) launched in 2008 with 120 bicycles at 10 locations, serving approximately 1,700 users. Clear Channel Communications, Inc., owned and maintained the entire system as part of a 20-year bus shelter contract.[15] Users paid an annual fee of US$40 and could rent bicycles for up to three hours at a time with an unlimited number of rentals. The program officially ceased operating in January 2011, but it paved the way for Capital Bikeshare, a larger, citywide program that launched in September 2010. Capital Bikeshare is operated by BIXI's American partner organization, Alta Bicycle Share, Inc., and has a total of 1,200 bicycles and 130 stations in the District of Columbia and Northern Virginia. Today, in partnership with BIXI and Alta Bicycle Share, Inc., of Portland, OR, PBSC Urban Solutions provides the equipment for all BIXI systems in Canada and Capital Bikeshare, New Balance Hubway, and Nice Ride Minnesota in the United States. At the end of its first year of operation, more than one million trips had been made with Capital

Bikeshare bikes.[16] As of January 2012, the program had 18,000 members, some of whom were surveyed in this study.

In 2010, B-cycle launched its first program, in Denver, CO. As of January 2012, Denver B-cycle had 520 bicycles, 51 stations, and 79,701 members. In addition to Denver, as of May 2012, B-cycle operates in Boulder, CO; Broward County, FL; Chicago, IL; Houston, TX; Madison, WI; Omaha, NE; San Antonio, TX; and Spartanburg, SC. Two pilot programs—Des Moines B-cycle and Hawaii B-cycle—also launched in 2010 and 2011, respectively.

Nice Ride Minnesota launched in June 2010. It operated 960 bicycles and 116 stations in the Twin Cities in January 2012. In 2011, 217,000 trips were made with the system, which had about 3,800 annual and 30-day subscribers with an overall user population of 33,900 (including daily users).

In Boston, Alta Bicycle Share, Inc., operates the New Balance Hubway bikesharing system, named for its corporate sponsor, New Balance. The program launched in July 2011, and it operated with 600 bicycles and 61 stations in January 2012.[17]

Montreal launched its first IT-based bikesharing system—BIXI—in 2009. The parking authority of the city of Montreal originally developed the system; it is operated by PBSC Urban Solutions. In January 2012, the BIXI Montreal system had approximately 5,120 bicycles at 411 stations and nearly 40,000 members. In 2011, the BIXI system further expanded in Canada and launched BIXI Toronto, with 1,000 bicycles and 80 stations, as well as Capital BIXI in the Ottawa-Gatineau region with 100 bicycles and 10 stations. BIXI Montreal and Toronto users were surveyed for this study. In 2011, Golden Community Bike Share launched in Golden, British Columbia. As of January 2012, they had 15 bicycles and two stations.

> **As of January 2012, the U.S. had 15 IT-based public bikesharing systems accounting for 172,070 users and 5,238 bicycles. Canada had four IT-based bikesharing organizations, with more than 44,352 members and 6,235 bicycles.**

As of January 2012, there were 15 IT-based public bikesharing systems in the United States with 172,070 users and 5,238 bicycles. By January 2012, Canada had four IT-based bikesharing organizations with more than 44,352 members and 6,235 bicycles. Table 4 lists the existing IT-based bikesharing programs in the two nations, as of January 2012.

Table 4.   Existing IT-Based Public Bikesharing Programs in the United States and Canada as of January 2012 (n=19)

Organization†	Launch Date	Users	Bicycles	Stations
Canada				
BIXI Montreal	2009	40,000	5,120	411
BIXI Toronto	2011	4,200	1,000	80
Capital BIXI	2011	150	100	10
Golden Community Bike Share	2011	2	15	2
United States				
Boulder B-cycle	2011	7,170	120	15
Broward B-cycle	2011	1,029	275	20
Capital Bikeshare	2010	18,000	1,200	130
Chicago B-cycle	2010	10,000	100	7
DecoBike	2011	2,100	850	85
Denver B-cycle	2010	79,701	520	51
Des Moines B-cycle	2010	1,298	18	4
Hawaii B-cycle	2011	475	12	2
Madison B-cycle	2011	6,909	280	27
New Balance Hubway	2011	3,500	600	61
Nice Ride Minnesota	2010	33,900	960	116
Omaha B-cycle	2011	426	35	5
San Antonio B-cycle	2011	6,685	230	23
Spartanburg B-cycle	2011	877	14	2
Tulsa Townies *	2007	n/a	24	3

* Tulsa Townies does not offer a membership option to users.

† It is important to note that user populations are reported differently by organization (e.g., some include daily members, others do not).

Planned IT-Based Programs in the United States and Canada

As of May 2012, 17 IT-based programs were planned to launch in 2012 in the United States and one in Canada. These 18 planned programs are anticipated to have a total of approximately 21,100 bicycles. An additional 14 cities in the United States and two in Canada are exploring public bikesharing, with launch dates after 2012 or undetermined.

Table 5 lists all planned program launches in the United States and Canada.

Table 5.   Planned IT-Based Public Bikesharing Programs in the U.S. and Canada, as of May 2012 (n=34)

Country	Program	Projected Launch Date	Location	Generation	Bicycles	Business Model
Canadian Programs						
	BikeshareBC	Summer 2012	Vancouver, BC	IT-based	800	Non-Profit
	Calgary Bikeshare	Unknown	Calgary, AB	IT-based	Unknown	Unknown
	Hamilton Bikeshare	Unknown	Hamilton, ON	IT-based	Unknown	Unknown
U.S. Programs						
	Bike Nation Anaheim	Summer 2012	Anaheim, CA	IT-based	200	Vendor Operated
	BikeshareKC	Summer 2012	Kansas City, MO	IT-based	Unknown	Publicly Owned/ Contractor Operated
	Buffalo Bikeshare	Summer 2012	Buffalo, NY	IT-based	75	Unknown
	Charlotte B-cycle	Summer 2012	Charlotte, NC	IT-based	200	Non-Profit
	Chattanooga Bike Share	Summer 2012	Chattanooga, TN	IT-based	300	Publicly Owned/ Contractor Operated
	Chicago Bikeshare	Summer 2012	Chicago, IL	IT-based	3,000	Publicly Owned/ Contractor Operated
	Citi Bike	Summer 2012	New York, NY	IT-based	10,000	Publicly Owned/ Contractor Operated
	DecoBike	Summer 2012	Long Beach, NY	IT-based	400	Privately Owned/Operated
	Fullerton Pilot Bikeshare	Summer 2012	Fullerton, CA	IT-based	150	Publicly Owned/Operated
	myBike	Summer 2012	St. Petersburg, FL	IT-based/ Dockless	500	Privately Owned/Operated
	S.F. Bikeshare	Summer 2012	San Francisco, CA	IT-based	1,000	Publicly Owned/Operated
	SLC Bike Share	Summer 2012	Salt Lake City, UT	IT-based	100	Non-Profit
	Sun Valley Bikeshare	Summer 2012	Sun Valley, ID	IT-based/ Dockless	16	Unknown
	WE-cycle Aspen	Summer 2012	Aspen, CO	IT-based	100	Non-Profit
	Baltimore B-cycle	Fall 2012	Baltimore, MD	IT-based	250	Non-Profit
	City CarShare	Fall 2012	San Francisco, CA	IT-based	90	Non-Profit
	Bike Nation LA	Fall 2012	Los Angeles, CA	IT-based	4,000	Vendor Operated
	Austin Bikeshare	2013	Austin, TX	IT-based	400	Unknown
	Fort Collins Bikeshare	2013	Fort Collins, CO	IT-based	Unknown	Publicly Owned/Operated
	Portland Bikeshare	2013	Portland, OR	IT-based	Unknown	Publicly Owned/ Contractor Operated
	Not Yet Determined	2013	Bridgeport, CT	IT-based	Unknown	Unknown
	Not Yet Determined	2013	Milwaukee, WI	IT-based	240	Unknown
	Capital Community Bikeshare	Unknown	Lansing, MI	IT-based	Unknown	Unknown
	Newport Bikeshare	Unknown	Newport Beach, CA	IT-based	Unknown	Unknown
	Puget Sound Bike Share	Unknown	King County, WA	IT-based	Unknown	Unknown
	Social Bicycles (SoBi)	Unknown	New York, NY	IT-based/ Dockless	Unknown	Privately Owned/Operated
	Not Yet Determined	Unknown	Cincinnati, OH	IT-based	Unknown	Unknown
	Not Yet Determined	Unknown	Monterey, CA	IT-based	Unknown	Unknown
	Not Yet Determined	Unknown	New Haven, CT	IT-based	Unknown	Unknown
	Not Yet Determined	Unknown	New Orleans, LA	IT-based	Unknown	Unknown
	Not Yet Determined	Unknown	Philadelphia, PA	IT-based	Unknown	Unknown

U.S. IT-based startup activity increased significantly in 2011, with nine program launches. Figure 7 shows the increase in IT-based programs in the United States and Canada—existing program launches and planned startups. As of April 2012, 20 IT-based programs planned to launch by the end of the year (Houston B-cycle (TX) and Spokies in Oklahoma City, OK both launched in May 2012). This reflects growing interest in public bikesharing, greater public sector attention, and increasing public demand.
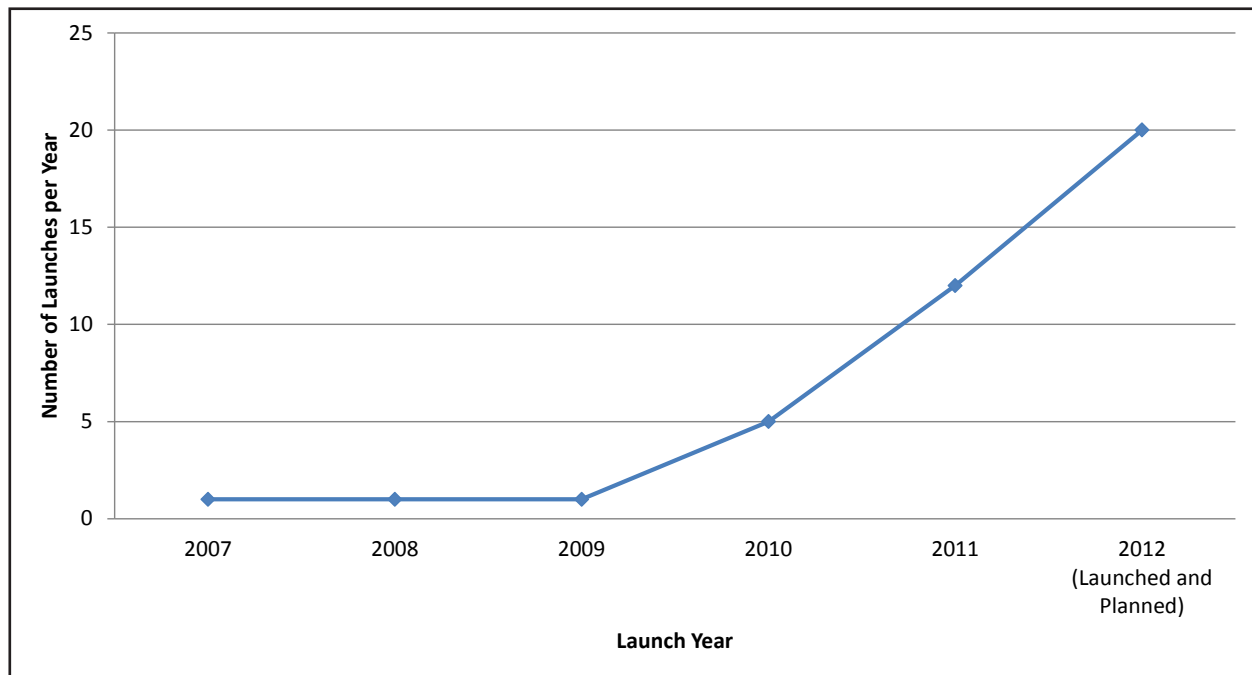
Figure 7.   Increase in IT-Based Public Bikesharing Programs in the United States and Canada as of May 2012

Figure 8 shows the locations of the planned program launches.

Figure 8.   Locations of IT-Based Public Bikesharing Programs in the United States and Canada Planning to Launch June – December 2012 (n=18)

The largest program launches (each with more than 1,000 bicycles) should occur by fall 2012 in Chicago, Los Angeles, New York City, and San Francisco. New York City plans to launch a public bikesharing program with a total of 10,000 bicycles and 600 stations starting

in July 2012.[18] The city has held 150 public meetings, events, and demonstrations to introduce the concept to the public. Thirteen neighborhood workshops were held with potential users to solicit their input on station placement. When launched, the system will be the largest operating bikesharing program in North

> **New York City plans to launch a public bikesharing program with a total of 10,000 bicycles and 600 stations starting in July 2012.**

America. In May 2012, Citibank announced that it would be the program's title sponsor (i.e., main or lead sponsor), providing US$41 million across five years. MasterCard has pledged US$6.5 million to be the system's exclusive payment sponsor, featuring its Pay Pass Tap & Go system.[19] The New York City program is called Citi Bike. Because of the unprecedented amount that Citibank is contributing, Citi Bike will be the first IT-based public bikesharing system that does not require public subsidy.[20]

In summer 2012, a US$7.9 million regional pilot program led by the Bay Area Air Quality Management District, in partnership with the San Francisco Municipal Transportation Agency, is scheduled to launch 500 bicycles at 50 stations throughout San Francisco's urban core.[21] The program will include 400 additional bicycles in Santa Clara County and 100 bicycles in San Mateo County along the Caltrain commuter rail corridor that runs from San Francisco to San José. If the program is successful and if additional funding is available, the pilot could be expanded to provide 13,000 bicycles regionally—nearly 3,000 in San Francisco and 10,000 in Santa Clara County.

Chicago is planning to launch a program with 3,000 bicycles and 300 stations in summer 2012, which will expand to 5,000 bicycles and 500 stations in 2013.[22] Alta Bicycle Share, Inc., was selected to be the system operator for New York City, Chicago, and San Francisco, with PBSC Urban Solutions as its vendor.

Finally, the Los Angeles program, a US$16 million Bike Nation investment, plans to launch 4,000 bicycles at 400 stations over 24 months beginning in summer 2012 in Anaheim and fall 2012 in Los Angeles.[23]

BUSINESS MODELS

A number of public bikesharing business models have evolved with the advent of IT-based systems. They include: 1) non-profit, 2) privately owned and operated, 3) publicly owned and operated, 4) public owned/contractor operated, 5) street-furniture contract, 6) third-party operated, and 7) vendor operated. Vendor-operated systems are classified as emerging. There can be overlap among these models due to variations in ownership, system administration, and operations. A description of each business model is provided in Table 6.

Table 6.   Public Bikesharing Business Models

Business Model	Definition	Example
Non-Profit	• Goal of covering operational costs and expanding service • Start-up and operational funding typically are supported by grants, sponsorships, and loans	Denver B-cycle
Privately Owned and Operated	• Owned and operated by a private entity • Operator provides all funding for equipment and operations • May have limited contractual agreement with public entities for rights-of-way	DecoBike
Publicly Owned and Operated	• Owned and operated by a public agency or local government • Agency subsidizes bikesharing with system revenue	Golden Community Bike Share
Publicly Owned/Contractor Operated	• Owned by a public agency or local government, responsible for funding and administering the system • Operations are contracted to a private operator	Capital Bikeshare; Capital BIXI
Street Furniture Contract	• Operator permitted to operate in a jurisdiction in exchange for advertising rights, generally with street furniture • System funded through advertising revenue	SmartBike D.C.
Third-Party Operated	• Operated in partnership with local businesses in exchange for a percentage of the profit • Hybrid operation scheme that can be paired with other business model	Chicago B-cycle
Vendor Operated	• Operated by the same company that designs and/or manufactures the system equipment (the vendor)	Bike Nation Anaheim (Planned)

As of January 2012, 11 (58%) of the 19 IT-based public bikesharing programs in the United States and Canada were non-profit, four (21%) were privately owned and operated, three (16%) were publicly owned and contractor operated, and one (5%) was publicly owned and operated. No programs were managed as part of a street-furniture contract. Non-profit programs accounted for 82% of the membership and 66% of the bicycles deployed. Publicly owned and contractor operated programs accounted for 10% of the membership and 17% of the bicycles deployed. Privately owned and operated programs accounted for 8% of the membership and 17% of the fleets deployed. At the time of this writing, there was only one publicly owned and operated service, which was located in Canada. Given its recent launch, it accounts for less than 1% of members and fleets deployed and is not included in Figure 9.
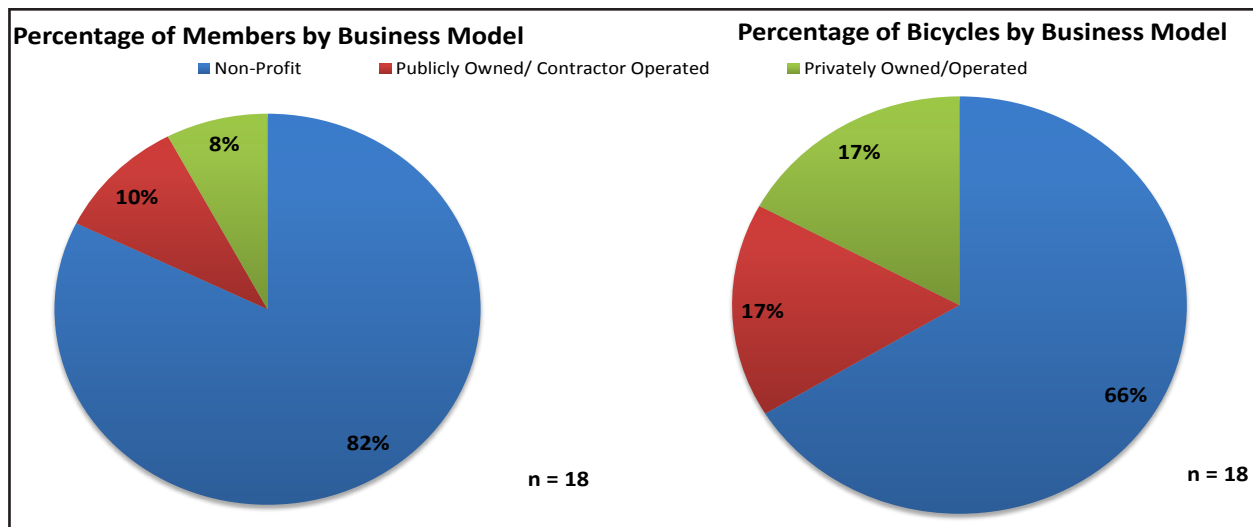
Percentage of Members by Business Model   **Percentage of Bicycles by Business Model**

■ Non-Profit   ■ Publicly Owned/ Contractor Operated   ■ Privately Owned/Operated

Figure 9.   Members and Bicycles by Business Model in the U.S. and Canada (n=18)

Between 2007 and 2009, three IT-based bikesharing programs were launched in North America. Of these, two were non-profit and one was a street-furniture contract. Beginning in 2010, there was a greater diversity of business models, with one of the five launches privately owned and operated, one publicly owned and contractor operated, and three non-profit. In 2011, three of the 12 program launches were privately owned and operated, another two were publicly owned and contractor operated, one was publicly owned and operated, and the remaining six were non-profits.

Of the programs planned to launch in 2012 and 2013, 18 have identified a business model: six plan to launch as non-profits, five as publicly owned and contractor operated, three as publicly owned and operated, two as privately owned and operated, and the remaining two as vendor operated. Two of these planned program launches (Buffalo Bikeshare and City CarShare) will be operated by a non-profit carsharing program (i.e., short-term auto access).

Member-to-Bicycle Ratios

As of January 2012, the average member-to-bicycle ratio in the United States and Canada (combined) was about 19 members to each bicycle (19:1). In the United States, the average member-to-bicycle ratio is higher, 33:1; in

> **For most business models, member-to-bicycle ratios range between eight and nine members for every bicycle (8:1 to 9:1).**

Canada, the average is 7:1. For most business models, member-to-bicycle ratios are from eight to nine members for every bicycle (8:1 to 9:1). The exception is non-profits, which have an average member-to-bicycle ratio of 23:1, in large part due to a very high membership among a few of the operators. Two non-profit and two for-profit operators maintained member-to-bicycle ratios from 62:1 to 153:1. The higher ratios suggest less intensive or regular use by users and may also indicate a greater share of trips on shorter-term passes (i.e., daily or weekly, rather than annual) or by recreational users rather than

commuters. Figure 10 shows a scatter plot of member-to-bicycle ratios of the 18 IT-based programs surveyed that offer membership (Tulsa Townies offers no membership).
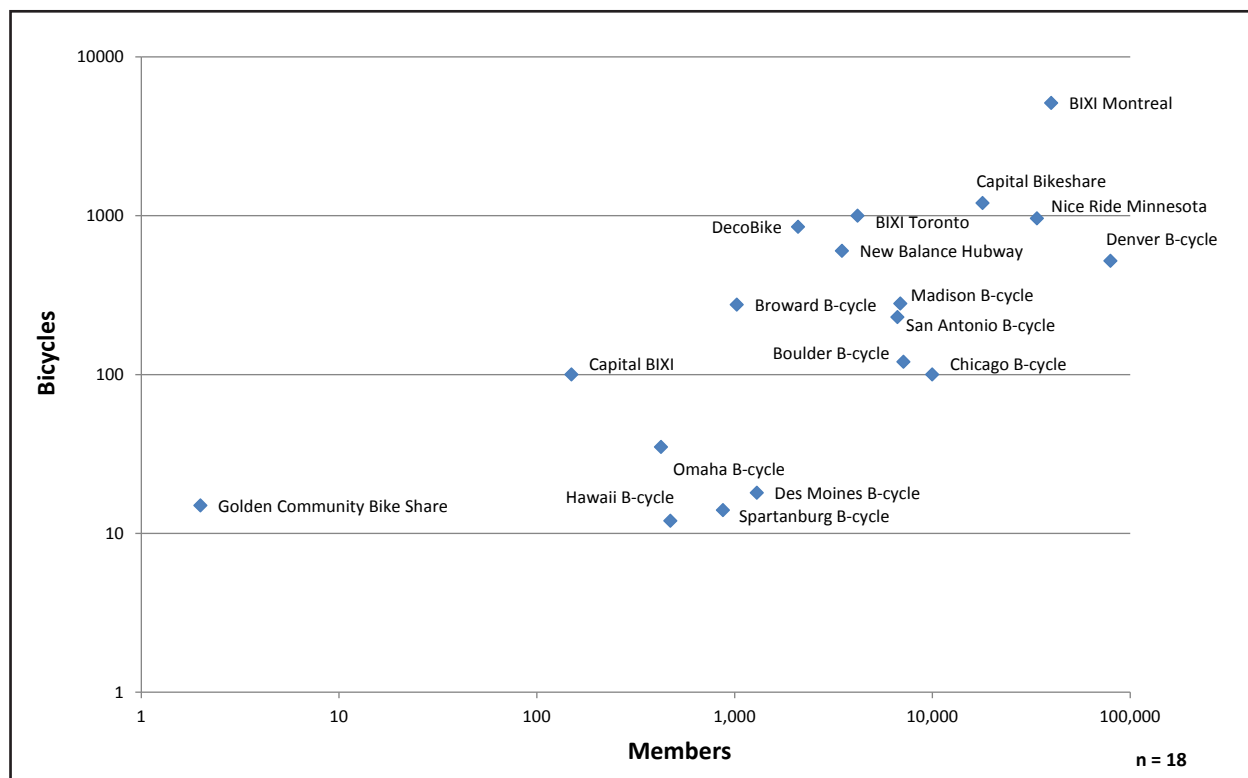
Figure 10. Member-to-Bicycle Ratios of IT-Based Programs (Logarithmic Scale) (n=18)

PUBLIC BIKESHARING ECONOMICS

The economics of public bikesharing include organizational funding, user fee revenue, and financial sustainability.

Funding

Fifty-eight percent (n=11) of the 19 organizations reported receiving some form of startup and/or operational funding. Sixteen percent (n=3) did not receive startup and/or operational funding. Five operators did not provide data on funding sources. Funding for public bikesharing is frequently obtained through a combination of sources, including advertising, user fees, grants, loans, sponsorships, health-care/tobacco settlement funds, and governmental funds for capital costs, operational costs, or both. In many locations, public bikesharing startups have received some combination of local, state, and/or federal government funding. Operational costs are typically funded through a combination of user fees, advertising, and sponsorships. Advertising-based business models and funding are more common in European bikesharing systems, while North American systems tend to rely on sponsorships. The main difference between the systems is whether an advertising firm runs the program or the program sells advertising. Figure 11 provides an overview of the types of funding and revenue received. The top three funding and revenue sources

were user fees (collected by 95% of all operators), sponsorships (collected by 89% of operators), and advertising (collected by 68% of operators).
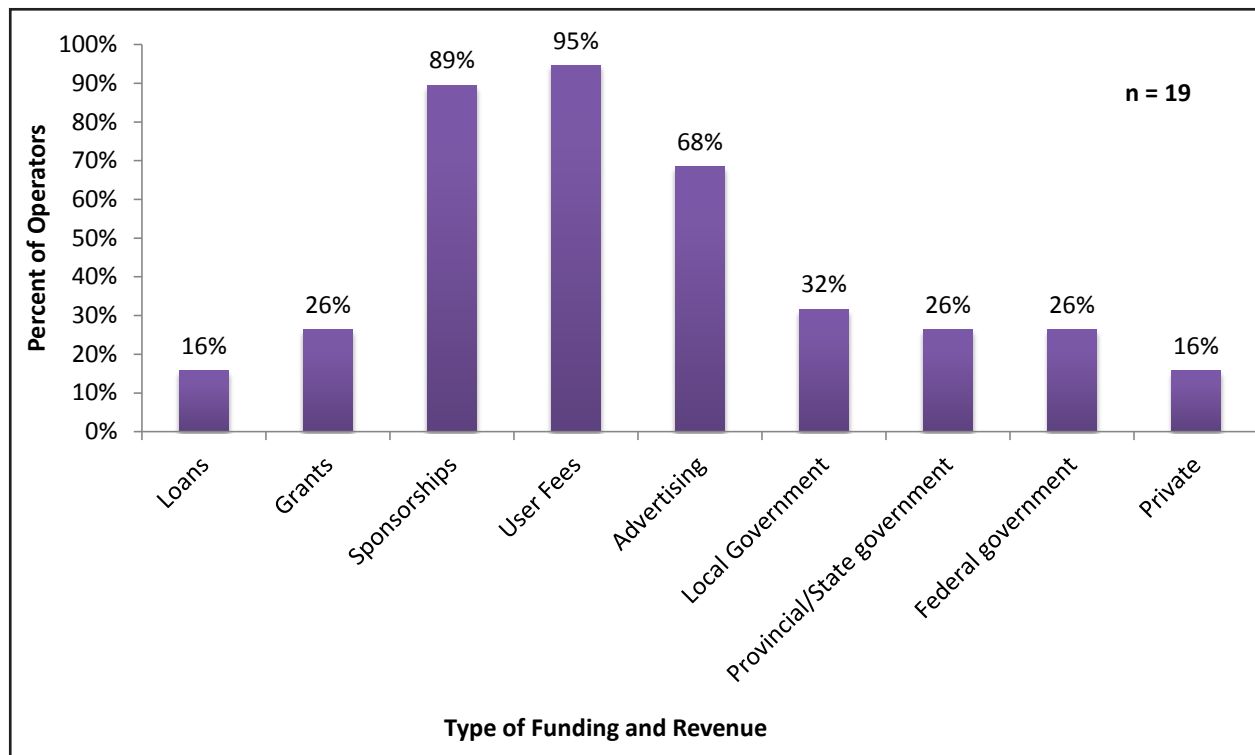
Figure 11. Types of Funding and Revenue (n=19)

Some operators declined to disclose detailed information about organizational funding; however, through research, we were able to discern both the prevalence of funding and revenues received (sorted by type—Figure 11).

We collected data on the number of funding sources, by type (e.g., loans, grants, sponsorships). We then used these data to assess funding portfolio diversity, which ranged from less diverse (three funding sources), to moderately diverse (four funding sources), to more diverse (five funding sources). Thirty-two percent of the 19 IT-based North American operators had a less diverse funding portfolio (n=6), 42% had a moderately diverse funding portfolio (n=8), while the remaining 26% had a more diverse funding portfolio (n=5), as illustrated in Figure 12.

> **The top three public bikesharing funding and revenue sources were user fees, sponsorships, and advertising.**
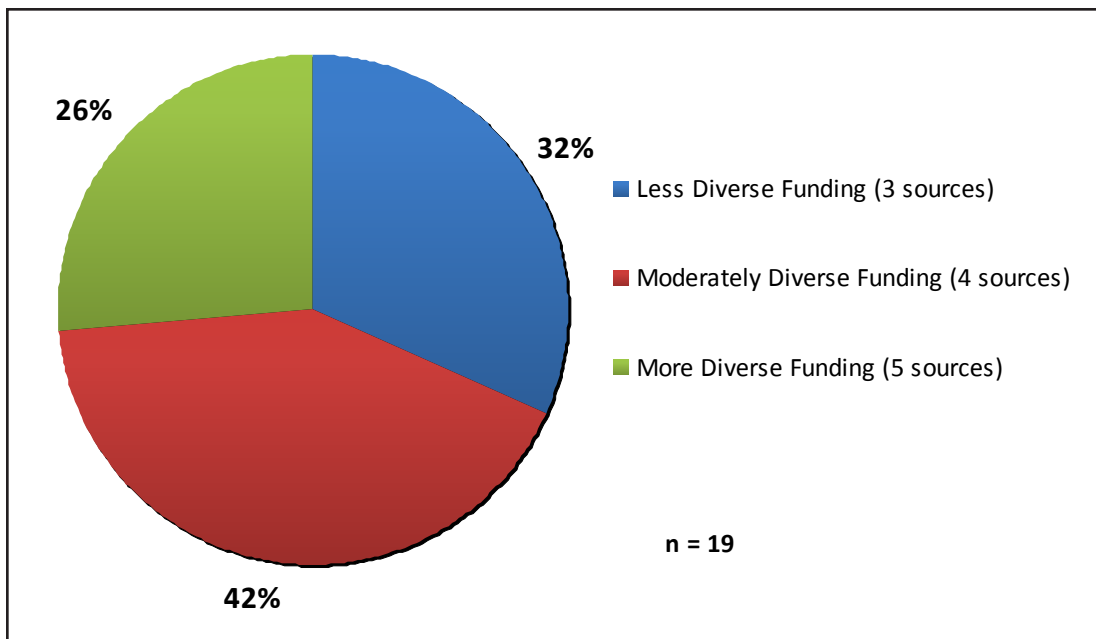
Figure 12. Funding-Portfolio Diversity (n=19)

Two of the three publicly owned and contractor operated bikesharing systems in North America had very diverse funding portfolios containing at least five of the nine funding-source categories. Although we found no correlation between the operators' funding diversity and launch year or organizational size, the two most diversely funded programs are both publicly owned and contractor operated and share the same contractor.

User-Fee Revenue

Most bikesharing programs raise revenue through user fees based on a variety of memberships, including daily passes, weekly passes, monthly memberships, and annual memberships. Membership levels are defined in Table 7.

Table 7.   Membership Definitions

Common Membership Levels	
Day pass	24-hour access for daily users
Week pass	7-day access for users
Monthly member	30-day membership for regular users
Annual member	365-day membership for regular users

Seventeen of the 19 IT-based North American public bikesharing operators (89%) offer a 24-hour pass and a 30-day membership option. Seventeen of them (89%) also offer annual memberships. The cost for a 24-hour pass varies from $0 to $10, averaging CA/US$5.49. (Note: 1-1 CA/US exchange used.) Figure 13 shows the pricing structure, by organization, for daily users of trips ranging from 30 minutes to four hours.
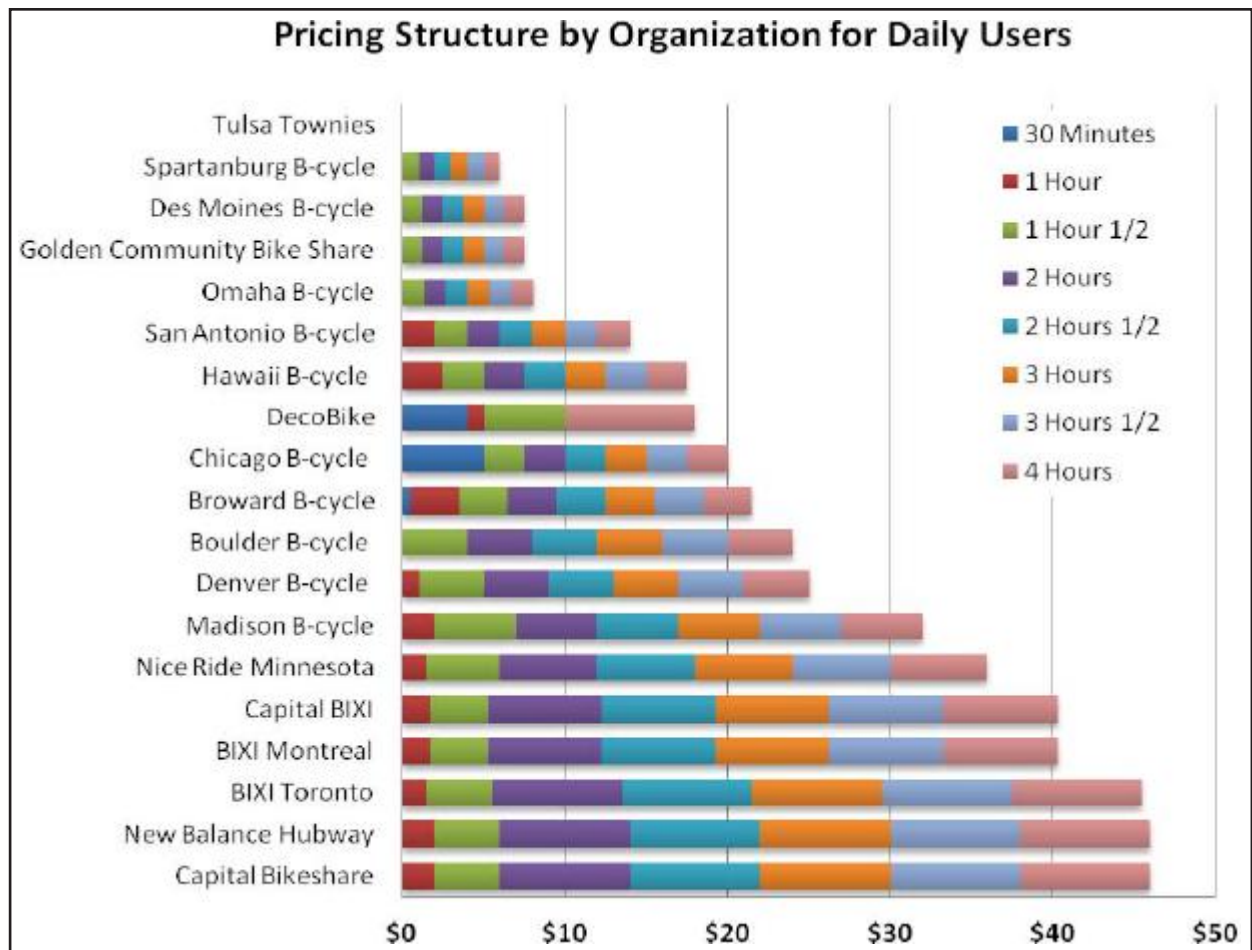
Figure 13. Public Bikesharing Program Pricing Structure (in May 2012) (n=19)

Notes: 1-1 CA/US exchange used.

   Tulsa Townies requires a refundable US$100 credit card deposit upon use, but it is otherwise a free service.

The cost of a 30-day membership varies from $15 to $40, averaging CA/US$31. The cost of an annual membership varies from $30 to $95, averaging CA/US$66, as shown in Figure 14.

Annual Membership Cost

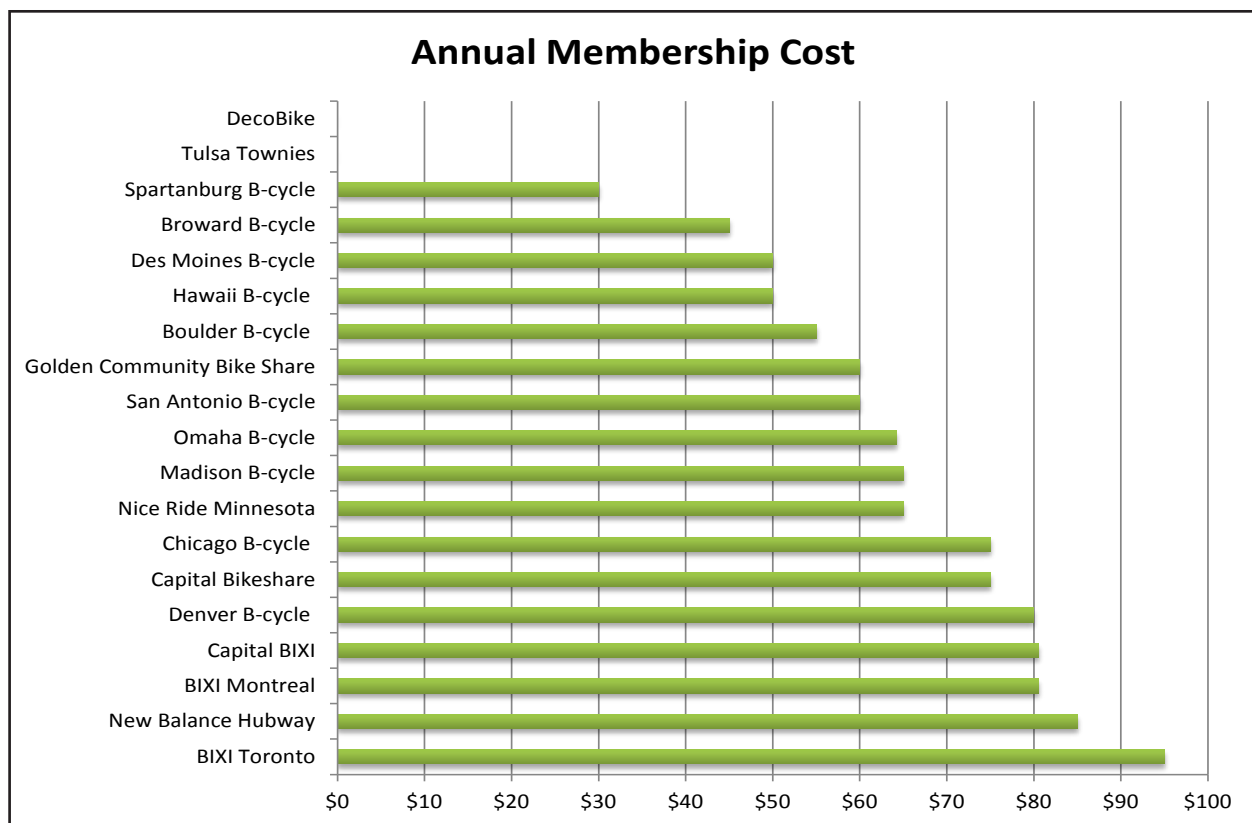| Operator	Cost
DecoBike	
Tulsa Townies	
Spartanburg B-cycle	$30
Broward B-cycle	$45
Des Moines B-cycle	$50
Hawaii B-cycle	$50
Boulder B-cycle	$55
Golden Community Bike Share	$60
San Antonio B-cycle	$60
Omaha B-cycle	$64
Madison B-cycle	$65
Nice Ride Minnesota	$65
Chicago B-cycle	$75
Capital Bikeshare	$75
Denver B-cycle	$80
Capital BIXI	$81
BIXI Montreal	$81
New Balance Hubway	$85
BIXI Toronto	$95

Figure 14. Public Bikesharing Annual Membership Cost (n=19)

Notes: 1-1 CA/US exchange used.

  Tulsa Townies requires a refundable US$100 credit card deposit upon use, but it is otherwise a free service.
  DecoBike does not offer an annual membership.

In most systems, the first half hour of public bikesharing is free, and time charges increase in stepped amounts after that. Most users pay a flat annual or monthly fee and make trips of less than 30 minutes. Trip duration is a key issue associated with business-model sustainability—operators typically generate the most revenues from daily users who exceed the 30-minute free-usage period (e.g., tourists).

Financial Sustainability

Four operators provided data on the percentage of farebox recovery (i.e., the percentage of operational costs covered by user fees), which ranged from 46% to 100%, averaging 74%. Although they were unable to provide a percentage of farebox recovery, an additional five operators stated that their programs were close to being self-sustaining. Three operators stated that they were not yet sustainable. One operator stated that all of its costs were covered by its sponsors. Another operator reported that about half of its funding came from sponsors and half came from users. The remaining five respondents either did not know or did not provide a response.

> **Operators typically generate the most revenues from daily users who exceed the 30-minute free-usage period (e.g., tourists).**

All of the policy experts interviewed indicated that it would be preferable for public bikesharing operations to be self-sufficient (i.e., needing no governmental support). About

half of them thought that bikesharing would be self-sufficient in the future. The others felt that since no other transportation system is required to be self-sufficient, public bikesharing should not be held to a different standard. A number of experts did not want to require financial sustainability as a determinant for system design. They thought that to provide sufficient geographic coverage across a region, a system might need financial assistance. One expert believed financial sustainability could be achieved after three to five years of operations, while another indicated that sustainability could be obtained if each bicycle were used for four to five trips per day.

BIKESHARING PARTNERSHIPS

Partnerships are key to bikesharing's success. This section reviews three key types of bikesharing partnerships: revenue-enhancing partnerships, partnerships that enhance equity and improve system access, and partnerships with public transit agencies.

Revenue-Enhancing Partnerships

As public bikesharing becomes more mainstream, a number of partnerships are evolving among government, the private sector, and bikesharing operators. Existing and planned partnerships/sponsorships include station sponsors, corporate memberships, federal/ General Services Administration (GSA) memberships, partnerships with carsharing organizations to reduce single-occupant vehicle usage, and agreements with local bike shops that provide helmet discounts. Partnerships with carsharing organizations, public transit agencies (for discounts and combined public transit cards), and health insurance providers (for free or discounted memberships) are believed to be among the most beneficial for public bikesharing users.

All 19 of the operators interviewed maintain some form of partnership or sponsorship. Private-sector partnerships include corporate sponsorships, station sponsorships, and partnerships with commercial firms ranging from health insurance to hotels and banks. In Colorado, Courtyard by Marriott became the first hotel to install B-cycle stations on its property.[24] A number of businesses have established closed-bikesharing (non-public) systems for employees to use (e.g., Humana in Kentucky.)[25]

In addition to public-transit partnerships, collaboration with governmental agencies is key to public bikesharing's success. In Washington, D.C., a number of agencies sponsor Capital Bikeshare. Amending local ordinances to enable public bikesharing programs to increase cost recovery with corporate advertising at their bike stations is an important way that local governments can support bikesharing.[26] For example, Washington, D.C., has a law that prohibits advertising on District-owned property, but special legislation was passed to allow bikesharing advertising on bus shelters.[27]

Sixteen of the 19 IT-based bikesharing operators (84%) display advertisements on their systems. Nine operators (47%) display advertisements both on their bicycle baskets and at bicycle docking stations/kiosks. Seven operators (37%) display advertisements on their program's website. And six of them (32%) display advertisements on the rear tires of their bicycles. Only one operator displays advertisements on chain guards and handlebars.

Partnerships to Enhance Equity and System Access

Public bikesharing operators can use program partnerships to ensure equity and system access. The requirement to use a credit card has often been perceived as a barrier to bikesharing use, as well as an equity concern (low-income and younger riders have less access to credit cards).

> **Many experts consider partnerships between public transit and bikesharing key to public bikesharing's success.**

Six of the 19 IT-based North American programs (32%) specified that they allow debit cards as an alternative to credit cards. Additionally, in Washington, D.C., Capital Bikeshare has partnered with multiple banks to offer discounted annual memberships to "unbanked" residents who sign up for either a debit card or credit card. This partnership serves the dual purpose of increasing membership and providing prospective members an easy way to obtain the required debit or credit card.[28,29] Capital Bikeshare also has introduced partnerships aimed at providing access for low-income and homeless individuals. In March 2012, it launched a pilot program with the non-profit Back on My Feet, offering memberships to homeless individuals who attended weekly fitness programs and educational/job-training programs. Members in the pilot program will be able to use bikesharing.

Public Transit Partnerships: Encouraging Modal Connectivity

Many experts consider partnerships between public transit and bikesharing key to public bikesharing's success. In August 2011, the Federal Transit Administration (FTA) established a formal policy on the eligibility of bicycle-system improvements for FTA funding that includes improvements located within three miles of a public transit stop.[30] Five operators (26%) indicated colocating bikesharing stations with public transit (n=19). Rates of colocation in the United States and Canada are comparable, 27% (n=4/15) and 25% (n=1/4), respectively. The colocation of bicycle fleets with public transit is much more common among larger operators. Four of the nine operators with medium-size and large fleets (fleets of 250 to 999 bicycles and fleets of more than 1,000 bicycles, respectively) colocate their bikes with public transit.

Public transit authorities can support both cycling and bikesharing in a variety of ways. Many provide bike parking and bike racks on buses and permit bicycles on trains. Increasingly, they are supporting bikesharing by colocating bike docks and public transit stations; integrating information and technology; providing information on transit routes, station maps, and bicycle availability; and exploring a common public transit/bikesharing card.

Experts we interviewed said that digital linking (i.e., integrating real-time data, apps, websites, and online maps) with public transit was critical. As of May 2012, no North American bikesharing operator had a common bikesharing/transit card. Seven public bikesharing operators out of 19 IT-based operators (37%) did have integrated bikesharing transit maps, although they were more common in the United States than in Canada—40% (n=6/15) and 25% (n=1/4), respectively. Not surprisingly, operator size is a key factor in integrating public transit and bikesharing maps. Sixty-seven percent of the medium-size and large operators (those with fleets exceeding 250 bicycles) have integrated transit

and bikesharing maps (n=6/9). Public transit discounts and collaboration with carsharing operators are other partnerships that could encourage public bikesharing and modal connectivity. Bikesharing member/transit specials are employed in only 12% of programs (n=2/17), both of which are located in Canada. Two operators we interviewed were uncertain whether their programs had any member/rider specials.

Other interesting approaches to public bikesharing include Communauto in Quebec, in which carsharing members who have public transit passes receive carsharing rebates, as well as taxi and public bikesharing discounts.[31] Denver's B-cycle plans to start co-marketing with eGo Carshare to provide bikesharing and carsharing services. We found several examples of transit/bikesharing integration and anticipate that this will be a key area of development in the coming years.

LAND USE AND INFRASTRUCTURE

Key land-use issues in North American bikesharing include the location of bike stations on public versus private land, the distance between docking stations, the proximity of docking stations to public transit, and supportive bicycle infrastructure.

Public versus Private Land

Five of the IT-based North American operators indicated that their public bikesharing stations were located entirely on public land, while another five were located mostly on public land. Two reported that their stations were located on private land, and three stated that their docking ports were located on both public and private lands, as illustrated in Figure 15. Fifteen operators responded to this question.
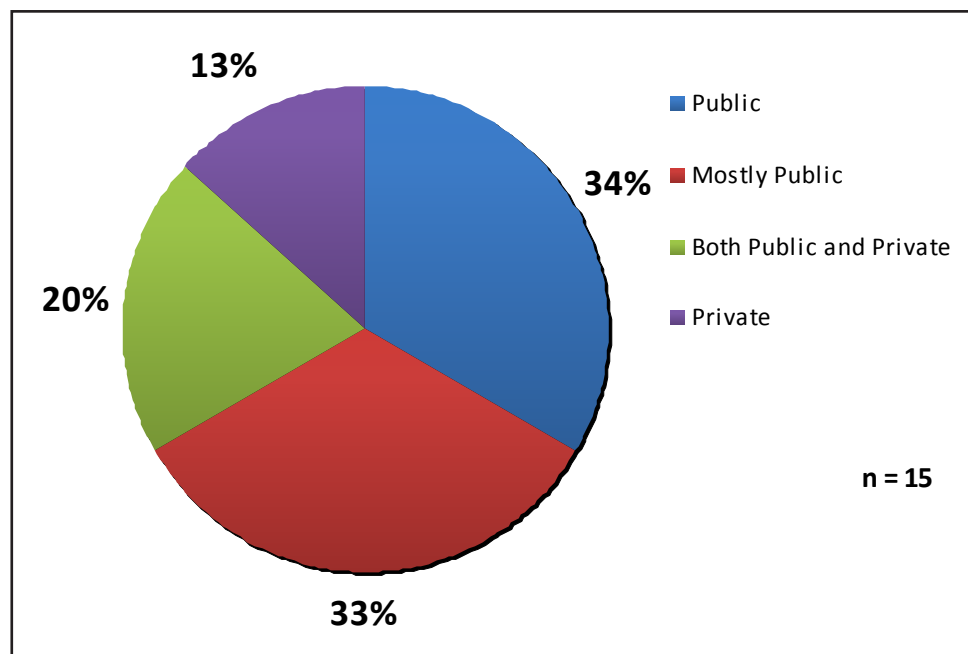

Figure 15. Public Bikesharing Station Locations (n=15)

All of the large operators that responded indicated using public land (n=2/2), in contrast to 67% of the operators with fleets ranging from 250 to 999 bicycles (n=4/6) and 86% of those with fleets of less than 250 bicycles (n=6/7). Experts indicated that in almost all cases, use of the land is free. In a few cases, sponsors pay operators to locate bikesharing on their property. In one isolated case, an operator had to pay for use of a municipal property. In San Francisco, public parking will be relocated to create space for public bikesharing. Although operators generally do not pay for the use of land, there have been instances where they had to either move or install on-street furniture as part of their agreement.

Distance Between Docking Stations and Public Transit Proximity

To target transit riders, we asked operators to assess the optimum distance between docking stations and the maximum distance from public transit (Figure 18). Figure 16 and Figure 17 compare the optimum distances between stations in the United States and Canada.

Two of the operators (10%) indicated that the optimum distance is between 100 and 300 yards, as shown in Figure 16. Ten (53%) reported that the optimum distance between stations is between 300 yards and one-quarter mile. Four (21%) indicated that the optimum distance is between one-quarter mile and one-half mile. One (5%) stated an optimum distance of one-half mile to three-quarter miles. Finally, two (11%) stated an optimum distance greater than three-quarter miles.
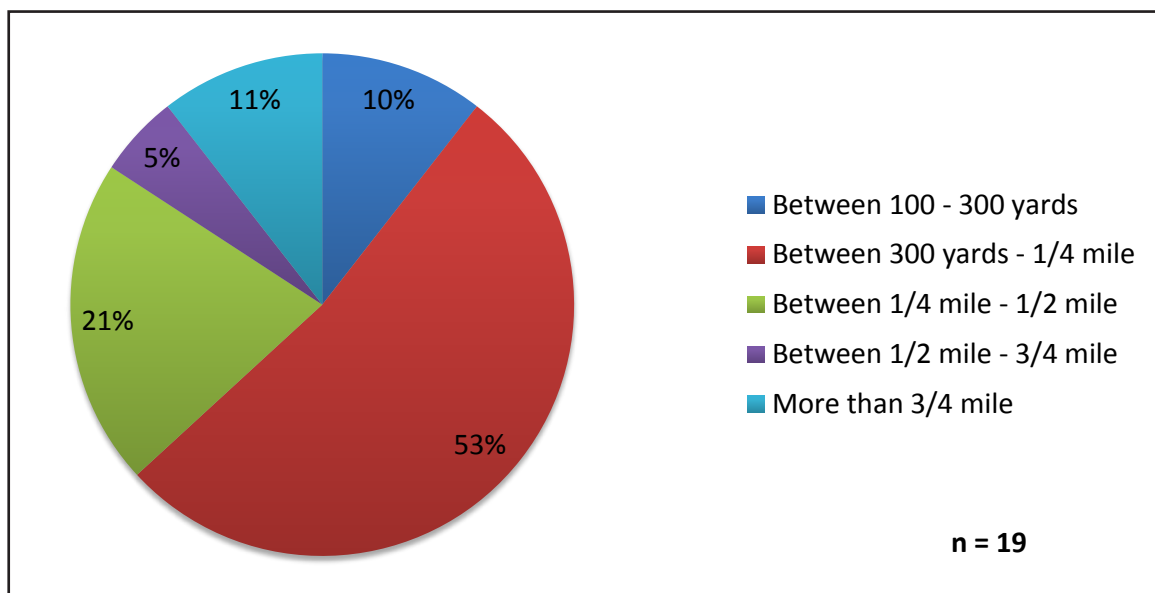
Figure 16. Operator Stated Optimum Distances Between Docking Stations (n=19)

Three responding Canadian operators stated that the optimum distance between docking stations is between 300 yards and one-quarter mile, as did seven of the U.S. operators. The other Canadian operator indicated an optimum distance of between one-quarter and one-half mile. U.S. operators reported a wider range: two assessed the optimum distance as between 100 yards and 300 yards; while another three assessed it to be between one-quarter mile and one-half mile. The complete distribution of responses by within-country percents is presented in Figure 17.
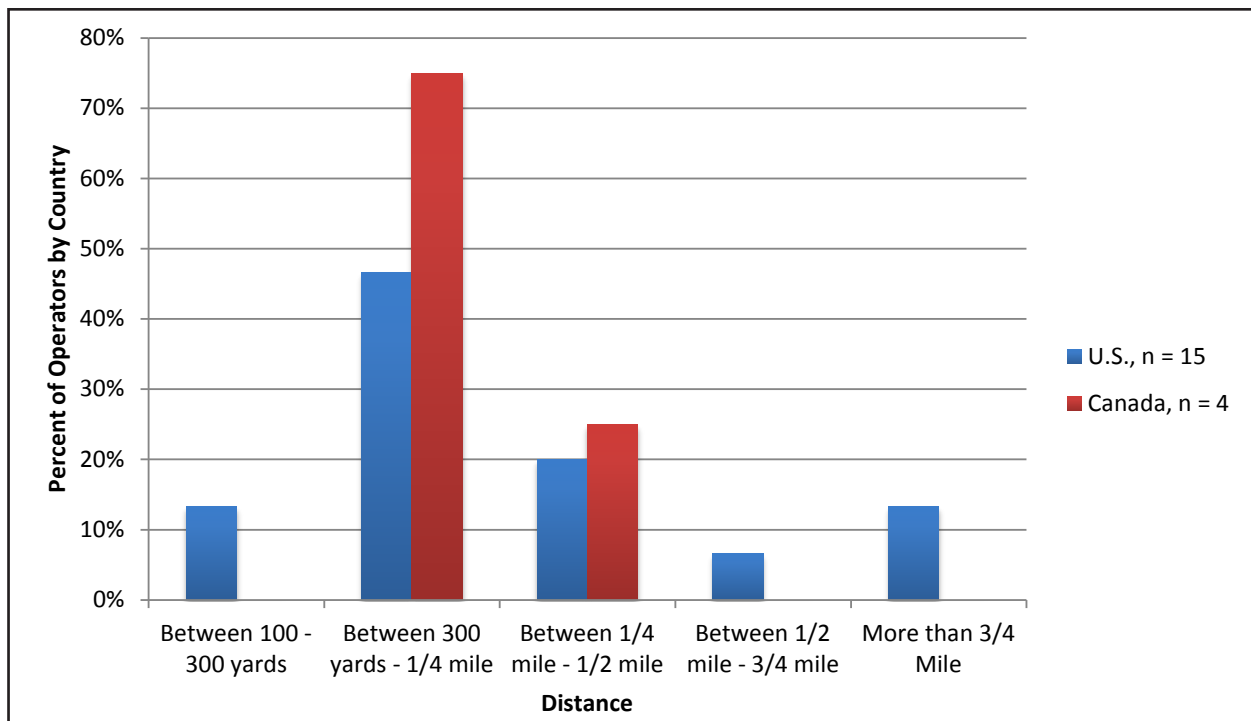
Figure 17. Operator Stated Optimum Distances Between Docking Stations in the United States and Canada (n=19)

Not surprisingly, operators with larger fleets prefer a closer spacing between docking stations. The average optimum distances between stations of larger fleets was generally shorter than those of smaller fleets. Closer distances help to reduce the operational costs associated with system rebalancing.

Three of nine respondents (33%) indicated that between 300 yards and one-quarter mile is the optimal maximum distance from a public transit station for docking stations, as shown in Figure 18. Three indicated a maximum distance of 25 yards, and another three indicated between 25 yards and 300 yards. This question had a low response rate—only 47% of the North American operators responded (9/19). Operators that did not actively attempt to integrate with their regional transit system either declined to answer or were not asked this question.

Figure 18. Optimal Distance from a Public Transit Station in the United States and Canada (n=9)

Supportive Cycling Infrastructure

Local governments can support public bikesharing through supportive cycling infrastructure. Bicycles and automobiles can interact through: 1) traveling on roadways with no designated bike lanes, 2) t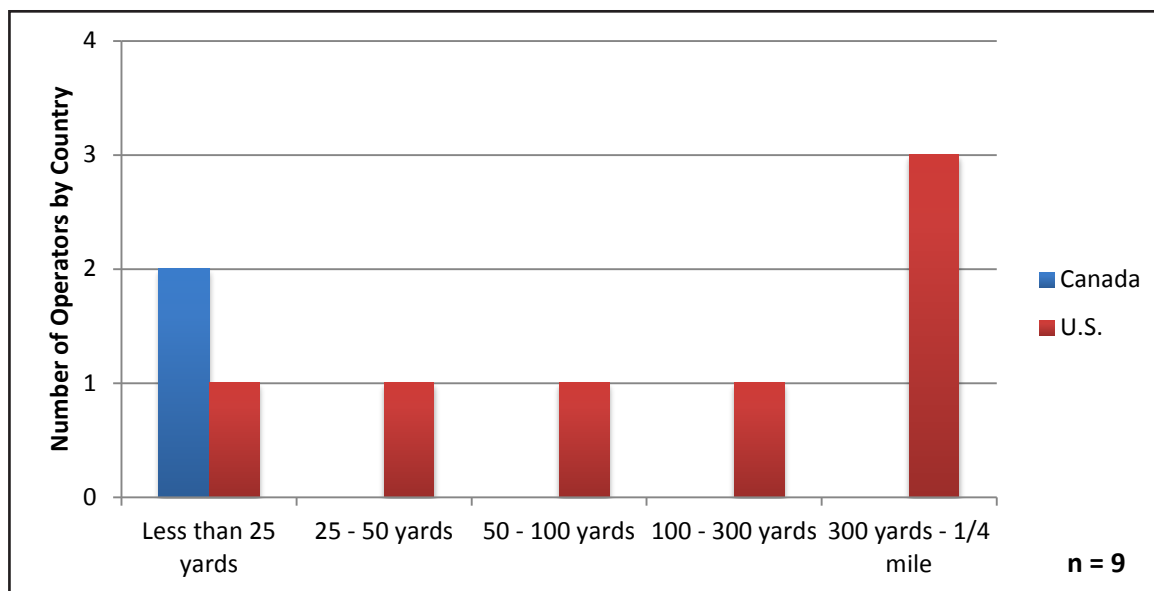raveling on roadways with colocated bike lanes, and 3) traveling on roadways with physically separated bike trails. Generally, investment in bike lanes tends to be least expensive because the existing roadway infrastructure can be used. Other infrastructure options include buffered bicycle lanes (diagonal stripping between traffic and bicycle lanes); bicycle tracks (adding barricades between on-street vehicle traffic and cyclists along on-street bike lanes), as illustrated in Figure 19; and bicycle boulevards (dedicating streets to bicycle traffic or encouraging cyclists to use specific traffic-calmed routes).[32] These strategies to support cycling have been incorporated in Berkeley, CA; New York City; Montreal; Portland, OR; San Francisco; Vancouver, BC; and Washington, DC.

Providing adequate bike parking is another important infrastructure measure. Although less critical with public bikesharing, since bicycles are docked at bike stations, policy experts interviewed stated additional bike parking can encourage bikesharing by offering infrastructure at intermittent stops between check-out and check-in of bikesharing bicycles. Providing bike parking can also encourage commercial activity by increasing the number of visitors to a location. A single-car parking space can be replaced with multiple-bicycle parking spaces.[33] Chicago, Minneapolis, Montreal, New York City, Portland, San Francisco, Toronto, Vancouver, and Washington, D.C., all have ordinances requiring a minimum amount of bike parking.[34,35,36,37,38,39,40,41,42] The majority of the ordinances require bike parking to supplement, not replace, vehicle parking. Although they vary by location, the ordinances typically mandate a minimum percentage of bike parking relative to vehicle parking or a minimum number of bike parking spaces per residential unit per square foot of commercial space.

Figure 19. Bicycle Tracks in Montreal

Source: http://thecityfix.com/files/2011/05/montreal_bikelane.jpg

BIKESHARING OPERATIONS

Bikesharing operations include seasons of operation, membership and age requirements for system use, system usage, theft and vandalism, accidents, liability insurance, and helmet laws and usage.

Seasons of Operation

Of the 19 programs interviewed, only seven (37%) operate year-round, as shown in Figure 20. The remaining 12 (63%) operate seasonally, although the length of the season depends primarily on the weather at the program location.
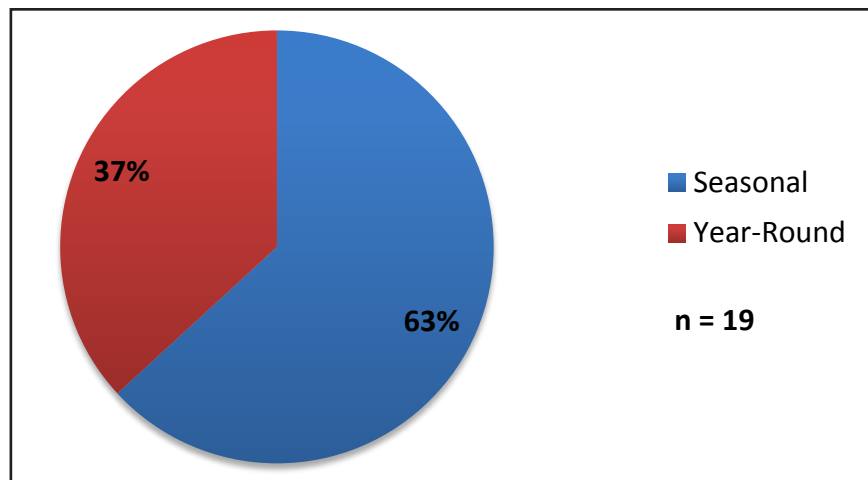
Figure 20. Seasonal vs. Year-Round Operations (n=19)

Membership and Age Requirements

Operators employ different definitions to classify their users. This is particularly evident when operators distinguish between members and non-members. Only one of the operators interviewed does not offer a membership option. The remaining 18 offer different levels of membership based on time commitment: day passes (often not included in membership

numbers), week passes, monthly memberships, and annual memberships. Membership was required by 11 of the 19 IT-based public bikesharing operators (58%). Interestingly, the largest six operators, measured by the size of their bicycle fleets (32% of the operators) do not require membership.

The minimum age is 18 years or older for most systems (95%). Only one operator, Omaha B-cycle, requires its users to be 19 years of age or older (due to the age of majority laws in the State of Nebraska). Eight systems enable younger riders to use the system if they have a valid driver's license, if they sign in through the account of their parental guardian, or both. The age requirements for younger users are 14 years and older for BIXI (Capital, Montreal, and Toronto) and 16 and older for Boulder and Denver B-cycle, Capital Bikeshare, New Balance Hubway, and Nice Ride Minnesota.

System Usage

In the expert interviews, operators also provided data on their typical trip purpose: recreational, non-recreational, or both. Of the 19 respondents, eight (42%) indicated that the typical trip purpose is for recreational use, eight (42%) reported typical use as non-recreational, and two (11%) indicated an equal division between recreational and non-recreational use, as shown in Figure 21.
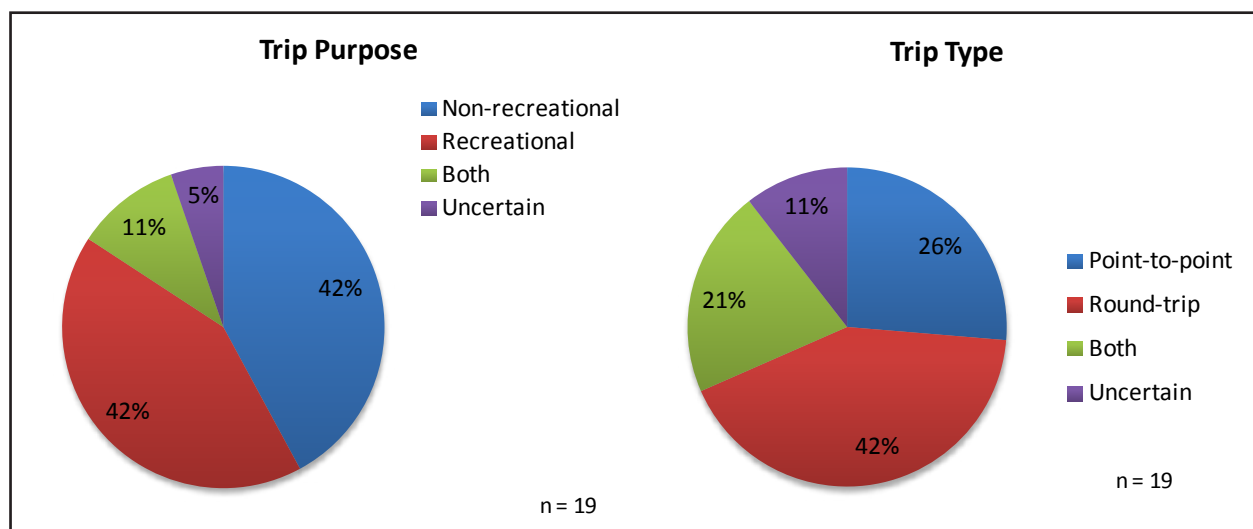
Figure 21. Trip Type and Purpose (n=19)

All of the three largest operators (with 1,000 or more bicycles) stated that their typical trip purpose is for non-recreational use. A number of operators also stated that the type of pass purchased frequently drives system use. For instance, day-pass users are much more likely to be recreational users, while annual members are more likely to use the system for commuting. In addition, some operators noted that system usage trends vary dramatically between weekends and workweeks.

Operators also provided data on whether the typical trip purpose in their system is point-to-point, round-trip, or both (Figure 21). Five of the 19 operators responding (26%) indicated that point-to-point trips are the most prevalent, while eight (42%) reported that round-trips

are most common. The remaining four (21%) stated that round-trip and point-to-point trips are equally common. Two operators were uncertain.

Theft and Vandalism

North American bikesharing operators measure theft data in two ways: 1) as the number of annual thefts in their system or 2) as a percentage of annual thefts in their system. Fifteen North American operators provided data on the number of bicycles stolen in 2011. Nine of them reported no thefts. Two operators each had one theft, and another reported a total of seven thefts in 2010 and 2011. Another three operators stated that less than 1% of bicycles in the system were stolen. Four operators either did not have theft data or declined to provide it.

One operator noted that use of a 24-hour camera monitoring system at each docking station was very effective in deterring theft and vandalism. Another operator reported vandalism on 5% to 6% of bicycles in the system. Fifteen North American operators provided data on the severity and types of vandalism incidents. One operator reported having two bicycles destroyed by vandalism, and ten North American operators indicated minimal vandalism involving graffiti, gum, air let out of tires, slashed tires, stolen bike locks, and locking bikes together. Four reported no vandalism in 2011.

The low rate of theft and vandalism among 19 IT-based bikesharing operators in the United States and Canada is due in part to the proprietary nature of the bikes, many of which have proprietary bolts, axle nuts, fenders, and handlebars. Eighteen of the operators (95%) employ a special bicycle design to reduce theft and vandalism, and all of the operators indicated that they employ gearing with antitheft and antivandalism technology. Other antitheft and antivandalism features include: non-removable seats, theft-deterrent fasteners, and the need for special tools to remove or alter parts.

> **The low rate of theft and vandalism among 19 IT-based bikesharing operators in the United States and Canada is due in part to the proprietary nature of the bikes, many of which have proprietary bolts, axle nuts, fenders, and handlebars.**

The industry experts and public agencies interviewed generally agreed that some degree of theft and vandalism would likely occur within public bikesharing systems, but they did not perceive it as a significant problem. A number of experts stated that public bikesharing systems in North America had experienced significantly lower levels of theft and vandalism than those in other countries or regions of the world. One expert indicated that increased system publicity resulted in a corresponding rise in the amount of vandalism, but he could not quantify the amount. Another noted total vandalism costs of less than US$5,000 in 2011. Most experts stated that vandalism usually occurred while bikes were docked rather than checked out. The experts also provided a number of key strategies that could be employed to minimize vandalism, most of which focus on reducing theft and vandalism while bicycles are docked.

They include the following:

> - **Locating stations in busy, well-lit areas;**
> - **Maintaining the appearance of the stations, as deterioration (e.g., graffiti) encourages further theft or vandalism;**
> - **Using graffiti-proof paint;**
> - **Establishing a mechanism for users, residents, and businesses to report suspicious activity;**
> - **Having local police periodically patrol public bikesharing stations;**
> - **Installing station cameras and improving station lighting; and**
> - **Selecting corporate sponsors that are "popular" to discourage vandalism that might be targeting a particular sponsor rather than the system itself.**

Accidents

Experts had very different views on what aspects of riding in traffic are the most dangerous for bicyclists. Two indicated right turns ("right hook") and "dooring" (when a car door is opened into an oncoming bicycle), while two others indicated left turns ("left hook") and buses. One expert reported that crashes increase in the winter and that light rail could be dangerous because bicycle tires can get caught in the rails. Another expert indicated that large vehicles, in any situation, constitute the greatest hazard for bicyclists. Finally, one expert reported that cyclists can endanger themselves when riding in traffic by not following signs, not stopping at intersections, going too fast, and wearing headsets.

Public bikesharing operators have numerous mechanisms for measuring the number of accidents in their systems. Of the 14 operators that provided accident statistics, accident rates were relatively low, averaging 1.36 accidents reported systemwide in North America in 2011. One noted an accident rate of approximately one accident for every 50,000 to 60,000 rides. Another reported one accident after approximately 100,000 miles of riding. Experts also indicated that the majority of accidents are relatively minor and that very few are serious or fatal. Some operators, including Capital Bikeshare, provide a 24-hour telephone number for reporting accidents.[43]

We found a slight correlation between program size (number of bicycles) and the average number of accidents reported per year. Operators with more than 1,000 bicycles had an average of 4.33 accidents reported per year; those with between 250 and 1,000 bicycles averaged 0.6 accidents reported a year; and those with less than 250 bikes had 0.3 accidents reported per year. Overall, the average number of annual accidents reported for the four Canadian operators was 2.75, compared with 0.46 for American operators.

In order to reduce accidents, a variety of road-design techniques geared toward addressing safety concerns have been developed. These include traffic-calming (e.g., speed bumps, medians, and raised intersections); painting bike lanes bright colors to increase visibility

to vehicular traffic; and adding advance stop lines for bicycle lanes to stop cyclists before potential turning conflicts.

Public Bikesharing Insurance

We interviewed 15 out of 19 IT-based public bikesharing programs to understand their insurance coverage; three respondents only acknowledged carrying insurance but declined to provide additional details due to proprietary concerns. The other operator neither responded nor confirmed carrying any type of insurance coverage. In June 2012, we conducted five expert interviews with brokers, underwriters, and attorneys with experience in public bikesharing insurance. Some insurance underwriters identified in North America include: Burlington Insurance, Citadel Insurance Services, CNA, First Mercury Insurance Company, Great American Insurance Group, The Hartford, Hays Companies, Horizon Agency, Inc., Kinsale Insurance, Lloyd's, Municipal Insurance Association of British Columbia, and Philadelphia Insurance Companies.

> **Some insurance underwriters identified in North America include: Burlington Insurance, Citadel Insurance Services, CNA, First Mercury Insurance Company, Great American Insurance Group, The Hartford, Hays Companies, Horizon Agency, Inc., Kinsale Insurance, Lloyd's, Municipal Insurance Association of British Columbia, and Philadelphia Insurance Companies.**

The experts indicated that public bikesharing insurance varied considerably based upon the operator's business model. This is because local governments, non-profits, and for-profits have different insurance requirements and may have existing policies that could be extended to cover bikesharing systems as well (e.g., local governments and public transit agencies). Seven types of common insurance policies were identified that could be applicable to public bikesharing, as listed in Table 8.[44]

Table 8.   Overview of North American Bikesharing Insurance

Types of Bikesharing Insurance	
General Commercial Liability	Protects from public and product liability risks that may include bodily injury or property damage caused by direct or indirect actions of the insured. Liability insurance is designed to offer protection against third-party insurance claims (e.g., someone who suffers a loss either from using a bikesharing system or a loss of a non-user resulting from the use of a bikesharing bicycle). Generally, unless self-insured by a sponsor or local government entity, most North American bikesharing programs carry some form of liability coverage. One broker indicated that the minimum premium for liability coverage started at US$5,000 annually for a basic US$1M policy.
Constructive Total Loss	Insurance covering repair costs for an item that is more than the current value of that item. It can also refer to an insurance claim that is settled for the entire property amount on the basis that the cost to repair or recover the damaged property exceeds its replacement cost or market value.
Worker's Compensation	A form of insurance providing wage replacement and medical benefits to employees injured in the course of employment in exchange for mandatory relinquishment of the employee's right to sue his or her employer for the tort of negligence.
Commercial Automobile	Provides financial protection against physical damage and/or bodily injury resulting from traffic collisions and against liability that could also arise. In public bikesharing, this insurance is generally applied towards employees that rebalance bikes using trucks or any other program vehicles, if applicable.
Professional Liability (Errors and Omissions)	A form of liability insurance that helps protect professional advice and service-providing companies from bearing the full cost of defending against a negligence claim made by a user and damages awarded in such a civil lawsuit.
Inland Marine	Indemnifies loss to moving or movable property (e.g., the shipment of bikes and kiosks after purchase).
Rigger's Liability	Insurance designed to protect the movement and relocation of kiosks (specifically when kiosks are relocated using cranes).

Specific to general liability coverage, the experts indicated that a particular challenge is developing one coverage limit that meets the requirements for all property owners (public and private) with kiosks on their land. The minimum liability coverage for property owners with bikesharing kiosks on their property often reflects the highest limits required by an entire group of property owners. According to the experts interviewed, this can make liability policies cost prohibitive, if a property owner requests an excessively large limit over other land owners (e.g., US$10M of liability coverage when other property owners only require US$3M). As such, the operator and the broker must negotiate a coverage level that is acceptable to all property owners with bikesharing kiosks. Generally, the operators do not insure individual bicycles because repair or replacement costs would be less than the typical deductible. However, according to one insurance broker, a few operators have insured bicycles while they are parked in the kiosk (in the case of kiosk loss) and in storage for seasonal programs. One broker thought the recommended coverage level

for bikesharing is US$2M in constructive total loss, with an additional US$5M umbrella policy. A constructive total loss is a situation where repair costs and salvage costs equal or exceed the value of the insured item. An umbrella policy typically refers to a policy that protects the assets and future income of a bikesharing program in addition to their primary policies.

The experts indicated that there are three key factors that determine premiums: 1) geographic location, 2) limits and deductibles, and 3) system usage. These are explained in greater detail in Table 9.

Table 9. Key Factors Used To Determine Public Bikesharing Insurance Premiums

Geographic Location	Geographic location is one of the factors insurers use when pricing a public bikesharing policy. Bikesharing insurance rates can change based on the following: • *Urban vs. Rural:* Bikesharing programs in urban areas generally pay more for insurance than those operating in rural areas because the likelihood of an accident or theft increases where populations are larger. However, if a rural program is in a region where dangerous weather is a constant concern, insurance rates may be higher due to the increased risk of damage. • *Litigious Nature* of the area where a program is operating. • *State Tort Laws:* Some states may require certain types of coverage, which can increase premiums.
Limits and Deductibles	• *Coverage Limit* refers to the highest dollar amount an insurance company will pay for a covered loss. Higher coverage limits increase premium costs. • *Deductible* is the portion of out-of-pocket expenditures that the bikesharing program agrees to pay when a claim is made against the insurance policy.
System Usage	• There are various ways of measuring system use. This can include the number of users, bicycles, or rides within a system. Generally, number of bikesharing rides is viewed as the most accurate measure of system usage. Higher system use results in higher premiums.

In addition to these key factors, insurance premiums can be designed around: 1) percent of kiosk sales (e.g., percent of ridership revenue); 2) percent of gross revenue (e.g., percent of total revenue including ridership, sponsorships, advertising etc.); and 3) number of rides (e.g., premiums based on how often the bicycles are used). Percent of kiosk sales were indicated to be a sub-optimal method of structuring premiums because many operators include a certain amount of free usage built into their system. Gross revenue was the least preferred method because including advertising revenue, along with kiosk sales, does not lead to increased risk. Finally, structuring premiums based on number of rides was perceived to be the most fair and accurate method, as the number of rides can be correlated to the amount of usage and program risk an operator confronts.

The four most common types of insurance coverage carried by United States and Canadian bikesharing operators include: general liability coverage, worker's compensation,

commercial auto, and inland marine coverage. Three operators indicated that their total insurance costs represented less than 5% of their total operating costs.

General Liability Coverage

Due to the proprietary nature of insurance coverage, only nine of the 15 U.S. operators were able to provide details on their program's liability coverage. These programs maintained a general liability policy with coverage ranging from US$1M to $5M, with limits ranging from US$500,000 to $2M per an occurrence and deductibles ranging from US$1,000 to $10,000. Another program had a limit of US$1M per an occurrence. One insurance broker interviewed recommended a US$2 to 5M general liability policy, with a US$5,000 deductible and a limit of US$1M per claim.

Two operators reported paying an average cost of US$8,416; premiums range from US$5,000 to $11,832 annually for this coverage. As of May 2012, only two operators noted having a total of 16 successful liability claims. Fifteen of these claims belonged to one large operator with more than 1,000 bicycles. Two ways that public bikesharing operators manage risk is through regular scheduled maintenance of their fleets and through user liability waivers. All 19 North American operators require users to sign a liability waiver prior to using the system.

Workers' Compensation

Five programs indicated carrying workers compensation coverage, with coverage varying from US$100,000 per accident up to $500,000. Premiums for this coverage ranged from US$684 to $7,920 annually. As of May 2012, one of these five programs reported having one workers' compensation claim.

Commercial Auto Coverage

Four programs provided information on their commercial auto policies. Although these policies were largely dictated by state law, these programs maintained coverage including: US$500,000 per occurrence and US$3M per vehicle, with varying comprehensive and collision deductibles, averaging US$500 and $1,000, respectively. The annual premiums for these policies averaged US$4,000.

Inland Marine Coverage

Two programs indicated carrying inland marine coverage. Their insurance carried a maximum limit of US$1,000 per an item and up to US$500,000 per an occurrence. The average cost of this coverage was US$5,146 annually. In addition to inland marine coverage, one insurance broker indicated selling rigger's insurance (i.e., insurance for a contractor's liability arising from moving property and equipment that belongs to others, such as lifting bicycle kiosks with a crane), providing special coverage for the movement and installation of stations, particularly when handled by cranes and other construction equipment.

Miscellaneous Coverage

One multi-program operator maintains a combined insurance policy covering five programs under one policy. The coverage combines policies from a number of underwriters and includes general liability coverage, auto insurance, property insurance, workers' compensation, professional insurance, and errors and omissions coverage. The total value is CA/US$50M across all five programs, with an approximate annual cost of CA/US$100,000.

> **All 19 North American operators require users to sign a liability waiver prior to using the system.**

Two programs maintained umbrella policies, with coverage ranging from US$640,000 to $3M per claim. The deductibles for these policies were US$1,000, and the cost of these policies averaged US$3,254. Only one program had coverage for individual bicycles. This program had a theft deductible of US$1,000. Recall that program operators reported low rates of theft and vandalism overall. Nine operators reported no thefts. Two operators had one theft, and another reported a total of seven thefts in 2010 and 2011. Another three operators stated that the percentage of operational costs used to pay for theft averaged 2.7% of their annual operational expenditures.

Bikesharing Insurance in the Future

Insurance brokers were also interviewed regarding industry standards, both insurance and risk management strategies, such as standardized bicycle maintenance and inspection schedules. While the brokers agreed that the development of a standard insurance coverage or policy would be positive for the industry, they also had concerns about establishing industry standards. In particular, one expert indicated that new startup programs could suffer because they might not be able to keep pace with the revenue required to maintain a high level of coverage. Additionally, another broker was concerned that industry standards (e.g., bicycle maintenance schedules) would collectively raise the cost of doing business among all public bikesharing operators and place other operators that are in non-compliance with those industry standards at greater risk for potential claims.

More broadly, the experts indicated a fair amount of concern regarding public bikesharing insurance in the future. Because accident rates and claims have been very low, experts are concerned that as bikesharing becomes more mainstream there could be an increase in the number of claims. They also expressed concern about the creation of negative case law (e.g., excessive personal injury settlements), as bikesharing becomes more commonplace. However, one broker speculated that there will more likely be an increase in claims against vehicle drivers involved in bikesharing accidents in contrast to claims against the bikesharing operator. However, if there is an increase in the number of claims, the experts expressed concern that premiums would increase and either make insurance cost prohibitive or completely unavailable for either existing programs or new entrants.

Helmet Laws and Usage

In addition to roadway design, helmet laws are a key policy measure aimed at making cycling safer. Helmet laws are generally perceived by public bikesharing experts and users as an obstacle to bikesharing use because of the inconvenience associated with

carrying a helmet, lack of availability for last-minute trips, and the challenges associated with providing sterile shared-use helmets. As of April 2012, Golden Community Bike Share (Golden, BC) was the only program in which helmet use was required, due to the fact that British Columbia implemented a mandatory helmet law for all ages in 1996.[45] The organization offers complimentary helmets with each bike rental. Seven additional operators offer helmets, although use is not mandatory. Three of them sell helmets at a central location operated by the bikesharing provider (Chicago B-cycle, DecoBike, and San Antonio B-cycle), and two offer helmets for purchase when members join (Capital Bikeshare and New Balance Hubway). Additionally, two operators previously provided free helmets as part of memberships (Denver B-cycle and Nice Ride Minnesota). Many operators offer helmets through partnerships with local bike stores and provide helmet purchase discounts.

An anonymous operator indicated that it had recently completed a study on helmet usage within its system. Thirty-two percent of the members used a helmet, compared with a rate of 72% helmet use among all bicycle riders citywide. While experts agreed that users would prefer to wear helmets, most do not wear them while using public bikesharing due to the inconvenience of carrying one. A study conducted by the Beth Israel Deaconess Medical Center of more than 3,000 cyclists at 43 bike stations in Washington, D.C. and Boston found that more than half of the cyclists did not wear helmets, and 80% of bikesharing users did not wear them.[46]

Industry experts, public agencies, and policymakers indicated that individuals may or may not choose to use public bikesharing on the basis of helmet availability and perceived risk. Some also noted that individuals making shorter trips and spontaneous users were less likely to use helmets than commuters. Experts generally agreed that if a helmet law were required in their region, an exemption for public bikesharing would encourage use. Indeed, Melbourne Bike Share (Melbourne, Australia) has received some attention among the bikesharing industry for its local helmet laws, which many experts hypothesize have limited the program's success. The program's 600-bicycle fleet averages 70 trips per day, 10% the usage of comparable programs in London and Dublin, not accounting for differences in density and land use.[47,48]

In Vancouver, BC, three private companies are developing options for providing sterile shared helmets, including a helmet-rental sanitizing machine and disposable helmets (e.g., SandVault's HelmetStation, a fully integrated helmet-dispensing system that sanitizes the helmets upon return, shown in Figure 22).[49]

Helmet Station	Manufacturer	Use
	SandVault www.sandvault.com	BikeshareBC (planned)

Figure 22. An Innovative Helmet Station

PUBLIC BIKESHARING TECHNOLOGY

Public bikesharing technology in North America includes the following topics: bicycle types, bicycle accessories, bicycle tracking, bicycle and docking-station costs, dock and kiosk types, location bicycles and bicycle availability, system balancing and demand management, and levels of IT implementation.

Bicycle Types

As shown in Figure 23, as of April 2012, 53% (n=10) use Trek bicycles, 31% of the 19 IT-based operators (n=6) use PBSC Urban Solutions bicycles, 5% (n=1) use the DecoBike Cruiser, and 11% (n=2) used bicycles of other brands, such as Kona and Worksmith. DecoBike uses a custom-built bicycle exclusively for its system. Three-speed bicycles are used by 89% of the operators (n=17), and one-speed bicycles are used by 11% (n=2).
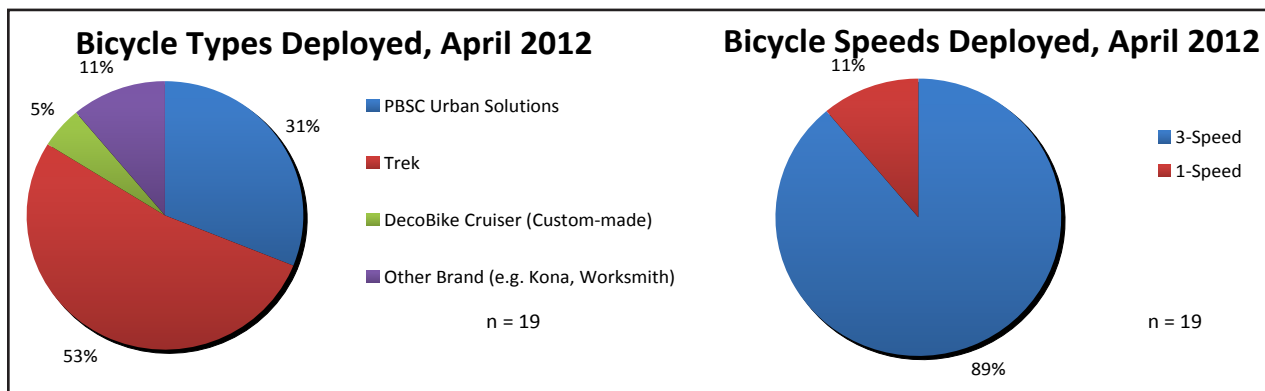

Figure 23. Bicycle Types and Speeds Deployed, as of April 2012 (n=19)

Seventeen of 19 IT-based operators (89%) also use bicycles specifically built for their organization, while two (11%) use bicycles purchased off-the-rack. Thirteen of the operators that had more than 100 bicycles used bicycles specifically built for their organization. While none of the current operators have deployed electric bicycles yet, City CarShare in San Francisco plans to launch an electric bicycle fleet in conjunction with its carsharing fleet in 2012/2013. Pictures of common bikesharing bicycles are included in Table 10.

Table 10. Bicycles Used in IT-based North American Public Bikesharing Programs

Bicycle	Manufacturer	Vendor	Use
	Cycles Devinci	PBSC Urban Solutions www.bixisystem.com	BIXI Montreal, BIXI Toronto, and Capital BIXI; Capital Bikeshare; New Balance Hubway; Nice Ride Minnesota
	DecoBike	DecoBike www.decobike.com	DecoBike
	Kona	SandVault www.sandvault.com	Golden Community Bike Share
	Trek	B-cycle www.bcycle.com	Boulder B-cycle, Broward B-cycle, Chicago B-cycle, Denver B-cycle, Des Moines B-cycle, Hawaii B-cycle, Madison B-cycle, Omaha B-cycle, San Antonio B-cycle, and Spartanburg B-cycle
	Worksman Cycles	SandVault www.sandvault.com	Tulsa Townies

Bicycle Accessories

Not surprisingly, a majority of the 19 IT-based programs (63%) equip their bikes with self-generating lights (n=12), and 32% equip them with regular lights (n=6). Only one operator did not equip its bicycles with lights, in order to deter users from using the system at night. Sixty-eight percent of the 19 programs (n=13) equip their bicycles with bells and baskets, and 37% (n=7) equip them with luggage racks.

Bicycle Tracking

Tracking mechanisms can aid operators in fleet management and the retrieval of lost or stolen bicycles. Eighteen of the 19 IT-based operators (95%) indicated that they use RFID technology, and seven (37%) reported using both GPS and RFID technology. One operator uses neither of these technologies. One of the operators using only RFID technology indicated that it planned on converting to GPS technology in the near future. Not surprisingly, the majority of GPS applications are in organizations launched in 2011 and later. Of the 12 programs launched in 2011, 42% (n=5) use both RFID and GPS. Operators reported that bicycles are tracked at check-in and check-out when docked and undocked. In most systems, GPS technology is used not to track the bicycles, but to enable members to track their distance traveled (miles or kilometers), calories burned, and carbon offset, through the operator's website.

Bicycle and Docking-Station Costs

Operators were asked about their bicycle and docking-station costs, including the operational costs to manage their infrastructure. Ten operators provided per-bicycle cost estimates, ranging from US$750 to $7,000, with an average cost of about US$1,800. The other operators declined to provide costs for their bicycles.

Vendors usually sell complete station systems that include bicycles, kiosks, map frames, customer keys, spare parts, supplies, and shipping.[50] Only five operators provided data on the cost of docking stations. The average was US$39,550 per station. Other studies have documented station costs ranging from US$26,064 to $58,000. According to one, the cost of a small station (four bicycles and seven docks) is US$26,064. A larger station (13 bicycles and 19 docks) costs up to US$52,275.[51] An operator survey performed by Toole Design Group, LLC, between November 2011 and January 2012, noted equipment and installation costs ranging from US$35,000 to $58,000 per docking station with 11 to 19 docks.[52]

Four of the operators we interviewed provided cost estimates for relocating a mobile station, which averaged US$4,000. Another study indicated relocation costs of US$1,000 to $1,500 for Capital Bikeshare docking stations in Washington, D.C.[53]

According to Toole Design, annual operating costs range from US$12,000 to $28,000 for a docking station with 11 to 19 docks.[54] Capital Bikeshare reported total annual operating costs of US$2 million, with an average of US$1,860 per bike.[55]

Dock and Kiosk Types

As of April 2012, three vendors provided kiosks and docking stations: PBSC Urban Solutions, B-cycle, and SandVault. Pictures of common bikesharing docks and kiosks are included in Table 11.

Table 11. **Docking Stations Used in IT-based North American Public Bikesharing Programs**

Docking Station	Manufacturer	Use
	Kiosk Information Systems www.kiosk.com	Boulder B-cycle, Broward B-cycle, Chicago B-cycle, Denver B-cycle, Des Moines B-cycle, Hawaii B-cycle, Madison B-cycle, Omaha B-cycle, San Antonio B-cycle, and Spartanburg B-cycle
	SandVault www.sandvault.com	Golden Community Bike Share; Tulsa Townies
	SandVault www.sandvault.com	DecoBike
	PBSC Urban Solutions www.bixisystem.com

8D Technologies www.8d.com | BIXI Montreal, BIXI Toronto, and Capital BIXI; Capital Bikeshare; New Balance Hubway; Nice Ride Minnesota |

Ten of 19 IT-based operators (53%) use B-cycle docks and kiosks, six (32%) use PBSC Urban Solutions/8D Technologies docks, and three (16%) use stations designed by SandVault. Ten of 19 operators reported (53%) use mobile docks that can be relocated, five (26%) use fixed docking stations, three (16%) using both, and one (5%) was uncertain. Station specifications are shown in Figure 24.
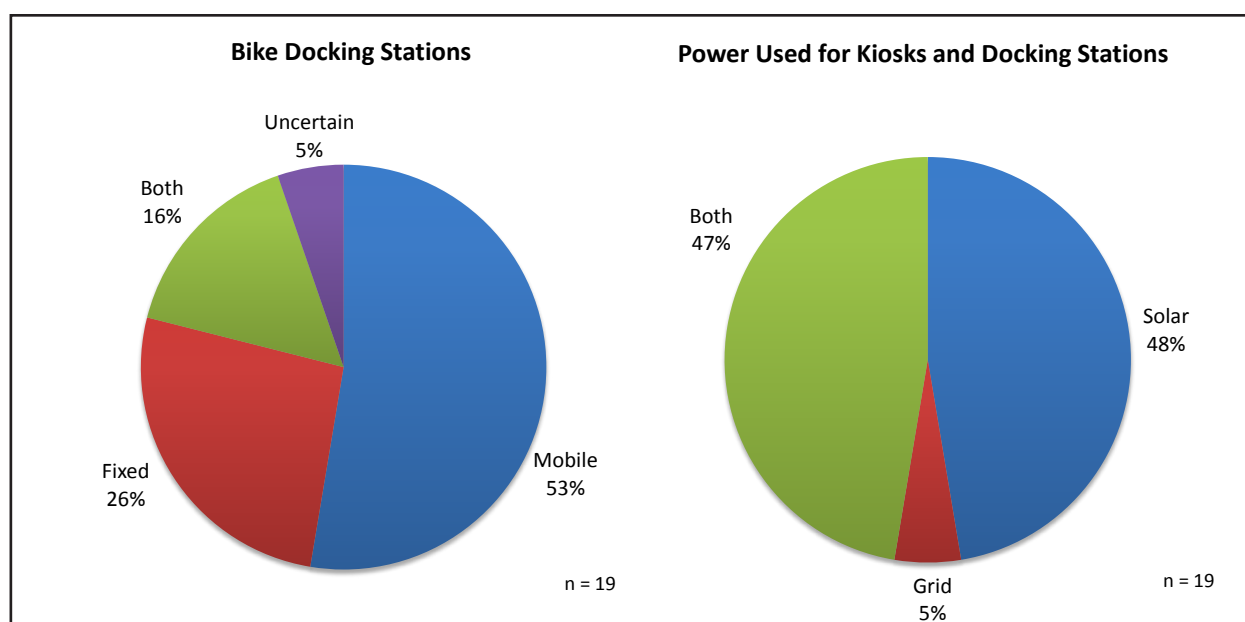
Figure 24. Docking-Station Specifications (n=19)

While the majority of operators use mobile docking stations that can be relocated, most stated that they either did not plan on moving them or rarely moved them. Nine of 19 IT-based operators (47%) use solar power exclusively for their kiosks and docking stations, and nine (48%) use a combination of solar and grid power. Only one uses grid power exclusively. (Note one grouping rounded to 48% to equal 100%.) The primary reason experts gave for using grid-powered systems instead of solar was insufficient sun exposure due to either building cover or weather. All of the planned programs that provided data on their proposed docking stations anticipated using solar power. Finally, the number of ports at each docking station ranged from seven to 130, averaging 20 per station.

> **While the majority of operators use mobile docking stations that can be relocated, most stated that they either did not plan on moving them or rarely moved them.**

All public bikesharing programs require a user interface to check bicycles in and out. These interfaces typically require users to register prior to bicycle check-out. Preregistration can create usage barriers (e.g., because of time constraints, credit card use), but it tends to increase system accountability and it discourages theft. The most common tools for bicycle access are smartcards, smart keys, and access codes. As shown in Figure 25, 11 of the 19 IT-based operators (58%) employ smartcards, six (32%) use smart keys, and two (10%) use access codes to retrieve bicycles in their systems. Four (24%) operators of the 17 that use either smart keys or smartcards also employ access codes to allow non-members to access the system.
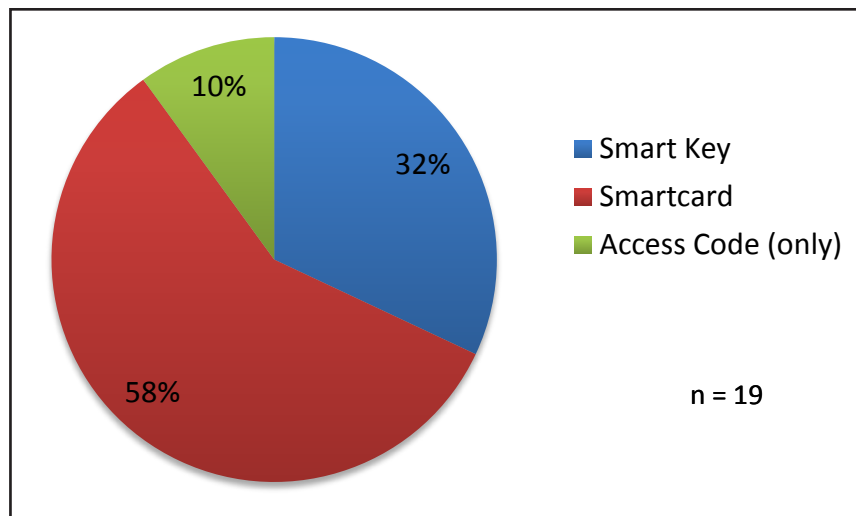
Figure 25. Bicycle Access (n=19)

When asked about payment methods, 13 out of 19 IT-based operators (68%) indicated that a credit card was required for system use, and six indicated that a debit card could be substituted for a credit card at their kiosks.

Twelve of 19 operators (63%) indicated that their stations had maintenance buttons that, when pressed by the user upon redocking, would automatically take bicycles out of service or send a dispatch signal that maintenance was required. Eighteen of the operators (95%) have liquid crystal display (LCD) touch screens at their docking stations.

Locating Bicycles and Bicycle Availability

Operators generally reported having similar methods for users to locate a station for bicycle pickup and drop-off. Most provide access to real-time information both on the Internet and through a mobile app. A few programs distribute hardcopy maps in addition to those that are located on the stations themselves.

When asked about bicycle availability, all operators mentioned situations in which a user wanted to check out a bicycle at a station but one was not available. A few described systems that attempted to dispatch trucks to rebalance bicycles in real time, and others indicated that their kiosks provide information on nearby bicycles. Similarly, all operators described situations in which members try to return bicycles and are unable to do so because of lack of space at the docking station. Most indicated that users are provided with 15 minutes of non-charged time to help them find a station nearby. Frequently, kiosks show where space is available to check in bicycles at nearby stations.

System Balancing and Demand Management

To meet demand, public bikesharing organizations must maintain enough bicycles for users wanting to check them out and enough open docking ports for users wanting to return them. Operators employ a variety of methods to balance bicycle and dock availability at stations, including physically moving bikes or offering incentives for users to move them

to less-popular docking stations. Many operators strive to uphold a specific ratio of bikes to docking ports to minimize rebalancing efforts. When asked what bicycle-to-docking port ratio they aim to maintain, 17 of the 19 operators interviewed responded (see Figure 26). The average in North America is one bicycle to every 1.7 docking ports. Targeted bicycle-to-docking-port ratios are slightly higher in Canada (1:1.9) than in the United States (1:1.7). Across programs, bicycle-to-docking-port ratios range from 1:1.7 to 1:1.8, with the average being 1:1.8. Publicly owned and contractor operated programs (e.g., Capital Bikeshare, BIXI Ottawa, and New Balance Hubway) tend to have the higher ratios, generally 1:1.8; non-profits have an average ratio of 1:1.7.

> **Operators in the U.S. and Canada aim to maintain a combined target average of 1 bicycle to every 1.7 docking ports.**
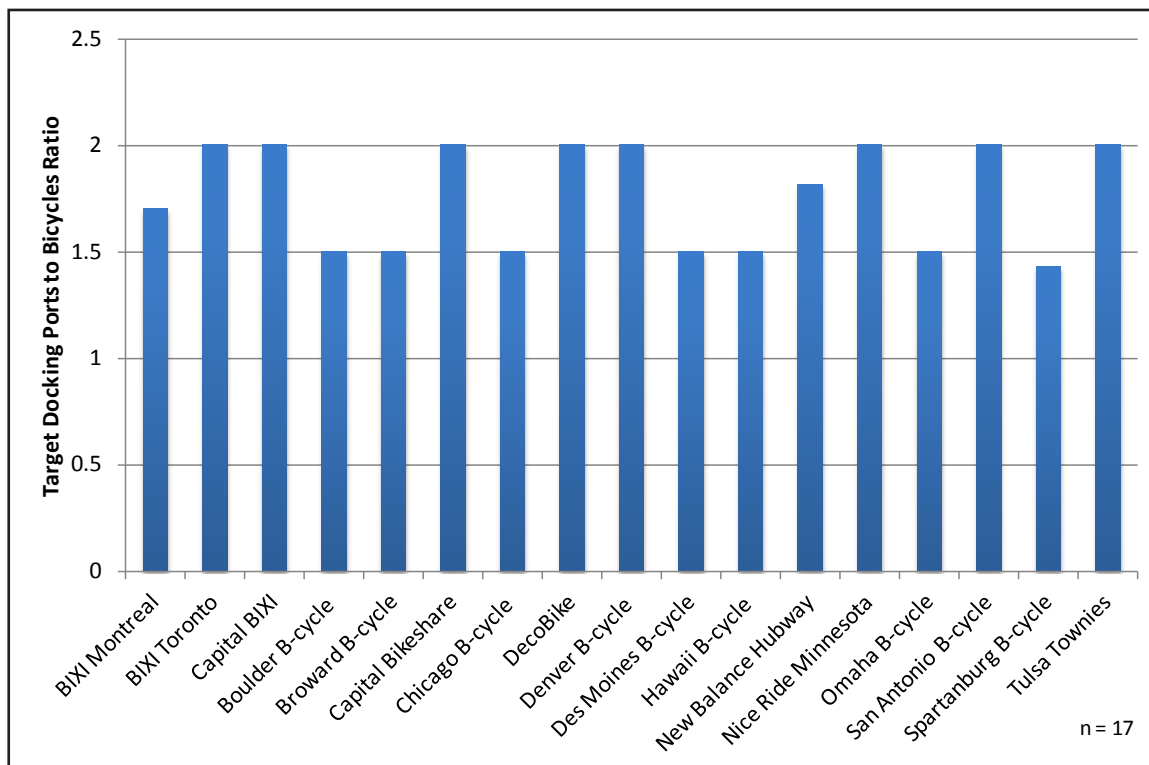
Figure 26. Bicycle-to-Docking-Port Ratio (n=17)

Despite their best efforts to maintain an adequate bike-to-docking-port ratio, all bikesharing operators indicated that they have to rebalance or redistribute bicycles throughout the system. Smaller programs (those with 250 bicycles or less) reported rebalancing frequencies of once or twice a season, whereas large programs need to rebalance continuously throughout the day. Ten out of 19 IT-based programs (53%) indicated rebalancing daily. Half of these programs rebalance their systems during peak public transit hours (i.e., 6 to 9 am and 4 to 7 pm), while three (30%) rebalance throughout most of the day, and two (20%) rebalance during the early morning (i.e., before 6 am). Methods used to manage supply and rebalance systems include trucks and trailers to move bikes, as well as incentives for users to park at stations that generally need bikes. In an effort to lessen their operational carbon footprint, some programs—including San Antonio B-cycle and Bike Nation LA (planned)— use or plan to employ sustainable transportation methods to rebalance their systems (see Figure 27 and Figure 28). San Antonio B-cycle uses a custom-made trailer pulled

by a battery-operated bike to rebalance. Some organizations reported using computer systems to monitor system balance in real time. In addition, one system plans to build a bicycle-docking depot at which users can dock their bikes when other stations are full. One expert indicated that lower urban densities frequently yield less need for rebalancing—often resulting in lower costs—but also less demand/revenue. The cost of rebalancing can be lowered by locating docking stations closer together. While rebalancing is clearly a challenge and operators are developing creative methods to maintain balance, they were not able to provide specific rebalancing costs.

Figure 27. Custom-Made Rebalancing Trailer, Nice Ride Minnesota

Figure 28. San Antonio B-cycle Rebalancing Vehicle Towed by Electric Bicycle

A few vendors have introduced the concept of dockless bicycle stations aimed at "dynamic self-rebalancing" (Figure 29); however, these systems had not been implemented by any of the IT-based bikesharing programs as of May 2012. Social Bicycles (SoBi), for example, has outfitted its bicycles with a solar-powered, GPS-enabled lockbox, eliminating the need for a docking station, but the lockbox concept has not yet been implemented. User incentives and disincentives both encourage dynamic self-rebalancing. For example, users who lock a bike outside of designated hub areas incur a fee, while those who return the bicycle to a high-demand location receive a credit. Dynamic pricing and dockless bikes can offer users more flexibility than traditional docking stations.

Figure 29. SoBi Dockless Bikes with Smartphone App and GPS-Enabled Lockbox

Photos From:

http://inhabitat.com/sobi-social-bicycle-sharing-system-makes-it-easy-to-find-and-rent-bikes/, http://www.wired.com/gadgetlab/2010/08/social-bikes-gps-tracked-phone-controlled-rides-in-nyc/

IT Implementation

There are three levels of technology implementation among the 19 IT-based programs in North America: 1) state-of-the-art, 2) state-of-the-practice, and 3) basic IT. We applied 22 different technology components to each category, then classified operators into a category based upon their implementation of at least 60% of the technology. Note if an operator had their own app, they received one point. If they also had a third-party app, they received an additional point. Thus, this category is worth up to two points, if a bikesharing program has both an operator and third-party app.

Classification in the basic IT category requires installation of automated docking stations; state-of-the-practice reflects the dominant technology trends in the industry; and state-of-the-art includes the most innovative technologies, which involve greater emphasis on public transit integration and improved user experience. See Table 12.

Table 12. IT-Implementation Classification and Definitions

Basic IT	Automated Docking Station	A station equipped with a kiosk and docking ports. The system mechanizes payment and bike parking, enabling users to retrieve and return bikes using smartcards, keys, or access codes.
State-of-the-Practice	Blog	A website or webpage, used explicitly to record opinions, news updates, and information.
	Email Listserv	An electronic mailing list used to communicate news updates and other information to members.
	Facebook Account	A Facebook page used to communicate news updates and other information to members. Facebook also provides a platform for additional user-to-user and user-to-operator communication.
	LCD Touchscreen on Kiosk	An electronic visual display located on the station kiosk that can detect the presence and location of a touch within the display area. Touchscreens are used to enhance user experience and system efficiency.
	Maintenance Button	A button located on the bicycle, docking port, or kiosk that enables users to alert system operators when bicycles or docking stations need repair.
	RFID Tracking	Radio Frequency Identification (RFID) is the use of a wireless non-contact system that uses radio frequency electromagnetic fields to transfer data from a tag attached to an object for the purposes of automatic identification and tracking. Operators use RFID to locate bicycles within the system and monitor station capacity.
	Real-time Data Available on Website	The system website displays a map of the system, showing station location and bicycle and docking port availability.
	Real-time Mobile Application	Also called mobile apps, mobile applications employ real-time data to provide news updates, program information, and a system map that displays station location and bicycle and docking port availability to users equipped with smartphones. Mobile apps can be designed by specific operators or third-party developers. Operators were evaluated on whether or not their organization had a mobile application specific to their organization, and/or if their users had access to an application designed by a third-party developer. Thus, this category can count up to two points, if a bikesharing program has both an operator and third-party app.
	Smart Card or Key Access	Smartcards are standard, credit card-sized cards, containing embedded integrated circuits. Members will insert the card into the kiosk, allowing them to pay more efficiently. Similarly, smart keys also contain embedded integrated circuits and are used for payment, but they are inserted directly into the docking port.
	Text Messaging Service	An opt-in service is used to communicate news updates and other information to members equipped with mobile phones.
	Twitter Account	Twitter accounts are used to communicate news updates and other information to members.
	User Data Dashboard	A website or webpage that provides users with personal system usage data, such as trip route and calories burned. Information is accessed through the user's personal account and employs a simplified user interface.
	Youtube Presence	Youtube is a website that is used to share information and marketing videos with members and is uploaded by the system operator. Operators may or may not hold an official Youtube account.
State-of-the-Art	Flexible Docking Stations	A mobile station equipped with a kiosk and docking ports that allows operators to transfer stations to different locations according to usage patterns and user demand.
	Clean Docking Stations	The use of solar-powered stations further reduces emissions and the need to secure access to an energy grid to support operations.
	GPS Tracking	Global Positioning System (GPS) is a satellite-based navigation system comprised of a network of satellites. GPS is used by operators to support better user metrics by tracking bicycle trips, allowing real-time rebalancing, and acting as a theft deterrent.
	Integration of Real-Time Data between Bikesharing and Public Transit Systems	The integration of real-time data from bikesharing and public transit systems, displaying bicycle and docking port availability in conjunction with transit arrival and departure times. Information is displayed on LCD screens in public spaces.
	Real-Time Relocation Technologies	Technologies that rely on real-time data to reduce the cost and impact of rebalancing stations by introducing more efficient redistribution methods (e.g., specially designed vehicles, real-time and/or automated technologies facilitating demand responsiveness, and incentives for user-based dynamic self-rebalancing).
	Technology to Assist and Minimize Rebalancing	Technologies used to assist in fleet management, either to encourage users to self-balance the system and/or provide operators with data that can be used for more effective and efficient system balancing.
	System Data Dashboard	A website or webpage that provides users and the general public with system usage data, such as the number of bicycles in service and the total number of trips per month. Information is available to the general public through a simplified user interface.

As shown in Figure 30, five of the 19 IT-based North American operators (26%) were identified as state-of-the-art, 12 (63%) as state-of-the practice, and two (11%) as basic IT. In the United States, five of 15 operators (33%) were categorized as state-of-the-art, nine (60%) as state-of-the-practice, and one (7%) as basic IT. In Canada, three of four operators (75%) were identified as state-of-the practice, and one (25%) was identified as basic IT. The use of GPS tracking technology is a key factor distinguishing state-of-the-art from state-of-the-practice.
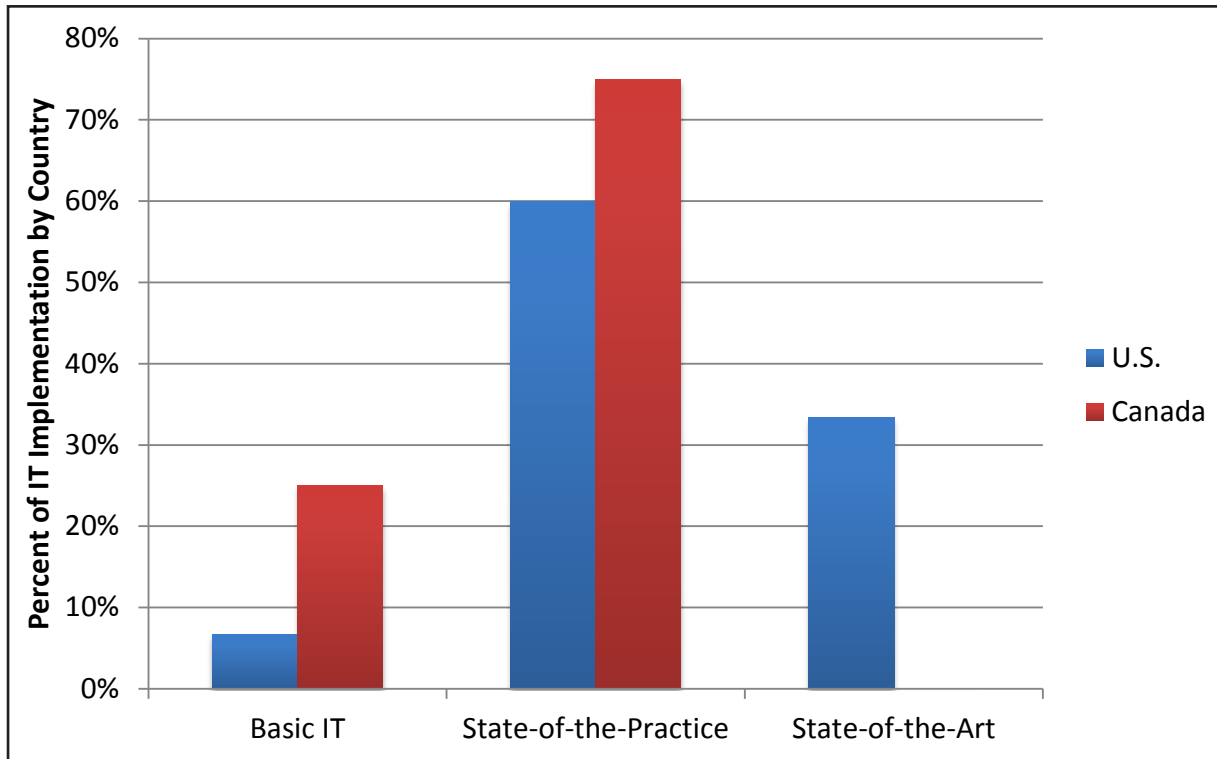
Figure 30. IT Implementation in the United States and Canada (n=19)

Communicating to members via Facebook, Twitter, YouTube, blogs, and other websites is commonplace among North American operators. Seventeen (89%) of 19 operators use Facebook, 17 use Twitter, four (21%) employ blogs, and four (21%) use YouTube. Seventeen of the operators use some type of mobile app, and 11 have developed an operator-specific app. BIXI is currently developing an app for its three systems— BIXI Montreal, BIXI Toronto, and Capital BIXI. SpotCycle, a mobile app developed by 8D technologies, is currently available for six systems and is planning to expand its availability to an additional 15 programs (see Table 13).

> **Communicating to members via Facebook, Twitter, YouTube, blogs, and other websites is commonplace among North American operators.**

Table 13. Mobile Apps Used in IT-based North American Public Bikesharing Programs

Mobile Application	Developer	Used by
	B-cycle www.bcycle.com	Boulder B-cycle, Broward B-cycle, Chicago B-cycle, Denver B-cycle, Des Moines B-cycle, Hawaii B-cycle, Madison B-cycle, Omaha B-cycle, San Antonio B-cycle, and Spartanburg B-cycle
In Development	BIXI montreal.bixi.com	In development; will be used by BIXI Montreal, BIXI Toronto, and Capital BIXI
	DecoBike www.decobike.com	DecoBike
	SpotCycle www.spotcycle.net	BIXI Montreal, BIXI Toronto, Boulder B-cycle, Broward B-cycle, Capital Bikeshare, Capital BIXI, DecoBike, Denver B-cycle, Des Moines B-cycle, Hawaii B-cycle, Madison B-cycle, New Balance Hubway, Nice Ride Minnesota, Omaha B-cycle, San Antonio B-cycle, Spartanburg B-cycle

Thirteen of 18 North American operators (72%) use email to communicate with members, and eight (44%) use a text-messaging service. One operator declined to respond when asked about email listserv and text-message communication with members. Eleven of the 18 operators (61%) have an in-house customer service (i.e., managed by the operator); five (28%) have a third-party customer service (e.g., routed through an offsite or out-of-town-vendor-operated call center); and two (11%) use both an in-house and a third-party customer service. Operators also noted that instructions and online videos (both on the Internet and at kiosks) are useful in conveying messages about how to use the system. Finally, operators indicated that the following information would be helpful for public bikesharing users:

- Integrated bikesharing system/public transit maps;

- Information on full stations (i.e., those with no bike parking);

- Estimated travel times;

- Quick response codes on maps, kiosks, and printed information (barcodes that can be read by smartphones, directing users to a program's website);

- Integration of public bikesharing apps with other useful apps;

- Elimination of the delay in getting data to the app (making it truly real time); and

- Printed maps showing bikesharing locations, recommended bike routes and infrastructure, public transit stations, and routes.

SUMMARY

Operator and stakeholder interviews provided information on the growth of public bikesharing in the United States and Canada. Since 1994, there have been 32 program startups and nine program closures in the United States and eight program launches and two program closures in Canada. As of January 2012, there were 15 IT-based public bikesharing systems in the United States, with 172,070 members and 5,238 bicycles. By January 2012, Canada had four IT-based bikesharing organizations, with more than 44,352 members and 6,235 bicycles. The combined average member-to-bicycle ratio in the United States and Canada was 19:1. Operators in the U.S. and Canada aim to maintain a combined target average of 1 bicycle to every 1.7 docking ports. As of January 2012, the majority of bikesharing programs were non-profits. Seventeen additional programs are planned to launch in 2012 in the United States, and one is planned in Canada.

North American programs support their operations through a combination of startup and operational funding sources, primarily sponsorships and user fees. Revenue-enhancing partnerships, partnerships with public transit, and collaboration with institutions to ensure equity and service access are key to bikesharing success. More than half of the operators interviewed indicated that the optimum distance between stations is between 300 yards and one-quarter mile. Over 40% of the operators reported that the typical trip is round-trip. Theft, vandalism, and accidents were reported to be relatively minor challenges. Still, all North American operators require a liability waiver. While public bikesharing programs in the United States carry a variety of insurance coverage, the four most common include: general liability, worker's compensation, commercial auto, and inland marine.

While the vast majority of programs employ similar technologies and have been classified as state-of-the-practice, we categorized five programs as state-of-the-art. The principal distinguishing factor between state-of-the-art and state-of-the-practice programs is the deployment of GPS systems that support real-time tracking, real-time data integration with public transit, and system dashboards.

IV. USER SURVEY AND BIKESHARING IMPACTS

We implemented our user survey between November 2011 and January 2012 across early public bikesharing systems operating in four locations in North America: Montreal (n=3,322); the Twin Cities (Minneapolis and Saint Paul) (n=1,238); Toronto (n=853); and Washington, D.C. (n=5,248). Based on approximate membership data for all four locations, the overall response rate was about 15%. The survey was administered online for all of the systems. Some programs were in the process of completing their own surveys at the time of the study, so different degrees of coordination were required in each city. In Washington, D.C., Capital Bikeshare completed its survey independently, but it was receptive to taking comments and inserting questions to inform our study results. Capital Bikeshare also solicited survey respondents independently, but shared the raw data for analysis in this report. The other organizations sent their members a link to take the survey operated by researchers through QuestionPro, an online survey engine. We summarized the available raw data, and then provided it to the participating organizations. The data across all organizations were then aggregated for this analysis. Each survey contained questions tailored to the specific cities in which the respondents lived. A reminder email was sent several days after the introductory email for each organization. An incentive of CA/US$50 was offered as a raffle-based prize for each survey. The incentives were distributed in January 2012. Table 14 illustrates high-level statistics and sample sizes of participating operators at the time of the survey. All four bikesharing programs surveyed both annual and 30-day subscribers. Note that for Nice Ride Minnesota the surveyed population is different from the total user population reported in Chapter III. This is due to Nice Ride including daily users in their total user population.

Table 14. Organizations Participating in the Survey

Program	Users	Bicycles	Stations	Sample Size
Capital Bikeshare (D.C.)	18,000	1,200	130	5,248
Nice Ride Minnesota (Twin Cities)	3,630	1,200	116	1,238
BIXI-Montreal	40,000	5,120	411	3,322
BIXI-Toronto	4,000	1,000	80	853

This chapter presents and analyzes the survey results. The analysis provides an overview of the cities in which the survey was conducted and a demographic profile of the entire sample. We then explore trip purposes and trip making, based on the survey data, as well as operational data made available by two U.S. operators (Capital Bikeshare and Nice Ride). We also discuss user perceptions regarding each program and helmet use. Next, modal shifts in public transit, driving, and auto ownership are examined. The chapter concludes with an examination of the ways commute distance distinguishes public bikesharing users from the general population and impacts modal shift as a result of public bikesharing.

LIMITATIONS

Like all studies, ours has data and analytical limitations. First, the user survey data on bikesharing perceptions and travel activity changes are self-reported and therefore subject to uncertainties in personal recollection and travel-activity measurement. Second, all surveys, including the U.S. Census, are subject to some degree of non-response bias when subpopulations with certain behaviors choose not to respond in disproportionate numbers. We do not believe that such an effect is large in this study because the questions are not very sensitive in nature. Finally, only four operators in the rapidly growing bikesharing industry completed the survey. Thus, the results reflect the behavior of early adopters and are not generalizable across the 19 operators discussed in Chapter III. Nevertheless, the results provide early understanding that can help to guide the industry and its stakeholders moving forward.

RESULTS

The survey results suggest that public bikesharing plays a different role in different cities. While public bikesharing facilitates some people to use public transit more in all cities, it also facilitates others to make quicker trips with bicycles, which enables some users to reach their destinations sooner than they would with bus or rail. In denser cities that have extensive

> **While public bikesharing facilitates some people to use public transit more in all cities, it also facilitates others to make quicker trips with bicycles, which enables some users to reach their destinations sooner than they would with bus or rail.**

public transportation infrastructure, bikesharing appears to serve as an extension of the public transit system. Indeed, this is how survey respondents perceived it in each city. In larger cities, bikesharing has resulted in decreased use of modes such as walking, traditional biking, and rail, as riders found that bikesharing was a quicker, less expensive means of traveling from one point to another. In all cities, public bikesharing has reduced automobile use and even vehicle ownership. In part, the changes may be a function of the intensity of public transit within the city. Larger cities tend to have more-intensive rail and bus lines that are crowded during peak times and have stops closer together. Smaller cities tend to have more available capacity. In larger cities, people were found to both increase and decrease their public transit use as a result of bikesharing. Overall, more people use bikesharing to make short trips that were previously made by transit, while bikesharing has enabled an increase in public transit use for others.

The impact of bikesharing on public transit ridership is not universal across urban environments. In the least dense location of the survey, the Twin Cities, public bikesharing was found to facilitate an overall increase in walking and public transit and also to serve as a substitute for driving. It appears to play a greater role in increasing traditional public transit use and connectivity, even though the public transit infrastructure is the least extensive of all the locations surveyed. This is not to say that public bikesharing is not used in larger cities to connect to public transit. However, some public bikesharing members reported using the shared bikes instead of taking the bus, rail, or taxi, which can free up capacity on those modes and extend the reach of public transit. To offer insight into the differences in

public transit infrastructure and populations of the cities surveyed, Table 15 provides some statistics on each.

Table 15. Public Transit and Population Statistics of Participating Cities

Transit Facts	Washington, D.C.	Toronto	Montreal	Minneapolis-St.Paul
Kilometers of Rail Track	341	373	122	40
Number of Buses	1,495	1,811	1,600	885
Number of Rail (or Metro) Cars	1,106	951	759	27
Unlinked trips	418,125,650	477,357,000	388,600,000	78,048,647
Population Facts	**Washington, D.C.**	**Toronto**	**Montreal**	**Minneapolis-St.Paul**
Population Density	601,723	2,503,281	1,620,693	667,646
Area (km^2)	177	630	365	288
Population Density (pop/km^2)	3,400	3,972	4,439	2,317
Year of Data	2010	2010 (transit) 2006 (population)	2010 (transit) 2006 (population)	2010

Sources: National Transit Database, 2011[56]; Toronto Transit Commission, 2011[57]; U.S. Census, 2010[58]; Statistics Canada, 2006.[59]

The size of the public transit system in each of the cities is indicated by several metrics, including the kilometers of track for fixed guideway systems, the number of buses, the number of rail cars, and the number of unlinked trips taken by passengers. The population data refer to the population within the city limits, which is more reflective of the actual public bikesharing service areas than is the population in the broader metropolitan region.

Table 16 shows the socioeconomic demographics of the survey sample—income, education, race, age, and student status—aggregated across the four programs. The distributions show that the sample population is generally young, with nearly 60% of the respondents under the age of 34, nearly 80% Caucasian, and 83% non-student. A striking feature of the population was the high education level within the sample: More than 85% of the sample have a Bachelor's degree or higher—far exceeding the level of the general population. However, this attribute is also typical of carsharing users, whose education levels are very similar. The income distribution of the sample population was also relatively elevated, but it was more in line with typical urban populations.

Table 16. Demographics of Survey Respondents

Age	Respondents	Education	Respondents
16 – 17 years old	11 (0%)	Less than high school	14 (0%)
18 - 24	1140 (11%)	High school	179 (2%)
25 - 34	5041 (48%)	Technical school/Cegep	901 (9%)
35 - 44	2193 (21%)	Bachelor's degree	4445 (42%)
45 - 54	1063 (10%)	Advanced degree (Masters, Doctoral)	4773 (46%)
55 - 64	892 (8%)	Prefer not to answer	103 (1%)
65 years or older	119 (1%)	**Total**	10475
Prefer not to answer	50 (0%)		
Total	10509	**Income**	
		Less than $10,000	385 (4%)
Race (all that apply)		$10,000 to $14,999	214 (2%)
Asian/Pacific Islander	598 (6%)	$15,000 to $24,999	400 (4%)
Black/African-American	243 (2%)	$25,000 to $34,999	555 (5%)
Caucasian	8290 (79%)	$35,000 to $49,999	1285 (13%)
Hispanic/Latino	391 (4%)	$50,000 to $74,999	1912 (19%)
Other	577 (5%)	$75,000 to $99,999	1478 (14%)
Prefer not to answer	417 (4%)	$100,000 to $149,999	1433 (14%)
Total	10516	$150,000 to $199,999	1222 (12%)
		$200,000 or more	741 (7%)
Student Status		Prefer not to answer	655 (6%)
Full-time student	1218 (11%)	**Total**	10280
Part-time student	631 (6%)		
Not a student	8788 (83%)	**Total Respondents**	10661
Total	10637		

Basic Usage Patterns

The survey probed some basic usage patterns to evaluate how respondents use bikes in the system. To start, it asked respondents about trip purpose. Respondents in Montreal, Toronto, and the Twin Cities were asked to indicate their most common bikesharing

> **The bikesharing programs in all the cities surveyed are most commonly used for traveling to work or school.**

trip purpose. A majority of members in Montreal and Toronto reported going to work or school as their most common trip purpose, as shown in Figure 31. In the Twin Cities,

travel to work or school is again the most common purpose (the value that occurred he most in the dataset). In its survey, Capital Bikeshare of Washington, D.C. asked the question slightly differently, soliciting the primary purpose(s) of the most recent Capital Bikeshare trip. The resulting distribution is remarkably similar to that of Nice Ride Minnesota. As in the Twin Cities, 38% indicated that their most recent trip was either to or from work. In all of the cities surveyed, the second and third most common trip purposes are social trips and errands. Other trip purposes seem relatively less important, particularly in the two Canadian cities. The distribution of trip purpose generally indicates that the bikesharing systems in all the cities surveyed are most commonly used for traveling to work or school. This is important for understanding how the provision of public bikesharing could alter or shift the mode shares of urban commute patterns.
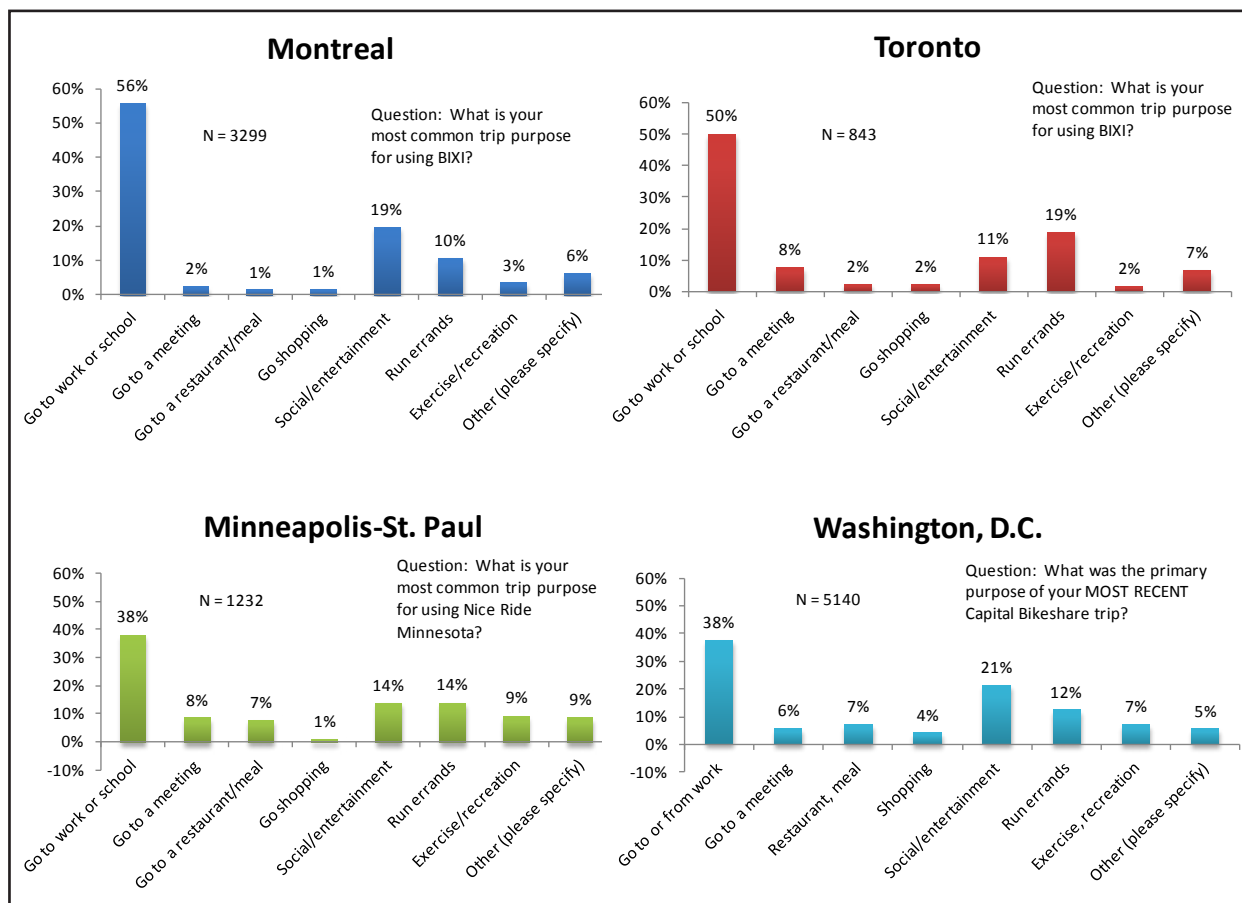

Figure 31. Public Bikesharing Trip Purpose

The ability of public bikesharing to facilitate one-way travel from station to station is generally unique to shared-vehicle use. The survey results and other data from the four cities indicate that users take advantage of the one-way (or station-to-station) travel capability. To evaluate travel patterns, we asked respondents to indicate how often they travel from one station to another, versus completing round-trips (i.e., trips that start and end at the same station). The results from Montreal, Toronto, and Minneapolis-Saint Paul indicate that respondents employ the system far more for one-way travel than for round-trips (Figure 32).
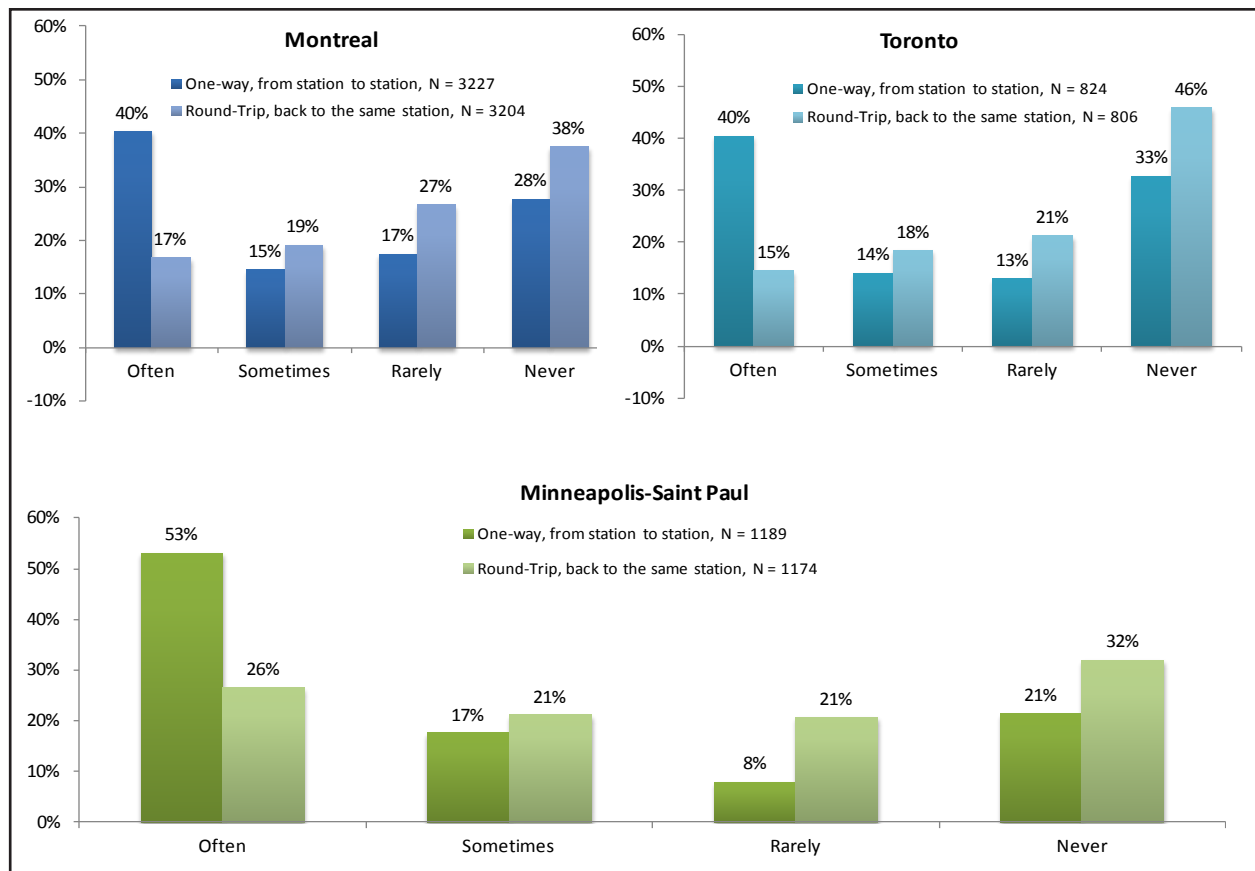
Figure 32. One-Way and Round-Trip Travel

During the course of this study, Capital Bikeshare and Nice Ride Minnesota released additional data to the public on trips taken with system bicycles.[60,61] The data include information on trip start time, end time, start station, and end station, which provides additional resources with which to evaluate travel pattern distributions from a comprehensive record of activity for the year 2011. Table 17 presents a quarterly summary of bicycle trips taken with the two organizations, including aggregate trips as well as round-trips. Nice Ride Minnesota shut down during winter 2010/2011 and did not operate during the first quarter of 2011. Capital Bikeshare operated year-round, but released only a small subset of raw activity data (10,976 individual trips) for the first quarter of 2011, while it actually logged 150,499 trips during that quarter. Capital Bikeshare took the initiative to post system operational data on its website, along with selected performance metrics, through an innovative custom web-based dashboard.[62] This tool has served as an additional resource beyond the raw data for public review of up-to-date information on system performance.

Table 17. Summary of Trip Information from Operational Data in 2011

System	Data Type	1st Quarter (limited data)	2nd Quarter	3rd Quarter	4th Quarter	Total
Capital Bikeshare (Washington, D.C.)	Total Trips	10,976†	374,203	405,450	313,001	1,103,630†
	Single-Station Round-Trips	584	24,240	23,643	13,553	62,020
	% of Single-Station Round-Trips	5.3%	6.5%	5.8%	4.3%	5.6%
Nice Ride Minnesota (Minneapolis-Saint Paul)	Total Trips	NA	60,785	117,219	39,526	217,530
	Single-Station Round-Trips	NA	5,840	11,237	2,827	19,904
	% of Single-Station Round-Trips	NA	9.6%	9.6%	7.2%	9.2%

† 1st Quarter 2011 Capital Bikeshare data released was a subset (7%) of total trips during the quarter.

Considering Capital Bikeshare's actual first-quarter ridership of 150,499 trips, ridership more than doubled in the second quarter. Table 17 shows that ridership peaked for both systems in the third quarter, with Nice Ride Minnesota achieving a near doubling from the second quarter. The fourth quarter decline in trips is in part a function of the shutdown that occurred in November. Across all of the quarters, there is a notable distinction in the percentage of round-trips, which is small for both organizations. Over the entire year, 5.6% of Capital Bikeshare trips and 9.2% of Nice Ride Minnesota trips started and finished at the same station. This small and rather consistent proportion for both organizations, coupled with data presented in Figure 32, supports the conclusion that public bikesharing for these two large U.S. operators predominantly supports one-way, point-to-point travel. The proportions of round-trips shown in Table 17 are "single-station" round-trips in which a bike is checked out and then re-docked to the same station. It does not reflect "multi-station" round-trips in which a bike is briefly docked at a station and then checked out again shortly after return to the original station.

For both of these systems, logistics and economics encourage this behavior. While all users have to subscribe to the operator (for a fixed fee), both systems charge no per-trip fee for any trip that is under 30 minutes. Charges then increase

Operational data for Capital Bikeshare and Nice Ride Minnesota in 2011 confirm that the vast majority of users are keeping trips within the free 30-minute window offered by both systems.

with time that a bicycle is checked out. Also, bicycles within these systems do not have their own locks. Thus, users cannot secure a bicycle unless they bring their own locks. The system is designed to encourage users to dock a bicycle, even if they are stopping at a location for only a short time. The operational data considers these short docking events as one-way trips. Hence, the survey data presented in Figure 32 suggest that more travelers may be using bikesharing for multi-station round-trips in proportions that are higher than indicated in the operational data. Nevertheless, both Figure 32 and Table 17 suggests that bikesharing predominantly facilitates one-way trips in these cities.

The raw operational data also provide a comprehensive picture of trip duration for 2011. The distribution of trip duration across all data confirms that the vast majority of users are keeping trips within the free 30-minute window offered by both systems. Figure 33 shows the distribution of trip duration for both systems.
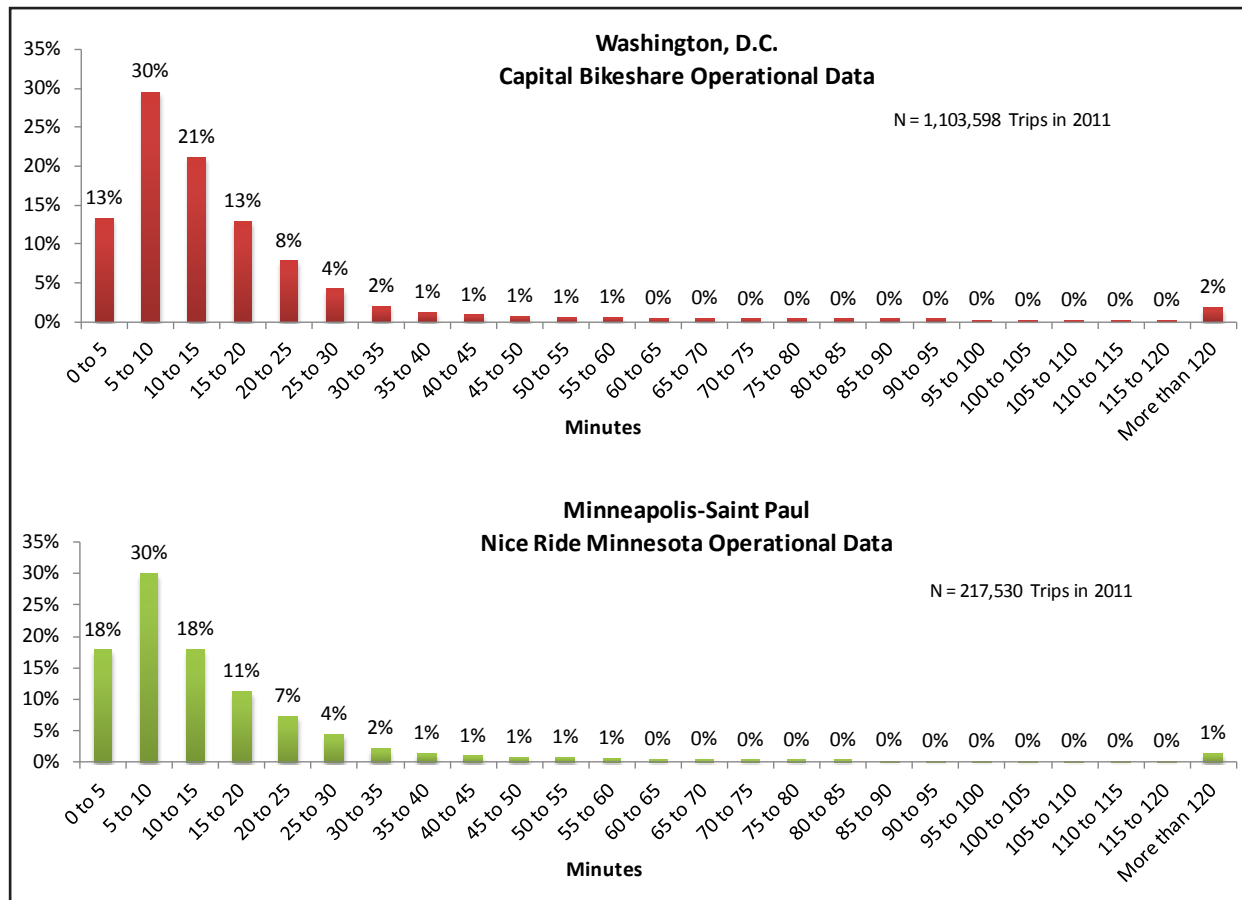

Figure 33. Distribution of Station-to-Station Trip Duration in 2011

The raw data suggest that about 89% of the trips taken with Capital Bikeshare are of less than 30 minutes duration. In the Twin Cities, the proportion is a remarkably similar 88%. It thus appears that most people in these cities are using public bikesharing to make relatively short and direct trips that fulfill a transportation need, rather than for recreational excursions. Finally, operational data from Nice Ride Minnesota contain de-identified subscriber IDs, which could match multiple trips to a user, but not otherwise identify him or her. These data could provide insights on the distribution of usage frequency across users for the entire year. The operational data consists of all users, including annual subscribers and 24-hour casual users. Figure 34 illustrates this distribution for each month of operation during 2011.
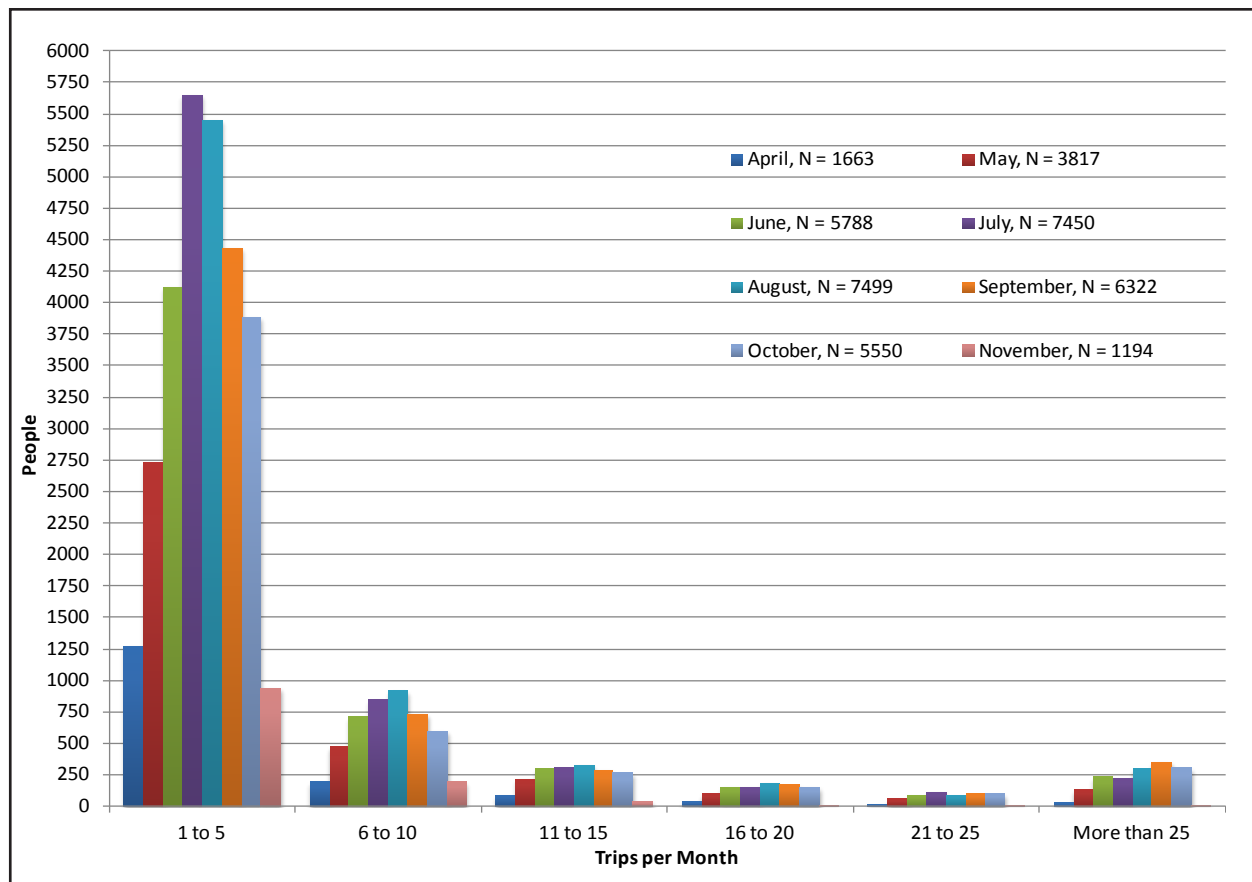
Figure 34. Usage Frequency of All Nice Ride Minnesota Users in 2011

Ridership in Nice Ride Minnesota peaked in July and August, explaining the third-quarter peak observed in Table 17. In July 2011, more than 5,500 members used public bikesharing in the Twin Cities one to five times a month. In August 2011, nearly 1,000 members used the system six to ten times, and more than 250 used it 11 to 15 times. The data also show that in the third quarter, more than 250 people used Nice Ride more than 25 times each month.

User Perceptions

The survey asked a number of questions about respondents' perceptions of public bikesharing and its relationship to their city. These included Likert-scale questions about the perceived improvement in connectivity to public transit, as well as some public health benefits of bikesharing. Capital Bikeshare's survey was implemented as part of an independent effort. It included Likert questions about connectivity and public health in the Minnesota survey and also in Montreal and Toronto. The responses provide insights on the perceptions of a large share of users. Figure 35 shows the response to one of the high-level questions related to the relationship of bikesharing to the public transit system. Respondents in Montreal, Toronto, and the Twin Cities were asked to indicate whether they agree or strongly agree with the statement: "I think of [bikesharing] as an enhancement

> **Over 95% of survey respondents view the bikesharing system within their city as an enhancement to public transit.**

to the [local city] public transportation system." In the actual survey, [bikesharing] was indicated by the system name, as was [local city].
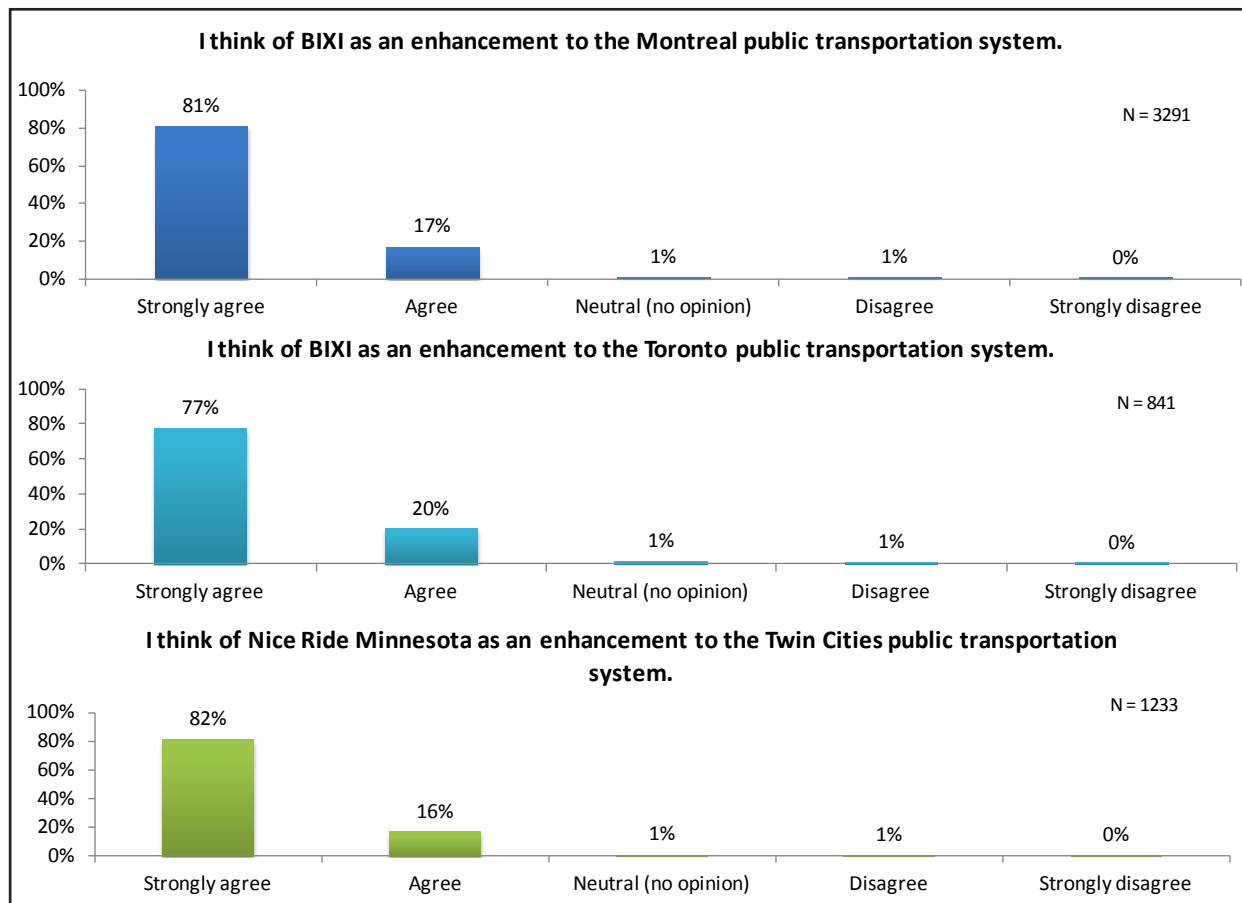

Figure 35. Perceptions of Bikesharing as an Enhancement to Public Transportation

As indicated in Figure 35, the respondents overwhelmingly view the bikesharing system within their city as an enhancement to public transit. More than 95% of those in each city either agreed or strongly agreed with the statement. To examine connectivity, we asked respondents to assess whether they believed public bikesharing had improved the connectivity of their city's transportation system. Figure 36 shows the distribution of responses.
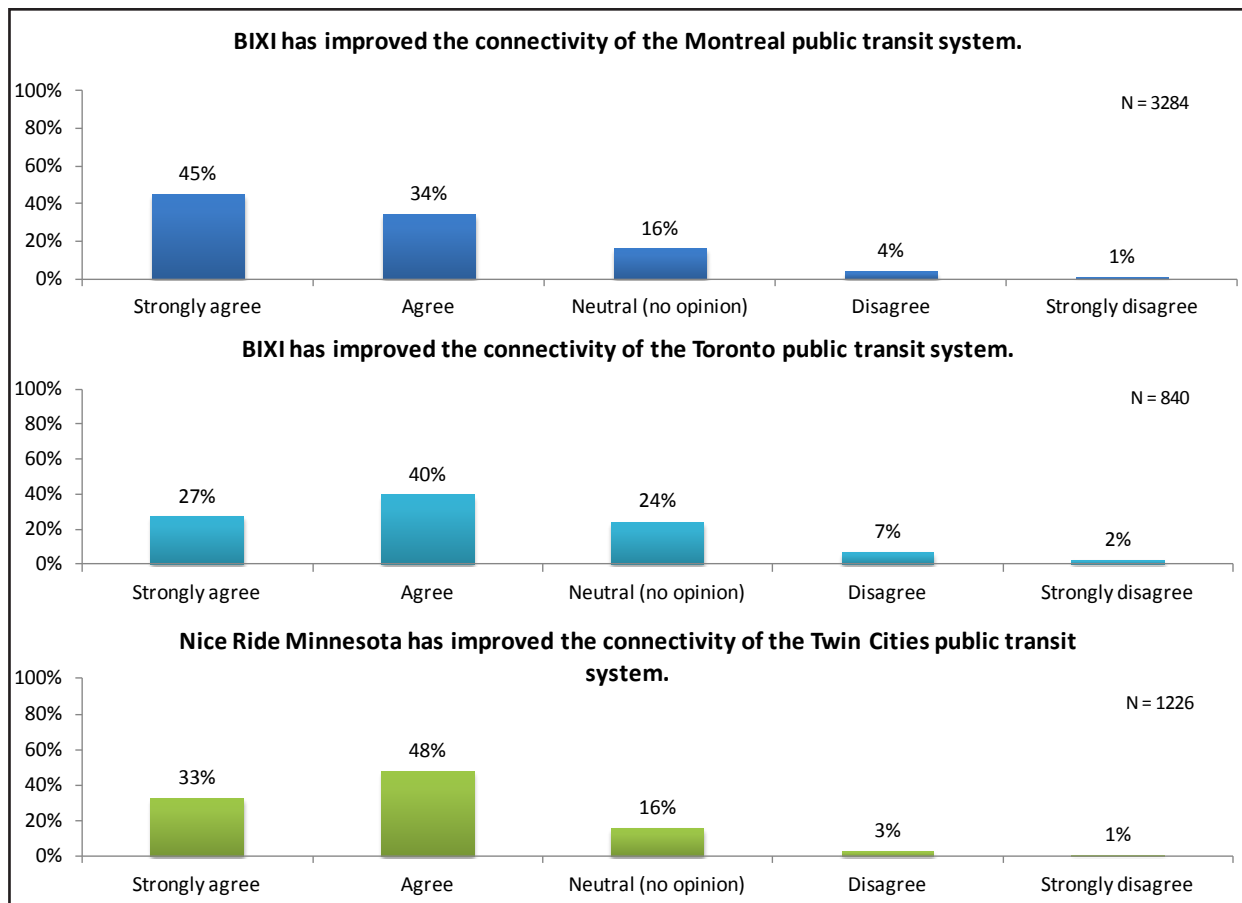
BIXI has improved the connectivity of the Montreal public transit system.

N = 3284

BIXI has improved the connectivity of the Toronto public transit system.

N = 840

Nice Ride Minnesota has improved the connectivity of the Twin Cities public transit system.

N = 1226

Figure 36. Perceptions of Bikesharing as an Improvement in Public Transit System Connectivity

Large majorities of respondents within each city reported that bikesharing had improved their public transit system connectivity. The distribution of responses indicates that 67% of respondents agreed with the statement in all three cities.

Respondents were also asked whether they had ever made any trips with bikesharing and public transit together instead of using an automobile. This question was designed to probe the degree to which bikesharing, as a complement to public transit, was displacing auto trips. The results of the distribution show that this is occurring in all the cities, but not everyone uses public bikesharing in this way (Figure 37). Indeed, across the three city sample, 41% agreed that they had made trips with public transit and bikesharing, which they had previously made by automobile.
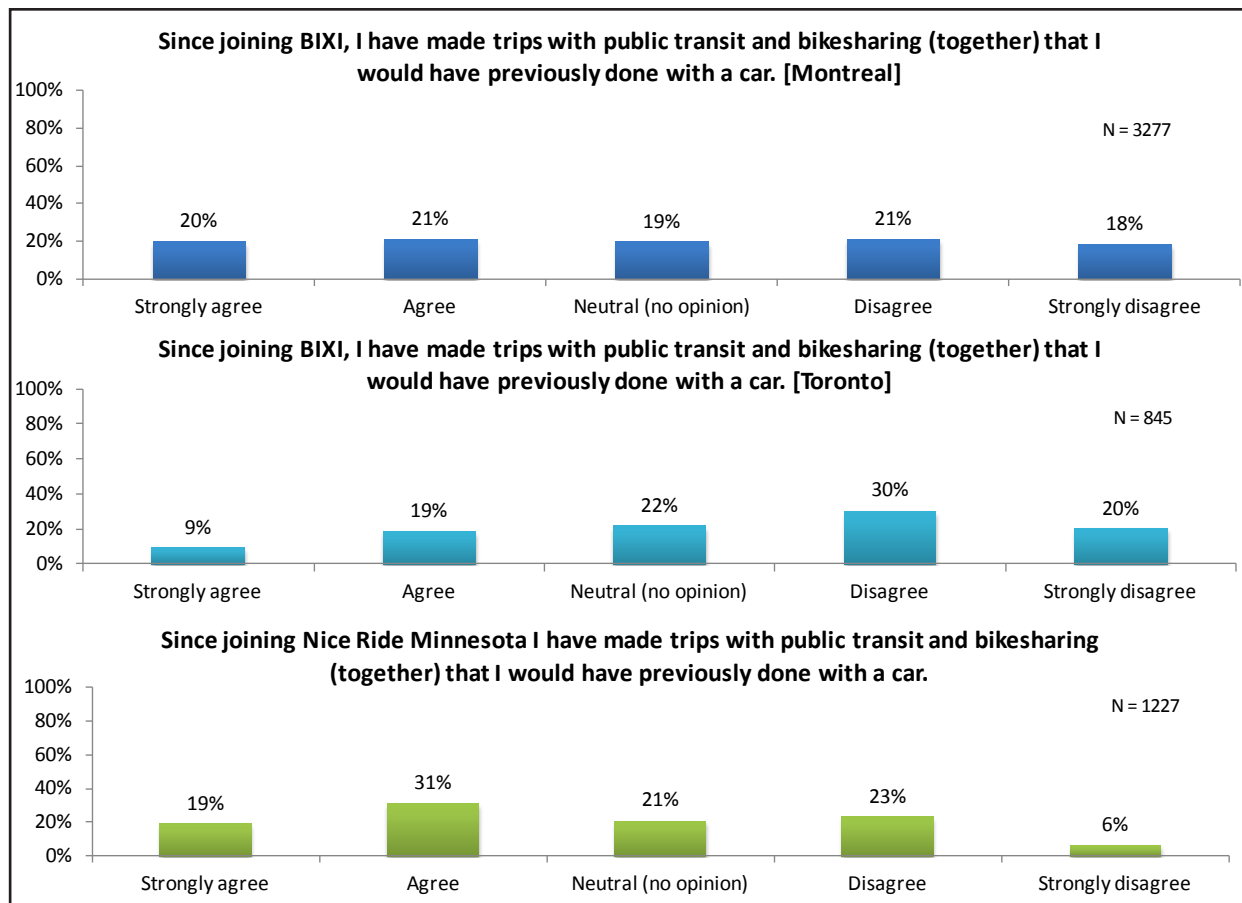
Figure 37. Use of Public Transit and Bikesharing Trips Instead of Automobile Travel

Figure 37 shows that about 40% of the respondents in Montreal have used bikesharing with public transit for trips that were previously made by car. In Toronto, nearly 30% agreed with this statement, while in the Twin Cities, the percentage was 50%. The more even distribution of response across the Likert scale demonstrates that bikesharing has played a role in reducing automobile use and increasing public transit for certain trips, but this type of trip substitution is not necessarily practiced by the majority of respondents.

> **Across the three city sample, 41% agreed that they had made trips with public transit and bikesharing, which they had previously made by automobile.**

Finally, bikesharing provides an opportunity for members to get more exercise. Figure 38 shows the distribution of responses to the statement: "I get more exercise now that I am a member of [bikesharing]," which indicates that a majority of respondents believe that bikesharing increases their exercise. Sixty-four percent of respondents across the three cities agreed that they get more exercise since joining public bikesharing.
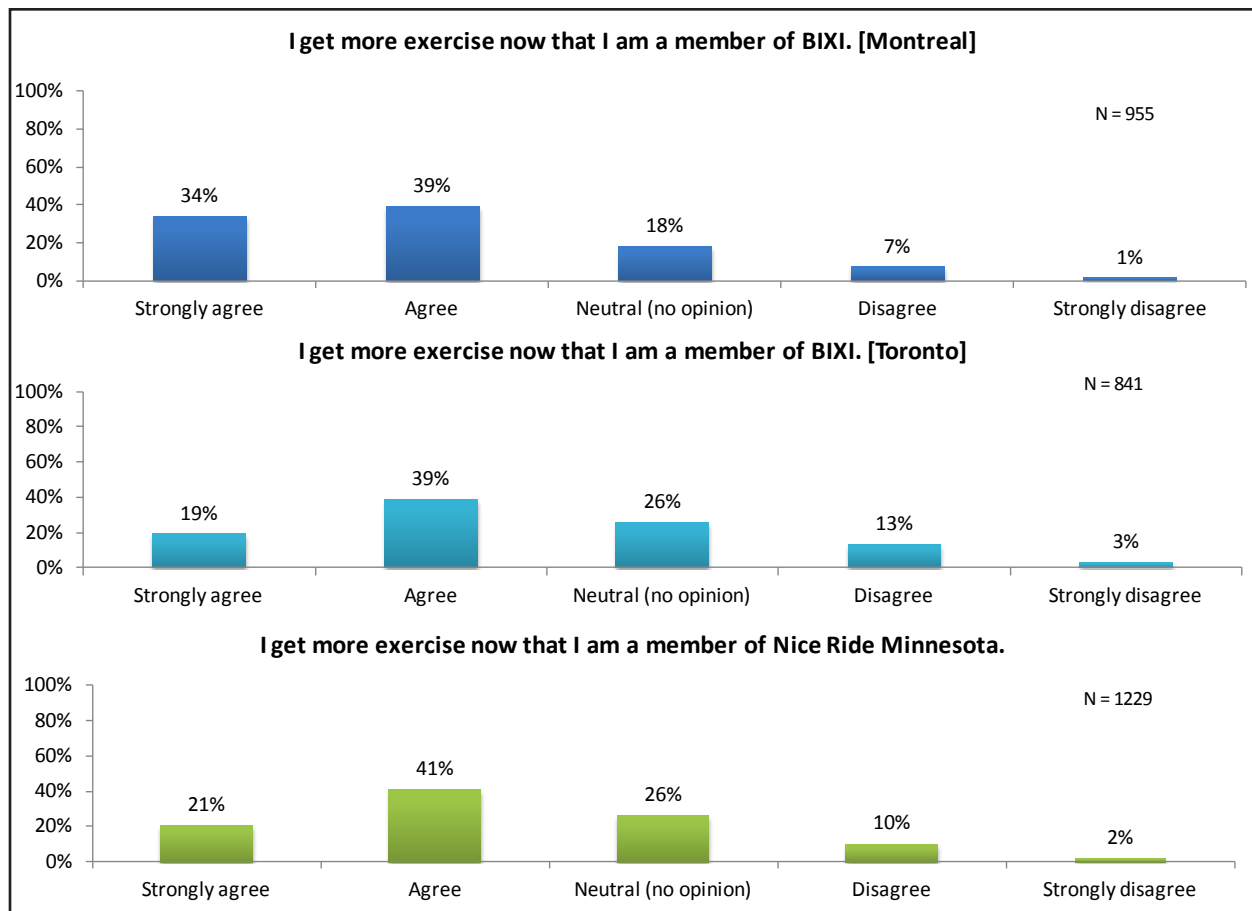
Figure 38. Impact of Bikesharing on Exercise

A branching error in the implementation of this question in the French-Canadian survey reduced the sample size in Montreal to just under 1,000 respondents. Nearly 75% of the Montreal participants (top graph) agreed with the statement, whereas in Toronto and Minneapolis, approximately 60% agreed.

Overall, the results of the Likert-scale questions suggest that bikesharing is playing an important role in increasing the connectivity of the public transportation system, reducing automobile trips, and increasing physical activity. This does not mean, however, that

64% of respondents across the three cities agreed that they get more exercise since joining public bikesharing.

public transit use always increases as a result of bikesharing. The impact was observed in both directions (i.e., increasing and decreasing the connectivity of traditional public transit use among members).

Helmet Use with Public Bikesharing

Helmet use with public bikesharing systems is an issue of concern for a number of operators. There are several obstacles to using helmets with bikesharing bikes in contrast to personal bikes. Most personal bike trips start from home, where the decision to take a bicycle is made in the same location where a helmet is available. Bikesharing trips, which can be made anywhere in the city and may not be planned at the start of the day, start and

end in locations without helmet availability. In order to use a helmet with bikesharing, the user must leave their home knowing that they will take public bikesharing at some point later in the day. Bikesharing operators typically do not provide on-site helmets, in part due to sanitary concerns and logistical difficulties.

To understand helmet use among bikesharing users the survey probed respondents on their relative frequency of helmet use while using public bikesharing. Figure 39 illustrates the distribution of the questions asked of each system users. The question was asked slightly differently in the American and Canadian cities, but the general distribution of response is similar. Within each city, the response "Never" is the most common. It is the highest in Montreal and the Twin Cities at 62% and 50%, respectively. In Toronto, 45% of respondents never wear a helmet while bikesharing, and in Washington, D.C. the share of "Never" responses is 43%.
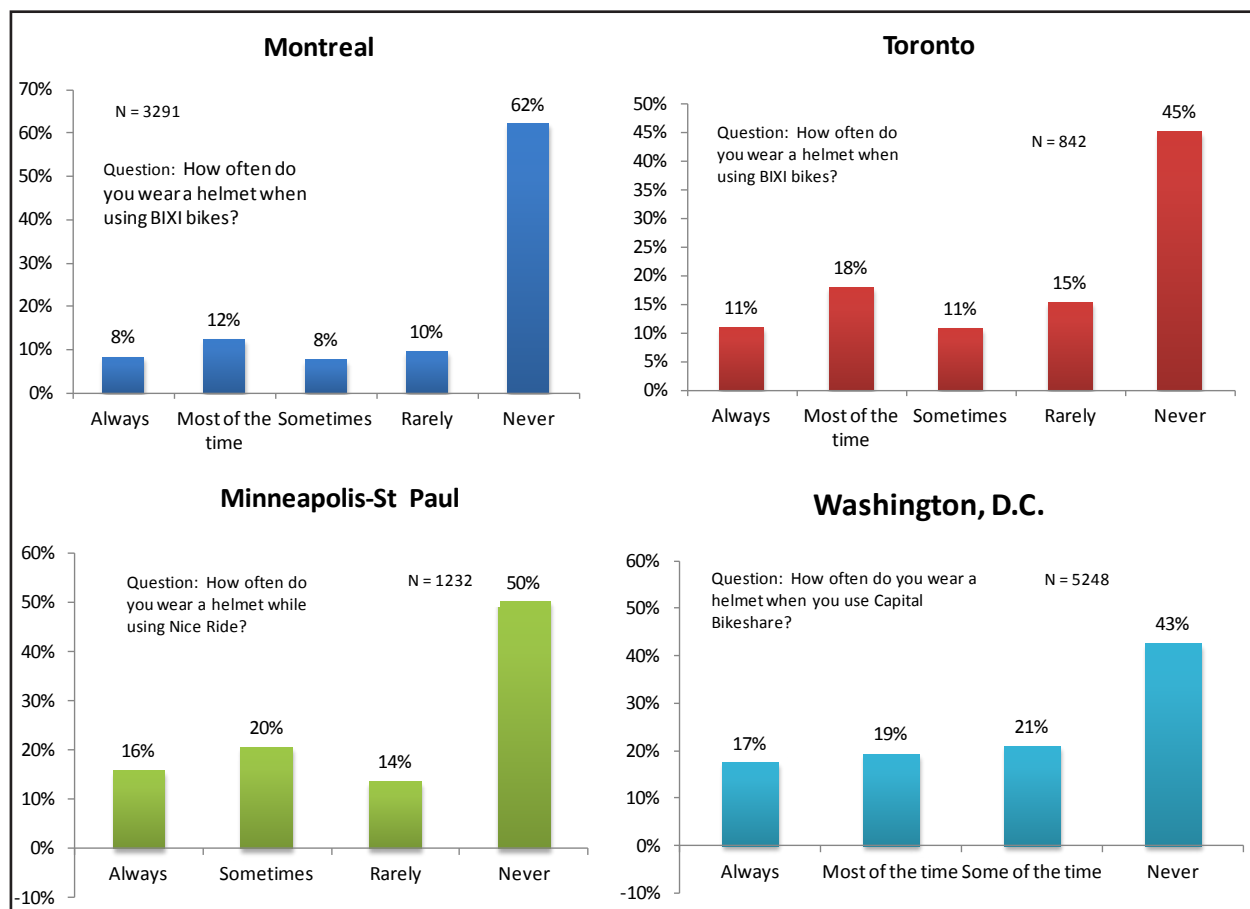

Figure 39. Helmet Use with Public Bikesharing

The "non-Never" responses differ slightly across cities, but distributions show that between 20% to 36% of respondents wear helmets when using bikesharing. This proportion being at least one in five respondents, indicates that using a helmet regularly with bikesharing is doable, but this may be lifestyle related or specific to travel circumstances. Nevertheless, never using helmets is the highest response across organizations given the challenges outlined above.

CHANGES IN TRAVEL-MODE USE RESULTING FROM PUBLIC BIKESHARING

Survey respondents were asked to evaluate how public bikesharing had altered their travel patterns. The structure of the question was geared toward assessing the direction of change in use for each transportation mode. The responses were given on

> **Public bikesharing resulted in about 7% of the survey respondents increasing their bus use and 38% reducing it.**

an ordinal scale. The question wording was also structured to allow respondents to indicate whether the availability of public bikesharing was the primary reason for the shift in travel patterns. For example, in Toronto and Montreal, respondents reported their change in bus use by finishing the statement: "As a result of my use of BIXI, I use the bus…." They could select from the following options: "Much more often," "More often," "About the same (bikesharing has had no impact)," "Less often," and "Much less often." The surveys also provided opt-out responses that pertained to specific changes that were unrelated to public bikesharing. In addition to the five choices, respondents could also select: "I did not ride the bus before, and I do not ride the bus now," as well as "I have changed how I use the bus, but not because of BIXI." This allowed respondents to distinguish circumstances that might have impacted their mode use from the influence of public bikesharing. To aggregate the results across surveys, we combined the three responses that broadly indicate "no change in use of this mode" into one category summarized as "no change as a result of public bikesharing." Figure 40 shows the change in aggregated responses across surveys indicating the change in bus use among respondents. Within each survey, respondents were asked the question in the context of their own operator.
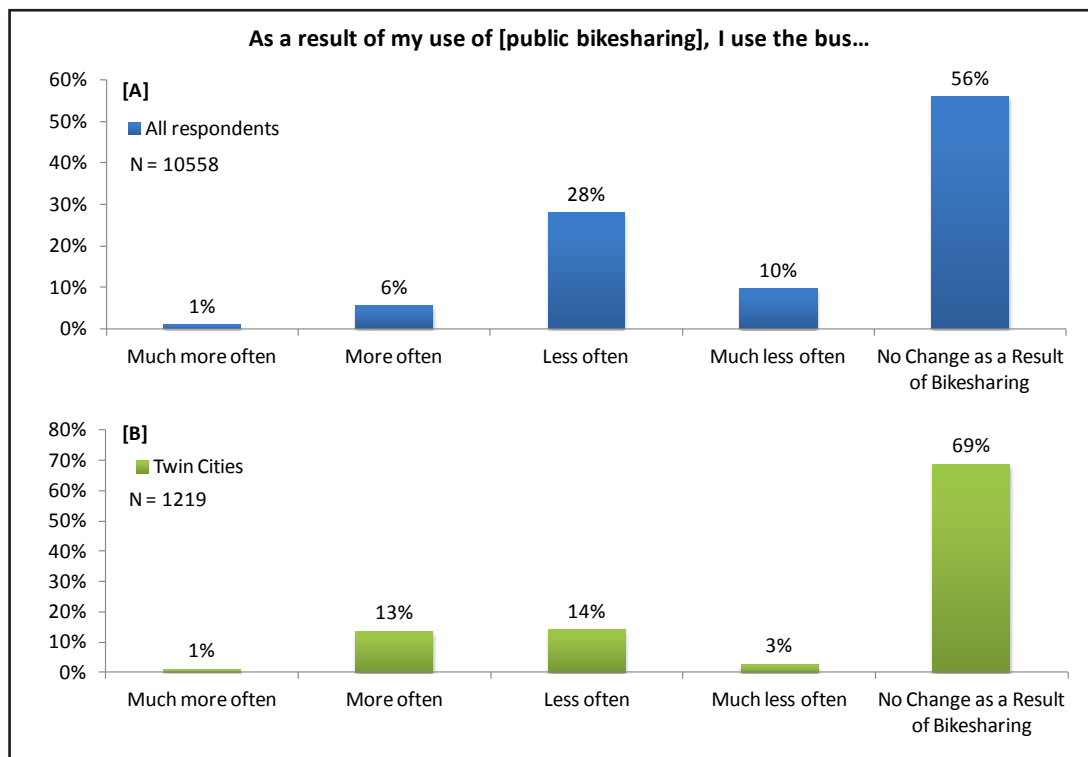

Figure 40. Reported Change in Bus Use Caused by Public Bikesharing in Four Early North American Programs

The top portion of Figure 40 shows the distribution of responses from all respondents across the four cities. The bottom portion provides the distribution of respondents within the Twin Cities. Data on the Twin Cities are presented separately because of the clear departure from the distributions observed in the overall sample. In the overall sample, public bikesharing resulted in about 7% of respondents increasing their bus use and 38% reducing it. The remaining 56% did not change their overall bus use. In the Twin Cities, about 69% of respondents indicated that public bikesharing had not influenced their bus use, while 14% increased their use and 17% decreased it.

With a similar question, we asked about the change in rail ridership resulting from public bikesharing. The cities participating in the survey have different types of rail systems. Montreal, Toronto, and Washington, D.C. all have subterranean heavy-rail systems (subways), while the main urban rail service in the Twin Cities is a 19-station light-rail system called the Hiawatha Line (soon to be renamed the Blue Line as the system expands). The line operates within Minneapolis and the suburban city of Bloomington.

The distribution of change in urban rail use is presented in Figure 41, which shows the split between the entire sample and the subsample of respondents in the Twin Cities. Similar to the structure of the previous question, the placeholder [public bikesharing] pertained to the organization, while [urban rail] was "the subway" in Toronto and Montreal; "Metrorail" in Washington, D.C.; and "the Hiawatha Line" in Minneapolis.
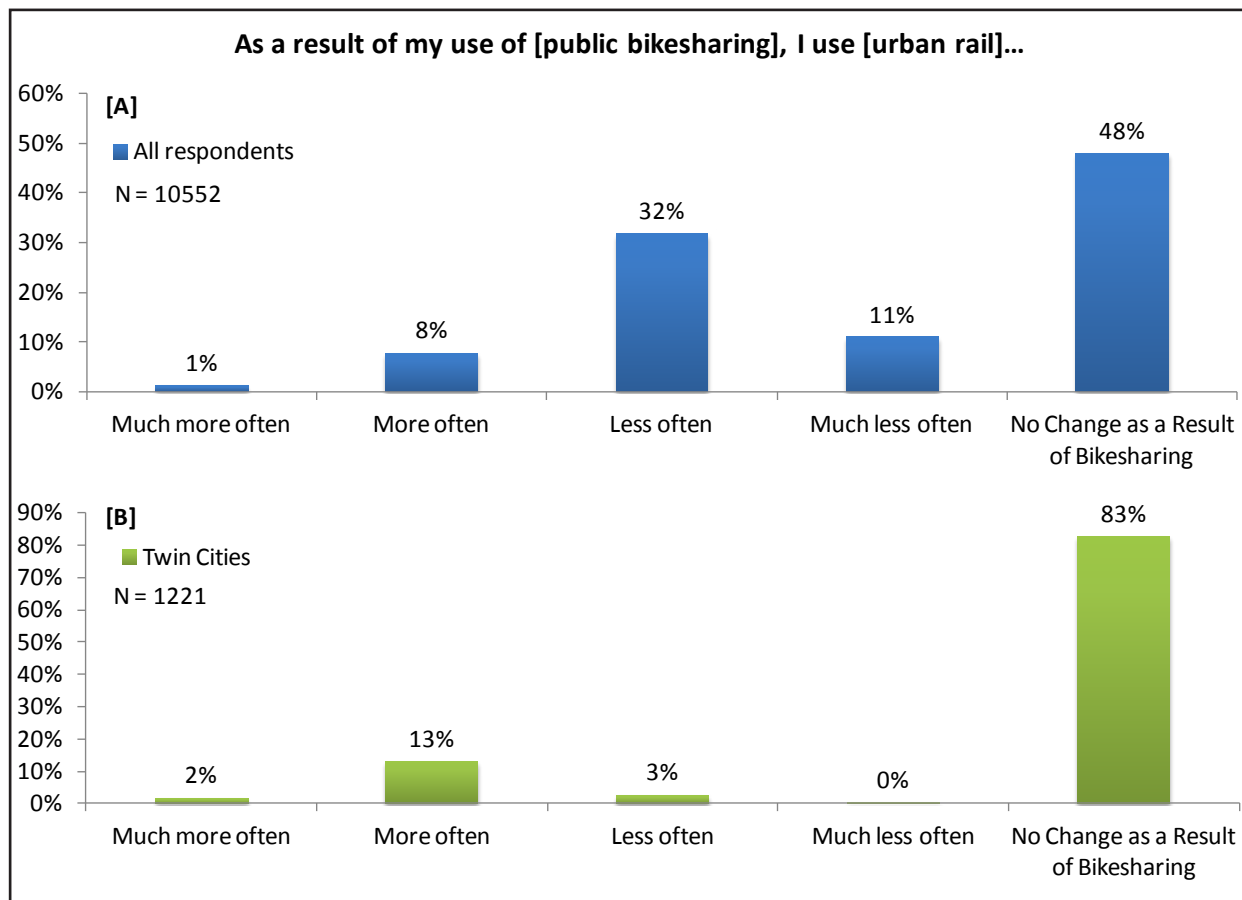

Figure 41. Change in Urban Rail Use Caused by Public Bikesharing

There was a significant distinction between the impact in the broad sample and the shifts exhibited in the Twin Cities. As with bus use, more public bikesharing members appear to ride rail systems less often. However, the circumstances behind these substitutions may be different. For those riding rail more often, public bikesharing provides

> **9% of all respondents increased rail as a result of bikesharing, and 43% decreased rail use. In the Twin Cities, 15% increased and 3% decreased rail use as a result of bikesharing.**

a connection to and from rail that did not exist previously. In contrast, those riding rail less frequently may have found that public bikesharing provides shorter and less-expensive trips. Nine percent of all respondents increased rail as a result of bikesharing, and 43% decreased rail use. The Twin Cities results differ from those in the broader sample in terms of balance: 15% of respondents increased their light-rail use, and only 3% decreased it. Toronto also has a streetcar system that was queried in a separate but identically constructed question. The distribution of responses to change in streetcar use was consistent with the distribution of responses to change in subway use (or urban rail use) in Toronto.

These results are backed by an additional question that asked more generally about public transportation use (Figure 42). Respondents in the Twin Cities, Montreal, and Toronto were asked how their public transportation use had changed as a result of public bikesharing. Capital Bikeshare's survey was implemented separately from the other three cities in this study and did not reflect this question.

> **About 40% of respondents felt that their public transit use had fallen as a result of their public bikesharing usage. At the same time, 18% of the respondents thought that public bikesharing had facilitated an increase in public transit use, while 42% believed that it had no impact.**

The responses illustrate the same general trend as those more specific to rail and bus usage. About 40% of the respondents felt that their public transit use had fallen as a result of their public bikesharing usage. At the same time, 18% of the respondents thought that public bikesharing had facilitated an increase in public transit use, while 42% believed that it had no impact. In the Twin Cities, the distribution was again shaped differently, with 28% of the respondents indicating that their public transportation use had increased, 11% reporting that their public transportation use had dropped overall, and 60% believing that public bikesharing had no impact on it.
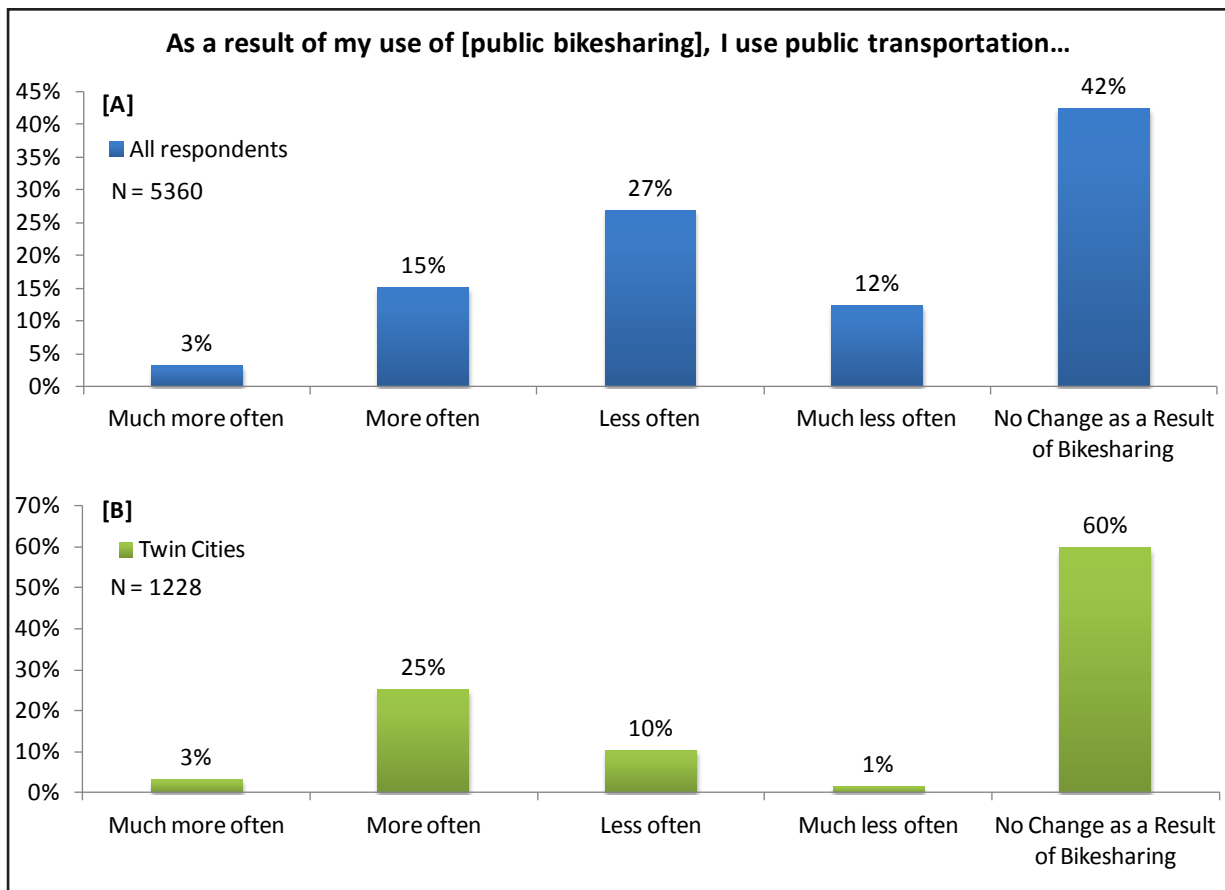
As a result of my use of [public bikesharing], I use public transportation...

Figure 42. **Reported Change in Public Transportation Use as a Result of Bikesharing**

There are a number of possible reasons for the net effect of public bikesharing on public transit use in the Twin Cities being in the opposite overall direction from that of the larger cities. It may be that there is less public transit connectivity and less public transit use in the Twin Cities than in the other locations. As shown in Table 15, the Twin Cities are the least dense cities in the survey, and they have the most limited public transit system. Public bikesharing there could be serving as an improvement to existing transit connectivity, making access to and egress from public transit easier in an environment in which origins and destinations are more spread out and less connected by rapid transit. Also of consideration is the shape of the rail line. The Hiawatha Line is a single, 20-km-long north-south line, and its unidirectional nature would make public bikesharing less of a substitute. Public bikesharing, however, does enhance access to and egress from the light-rail line.

In contrast, the urban rail systems of Washington, D.C., Montreal, and Toronto all resemble a web of less-linear lines. In these larger cities, some point-to-point travel previously completed by urban rail transfers may now be faster with public bikesharing. Figure 43 shows the Metrorail maps of each of the four systems as of 2012.
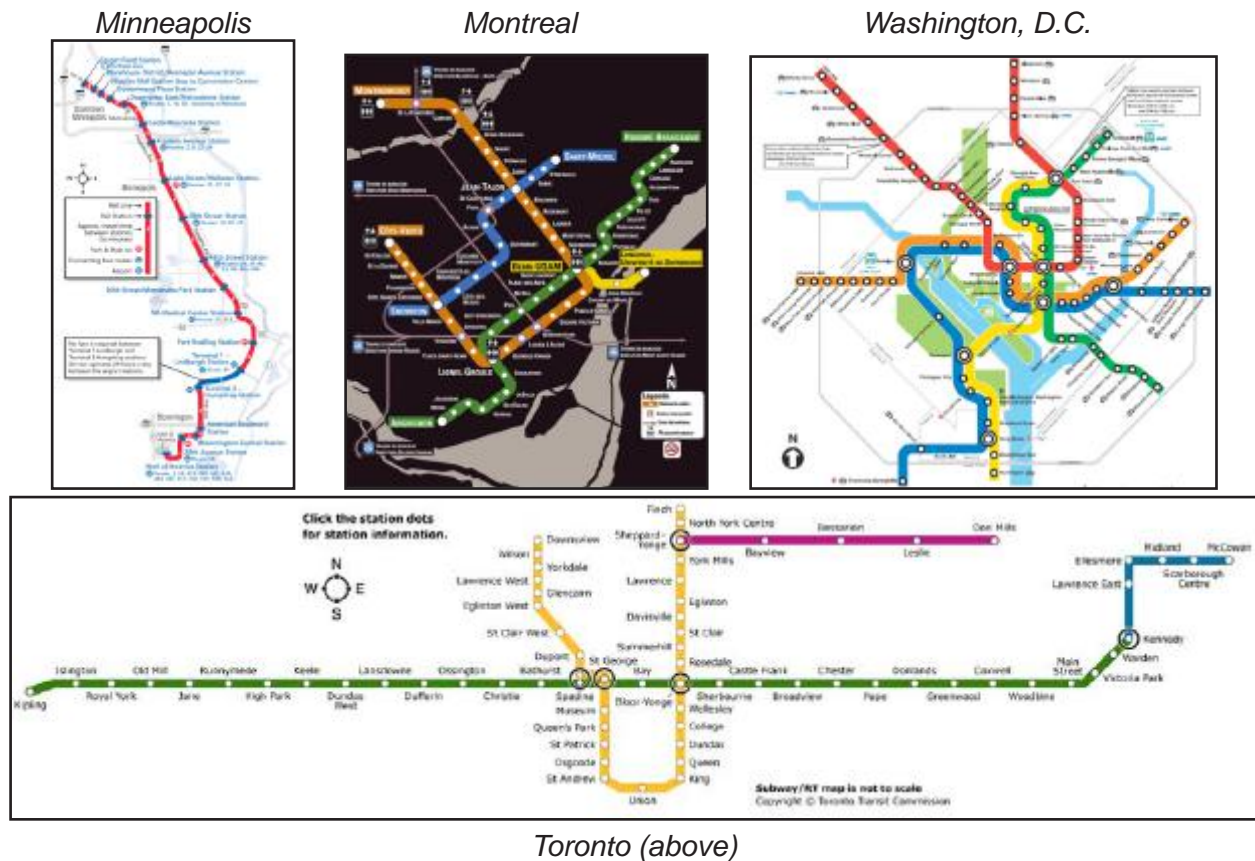
Minneapolis *Montreal* *Washington, D.C.*

Toronto (above)

Figure 43. Urban Rail Systems of the Cities Surveyed

Sources: WMATA, 2012[63]; Metro Transit, 2012[64]; Toronto Transit Commission, 2012,[65] STM, 2012.[66]

Public bikesharing has had a similar impact on walking in the different cities. In all three of the larger cities, more respondents reported walking less as a result of public bikesharing, while in the Twin Cities, more respondents reported walking more. The underlying reason behind the difference in results is not entirely clear, but it may be similarly derived from the different impacts that public bikesharing is having on connectivity in the different cities. In the Twin Cities, it may be bridging critical gaps that foster new forms of travel. As people use bikesharing in conjunction with public transit more, they walk more. In the larger cities, many trips that were previously completed by walking (and public transit, perhaps jointly) are instead made with public bikesharing. The distributions of the overall sample and the Twin Cities subsample are shown in Figure 44.
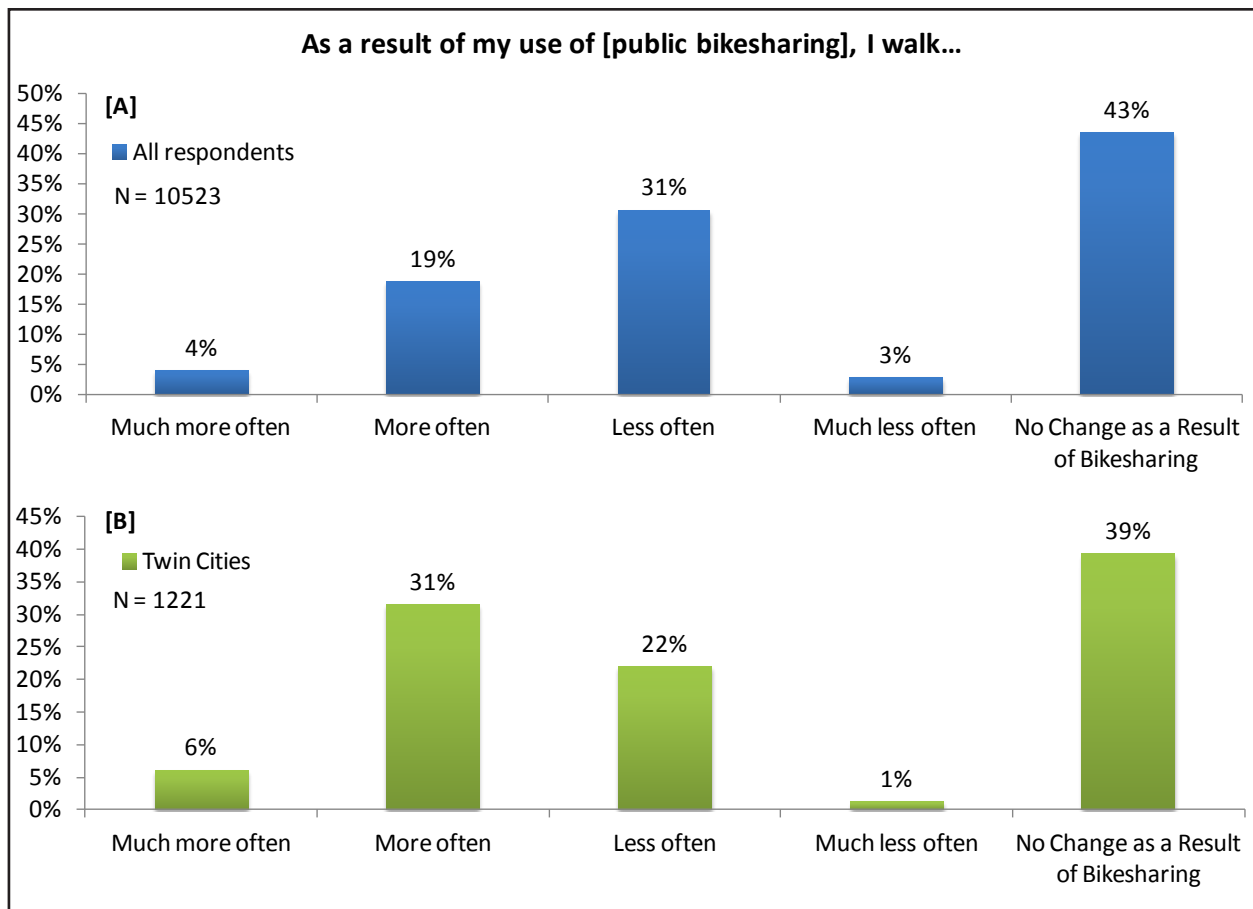
Figure 44. Change in Amount of Walking Resulting from Public Bikesharing

In the overall sample, 23% of the respondents walked more as a result of public bikesharing, whereas 34% walked less. In the Twin Cities, the same dynamics that may have contributed to respondents using rail more are also at play with respect to walking, as 37% of the respondents reported walking more due to public bikesharing, while only 23% reported walking less.

> **In the overall sample, 23% of the respondents walked more as a result of public bikesharing, whereas 34% walked less.**

> **72% of the overall sample reported bicycling more as a result of public bikesharing.**

Respondents were also asked about their change in bicycle use as a result of public bikesharing. Not surprisingly, the sample universally reported bicycling more in all of the cities. Indeed, 72% of the sample reported bicycling more due to public bikesharing. The distributions of the overall sample and the Twin Cities subsample are shown in Figure 45 and are generally similar.
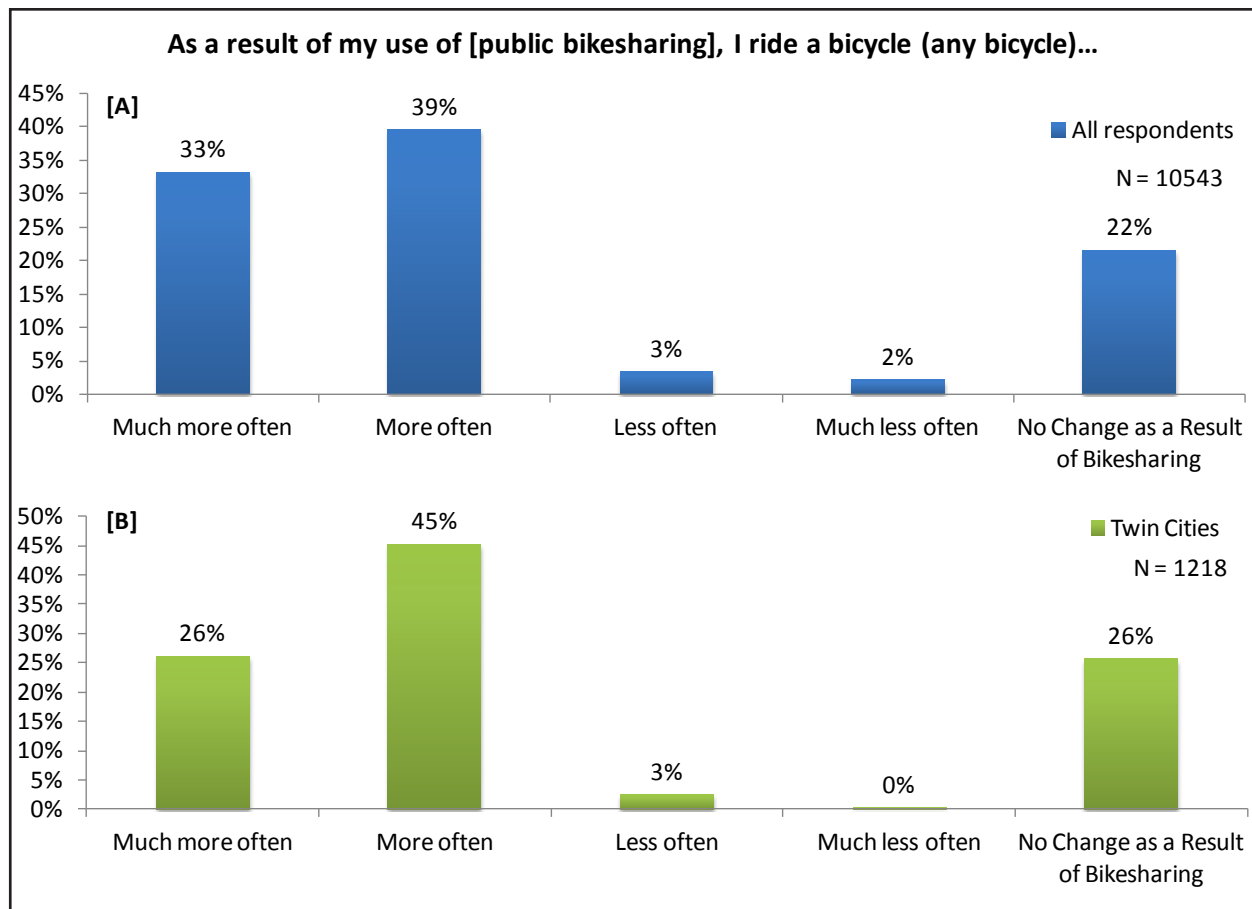
As a result of my use of [public bikesharing], I ride a bicycle (any bicycle)…

[A]

- Much more often: 33%
- More often: 39%
- Less often: 3%
- Much less often: 2%
- No Change as a Result of Bikesharing: 22%

■ All respondents
N = 10543

[B]

- Much more often: 26%
- More often: 45%
- Less often: 3%
- Much less often: 0%
- No Change as a Result of Bikesharing: 26%

■ Twin Cities
N = 1218

Figure 45. Change in Bicycling Due to Public Bikesharing

Thus far, the results appear to demonstrate that public bikesharing has a mixed impact on public transit usage, based on the urban environment, although other factors may also be in play (e.g., existing modal split, city culture). Public bikesharing appears to be acting as a new transportation mode in the larger cities—Montreal, Toronto, and Washington, D.C.—providing a new option for independent mobility. This new option draws from other modes that were used before. In the comparatively smaller Twin Cities, public bikesharing may be serving a similar role, while simultaneously acting as a complement to the existing public transit infrastructure. This dichotomy of impact may be connected to differences in population density, public transit connectivity, and perhaps system operations across the cities, although all of the surveyed systems use the same equipment vendor, PBSC Urban Solutions. More research is needed with a larger dataset of North American cities and operators over time to isolate the key explanatory factors behind the behavioral and travel impacts observed among the early-adopter cities in this study.

The survey also asked about the impact that public bikesharing has had on automobile travel. The responses indicate that public bikesharing is universally drawing modal share away from auto modes. Respondents were asked to assess how public bikesharing had impacted their use of taxis and personal driving. Figure 46 shows the distribution of the impact on taxi use for both the overall sample and the Twin Cities subsample. The shift away

46% of the overall sample reported a reduction in taxi use as a result of public bikesharing.

from auto use is greater in the larger cities than in the Twin Cities. Taxis play a bigger role in the transportation system of larger cities. Thus, not surprisingly, 80% of the Twin Cities subsample said their taxi use was unaffected. In the overall sample, 46% reported a reduction in taxi use as a result of public bikesharing.
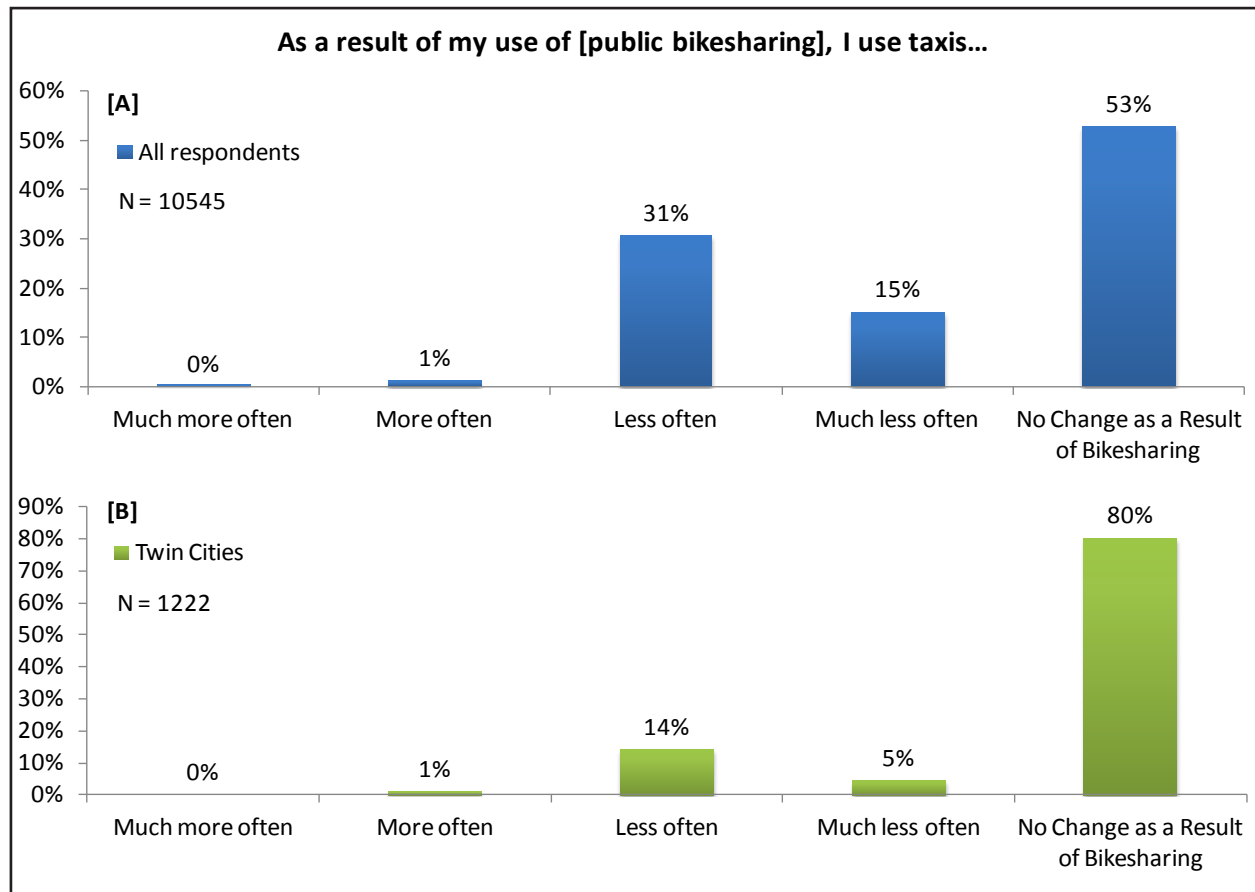

Figure 46. Change in Taxi Use Due to Public Bikesharing

Unlike the shifts observed in public transit and walking, in which people shifted both toward and away from the given mode, the observed shift with respect to automobiles is almost entirely in one direction. This is even more evident in the distribution of responses to changes in personal driving, shown in Figure 47.
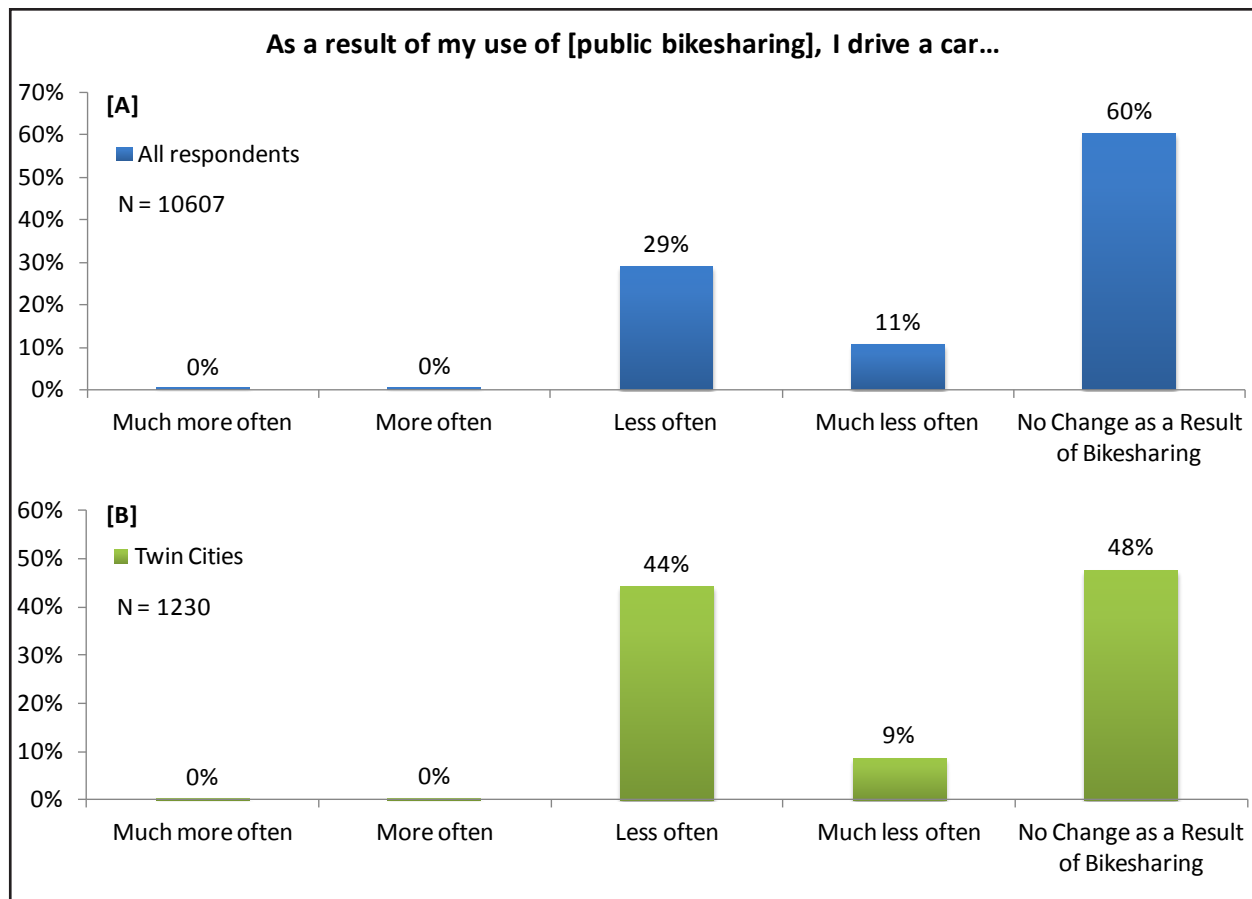
As a result of my use of [public bikesharing], I drive a car…

Figure 47. Changes in Personal Driving as a Result of Public Bikesharing

> **40% of the entire sample felt that they drove less as a result of public bikesharing.**

Forty percent of the respondents in the entire sample felt that they drove less as a result of public bikesharing. The effect in the Twin Cities is more pronounced than that in the large cities: 53% believed their overall driving had fallen as a result of public bikesharing, while 48% thought public bikesharing had caused no driving change. Across the cities, almost no respondents believed that public bikesharing had facilitated an increase in driving.

We also probed whether public bikesharing had impacted vehicle ownership. Since access to shared mobility has been demonstrated to alter personal transportation use—for example, carsharing has been widely shown to lower vehicle ownership[67,68]—it is natural to hypothesize that public bikesharing would produce similar effects. To explore this issue, we asked survey respondents whether they had "sold or donated a vehicle" or "considered selling or donating a vehicle" since joining public bikesharing. The survey asked those that did not respond "No," a question to assess the relative importance of public bikesharing on their vehicle ownership status. Figure 48 shows the distribution of responses. (The sample of 8,086 is smaller than the total sample size, as the question was not posed to individuals who indicated that they did not have access to a personal vehicle.)
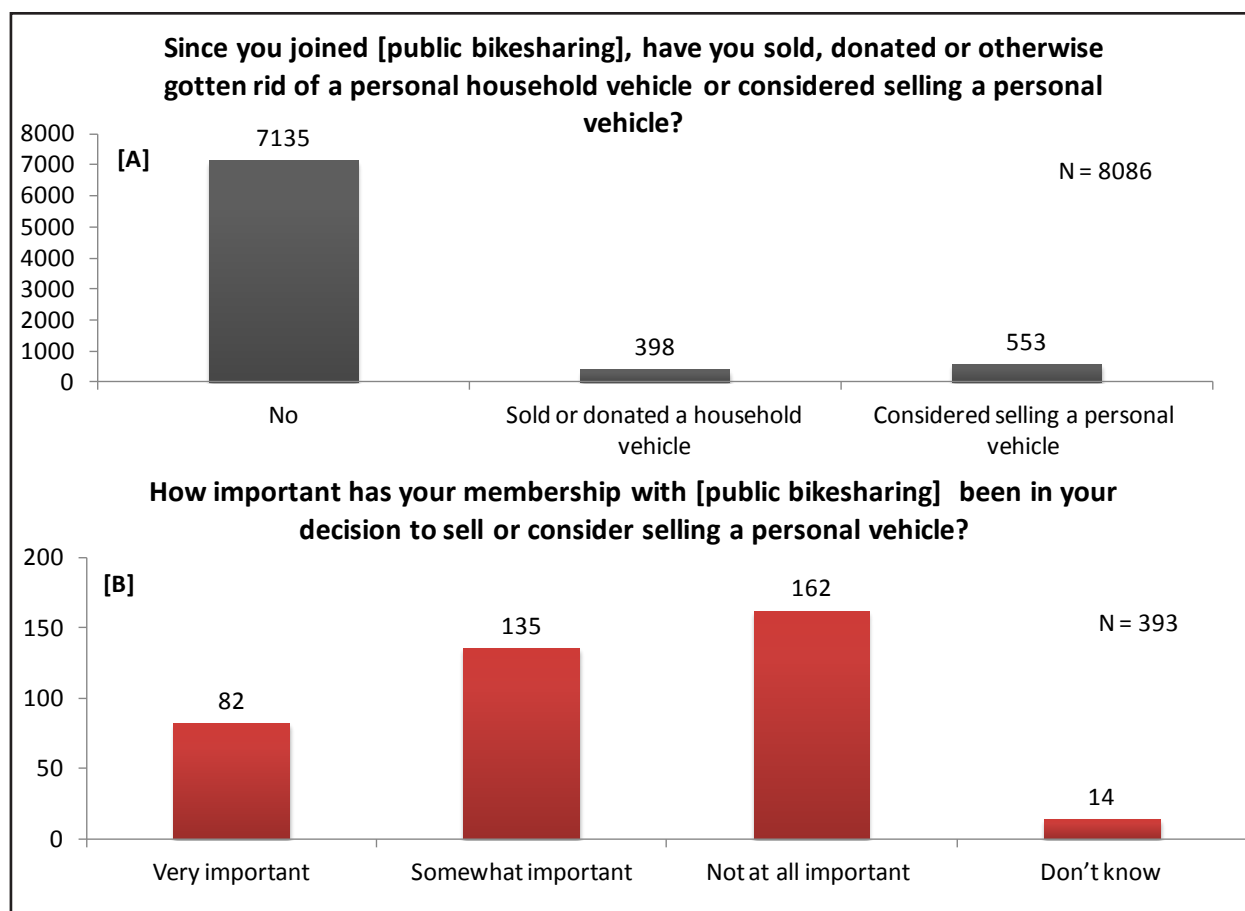
Since you joined [public bikesharing], have you sold, donated or otherwise gotten rid of a personal household vehicle or considered selling a personal vehicle?

[A]

N = 8086

	No	Sold or donated a household vehicle	Considered selling a personal vehicle
	7135	398	553

How important has your membership with [public bikesharing] been in your decision to sell or consider selling a personal vehicle?

[B]

N = 393

	Very important	Somewhat important	Not at all important	Don't know
	82	135	162	14

Figure 48. Reduction of Vehicle Ownership Due to Public Bikesharing

The bottom part of Figure 48 shows the responses of those who said that they had "sold or donated a household vehicle." Eighty-two respondents (0.77%) in the entire sample considered the availability of public bikesharing to be "very important" in their decision to sell a

> **2% of the entire sample considered public bikesharing to be "somewhat" to "very important" to their decision to sell a vehicle or postpone a vehicle purchase.**

vehicle or postpone a vehicle purchase, and 217 (2%) considered public bikesharing to be from "somewhat important" to "very important." While these numbers are not large compared with the vehicle-shedding percentages of carsharing (approximately 25%),[69] they demonstrate that public bikesharing has produced a measureable reduction in vehicle ownership.

The data also suggest that automobile reduction resulting from public bikesharing is relatively greater in the larger, denser cities. Of the 217 respondents indicating that public bikesharing played a role in their vehicle reduction, 56% were from Montreal, 25% were from Washington, D.C., 8% were from Toronto, and 11% were from the Twin Cities. The difference in magnitude is likely related to urban density and the relatively higher costs of auto ownership in large cities. It could also be related to public bikesharing system size and age. Montreal has the oldest program (launched in May 2009), followed by the Twin Cities (June 2010); Washington, D.C. (September 2010); and Toronto (May 2011). At the time of the survey, Toronto also had the smallest system. System age (e.g., Toronto's was

seven months old at the time of the survey) and size (Toronto had 4,000 members, 1,000 bikes, and 80 stations in November 2011), along with urban density, could affect vehicle reductions, since the decision to shed a vehicle requires time and planning.

The surveys in the Twin Cities, Toronto, and Montreal collected information on the location of home and work of public bikesharing users in the form of a street intersection near the location of each. This provided sufficient precision for travel analysis but was imprecise enough to preserve anonymity. The distance and time between home and work locations were then determined by passing the location pairs to Google Maps, obtaining the directions, and recording the time and distance for driving by car. In Washington, D.C., only the home and work ZIP codes were collected. The same method (using Google Maps) was applied, using the ZIP codes as centroids.

Among other analyses, the information we obtained can be used at a high level to understand how the commute needs of public bikesharing users differ from those of the general population within each of the cities. Figure 49 presents the distribution of travel times to work for public bikesharing members in Washington, D.C. and the Twin Cities. For comparison, the distribution of travel times to work as reported in these two cities in the 2010 American Community Survey (ACS) is provided alongside each of the sample distributions.[70] The public bikesharing travel time to work was computed as the Google Maps-reported "driving" travel time, as this was the mode used most in the general population in both cities. In the Twin Cities, the 2010 one-year ACS reported that 71% of commuters 16 and older drove alone to work, while in Washington, D.C. and Arlington, VA the figure from the same survey was 48%.
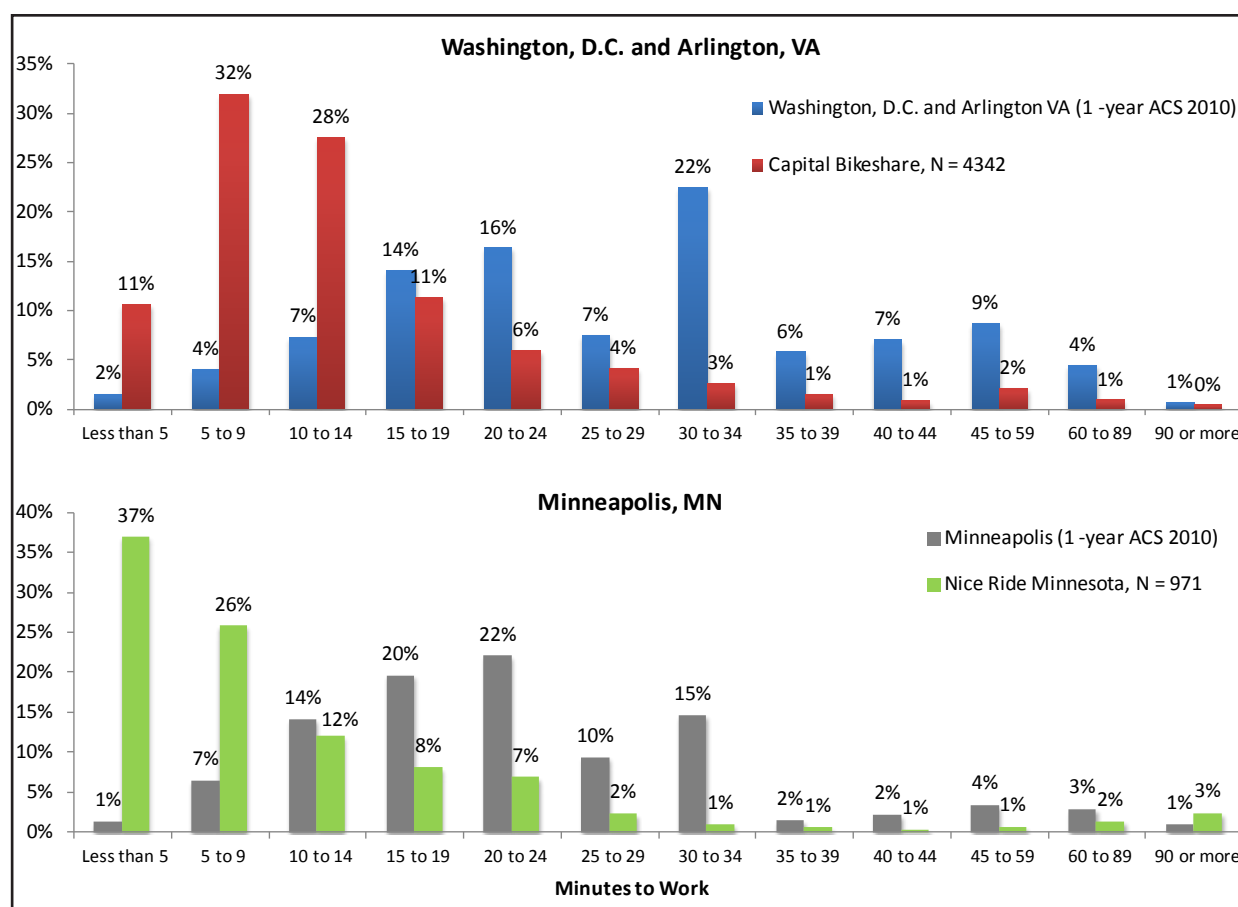
Figure 49. Distribution of Work Travel Times in Washington, D.C., and the Twin Cities

There appears to be a distinction between the commute needs of the general population and those of public bikesharing users. Public bikesharing members have shorter commutes than the general populations in their respective cities. In Washington, D.C. and the Twin Cities, more than 70% of public bikesharing users

> **Public bikesharing members have shorter commutes than the general populations in their respective cities. In Washington, D.C. and the Twin Cities, more than 70% of public bikesharing users live within a 15-minute drive time of their work location.**

live within a 15-minute drive time of their work location. In the Twin Cities, nearly 40% of users live within a five-minute drive time of their work location, while a similar proportion of Washingtonian bikesharing members live within a 10-minute drive of their work. The ACS data drawn from both cities show that only about 13% of working people in Washington, D.C. have a 15-minute travel time to work, whereas in the Twin Cities, this proportion is close to 22%.

Data on the population in Canada were obtained from the General Social Survey of 2006. Statistics Canada, which is Canada's equivalent of the U.S. Census, conducts a census of the population every five years; the most recent data were collected in 2011. However, information on distance to work was obtained from separate semi-decadal surveys of the general population, which focused on health and well-being. Through the University of

California, we obtained a license to use the public micro-data file from the 2005 General Social Survey (Cycle 19, called the Time Use Survey) from Statistics Canada, which contained a question on distance to work for about 19,000 respondents nationwide. The responses were weighted to match the population distribution in the country. Precise information on respondent location (census tract, city, etc.) was scrubbed from the public file. Information on whether the respondent lived in an urban or rural environment was available, as was the specific province of respondent residence. By selecting the urban residence of the provinces of Quebec and Ontario, we were able to generate a proxy (albeit imperfect) to evaluate the distribution of commute distance of Canadians in Montreal and Toronto. Montreal is the dominant urban environment in the province of Quebec (21% of the Quebec population), and Toronto holds about the same share (20%) of the Ontario population. Figure 50 shows the distribution of distance to work in the two participating Canadian cities. The population distribution is based on the weighted sample derived from the General Social Survey. The shape of the population distance-to-work distribution in both Canadian cities is different from those of the U.S. populations in that the mode of both distributions occurs in the category representing the smallest distance (i.e., 0 to 4 km to work).
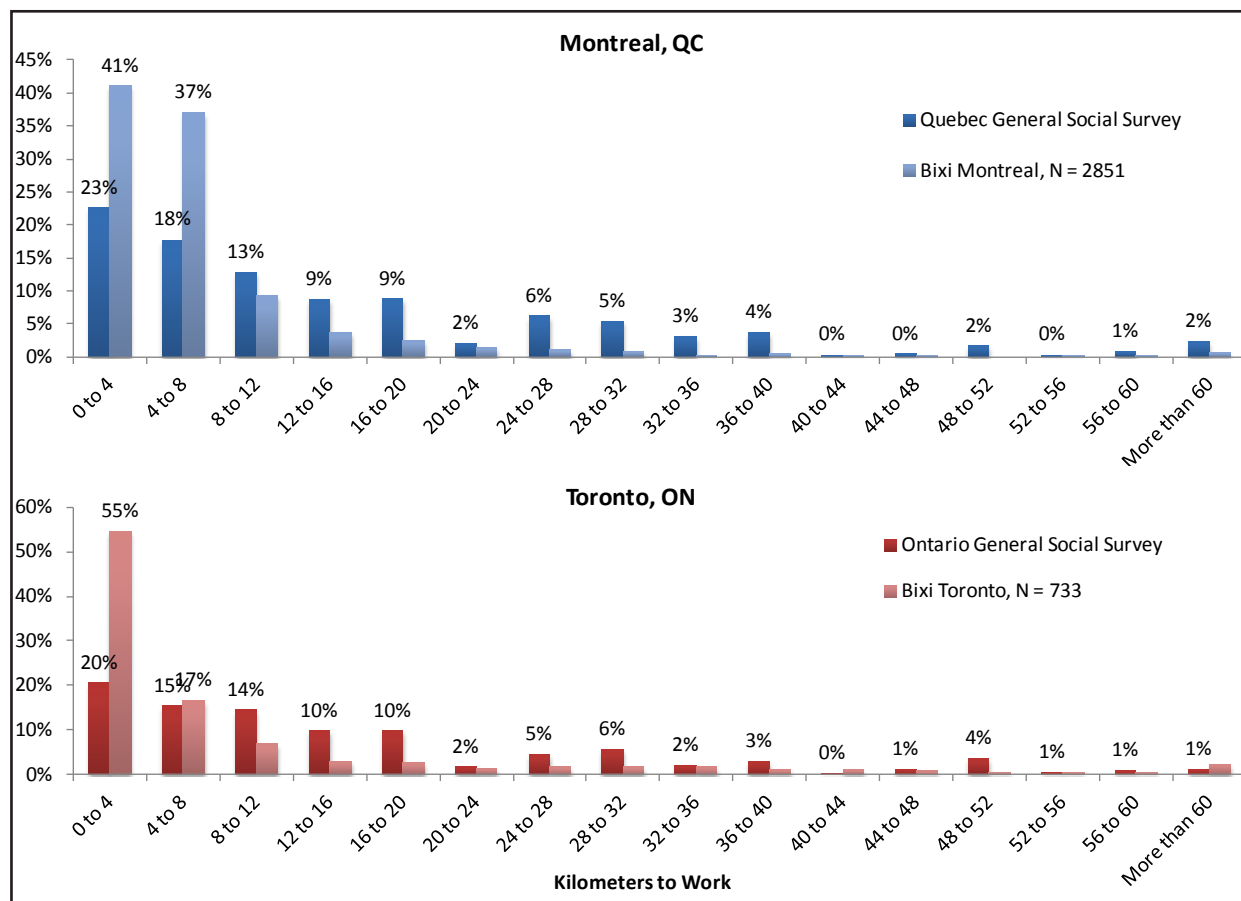

Figure 50. Distribution of Work Travel Distances in Montreal and Toronto

Also evident from the comparative distributions is the higher share of public bikesharing respondents living within 4 km of work. In Montreal, 41% of respondents live within 4 km, as contrasted to 23% of the population. In Toronto, the share is 55%. Thus, the Canadian population data generally show that people in the Canadian cities in this study have shorter

commutes than those living in the U.S. cities. The sample survey data also demonstrate that public bikesharing members appear to have shorter commutes than those of the population in which they live.

This consistent distinction across all four cities suggests that relatively short commutes may be attributed to public bikesharing members. A similar result was found for carsharing members in a previous study.[71] Thus, it is possible that having a relatively short commute is one attribute that facilitates being able to use and be comfortable with shared-use mobility. More research is needed to confirm this insight, but when explored, the initial data suggest that members of public bikesharing and carsharing services may have workplaces that are relatively close to home.

The survey results indicate that the sample was split into those that increased rail and bus usage and those that decreased it. The commute distances of the respective subsamples defined in this way revealed that those who decreased both rail and bus use had shorter commutes on average than those who increased their rail and bus use. This result was consistent across all operators for both rail and bus. Figure 51 shows the distribution of commute distances for the samples, defined by the direction of change in rail and bus use. The result suggests that public bikesharing may facilitate public transit connections more for those who have farther to travel to work and otherwise provides a mode that substitutes for public transit for those with shorter commutes.
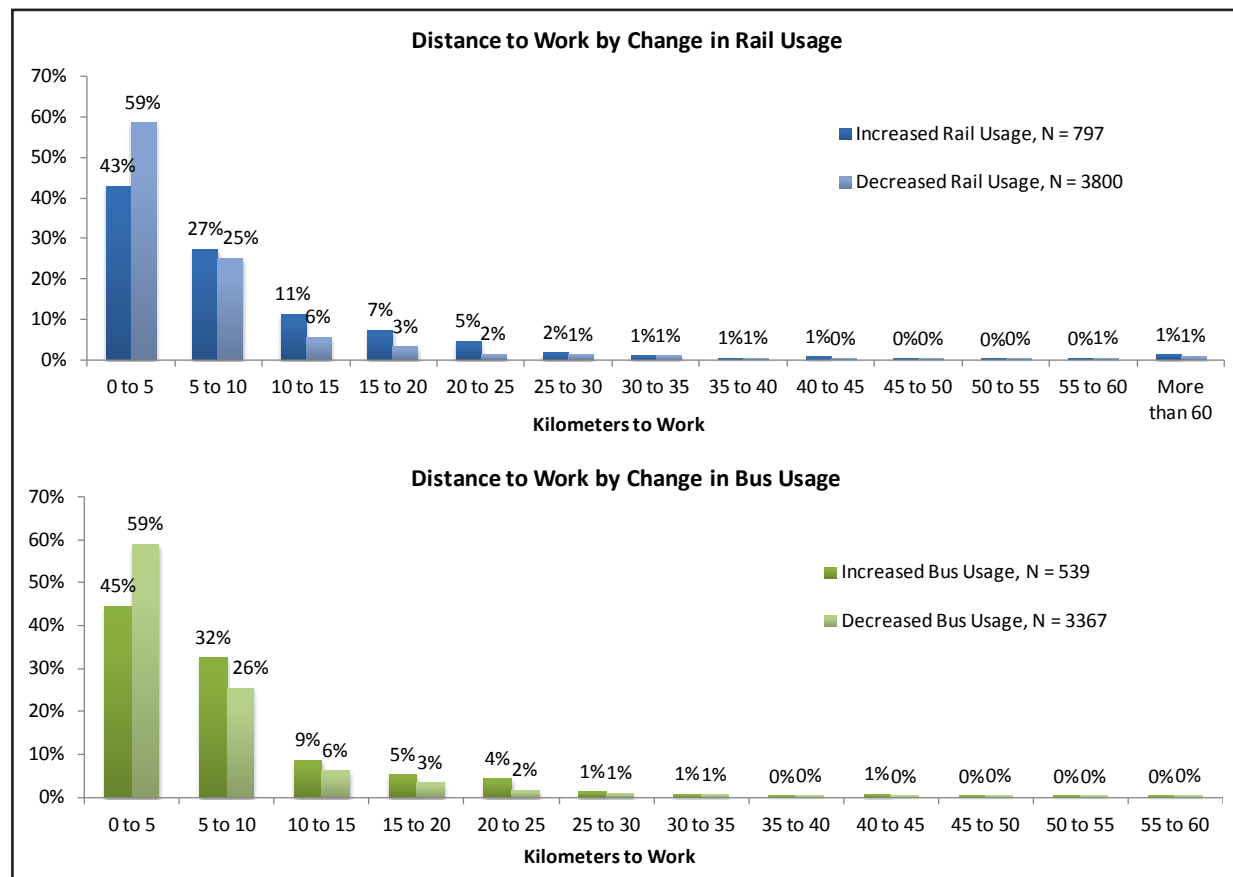

Figure 51. Distribution of Respondent Distance to Work, by Change in Rail and Bus Usage

SUMMARY

The survey results indicate that public bikesharing has had a notable and causal impact on user mobility. It has helped to facilitate connections to public transit in all cities, but in the larger cities, respondents indicated that they were using public transit less. The exception was the Twin Cities, where public transit use appears to have increased as a result of public bikesharing. A similar trend was exhibited for walking: Public bikesharing substituted for walking in the three largest cities and augmented walking in the Twin Cities. Finally, in all cities, public bikesharing appeared to substitute for driving and in a number of cases helped to lower vehicle ownership. Overall, the initial results of this study illustrate that public bikesharing has improved transportation in all of the cities surveyed by acting as an innovative mobility option that expands the reach of public transportation and provides health benefits.

V. CONCLUSION

Public bikesharing provides access to bicycles for short-term use that can be picked up and dropped off at different locations, the same location, or both throughout a network of bicycle docking stations. It encourages use of a zero-emission travel mode, increases exercise, expands mobility options, and can provide both a first-and last-mile and a many-mile solution. Innovations in IT and their application to public bikesharing have allowed it to advance from small community-based entities to large, citywide operations. Bikesharing operators have grown in both number and geographic scale. As of January 2012, 19 IT-based bikesharing programs were operating in the United States and Canada, with 216,422 users sharing 11,473 bicycles.

This study focused on the state of IT-based public bikesharing in the United States and Canada and the social and environmental impacts of early bikesharing organizations. Interviews were conducted with 14 bikesharing stakeholders, five bikesharing insurance experts, and 19 representatives from bikesharing operators in the United States and Canada. In addition, a user survey was conducted with members of four early bikesharing organizations in North America.

The user survey was administered in fall 2011/early 2012 (n=10,661). Operators in four locations participated: Montreal, Toronto, the Twin Cities, and Washington, D.C. The survey found that the most common trip purpose for public bikesharing is travel to work or school, followed by social entertainment and errands, indicating that these bikesharing programs are generally used for practical travel purposes as opposed to recreational use. These four large bikesharing programs (i.e., 1,000 bikes or more), while available for recreational use by tourists and others, are more broadly used as an extension of the public transportation system.

The survey showed that public bikesharing has had a notable impact on user travel behavior. A majority of the respondents believe that bikesharing is an enhancement to public transportation, improves connectivity, and increases their personal exercise. Public bikesharing appears to be drawing some respondents from all modes, including driving and public transit (bus and rail). The nature of this impact differs across the cities examined in this study. In the larger cities, public bikesharing has increased bicycle use while reducing other modal shares—including private vehicle and public transit use. In the Twin Cities, the least dense and transit-intensive urban area examined, public bikesharing has increased bicycle use, walking, and light-rail use (with little net change in bus usage). In all cities, respondents stated that they had reduced both driving and taxi use as a result of bikesharing. While the survey results reflect initial and early-adopter findings, they suggest that public bikesharing has improved transportation sustainability in all cities (by reducing automotive energy use); they also suggest that public bikesharing may be able to enhance transportation connectivity in a medium-size city. The reduction of energy use and emissions is a key motivation for public bikesharing. The survey also illustrates that commute distance is an important factor that distinguishes bikesharing users and the way they alter travel in response to bikesharing. Bikesharing users generally have shorter commute distances than the general population in all the cities surveyed, but those with relatively longer commutes are more likely to increase public transit use as a result

of bikesharing. Overall, a majority of respondents reported getting more exercise since become a bikesharing user.

Helmet use across cities was somewhat limited. Depending on the city, 43% to 62% of respondents reported never using a helmet while bikesharing. However, between 20% and 36% reported using helmets with bikesharing with relatively high frequency, depending on the city. Further study of these dynamics is needed across a larger set of cities and operators in North America over time to better understand key factors in the success of public bikesharing and how to optimize its impacts and operations.

We conducted 19 interviews with North American operators in April 2012, 15 of which were in the United States and four of which were in Canada. We also supplemented our bikesharing insurance data by interviewing five insurance experts. Seven bikesharing business models were identified including: 1) non-profit, 2) privately owned and operated, 3) publicly owned and operated, 4) public owned/contractor operated, 5) street-furniture contract, 6) third-party operated, and 7) vendor operated. Five of the seven are currently active. The average member-to-bicycle ratio for the United States and Canada combined was 19:1, but the ratio in the United States was considerably higher (33:1) than that in Canada (7:1). More than three-quarters of the operators interviewed indicated receiving some type of startup or operational funding. North American systems generally rely on sponsorships and user fees for revenue and public land for non-monetary support (i.e., station placement). Interviews with both operators and experts signified the importance of partnerships—particularly with public transit—in bikesharing's success. Public bikesharing insurance is also an important issue and policies vary considerably across the industry. This is because local governments, non-profits, and for-profits have different insurance requirements and may have existing policies that could be extended to cover bikesharing systems as well (e.g., local governments and public transit agencies). In general, insurance premiums are influenced by: 1) geographic location, 2) limits and deductibles, and 3) system usage.

Providing public bikesharing users with public transit discounts and colocating bikesharing facilities with transit stops can encourage cross-flow between public transit and bikesharing by expanding the catchment area of transit. Operators and experts also indicated that digital linking (i.e., integrating real-time data, apps, websites, and online maps) with public transit is very important in a multi-modal transportation network.

As public bikesharing becomes more mainstream, the development of industry standards and increased collaboration may occur in key areas, notably public policy and insurance. Existing and planned partnerships/sponsorships include: station sponsors, corporate memberships, government memberships, partnerships with public transit and carsharing organizations, and collaboration with bike stores and other agglomeration economies. While a common critique of IT-based public bikesharing is that a credit/debit card is typically required for membership and system use, innovative partnerships, such as providing joint memberships with financial institutions, can enhance system accessibility.

While all of the operators interviewed were IT-based programs, we identified differences in the level of technological implementation ranging from basic IT to state-of-the-art. As third-

generation systems evolve into fourth-generation systems, innovations such as dockless stations, dynamic pricing, and increased levels of public transit integration (e.g., smartcard integration and greater levels of real-time information) will likely be emphasized.

As of May 2012, there were 34 planned programs in the United States and Canada. Eighteen of these planned programs anticipate launching in the second half of 2012, with an estimated 21,000 bicycles.

Local and regional governments and transportation authorities can do a number of things to support public bikesharing in their region, including:

- **Providing endorsements, outreach, co-promotions, and media events;**

- **Including public bikesharing in applications for grants, loans, and other incentives;**

- **Providing access to public rights-of-way for bike stations and advertising;**

- **Issuing a request for proposal (RFP) to bring public bikesharing to their region;**

- **Becoming public bikesharing customers; and**

- **Encouraging public bikesharing in development projects.**

As public bikesharing operators and local/regional governments contemplate the implementation of bikesharing, the following policy questions are important to consider:

1) **Where will bike stations be located and will vehicle parking have to be removed or modified to enable space for bike stations?**

2) **What type of fees (if any) should be assessed to public bikesharing operators accessing public rights-of-way?**

3) **What type of financial support is appropriate for the startup and ongoing operation of a public bikesharing program?**

4) **Should there be a different policy for providing financial support and charging fees to for-profit and non-profit public bikesharing providers?**

5) **What ordinances and policies will a local government need to address before implementing public bikesharing?**

   a. **What type of signage and markings will identify public bikesharing locations and who will be responsible for their installation and maintenance?**

   b. **Will bikes be allowed on rail and bus transit?**

   c. **Will advertising be allowed on bicycles and/or bike stations?**

6) **What type of public involvement processes are needed (e.g., workshops, crowd sourcing via social media, and demonstrations)?**

7) **How will public bikesharing operators document the social, safety, and environmental impacts of their organization over time?**

8) **How will bikesharing insurance evolve over time and how might operators work together to develop industry standards and reduce risk?**

9) **Should operators consider a consistent methodology for reporting user populations (e.g., combining annual and 30-day members in user totals and reporting daily users separately)?**

New public bikesharing entrants, possible program mergers, continued technological innovation, and policy developments will continue to characterize bikesharing in the coming years. Additionally, public bikesharing may receive more attention as a sustainable transportation alternative as a result of rising fuel prices, public health concerns, smart-growth initiatives, and climate-change concerns.

APPENDIX A: EXPERT INTERVIEW SCRIPT

I.   Introduction

Hello, my name is XXXX. I am contacting you per our previous arrangement to ask you some questions about your experience with public bikesharing. (reference previous telephone conversation or email). Before we begin the interview I would like to read this consent form to you and confirm that you agree to participate in this research. (If you have previously sent them the consent form, just ask if they have any questions and confirm that they consent.)

II.   Preliminary Information

    a) Identify name, position, and organization of interviewee.

    b) Determine how interviewee's job tasks pertain to bikesharing

    c) Date and time at which the interview took place.

III.   Expert Information

    I.   General Perceptions Towards Bicycles

        a. What do you think are the greatest benefits of public bikesharing in your region?

        b. What do you think are the greatest challenges for public bikesharing in your region?

        c. What is the one additional thing you would recommend to improve the public bikesharing experience in your area?

        d. In what ways do you think users find public bikesharing convenient?

        e. In what ways do you think users find public bikesharing inconvenient?

        f. Do you think there are differences in attitudes and lifestyle between people that use public bikesharing and people that do not?

            i. What do you think are the primary factors that set these two groups of people apart (income, age, fitness/health, attitudes towards environment, room to store bikes in their home, supportive bike infrastructure near home/work, safety concerns, attitudes towards oil security, education, other)?

    II.   Operations

        a. Do you ever have to redistribute bicycles within the system?

            i. How do you manage bicycle over-supply or under-supply at specific stations?

            ii. How often do you have to shift bicycles around?

            iii. What does it cost you to redistribute system bicycles on a typical day/week/month (whichever is easier to quantify)?

        b. Do people ever try to check out a bicycle and find one unavailable?

            i. How is this situation handled?

    c. Do people ever try to check in a bicycle and find no space is available?

        i. How is this situation handled?

    d. Are individual bicycles tracked with GPS or have any telematics equipment on them?

    e. What telematics equipment do stations have?

    f. Do stations require any power (or how much?)

III. Supporting Infrastructure:

    a. Bicycle Theft and Vandalism:

        i. Do you know if theft or vandalism is a problem for the bikesharing program in your area?

            1. If so, what could local government and businesses do to help minimize this problem?

            2. If so, what could the bikesharing operator do to minimize this problem?

    b. Information System:

        i. Can you briefly describe how a user (would) locates a bike station in your region for bicycle pickup or dropoff?

        ii. Do public bikesharing users in your region have access to real-time information (i.e., bike station parking, availability, etc.)?

        iii. What additional information would be helpful for public bikesharing users to have?

        iv. What do you think are the most effective ways for the public bikesharing system to communicate with users (text message, mobile phone call, web link, personal web link with user information, other)?

    c. Local Roadways and Infrastructure

        i. Are the bike lanes in your area separated from moving vehicles or colocated next to moving cars?

        ii. Do you think bicyclists plan their trips to take advantage of bike lanes that are separated from traffic?

        iii. Do you think bicyclists plan their trips to take advantage of bike lanes that are colocated with car lanes?

        iv. What aspect of riding in traffic do you think is most dangerous to bicyclists (left turn, round-abouts, signals, trucks, buses, inclement weather, other)?

        v. Do individuals that use the bikesharing system typically use helmets? Is it a concern/barrier for users that they must supply their own bicycle helmet?

    vi. Have there been any accidents involving the public bikesharing system? How many and nature of them? Does your program have insurance? Please provide insurance types (premiums, coverage levels, and deductibles, as appropriate).

    vii. What aspects of the roadways in your region do you think are most friendly to bikes?

       1. Please explain.

d. Links to Public Transit:

    i. Is there a link between public bikesharing and any of the public transit systems in your region?

       1. If so, please explain.

       2. If not, do you know why not?

    ii. Are there additional ways public bikesharing could be linked to public transit that would improve both public bikesharing and transit?

e. Other Affiliations:

    i. Does bikesharing in your area work with any specific employers?

       1. If so, please explain.

    ii. Does bikesharing in your area work with any other businesses (for example, discounts at bike shops, restaurants, or other stores)?

       1. If so, please explain.

    iii. What type of partner or affiliation do you think would be most beneficial to bikesharing members?

IV. Supporting Policy:

a. Local government:

    i. Did local government need to change any local policies for public bikesharing to come to your region?

       1. If so, please explain.

    ii. Are there other local government policy changes that you think would improve public bikesharing in your region?

       1. If so, please explain.

b. Local Public Transit:

    i. Did local public transit need to change any policies for public bikesharing to come to your region?

       1. If so, please explain.

       ii. Are there other public transit policy changes that you think would improve public bikesharing in your region?

            1. If so, please explain.

V.   Business Model and Economic Sustainability:

  a. What do the public bikesharing members pay to access bicycles? (or if you already have the rate structure, verify the information you have)

  b. Did the government (federal, state or local) provide any funds (or are they still providing funds)?

  c. Are there any other sources of funds to set up and operate the system (foundations, business sponsorship, other)?

  d. If either government or other sources of funding:

       i. Are these funds in the form of a loan to be paid back or a grant?

       ii. Are these funds necessary for start-up or are external funds necessary to operate the system?

            1. Please explain what the funds are being used for.

  e. Do you think public bikesharing operations can be financially self-sufficient or do you think that public bikesharing will continue to require public support?

       i. If financially self sufficient, please explain why, and how long you think it would take for a system to achieve self-sufficiency?

       ii. If public support, please explain what kind and level of public support you think will be required (i.e., % of subsidy of total operations).

  f. Do you think that public bikesharing should be financially self-sufficient or should receive public support?

       i. If public support, what do you think is the public benefit?

  g. Are the bike stations on public or private land?

       i. Does your bikesharing organization pay for the use of the land?

       ii. Did other uses for the land get moved to make room for the bike stations?

VI.   Social and Environmental Impacts

  a. What do you think are the greatest benefits of public bikesharing (social, environmental, other)?

  b. What do you think are the more challenging aspects of public bikesharing?

  c. Do you think that public bikesharing is used most often to replace a mode, to augment a mode (i.e., access to public transit), or to generate a new trip that otherwise would not have occurred?

d. What mode do you think public bikesharing tends to replace the most (single occupancy cars, carpooling cars, bus, rail, walking, personal bike, other)?

VII. Conclusion

a. Is there anything we didn't talk about that you would like to tell me?

b. If I have any follow-up questions to clarify any of your responses here, may I call you?

Thank you for your time.

APPENDIX B: PUBLIC BIKESHARING USER SURVEY

The survey reproduced in this appendix was given to users of BIXI in Toronto and is similar to the surveys administered in all of the cities by the University of California, Berkeley and MTI study team members. Users received surveys tailored to their operator and their city transportation system, but the general structure and content are similar. Toronto is given as an example, survey logic and branching implemented online are not shown.

CONSENT TO PARTICIPATE IN ONLINE SURVEY

BIXI and the University of California, Berkeley (UC Berkeley), Transportation Sustainability Research Center are partnering to conduct a survey to better understand the impacts of public bikesharing on travel behavior.

You can skip any questions that you do not wish to answer.

You will not receive any compensation for responding to this survey. If you take the survey and provide your email address at the end of the survey, you will be entered to win a US/CAD$50.00 Amazon.com gift certificate. Your odds of winning are at least 1 in 650 or better (depending on how many people take the survey). Your email will be used for the gift certificate drawing and will not be shared with a third party; it will be deleted from our system after the drawing is complete.

Your responses to this survey are encrypted in transmission, de-identified in storage, and will be maintained confidentially by BIXI and UC Berkeley.

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal rights because of your participation in this research study. If you would like to review the complete consent form for this research project, you may download a PDF of it at http:// tsrc.berkeley.edu/sites/tsrc.berkeley.edu/files/UCBConsentForm.pdf.

1. I have read the consent and agree to take the survey.

When did you join the BIXI system?

Month:

Year:

How often do you (or did you) ride a bike? (please choose one response per row)

	Less than once a month	Monthly	Every other week	1 to 3 days per week	4 to 6 days per week	7 days per week
Currently	❏	❏	❏	❏	❏	❏
Before you joined BIXI?	❏	❏	❏	❏	❏	❏

On average, how many times a month would you check out a BIXI bicycle?

What is your most common trip purpose for using BIXI?

1. Go to work

2. Go to school

3. Go to a meeting

4. Go to a restaurant / meal

5. Go shopping

6. Social/entertainment/visit friends

7. Run errands

8. Exercise/recreation

9. Other (please specify) _____

Before BIXI was available, how would you have made this trip most often? (check all modes that you would use during a single trip before bikesharing)

1. Bus

2. Subway

3. Commuter rail

4. Streetcar

5. Ferry

6. Personal bike

7. Drive alone

8. Ride as a passenger in a car

9. Taxi

10. Walk

11. Carsharing vehicle

12. I would not have made this trip

13. Other _____

Which of these modes do you usually use to complete this trip in conjunction with BIXI?

1. Bus

2. Subway

3. Commuter rail

4. Streetcar

5. Ferry

6. Personal bike

7. Drive alone

8. Ride as a passenger in a car

9. Taxi

10. Walk

11. Carsharing vehicle

12. I use bikesharing alone to complete this trip

13. Other _____

What is the approximate one-way distance of this trip by car?

Approximate one-way distance in kilometers:

Besides your most common trip purpose, for what other trip purposes have you used BIXI? (please check all that apply)

1. Go to work

2. Go to school

3. Go to a meeting

4. Go to a restaurant/meal

5. Go shopping

6. Social/entertainment/visit friends

7. Run errands

8. Exercise/recreation

9. Other (please specify) _____

Based on your experience with bikesharing, which transportation mode do you think is most complemented (or supported) by BIXI? (Please select one response)

1. Bus

2. Subway

3. Commuter rail

4. Streetcar

5. Ferry

6. Personal bike

7. Driving alone

8. Riding as a passenger in a car

9. Taxi

10. Walk

11. Carsharing vehicle

12. None of these

13. Other _____

What other modes do you think are well complemented (or supported) by BIXI? (Please select all that apply)

1. Bus

2. Subway

3. Commuter rail

4. Streetcar

5. Ferry

6. Personal bike

7. Drive alone

8. Ride as a passenger in a car

9. Taxi

10. Walk

11. Carsharing vehicle

Please indicate whether you strongly agree, agree, disagree, or strongly disagree with the following statements based on your experience with BIXI.

I get more exercise now that I am a member of BIXI.

1. Strongly agree

2. Agree

3. Neutral (no opinion)

4. Disagree

5. Strongly disagree

BIXI has made Toronto a more enjoyable place to live.

1. Strongly agree

2. Agree

3. Neutral (no opinion)

4. Disagree

5. Strongly disagree

I think of BIXI as an enhancement to the Toronto public transportation system.

1. Strongly agree

2. Agree

3. Neutral (no opinion)

4. Disagree

5. Strongly disagree

BIXI enhances my mobility within Toronto.

1. Strongly agree

2. Agree

3. Neutral (no opinion)

4. Disagree

5. Strongly disagree

BIXI provides me with an important link to and from the Toronto public transit system.

1. Strongly agree

2. Agree

3. Neutral (no opinion)

4. Disagree

5. Strongly disagree

Since joining BIXI, I have made trips with transit and bikesharing (together) that I would have previously done with a car.

1. Strongly agree

2. Agree

3. Neutral (no opinion)

4. Disagree

5. Strongly disagree

BIXI makes accessing and traveling from transit easier.

1. Strongly agree

2. Agree

3. Neutral (no opinion)

4. Disagree

5. Strongly disagree

BIXI has improved the connectivity of the Toronto transit system.

1. Strongly agree

2. Agree

3. Neutral (no opinion)

4. Disagree

5. Strongly disagree

As a result of my use of BIXI, I use public transportation . . .

1. Much more often

2. More often

3. About the same (bikesharing has had no impact)

4. Less often

5. Much less often

6. I did not use public transportation before and I do not use it now.

7. My use of public transportation changed, but not because of BIXI.

How often do you use BIXI in the following ways? (Please choose one response per row)

	Often	Sometimes	Rarely	Never
Bikeshare TO a subway station	❏	❏	❏	❏
Bikeshare FROM a subway station	❏	❏	❏	❏
Bikeshare TO a bus stop	❏	❏	❏	❏
Bikeshare FROM a bus stop	❏	❏	❏	❏
Bikeshare FROM one station to ANOTHER station	❏	❏	❏	❏
Bikeshare FROM one station BACK TO THE SAME station	❏	❏	❏	❏

Please tell us how your membership with BIXI has led to changes in your use of specific modes of travel.

As a result of my use of BIXI, I use the bus . . .

1. Much more often

2. More often

3. About the same (bikesharing has had no impact)

4. Less often

5. Much less often

6. I did not ride the bus before and I do not ride the bus now.

7. I have changed how I use the bus, but not because of BIXI.

As a result of my use of BIXI, I use the subway . . .

1. Much more often

2. More often

3. About the same (bikesharing has had no impact)

4. Less often

5. Much less often

6. I did not use the subway before and I do not the subway now.

7. I have changed how I use the subway, but not because of BIXI.

As a result of my use of BIXI, I use the commuter rail . . .

1. Much more often

2. More often

3. About the same (bikesharing has had no impact)

4. Less often

5. Much less often

6. I did not use the commuter rail before and I do not use the commuter rail now.

7. I have changed how I use the commuter rail, but not because of BIXI.

As a result of my use of BIXI, I use the streetcar . . .

1. Much more often

2. More often

3. About the same (bikesharing has had no impact)

4. Less often

5. Much less often

6. I did not use the the streetcar before and I do not use the streetcar now.

7. I have changed how I use the streetcar, but not because of BIXI.

As a result of my use of BIXI, I use the ferry . . .

1. Much more often

2. More often

3. About the same (bikesharing has had no impact)

4. Less often

5. Much less often

6. I did not use the ferry before and I do not use the ferry now.

7. I have changed how I use the ferry, but not because of BIXI.

As a result of my use of BIXI, I walk . . .

1. Much more often

2. More often

3. About the same (bikesharing has had no impact)

4. Less often

5. Much less often

6. I did change how much I walk, but not because of BIXI.

As a result of my use of BIXI, I drive a car . . .

1. Much more often

2. More often

3. About the same (bikesharing has had no impact)

4. Less often

5. Much less often

6. I did not drive a car before and I do not drive a car now.

7. I did change how much I drive a car, but not because of BIXI.

To what extent does bikesharing contribute to your driving reduction?

1. Bikesharing is the sole reason for my driving reduction.

2. Bikesharing availability is a main reason for my driving reduction along with other factors.

3. Bikesharing availability is a minor reason for my driving reduction along with other factors.

4. Bikesharing availability is not a reason for my driving reduction.

As a result of my use of BIXI, I use taxis . . .

1. Much more often

2. More often

3. About the same (bikesharing has had no impact)

4. Less often

5. Much less often

6. I did not use taxis in Toronto before and I do not use them now.

7. I did change how much I use taxis, but not because of BIXI.

As a result of my use of BIXI, I ride a bicycle (any bicycle) . . .

1. Much more often

2. More often

3. About the same (bikesharing has had no impact)

4. Less often

5. Much less often

As a result of my use of BIXI, I use carsharing (AutoShare/Communauto/Zipcar) . . .

1. Much more often

2. More often

3. About the same (bikesharing has had no impact)

4. Less often

5. Much less often

6. I am not a member of carsharing.

7. I did change my use of carsharing, but not because of BIXI.

As a result of my use of BIXI, I shop at locations near existing bike stations . . .

1. Much more often

2. More often

3. About the same (bikesharing has had no impact)

4. Less often

5. Much less often

6. I do not shop locally.

How often do you wear a helmet when using BIXI bikes?

1. Always

2. Most of the time

3. Sometimes

4. Rarely

5. Never

How good a bicyclist do you consider yourself to be?

1. Expert

2. Very good

3. OK

4. Not too good

5. Not good at all

Please indicate the types of vehicles that are available to you on a regular basis? (check all that apply)

1. A personal bike (other than BIXI)

2. A car, van, SUV, truck or other person vehicle

3. A motor scooter or motorbike

4. A motorcycle

5. A carsharing membership

6. Taxi (street-hailable)

7. Existing carpool or vanpool arrangement

Please indicate the make, model, and year of the personal vehicle that you drive most (motor vehicles that you own or lease).

Make (e.g., Ford):

Model (e.g., Fusion):

Year (e.g., 2006):

Since joining bikesharing, approximately how many kilometers per month do you drive your personal vehicle on average?

Kilometers per month:

During the year before joining bikesharing, approximately how many kilometers per month did you drive this vehicle on average?

Kilometers per month:

Since you joined BIXI, have you sold, donated, or otherwise gotten rid of a personal household vehicle or considered selling a personal vehicle?

1. No

2. Sold or donated a household vehicle

3. Considered selling a personal vehicle

How important has your membership with BIXI been in your decision to sell or consider selling a personal vehicle?

1. Very important

2. Somewhat important

3. Not at all important

4. Don't know

Feel free to offer any further description of how BIXI has influenced your travel behavior or lifestyle within Toronto (optional).

If you have any suggestions for BIXI operations to help improve services, feel free to offer them here (optional).

Demographics and Approximate Home/Work Location

Please indicate two streets that cross near your HOME location as well as the city.

Street #1:	❏
Street #2:	❏
City:	❏

Approximately how long (in years and months) have you lived near this intersection? (e.g., 1 year and 9 months)

Whole years:

Months:

Please indicate two streets that cross near your WORK location as well as the city.

Street #1:	❏
Street #2:	❏
City:	❏

Approximately how long (in years and months) have you worked near this intersection? (e.g., 1 year and 9 months)

Whole years:

Months:

Are you male or female?

    1. Male

    2. Female

    3. Prefer not to answer

What is your age?

    1. 16–17 years old

    2. 18–24

    3. 25–34

    4. 35–44

    5. 45–54

    6. 55– 64

    7. 65 years or older

    8. Prefer not to answer

Approximately what is your expected household income this year?

1. Less than $10,000
2. $10,000 to $14,999
3. $15,000 to $24,999
4. $25,000 to $34,999
5. $35,000 to $49,999
6. $50,000 to $74,999
7. $75,000 to $99,999
8. $100,000 to $149,999
9. $150,000 to $199,999
10. $200,000 or more
11. Prefer not to answer

What is the highest level of education you have completed?

1. Less than high school
2. High school
3. Technical school/Cegep
4. Bachelor's degree
5. Advanced degree (Masters, Doctoral)
6. Prefer not to answer
7. Other (please specify):

Which of the following best describes your racial or ethnic background? (please check all that apply)

1. Asian/Pacific Islander
2. Black/African-American
3. Caucasian
4. Hispanic/Latino
5. Indian/Pakistani
6. Middle-Eastern or Arab
7. Native American/Alaska Native
8. Prefer not to answer
9. Other

What is your occupational status? (please check all that apply)

1. Full-time student

2. Part-time student

3. Employed full-time

4. Employed part-time

5. Stay-at-home parent

6. Unemployed, looking for work

7. Unemployed, not looking for work

8. Retired

9. Prefer not to answer

As part of your participation in this survey, would you like to take part in a drawing for a CAD/US$50 Amazon card? If so, please provide your email address below, and thank you for your participation.

1. No thank you

2. Yes, contact email is: _____

ABBREVIATIONS AND ACRONYMS

ACS	American Community Survey
CAD	Canadian Dollar
CO_2	Carbon Dioxide
FTA	Federal Transit Administration
GPS	Global Positioning System
GSA	General Services Administration
IT	Information Technology
RFID	Radio-Frequency Identification
SFMTA	San Francisco Municipal Transportation Agency
TSRC	Transportation Sustainability Research Center

ENDNOTES

1. Susan Shaheen, Stacey Guzman, and Hua Zhang. 2010. "Bikesharing in Europe, the Americas, and Asia: Past, Present, and Future," *Transportation Research Record: Journal of the Transportation Research Board*, 2143: 159–167.

2. Susan Shaheen, Stacey Guzman, and Hua Zhang. 2010. "Bikesharing in Europe, the Americas, and Asia: Past, Present, and Future," *Transportation Research Record: Journal of the Transportation Research Board*, 2143: 159–167.

3. Stewart Home. 1991. *The Assault on Culture: Utopian Currents from Lettrisme to Class War*. Edinburgh, UK: AK Press, 65–68.

4. Bike-sharing Blog. 2009. Pioneering Bike-sharing Program Goes Dark After 11 Years. http://bike-sharing.blogspot.com/2009/05/pioneering-bike-sharing-program-goes. html (accessed March 1, 2012).

5. Polis. 2011. One Hundred Million Trips Made with Paris' Public Bike Scheme Vélib. http://www.polisnetwork.eu/publicnews/61/45/One-hundred-million-trips-made-with-Paris-public-bike-scheme-Velib/ (accessed March 6, 2012).

6. Radials Blog. 2011. Do It for the Capital, Cycling Ovechkin. Photo from http://www. radialsblog.com/capital-cycling-ovechkin/ (accessed May 23, 2012).

7. The Bike-Sharing Blog. 2012. The Bike Sharing World, First Week of January 2012. Photo from http://bike-sharing.blogspot.com/2012_01_01_archive.html (accessed May 20, 2012).

8. Thomas O'Keefe and Joe Keating. The Yellow Bike Story. http://c2.com/ybp/story.html (accessed February 29, 2012).

9. Infosur Hoy. 2011. ECOBICI Bicycle Campaign a Hit in Mexico City. http://infosurhoy. com/cocoon/saii/xhtml/en_GB/features/saii/features/society/2011/12/08/feature-02 (accessed March 2, 2012).

10. Peter Noyce. ECOBICI Bicycle Campaign a Hit in Mexico City. August 12, 2011. http:// infosurhoy.com/cocoon/saii/xhtml/en_GB/features/saii/features/society/2011/12/08/ feature-02 (accessed April 14, 2012).

11. *Bicicultura*. 2010. Sistema de Bicicletas Públicas se Extenderá por Todo Santiago. http://www.bicicultura.cl/content/view/1164977/Sistema-de-bicicletas-publicas-se-extendera-por-todo-Santiago.html (accessed March 8, 2012).

12. Ibid.

13. SurveyGizmo. 2010. Nice Ride Subscriber Survey: Survey Report. https://appv3. sgizmo.com/reportsview/?key=102593-416326-6d13ea0276ea0822c9f59f4411b 6c779 (accessed February 29, 2012).

14. Denver B-cycle. 2011. 2011 Season Results. http://denver.bcycle.com/News. aspx?itemid=185 (accessed February 29, 2012).

15. Washington City Paper. 2010. R.I.P., SmartBike, Good Riddance. March 1, 2012. http:// www.washingtoncitypaper.com/blogs/housingcomplex/2010/09/16/r-i-p-smartbike- good-riddance/.

16. Capital Bikeshare. 2011. Capital Bikeshare Hits 1 Million Rides on First Anniversary. http://www.capitalbikeshare.com/news/2011/09/20/capital-bikeshare-hits-one-million- rides-on-first-anniversary (accessed March 1, 2012).

17. Hubway. 2012. Mayor Signs First-Ever Bike Share Contract Launching Hubway in Boston. http://thehubway.com/news/2011/04/21/mayor-menino-signs-first_ever-bike- share-contract-launching-hubway-in-boston (accessed May 15, 2012).

18. WNYC. 2012. City Holds First Bike Share Station Planning Workshop. http://www. wnyc.org/blogs/wnyc-news-blog/2012/feb/01/nyc-holds-first-bike-share-station- planning-workshop/ (accessed February 28, 2012).

19. Huffington Post. 2012. Bike Share Gets Citibank Sponsored 'Citi Bikes' and Summer Launch. http://www.huffingtonpost.com/2012/05/07/nyc-bike-share-citibank-citi-bike- summer_n_1496727.html (accessed May 21, 2012).

20. *New York Times*. 2012. "Citibank Pays to Put Name on Shared Bikes." http://www. nytimes.com/2012/05/08/nyregion/new-york-cycle-sharing-gets-a-name-citi-bike. html?_r=1 (accessed May 15, 2012).

21. SF.StreetsBlog.org. 2012. Bike-Share Coming to SF and Silicon Valley This July. http://sf.streetsblog.org/2012/02/02/bike-share-coming-to-sf-and-silicon-valley-this- july/ (accessed February 29, 2012).

22. City of Chicago. 2011. Chicago Seeks Partner to Solicit Sponsorship for New Bike Sharing Program. http://www.cityofchicago.org/city/en/depts/cdot/provdrs/bike/ news/2011/dec/chicago_seeks_partnertosolicitsponsorships.html (accessed March 2, 2012).

23. *Los Angeles Times*. 2012. "Bike-Share Program Coming to Los Angeles." http:// articles.latimes.com/2012/apr/16/local/la-me-0415-ciclavia-20120416 (accessed May 15, 2012).

24. SelfServiceWorld. 2011. Marriott Is First Hotel to Offer Bike-Share Program. http:// www.selfserviceworld.com/article/185587/Marriott-is-first-hotel-to-offer-bike-share- program (accessed March 8, 2012).

25. Bike-sharing Blog. 2007. Humana's Freewheelin' Ridin' High. http://bike-sharing. blogspot.com/2007/09/humanas-freewheelin-ridin-high.html (accessed March 8, 2012).

26. Melanie Kaplan. 2010. D.C. Unveils Country's Largest Bike Share Program. http:// www.smartplanet.com/blog/pure-genius/dc-unveils-countrys-largest-bike-share-program/4940 (accessed March 1, 2012).

27. Ibid.

28. Capital Bikeshare 2012.Bank on DC. http://www.capitalbikeshare.com/bankondc (accessed March 8, 2012).

29. Emily Badger. 2011. Bike-Sharing for the Unbanked. http://www.theatlanticcities.com/ commute/2011/12/bikesharing-unbanked/794/ (accessed March 8, 2012).

30. *Federal Register*, Vol. 76 No. 161. 2011. "FTA Policy Change."

31. *The Globe and Mail*. 2010. "Communauto Dominates in Quebec." http://www. theglobeandmail.com/report-on-business/small-business/grow/expanding-the-business/communauto-dominates-in-quebec/article1700890/ (accessed March 8, 2012).

32. John Pucher and Ralph Buehler. 2005. "Cycling Trends and Policies in Canadian Cities." *World Transport Policy and Practice* 11 (1), 43–61.

33. *Biking*. 2011. The Economic Case for On-Street Bike Parking. http://grist.org/ biking/2011-04-11-the-economic-case-for-on-street-bike-parking/ (accessed March 8, 2012).

34. City and County of San Francisco, 2010.Municipal Code. City and County of San Francisco, San Francisco, CA. http://library.municode.com/index.aspx?clientId=1413 9&stateId=5&stateName=California (accessed March 8, 2012).

35. City of Chicago, 2007.Chicago Zoning Ordinance. Chicago, IL. http://www.scribd.com/ doc/28487280/Chicago-Zoning-Ordinance-Parking-Table-17-10-0207a (accessed March 8, 2012).

36. City of Minneapolis, 2009. Minneapolis Bike Parking Regulations Guide. City of Minneapolis, Minneapolis, MN. http://www.ci.minneapolis.mn.us/bicycles/ BicycleParkingRegulations.pdf (accessed March 8, 2012).

37. City of Portland, 2010. Bicycles. City of Portland Bureau of Transportation, Portland, OR. http://www.portlandonline.com/transportation/index.cfm?c=34772 (accessed March 8, 2012).

38. City of Toronto, 2010. Cycling in Toronto. City of Toronto Transportation Services, Toronto, ON. http://www.toronto.ca/cycling/index.htm (accessed March 8, 2012).

39. City of Vancouver, 2001. Bicycle Parking Design Supplement. City of Vancouver, Vancouver, BC. http://vancouver.ca/engsvcs/parking/enf/pdf/bpds.pdf (accessed March 8, 2012).

40. DDOT, 2005. DC Bicycle Master Plan. District Department of Transportation, Washington, DC. http://www.dc.gov/DC/DDOT/On+Your+Street/Bicycles+and+Pedestrians/ Bicycles/Bicycle+Master+Plan (accessed March 8, 2012).

41. Ibid.p42

42. Ville de Montréal, 2010. Ville de Montréal Transportation and Public Works, Montréal, QC. Accessed March 8, 2012. http://ville.montreal.qc.ca/portal/page?_ pageid=5977,87707571&_dad=portal&_schema=PORTAL.

43. Ibid.

44. Hays Insurance Agencies, LLC. Glossary. http://www.haysinsurance.net/insurance-agency-insurance-glossary.htm?sid=27505 (accessed June 19, 2012).

45. Helmet Laws: British Columbia. http://www.cyclehelmets.org/1103.html (accessed May 17, 2011).

46. Kelly Lawman. Only 1 in 5 Bike Share Cyclists Wear a Helmet. April 30, 2012. http:// www.eurekalert.org/pub_releases/2012-04/bidm-o1i043012.php (accessed May 17, 2012).

47. "Have Helmet Laws Put the Skids on Australia's Bike Share Scheme?" August 9, 2011. http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=5&sqi=2 &ved=0CGEQFjAE&url=http%3A%2F%2Ftheconversation.edu.au%2Fhave-helmet-laws-put-the-skids-on-australias-bike-share-scheme-2703&ei=9e-JT5LELIHm2gXcq Jy3CQ&usg=AFQjCNHTfopgjhHRk_P_kdvvR1HVRRpslA (accessed April 14, 2012).

48. Clay Lucas. Helmet Law Makes Nonsense of Bike Hire Scheme. July 23, 2010. http:// www.theage.com.au/victoria/helmet-law-makes-nonsense-of-bike-hire-scheme-20100722-10my2.html (accessed April 14, 2012).

49. Christinne Muschi. 2012. Sterile Solutions Wheeled Out to Vancover's Shared Helmet Dilemma. http://www.theglobeandmail.com/news/national/british-columbia/ sterile-solutions-wheeled-out-to-vancovers-shared-helmet-dilemma/article2296867/ (accessed January 10, 2012).

50. Rebecca Gleason and Laurie Miskimins. 2012. *Exploring Bicycle Options for Federal Lands: Bike Sharing, Rentals and Employee Fleets*. Federal Highway Administration.

51. Ibid.

52. R. J. Eldridge and Mauricio Hernandez. 2012. "Bike Sharing in the United States: State of the Practice and Guide to Implementation." PBIC Livable Communities Webinar Series. Presented April 26, 2012.

53. Rebecca Gleason and Laurie Miskimins. 2012. *Exploring Bicycle Options for Federal Lands: Bike Sharing, Rentals and Employee Fleets*. Federal Highway Administration.

54. R. J. Eldridge and Mauricio Hernandez. 2012. "Bike Sharing in the United States: State of the Practice and Guide to Implementation." PBIC Livable Communities Webinar Series. Presented April 26, 2012.

55. Rebecca Gleason and Laurie Miskimins. 2012. *Exploring Bicycle Options for Federal Lands: Bike Sharing, Rentals and Employee Fleets*. Federal Highway Administration.

56. National Transit Database. 2010. Metro Transit & Washington Metropolitan Area Transit Authority (WMATA). http://www.ntdprogram.gov/ntdprogram/pubs/profiles/2010/agency_profiles/5027.pdf. http://www.ntdprogram.gov/ntdprogram/pubs/profiles/2010/agency_profiles/3030.pdf

57. Toronto Transit Commission. 2010. TTC Operating Statistics. http://www3.ttc.ca/About_the_TTC/Operating_Statistics/2010.jsp

58. U.S. Census. 2010. 2010 Demographic Profile Data. Population, Washington D.C., Minneapolis, St. Paul. U.S. Census.

59. Statistics Canada. 2006. Population and dwelling counts. A portrait of the Canadian population. http://www12.statcan.ca/census-recensement/2006/rt-td/pd-pl-eng.cfm

60. Capital Bikeshare. 2012. System Data. http://www.capitalbikeshare.com/system-data

61. Reuben Collins. VeloTraffic. 2012. "Nice Ride MN Data Set Made Public." http://velotraffic.com/2012/01/nice-ride-mn-data-set-made-public/ with link to https://niceridemn.egnyte.com/h-s/20120123/16df0eaa654c4213, provided by Mitch Vars.

62. Capital Bikeshare, Capital Bikeshare Dashboard. http://cabidashboard.ddot.dc.gov/CaBiDashboard/#Ridership/StartDate=11/30/2011EndDate=4/30/2012PubDate=4/30/2012.

63. Washington Metropolitan Area Transit Authority. http://www.wmata.com/rail/maps/map.cfm?

64. Metro Transit. Light Rail Route 55, Hiawatha Light-Rail Line. http://metrotransit.org/Data/Sites/1/media/pdfs/Schedules/RouteMaps/17/055Map.pdf

65. Toronto Transit Commission. 2012. Subway Map. http://www3.ttc.ca/Subway/interactivemap.jsp

66. Société de transport de Montéal (STM). 2012. The Métro Map. http://www.stm.info/english/metro/a-mapmet.htm

67. Elliot Martin, Susan Shaheen, and Jeffrey Lidicker. 2010. "The Impact of Carsharing on Household Vehicle Holdings: Results from a North American Shared-use Vehicle Survey," *Transportation Research Record: Journal of the Transportation Research Board*, No. 2143. Washington, D.C., 2010 pp. 150–158.

68. C. Lane. 2005. "PhillyCarShare: First-Year Social and Mobility Impacts of Carsharing in Philadelphia, Pennsylvania," *Transportation Research Record: Journal of the Transportation Research Board,* No. 1927, 158–166.

69. Elliot Martin, Susan Shaheen, and Jeffrey Lidicker. 2010. "The Impact of Carsharing on Household Vehicle Holdings: Results from a North American Shared-use Vehicle Survey." *Transportation Research Record: Journal of the Transportation Research Board*, No. 2143, 150–158.

70. U.S. Census. 2010. American Community Survey 1-Year Estimates. Table B08303: Travel Time to Work.

71. Elliot Martin and Susan Shaheen. 2011. "The Impact of Carsharing on Public Transit and Non-Motorized Travel: An Exploration of North American Carsharing Survey Data." *Energies,* 4(11), 2094–2114.

BIBLIOGRAPHY

Badger, Emily. 2011. Bike-Sharing for the Unbanked. http://www.theatlanticcities.com/commute/2011/12/bikesharing-unbanked/794/ (accessed March 8, 2012).

Bicicultura. 2010. Sistema de Bicicletas Públicas se Extenderá por Todo Santiago. http://www.bicicultura.cl/content/view/1164977/Sistema-de-bicicletas-publicas-se-extendera-por-todo-Santiago.html (accessed March 8, 2012).

Bike-sharing Blog. 2007. Humana's Freewheelin' Ridin' High. http://bike-sharing.blogspot.com/2007/09/humanas-freewheelin-ridin-high.html (accessed March 8, 2012).

Bike-sharing Blog. 2009. Pioneering Bike-Sharing Program Goes Dark After 11 Years. http://bike-sharing.blogspot.com/2009/05/pioneering-bike-sharing-program-goes.html (accessed March 1, 2012).

Biking. 2011. The Economic Case for On-Street Bike Parking. http://grist.org/biking/2011-04-11-the-economic-case-for-on-street-bike-parking/ (accessed March 8, 2012).

Boulder B-cycle. 2011. "2011 Annual Report". http://boulder.bcycle.com/LinkClick.aspx?fileticket=wrmQ-L2GXgI%3D&tabid=429.

Capital Bikeshare. 2012. Bank on DC. http://www.capitalbikeshare.com/bankondc (accessed March 8, 2012).

Capital Bikeshare. 2011. Capital Bikeshare Hits 1 Million Rides on First Anniversary. http://www.capitalbikeshare.com/news/2011/09/20/capital-bikeshare-hits-one-million-rides-on-first-anniversary (accessed March 1, 2012).

Capital Bikeshare Launches Homeless Bike-Sharing Program. March, 23 2012. http://www.wjla.com/articles/2012/03/capital-bikeshare-launches-homeless-bike-sharing-program-74105.html (accessed April 14, 2012).

Capital Bikeshare, Capital Bikeshare Dashboard. http://cabidashboard.ddot.dc.gov/CaBiDashboard/#Ridership/StartDate=11/30/2011EndDate=4/30/2012PubDate=4/30/2012.

Capital Bikeshare. 2012. System Data. http://www.capitalbikeshare.com/system-data

Castleman, Tim. 2010. Practical Cycle Partners with BionX for Cal/EPA Electric Bike Share Project. http://www.practicalcycle.com/company/blog/146-practical-cycle-partners-with-bionx-for-calepa-electric-bike-share-project (accessed March 8, 2012).

Cernansky, Rachel. 2011. Cycle Chalao! Bike Sharing Comes to India. http://www.treehugger.com/bikes/bike-sharing-india-cycle-chalao.html (accessed March 8, 2012).

City and County of San Francisco, 2010. Municipal Code. City and County of San Francisco, San Francisco, CA. http://library.municode.com/index.aspx?clientId=14139&stateId=5&stateName=California (accessed March 8, 2012).

City of Chicago, 2007. Chicago Zoning Ordinance. City of Chicago, Chicago, IL. http://www.scribd.com/doc/28487280/Chicago-Zoning-Ordinance-Parking-Table-17-10-0207a (accessed March 8, 2012).

City of Chicago. 2011. Chicago Seeks Partner to Solicit Sponsorship for New Bike Sharing Program. http://www.cityofchicago.org/city/en/depts/cdot/provdrs/bike/news/2011/dec/chicago_seeks_partnertosolicitsponsorships.html (accessed March 2, 2012).

City of Minneapolis, 2009. Minneapolis Bike Parking Regulations Guide. City of Minneapolis, Minneapolis, MN. http://www.ci.minneapolis.mn.us/bicycles/BicycleParkingRegulations.pdf (accessed March 8, 2012).

City of Portland, 2010. Bicycles. City of Portland Bureau of Transportation, Portland, OR. http://www.portlandonline.com/transportation/index.cfm?c=34772 (accessed March 8, 2012).

City of Toronto, 2010. Cycling in Toronto. City of Toronto Transportation Services, Toronto, ON. http://www.toronto.ca/cycling/index.htm (accessed March 8, 2012).

City of Vancouver, 2001. Bicycle Parking Design Supplement. City of Vancouver, Vancouver, BC. http://vancouver.ca/engsvcs/parking/enf/pdf/bpds.pdf (accessed March 8, 2012).

Collins, Reuben. VeloTraffic. 2012. "Nice Ride MN Data Set Made Public." http://velotraffic.com/2012/01/nice-ride-mn-data-set-made-public/ with link to https://niceridemn.egnyte.com/h-s/20120123/16df0eaa654c4213, provided by Mitch Vars.

Crumley, Bruce. 2009. Postcard from Paris: Cyclists Behaving Badly. March 4, 2009. http://www.time.com/time/world/article/0,8599,1882735,00.html (accessed April 14, 2012).

DDOT, 2005. DC Bicycle Master Plan. District Department of Transportation, Washington, DC. http://www.dc.gov/DC/DDOT/On+Your+Street/Bicycles+and+Pedestrians/Bicycles/Bicycle+Master+Plan (accessed March 8, 2012).

DeMaio, Paul. 2009. "Bike-sharing: history, impacts, models of provision, and future." *Journal of Public Transportation* 14-4 (2009): 41–56.

Denver B-cycle. 2011. 2011 Season Results. http://denver.bcycle.com/News.aspx?itemid=185 (accessed February 29, 2012).

Dill, Jennifer, and Theresa Carr. 2003. "Bicycle Commuting and Facilities in Major US Cities: If You Build Them, Commuters Will Use Them." *Transportation Research Record* 1828, 116–123.

Dill, Jennifer. 2009. "Bicycling for Transportation and Health: The Role of Infrastructure." *Journal of Public Health Policy* 30, S95–S110.

Dublin Cycling Campaign. 2012. Council Offers Bike Scheme for Deliveries. http://dublincycling.ie/node/688 (accessed March 8, 2012).

Earth Techling. 2010. Electric Bike Share Program Tested at College. http://www.earthtechling.com/2011/10/electric-bike-share-program-tested-at-college/ (accessed March 8, 2012).

Federal Register Vol. 76 No. 161. 2011. FTA Policy Change. Accessed March 8, 2012.

Fidler, Eric. 2012. Experimental Real-Time Transit Screens Come to Arlington, D.C. http://greatergreaterwashington.org/post/13241/experimental-real-time-transit-screens-come-to-arlington-dc/ (accessed March 8, 2012).

The Globe and Mail. 2009. "Paris's pedal power sets free uncivilized behaviour." http://veloptimum.net/velonouvelles/9/ART/6juin/GlobeMail20.htm

Helmet Laws: British Columbia. http://www.cyclehelmets.org/1103.html (accessed May, 17 2011).

Have Helmet Laws Put the Skids on Australia's Bike Share Scheme? August 9, 2011. http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=5&sqi=2&ved=0CGEQFjAE&url=http%3A%2F%2Ftheconversation.edu.au%2Fhave-helmet-laws-put-the-skids-on-australias-bike-share-scheme-2703&ei=9e-JT5LELIHm2g XcqJy3CQ&usg=AFQjCNHTfopgjhHRk_P_kdvvR1HVRRpslA (accessed April 14, 2012).

Hinds, Kate. 2011. "In Its First Season, Boston Bike Share Exceeds Projections; Will Expand Next Spring." http://transportationnation.org/2011/11/29/in-its-first-season-boston-bike-share-exceeds-projections-will-expand-next-spring/

Home, Stewart. 1991. *The Assault on Culture: Utopian Currents from Lettrisme to Class War*. Edinburgh, UK: AK Press, 65–68.

Houle, Marie-Hélène. 2011. "4 174 917 déplacements en BIXI en 2011 - BIXI atteint le seuil des 40 000 membres." http://www.newswire.ca/fr/story/880423/4-174-917-deplacements-en-bixi-en-2011-bixi-atteint-le-seuil-des-40-000-membres. (accessed March 1, 2012).

Hubway. 2012. Mayor Signs First-Ever Bike Share Contract Launching Hubway in Boston. http://thehubway.com/news/2011/04/21/mayor-menino-signs-first_ever-bike-share-contract-launching-hubway-in-boston (accessed May 15, 2012).

Huffington Post. 2012. Bike Share Gets Citibank Sponsored 'Citi Bikes' and Summer Launch. http://www.huffingtonpost.com/2012/05/07/nyc-bike-share-citibank-citi-bike-summer_n_1496727.html (accessed May 21, 2012).

Infosur Hoy. 2011. ECOBICI Bicycle Campaign a Hit in Mexico City. http://infosurhoy.com/cocoon/saii/xhtml/en_GB/features/saii/features/society/2011/12/08/feature-02 (accessed March 2, 2012).

ITDP. 2011. Guangzhou China. http://www.itdp.org/get-involved/sustainable-transport-award/previous-award-recipients/guangzhou-china-winner-2011 (accessed March 9, 2012).

Jha, Ruchi. 2012. An Inclusive Bike Sharing Concept-Rethink, Rebike, Recycle. http://www.designbuzz.com/inclusive-bike-sharing-concept-rethink-rebike-recycle.html (accessed March 8, 2012).

Kaplan, Melanie. 2010. D.C. Unveils Country's Largest Bike Share Program. http://www.smartplanet.com/blog/pure-genius/dc-unveils-countrys-largest-bike-share-program/4940 (accessed March 1, 2012).

Lane, C. PhillyCarShare: "First-Year Social and Mobility Impacts of Carsharing in Philadelphia, Pennsylvania." In *Transportation Research Record: Journal of the Transportation Research Board,* No. 1927, Transportation Research Board of the National Academies, Washington, DC, 2005, 158–166.

Lawman, Kelly. Only 1 in 5 Bike Share Cyclists Wear a Helmet. April 30, 2012. http://www.eurekalert.org/pub_releases/2012-04/bidm-o1i043012.php (accessed May 17, 2012).

LeClerc, Mauricio. 2002. Bicycle Planning in the City of Portland: Evaluation of the City's Bicycle Master Plan and Statistical Analysis of Relationship Between the City's Bicycle Network and Bicycle Commute. Portland State University, Portland, OR.

Lucas, Clay. Helmet Law Makes Nonsense of Bike Hire Scheme. July 23, 2010. http://www.theage.com.au/victoria/helmet-law-makes-nonsense-of-bike-hire-scheme-20100722-10my2.html (accessed April 14, 2012).

Madison B-cycle. 2012. "2011 Overview." http://legistar.cityofmadison.com/attachments/85a6af7b-3bb3-40bb-b5ab-d91e9720f0cc.pdf. (accessed February 29, 2012)

Martin, Elliot, and Susan Shaheen. 2011. "The Impact of Carsharing on Public Transit and Non-Motorized Travel: An Exploration of North American Carsharing Survey Data." *Energies,* V.4(11), pp. 2094–2114.

Martin, Elliot, Susan Shaheen, and Jeffrey Lidicker. 2010. "The Impact of Carsharing on Household Vehicle Holdings: Results from a North American Shared-Use Vehicle Survey." *Transportation Research Record: Journal of the Transportation Research Board*, No. 2143. Washington, D.C., 2010 pp. 150-158.

Metro Transit. Light Rail Route 55, Hiawatha Light-Rail Line. http://metrotransit.org/Data/Sites/1/media/pdfs/Schedules/RouteMaps/17/055Map.pdf (accessed June 1, 2012).

Montreal Master Plan, 2004. Ville de Montreal Transportation and Public Works, Montreal, QC. http://ville.montreal.qc.ca/portal/page?_pageid=2762,3099643&_dad=portal&_schema=PORTAL. (accessed March 8, 2012).

Moudon, Anne V., Chanam Lee, Allen D. Cheadle, Cheza W. Collier, Donna Johnson, Thomas L. Schmid, and Robert D. Weather. 2005. "Cycling and the Built Environment, a US Perspective." *Transportation Research* Part D10, 245–261.

Muschi, Christinne. 2012. Sterile Solutions Wheeled Out to Vancover's Shared Helmet Dilemma. http://www.theglobeandmail.com/news/national/british-columbia/sterile-solutions-wheeled-out-to-vancovers-shared-helmet-dilemma/article2296867/ (accessed January 10, 2012).

National Transit Database. 2010. Metro Transit & Washington Metropolitan Area Transit Authority (WMATA). http://www.ntdprogram.gov/ntdprogram/pubs/profiles/2010/agency_profiles/5027.pdf. http://www.ntdprogram.gov/ntdprogram/pubs/profiles/2010/agency_profiles/3030.pdf (accessed March 3, 2012).

Nelson, Arthur, and David Allen. 1997. "If You Build Them, Commuters Will Use Them." *Transportation Research Record* 1578, 79–83.

New Mobility. 2010. In Emilia Romagna the Integration of TPL tariff Extends to Bike Sharing. http://nuovamobilita.wordpress.com/category/co-mobilita/bike-sharing/page/2/ (accessed March 9, 2012).

New York Times. 2012. "Citibank Pays to Put Name on Shared Bikes." http://www.nytimes.com/2012/05/08/nyregion/new-york-cycle-sharing-gets-a-name-citi-bike.html?_r=1 (accessed May 15, 2012).

Noyce, Peter. ECOBICI Bicycle Campaign a Hit in Mexico City. August 12, 2011. http://infosurhoy.com/cocoon/saii/xhtml/en_GB/features/saii/features/society/2011/12/08/feature-02 (accessed April 14, 2012).

NYCDCP, 2009. Bicycle Parking. New York City Department of City Planning, New York, NY. http://www.nyc.gov/html/dot/html/bicyclists/bicycleparking.shtml (accessed March 8, 2012).

O'Keefe, Thomas, and Joe Keating. The Yellow Bike Story. http://c2.com/ybp/story.html (accessed February 29, 2012).

Polis. 2011. One Hundred Million Trips Made with Paris' Public Bike Scheme Vélib. http://www.polisnetwork.eu/publicnews/61/45/One-hundred-million-trips-made-with-Paris-public-bike-scheme-Velib/ (accessed March 6, 2012).

PRWeb. 2011. CityRyde Receives New Funding and Validation to Turn Bike Rides into Cash. http://www.prweb.com/releases/2011/7/prweb8619832.htm (accessed March 8, 2012).

Pucher, John, and Ralph Buehler. 2005. "Cycling Trends and Policies in Canadian Cities." *World Transport Policy and Practice* 11 (1), 43–61.

Pucher, John, Jennifer Dill, and Susan Handy. 2010. "Infrastructure, Programs and Policies to Increase Bicycling: An International Review." *Preventive Medicine* 48 (S1), S106–S125.

Radials Blog. 2011. Do It for the Capital, Cycling Ovechkin. Photo from http://www.radialsblog.com/capital-cycling-ovechkin/ (accessed May 23, 2012).

Romero, Carlos. "SpiCycles – in Barcelona." Presented at the Final Conference of the Chamber of Commerce & Industry of Romania, Bucharest, Romania, 19 December 2008.

San Antonio Office of Environmental Policy. "San Antonio Bikes." Presented at the Texas Trails and Active Transportation Conference, San Antonio, TX, February 1-3, 2012.

SelfServiceWorld. 2011. Marriott Is First Hotel to Offer Bike-Share Program. http://www.selfserviceworld.com/article/185587/Marriott-is-first-hotel-to-offer-bike-share-program (accessed March 8, 2012).

SF.StreetsBlog.org. 2012. Bike-Share Coming to SF and Silicon Valley This July. http://sf.streetsblog.org/2012/02/02/bike-share-coming-to-sf-and-silicon-valley-this-july/ (accessed February 29, 2012).

Shaheen, Susan, Stacey Guzman, and Hua Zhang. 2010. "Bikesharing in Europe, the Americas, and Asia: Past, Present, and Future," *Transportation Research Record: Journal of the Transportation Research Board*, 2143: 159–167.

Sherman, Aliza. 2013. How 4 Cities Are Deploying High-Tech Bike Sharing Programs. http://mashable.com/2011/07/13/bike-sharing-cities/ (accessed March 8, 2012).

Slimani, Keroum. "Vélo'v: bike hiring self-service." http://www.fedarene.org/documents/projects/Climact/Best-Practices/027_Velov_.pdf (accessed June 15, 2012).

Smith, Paul. 2010. Whip Bikes: Innovative Bike Sharing Model Launches in UK. http://www.triplepundit.com/2010/10/whip-bikes-bike-sharing/#comments (accessed March 8, 2012).

Société de transport de Montéal (STM). 2012. The Métro Map. http://www.stm.info/english/metro/a-mapmet.htm (accessed June 1, 2012).

Statistics Canada. 2006. Population and dwelling counts. A portrait of the Canadian population.http://www12.statcan.ca/census-recensement/2006/rt-td/pd-pl-eng.cfm (accessed January 1, 2012).

SurveyGizmo. 2010. Nice Ride Subscriber Survey: Survey Report. https://appv3.sgizmo.com/reportsview/?key=102593-416326-6d13ea0276ea0822c9f59f4411b6c779 (accessed February 29, 2012).

The Bike-sharing Blog. 2011. The Bike-sharing World: First Week of June 2011. http://bike-sharing.blogspot.com/2011/06/bike-sharing-world-first-week-of-june.html (accessed March 9, 2012).

The Bike-sharing Blog. 2012. The Bike Sharing World, First Week of January 2012. Photo from http://bike-sharing.blogspot.com/2012_01_01_archive.html (accessed May 20, 2012).

The Globe and Mail. 2010. "Communauto Dominates in Quebec." http://www.theglobeandmail.com/report-on-business/small-business/grow/expanding-the-business/communauto-dominates-in-quebec/article1700890/ (accessed March 8, 2012).

The Los Angeles Times. 2012. "Bike-Share Program Coming to Los Angeles." http://articles.latimes.com/2012/apr/16/local/la-me-0415-ciclavia-20120416 (accessed May 15, 2012).

Tilahun, Nebiyou, David M. Levinson, and Kevin J. Krizek. 2007. "Trails, Lanes, or Traffic: Valuing Bicycle Facilities with an Adaptive Stated Preference Survey." *Transportation Research* Part A 41, 287–301.

Toronto Transit Commission. 2010. TTC Operating Statistics. http://www3.ttc.ca/About_the_TTC/Operating_Statistics/2010.jsp (accessed June 1, 2012).

Toronto Transit Commission. 2012. Subway Map. http://www3.ttc.ca/Subway/interactivemap.jsp

U.S. Census. 2010. American Community Survey 1-Year Estimates. Table B08303: Travel Time to Work. U.S. Census.

U.S. Census. 2010. 2010 Demographic Profile Data. Population, Washington D.C., Minneapolis. U.S. Census.

Washington City Paper. 2010. R.I.P., SmartBike, Good Riddance. March 1, 2012. http://www.washingtoncitypaper.com/blogs/housingcomplex/2010/09/16/r-i-p-smartbike-good-riddance/.

Washington Metropolitan Area Transit Authority. http://www.wmata.com/rail/maps/map. cfm? (accessed June 1, 2012).

WNYC. 2012. City Holds First Bike Share Station Planning Workshop. http://www.wnyc. org/blogs/wnyc-news-blog/2012/feb/01/nyc-holds-first-bike-share-station-planning- workshop/ (accessed February 28, 2012).

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